An examination of large-scale land acquisitions and their possible effects on growth volatility

By

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A thesis submitted for the degree of Doctor of Philosophy in Economics

Trinity Business School

Trinity College Dublin

June 2020

Declaration

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Abstract

This thesis broadly covers two scientific fields, large-scale land acquisition and growth rate volatility. During my initial literature review I discovered a gap in the knowledge base which spans across both research areas of my thesis.

Large-scale land acquisitions[1] became notorious since GRAIN (2008) report and quickly got traction in certain scientific circles who researched their effects in many different fields with findings that most often highlighted their negative consequences. However more recently, academics started publishing articles which viewed LSLAs as a form of investments (either foreign or domestic). In this regard such investments could potentially result in more positive outcomes in *e.g.* economic growth, employment, export markets, technology transfers, *etc.*

However, as many of developing countries rely heavily on agriculture which often represents major if not the main part of their economy, thorough investigation of the effects of agriculture on growth rate volatility seemed to slip past the research community. The most similar studies, exploring growth and growth rate volatility, included (share of) agriculture as an independent variable. Those studies were in essence focused on the effects of different sectors of the economy and were not concerned with understanding the effects of agriculture in greater details. Such approach may come from agriculture's perceived simplicity as oppose to more interesting structures of industrial or service sectors. However agriculture is just as diverse as any other economic sector, and its influences on growth rate volatility are just as equally spread from positive to negative as they are in industries or services.

The idea of the diversity of agricultural effects came from the research of Isham, *et al.* (2005) who showed that coffee and cocoa significantly and negatively influence long term growth. When thinking about their effects it became obvious that they are in essence very similar produce; both are plantation, non-perishable crops grown for human consumption. That discovery sparked an idea that maybe other crops belonging to different (agricultural) groups yield different results.

Lack of studies of the effects of agriculture is surprising also because of the notorieties of contemporary occurrences of LSLAs.

[1] From now on LSLA refers to large-scale land acquisition

My research therefore fills both these identified gaps. My essay type chapter explores (among other things) the composition of crops production in LSLAs. The two empirical chapters, on the other hand, employ generalised method of moments regression on my dynamic panel dataset of 64 developing countries from 1971 to 2010 to study the effects of production and exports of agricultural crops on growth rate volatility.

The analysis of the Land Matrix database showed some commonalities between investors. It seems that investors prefer to invest in domestic region (except Europe and Northern America which invest in the closest appropriate region). The majority of deals are intended for crop production of which majority is intended for food. In that regard non-plantation crops are preferred over plantation crops. Most of food crops are non-perishable (mostly cereals). Among non-food crops the top two are biofuels and rubber.

The empirical chapters showed that increased share of production value of plantation crops in GDP significantly decreases growth rate volatility however their exports don't have any significant effect on growth rate volatility. Ratio between non-plantation and plantation crops is also significant with increased share of production of non-plantation crops relative to that of plantation crops increasing growth rate volatility. Plantation crops are present in almost half of all deals in the LSLA dataset.

Increased share of production of perishable crops in GDP again decreases growth rate volatility. Their growth rate volatility decreasing effect is strengthened with higher level of openness (the result is obtained through the inclusion of interaction term between openness and share of perishable crops). The effect of exports of perishable crops on growth rate volatility is not significant. Perishable crops represent 35 percent of crops produced on LSLAs whereas 65 percent are non-perishable.

Increased share of production of food crops in GDP significantly decreases growth rate volatility however their exports have no significant effect. In LSLA database 72 percent of deals are intended for food crops production (the remainder are intended either for non-food or mixed crop production).

Productions of four crop groups have growth rate volatility decreasing effect (vegetables; nuts; coffee, cocoa, and tea; and rubber) whereas oil crops increase growth rate volatility. Openness significantly strengthens growth rate volatility decreasing effect of two crop groups: coffee, cocoa and tea; and tobacco (which although not significant has growth rate volatility increasing effect). Exports of crop groups on the other hand have no significant effect on growth rate volatility. Vegetables account for 30 percent of food crops in LSLA dataset, nuts for 1.3 percent and coffee, cocoa, and tea 2.1 percent. Rubber accounts for 33 percent of non-food crops in LSLA dataset.

On the production side, the only significant diversification variable is diversification between food and non-food crops. Higher diversification between food and non-food crops increases growth rate volatility which is a surprising result. Finding that growth rate volatility increases with higher diversification between food and non-food crops probably rests in fact that diversification reduces domestic food supplies. On the other hand higher diversification of exports of all agricultural products, diversification in agricultural product groups, as well as diversification between processed and unprocessed crops, and between food and non-food crops have significant and decreasing effect on growth rate volatility. It might seem contradictory that diversification between food and non-food crops production increases growth rate volatility whereas increased export diversification between the two decreases it. Considering the explanation above (that higher diversification in food/non-food increases growth rate volatility because it increases domestic food insecurity) I can argue that when there is oversupply of domestically produced food crops (so food security is ensured) which are then exported, diversification between food and non-food crops exports becomes significant and its effect decreases growth rate volatility. Review of LSLAs showed wide ranging results for diversification in crop production from both investor and host country as well as regional and sub-regional perspective.

This thesis explores LSLAs in great details and then indicates on their potential economic effects by exploring agricultural crops' production and export structure on growth rate volatility. Although limited to research on production and export structure of agricultural crops and ignoring other relevant factors that often materialise in conjunction with LSLAs (infrastructure investments, irrigation systems, etc. on the positive side, and reduced biodiversity, gender inequality, water, etc. on the negative side) the thesis nevertheless paves the way for further research as well as informs relevant policy making bodies in affected economies.

Acknowledgments

For the completion of this thesis and throughout the working and writing of my thesis, I bear responsibility to numerous people who contributed to the final outcome.

First I wish to express my appreciation for the constructive comments and consistent encouragement provided by my supervisor Professor Doctor Frank Barry. Without his thoughtful and generous suggestions and guidance, I could never have completed my thesis.

I am also grateful to Professor Doctor Joseph McDonagh, Director of doctoral programme at TBS, TCD, for invaluable support and assistance during my period on doctoral programme.

I am also appreciative to the academic staff of doctoral programme and PhD students at Trinity Business School, Trinity College Dublin. Always helpful and prepared to offer advice, critique, and comments during my PhD study sessions they contributed invaluably to this thesis. I particularly benefited from comments by Professor Doctor Martin Fellenz, Professor Doctor Louis Brennan, and Professor Doctor Jennifer Berrill. My gratefulness extends to the administrative staff of doctoral programme Samantha Peavoy, and Valerie McCarthy as well as fellow student Deepak Saxena, PhD.

Special thanks must go to my wife, Patricija, who continuously supported me throughout my PhD, and our two kids: four years old Ivan Ruairi and two years old Erin Jelena, for bringing joy and relaxation during solitary work of research and writing.

Last but not least I would like to express my appreciations to my parents, brothers, and friends who supported me to complete this thesis.

Dedication

To my beloved wife Patricija

To my greatest gifts of all now almost four years old Ivan Ruairi and almost two years old Erin Jelena

And to my mother Ivana Franciska and my father Martin

Contents

List of figures:

List of tables

Abbreviations

CID	The Center for International Data
CSP	The Center for Systemic Peace
DI	Domestic investment
FAO	Food and Agricultural Organisation of the United Nations
FDI	Foreign Direct Investment
GAEZ	Global Agro-Ecological Zone
IAASTD	International Assessment of Agricultural Knowledge, Science, and Technology for Development
IFAD	The International Fund for Agricultural Development
IPCC	Intergovernmental Panel on Climate Change
LSLA	Large-scale land acquisition
OECD	Organisation for Economic Co-operation and Development
REDD	Reducing emissions from deforestation and forest degradation
SOLAW	The state of the world's land and water resources for food and agriculture
SSA	Sub-Saharan Africa
UCDP/PRIO	Uppsala University and Peace Research Institute Oslo
UNCCD	United Nations Convention to Combat Desertification
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
WB	The World Bank

1. Introduction

1.1 Motivation

In the first decade of the 2000s, media and non-governmental organisations started to highlighted “controversial” large-scale investments in land abundant developing countries (GRAIN, 2008). These investments, also called large-scale land acquisitions (LSLA), are a sub form of foreign direct investments. They are focused on investment in land which can be either agricultural (*i.e.* to grow crops) or land used for other purposes *e.g.* forestry, mining, tourism, *etc.* Those early reports highlighted severe negative consequences of such investments and treated them as a form of neo-colonialism. For that reason they dubbed them “land grabs” to highlight notorious practices employed. Since then many papers; see *e.g.* Borras *et al.* (2011), Deininger and Byerlee (2011), Anseeuw, *et al.* (2012a), Nolte (2014), Suhardiman, *et al.* (2015), Thondhlana (2015), *etc.* researched their influence on property rights, employment, gender equality, livelihoods, environment, biodiversity, *etc.* and often found negative consequences of LSLAs. Right or wrong, the authors often approached their research from more or less negativistic perspective.

On the other hand, academics and international organisations have more recently started highlighting their potential positive spillovers which can contribute to sustainable economic development of host countries, reducing poverty and inequality and increasing employment opportunities and food security; see *e.g.* Kay, D.C. (2002), Kay, C. (2009), Cotula, *et al.* (2009), World Bank (2010), Animashaun, *et al.* (2015), *etc.*

Their positivistic point of view is often based on studies of foreign direct investments in general; see *e.g.* De Mello, Jr. (1997), Borenzstein, *et al.* (1998), *etc.* Those studies have shown that foreign direct investments (from now on “FDI” refers to “foreign direct investment”) can have either positive or negative consequences, and that the final outcome often depends on the appropriate approach; see *e.g.* (OECD, 2002). When the motives of investors align with the needs and competencies of host country, spillovers are mostly positive whereas when they are misaligned consequences are mostly negative (World Bank, 2010). However, it should be noted that even when appropriate policies are in place, unaccountable elites and ambiguous contracts can result in less than optimal results. This holds especially true in developing and least developed countries where transparency often plays minor role.

The initial idea for the thesis was to explore the economic consequences of LSLAs with a focus on crops production. During those early stages of my research one of the fields I studied was concerned with economic consequences of natural resources. Relevant literature highlighted the idea that in majority of cases abundance of natural resources leads to meagre economic growth; see *e.g.* Sachs and Warner (1995; 1997; 2001), Rodriquez and Sachs (1999), Leite and Weidemann (1999), Gylfason (2000; 2001), Papyrakis and Gerlagh (2004), and many others. Because of the depressing outcome of resource abundance, they dubbed the phenomenon "resource curse" hypothesis. Among those studies, the one from Isham, *et al.* (2005) found out that certain plantation crops (*e.g.* coffee, cocoa, bananas, *etc.*) yield similar economic results as more traditional natural resources (*e.g.* oil and minerals); see also Woolcock, *et al.* (2001).

Results of that study in combination with my literature review of LSLAs showed that there exists a knowledge gap. Namely, no other research tried to understand potential economic consequences of LSLAs on economic growth from the perspective of crops production structure.

Additional research on growth rate volatility also showed that the same point (*i.e.* the effect of the structure of agriculture) was missing in that field of research. To the best of my knowledge, no studies were concerned with the relationship between crops production and export composition and growth rate volatility.

The previous two paragraphs constitute the essence of my motivation to explore the effects of LSLAs as well as crops' production and export structure on growth rate volatility. However, further research showed that my exploration is limited. Although studying the effects of crops' production and export structure on growth rate volatility proved to be relatively straight forward, exploration of the effects of LSLAs on growth rate volatility turned out to be impossible. The main reason for that is lack of data (*i.e.* there are no data on production volumes or values) and because of that I had to modify my research in that matter which subsequently ended up as an essay type chapter of this thesis. Nevertheless, I find information gained valuable especially since it may, through further studies, prove or disprove some of the critiques of LSLA database.

In its third chapter the thesis explores in the essay style, LSLAs and only conducts the most basic form of analysis of crops' production structure on those lands. As I explained in the previous paragraph, the information available prevents me to do any deeper analysis. Nevertheless, the analysis provides valuable information on the types of crops produced on LSLAs. Fourth and fifth chapters (both empirical chapters) of the thesis explore the effects of agricultural crops' production and export structures on growth rate volatility respectively.

I employ the same basic crops' structure throughout the thesis (*e.g.* plantation and non-plantation crops, perishable and non-perishable crops, food and non-food crops, *etc.*) however when available I also explore other possibilities. In this respect the third chapter (i.e. the essay type chapter) provides the least data (*i.e.* only production structure), chapter four provides information on production structure and value, whereas data available in the analysis for chapter five which explores the effects of crops' exports on growth rate volatility data provides the richest data environment and enabled me to explore the effects of additional variables (*i.e.* values of processed and unprocessed crops). Although data on LSLAs does not provide information on crops' production value or volume it nevertheless enabled me to explore my basic structural principles and gain knowledge on their importance for both host countries and investors.

1.2 Novelty and contribution

Contribution and novelty of this research touch both topics covered in the thesis, i.e. LSLAs and growth rate volatility.

Thesis' contribution to the knowledge in regard to LSLAs comes in the form of understanding of previously unexplored information contained in the Land Matrix dataset. The contribution closes identified gap in the scientific literature on the subject of LSLAs, and by an extension allows for further research into the topic of land acquisitions. Based on this contribution further research can for example help understand motivation for investments on the investor part as well as on the receiving side. The study could also prove important in exploration of assumed selection biases presumably inherent in the dataset.

Exploration of the effects of crops' production and export structure on growth rate volatility on the other contributes to the knowledge base in the relevant field. The effects of agriculture in general have been researched by a number of scholars however none examined the effects of crops' production and export structure. The existence of the gap is surprising in that exports of some crops have been identified as having negative effects on long term growth. In addition to being identified as significant contributors, agriculture in general often represents major economic sector in developing countries thus thorough understanding of its effects on the countries' economy seems prudent policy approach.

The novelty of the thesis rests in the way how agricultural products have been grouped. Grouping of crops into plantation and non-plantation, perishable and non-perishable, and food and non-food has been influenced by the two produce identified in scientific literature. Coffee, and cocoa, which significantly affect long term economic growth, are relatively similar products in that they are both plantation crops as well as non-perishable and meant for human consumption. Such division is of course arbitrary, and other researchers might find other groupings.

1.3 Thesis aim

The main aim of this thesis is to expand knowledge base through empirical examination of the effects of agricultural crops' production and export structures on growth rate volatility and to explore LSLAs from crops' production structure perspective.

2. Literature review

This chapter delivers literature reviews relevant to my thesis. Following logical development of my research questions as they evolved from the beginning the first sub-chapter of the literature review (sub-heading 2.1) covers LSLAs whereas the second part (sub-heading 2.2) covers background scientific research for the two empirical chapters.

2.1 Large-scale land acquisitions

Before I proceed with the LSLAs' literature review I would like to explain the two expressions I use within this sub-chapter. The first one is "land grab". The name perfectly fits the spirit of the narrative promoted by the NGOs who brought such practices into the spotlight. Inevitably the name carries strong bias.

The second one and the one I use in this thesis is "large-scale land acquisition". The expression is the most often used in scientific literature and is supposed to be bias-free[2]. Nevertheless when necessary for the sake of explanation or when referring to the literature I also use the name "land grab".

2.1.1 Introduction to large-scale land acquisitions

Ever since GRAIN (2008) published its report on LSLAs in developing countries, the so called "land grab"[3] featured in many published papers and reports; see *e.g.* Cotula, *et al.* (2009), von Braun and Meinzen-Dick (2009), Daniel and Mittal (2009), Oakland Institute (2010), Borras *et al.* (2011), Deininger, *et al.* (2011), Anseeuw *et al.* (2012a), Nolte (2014), Suhardiman, *et al.* (2015), Thondhlana (2015), *etc.* Aggressive campaigning and promotion of the topic resulted in its substantial media presence and helped focus attention of the public on such behaviours. Their findings, which covered diverse set of topics (*e.g.* property rights, employment, gender equality, livelihoods, environment,

[2] Bias-free in a sense that the name doesn't occupy extreme position or brings out strong emotions. However it inevitably is biased since it focuses on "large-scale" spectre of acquisitions; not to mention the fact that even the size of "large-scale" isn't defined.

[3] The term "land grab" is specified in International Land Coalition's Tirana declaration (International Land Coalition, 2011). In this declaration, land grabs are acquisitions of land or concessions that are one of the following: a) in violation of human rights, particularly the equal rights of women, b) that are not based on free, prior, and informed consent of the affected land-users, c) are not based on a thorough assessment, or are in disregard of social, economic, and environmental impacts, including the way they are gendered, d) are not based on transparent contracts that specify clear and binding commitments about activities, employment and benefit sharing, and e) are not based on effective democratic planning, independent oversight, and meaningful participation.

biodiversity, *etc.*), often found their devastating effects on the economy of the host country, lives of affected populations, environment and so on.

However, in time, researchers started to highlight dubious analyses used in those reports as well as unscrupulous use of questionable data which often came from biased resources and which are frequently not verified (or even verifiable); see *e.g.* Scoones, *et al.* (2013), Oya (2013), *etc.* The data used in those reports is often based on the datasets compiled by non-governmental organisations who gather information from media and other contributors. At the moment, dataset compiled by Land Matrix initiative (Land Matrix, 2017) is the only one being regularly updated. Regardless of the shortcomings of such databases they are the only sources of such data and are therefore useful precisely because of their uniqueness (Scoones, et al., 2013)[4].

As is mentioned above, in the early 2000s, media and non-governmental organisations started highlighting controversial large-scale investment practices in land abundant developing countries. Such practices are a sub form of foreign direct investments. They are focusing on investment in land which can be either for agricultural use (*i.e.* to grow crops) or for other purposes *e.g.* forestry, mining, tourism, *etc.* Those early reports highlighted severe negative consequences of such investments and treated them as a form of neo-colonialism, and were dubbed “land grabs” to highlight notorious practices employed. Since then many papers; see *e.g.* Borras *et al.* (2011), Deininger and Byerlee (2011), Anseeuw *et al.* (2012a), Nolte (2014), Suhardiman, *et al.* (2015), Thondhlana (2015), *etc.* researched land grabs’ influence on property rights, employment, gender equality, livelihoods, environment, biodiversity, *etc.* It is also worth mentioning that although reports predominantly focused on foreign governmental and semi-governmental investors, evidence suggests that domestic investments are of comparable numbers (Hall, 2011). Right or wrong, the authors approached their research from more or less negativistic perspective.

[4] There are also other sources of data on foreign (agricultural) investment (see *e.g.* UNCTAD (time-series from 1980), INTRACEN (dataset from 2006 – 2015), IMF (FDI data is based on IMF’s Balance of Payment)) however these datasets only provide information on aggregate monetary values and are therefore not suitable for my analysis which is interested in agricultural production structure. Database similar to the Land Matrix used in this analysis was also provided by GRAIN (2012) however its last update was in 2012.

2.1.2 Foreign direct investments

More recently academics and international organisations have started highlighting potential positive spillovers which can contribute to sustainable economic development of host countries, introduce new technologies, reduce poverty and inequality and increase employment opportunities and food security; see *e.g.* Kay, D.C. (2002), Kay, C. (2009), Cotula, *et al.* (2009), World Bank (2010), Animashaun, *et al.* (2015), *etc.*

Their positivistic view is often based on studies of FDIs[5]. Those studies showed that FDIs can have either positive or negative consequences, and that the final outcome often depends on the appropriate approach; see *e.g.* (OECD, 2002). When the motives of investors align with the needs and competencies of host country, spillovers are mostly positive whereas when they are misaligned consequences are mostly negative (World Bank, 2010). However, it should be noted that even when appropriate policies are in place, unaccountable elites and ambiguous contracts can result in less than optimal results. This holds especially true in developing and least developed countries where transparency often plays minor role.

2.1.3 Foreign direct investments in agriculture

In the previous section I touched on general effects of FDIs on developing countries. Now I want to explore in more detail FDIs in agricultural sector. Hirschman (1958, p. 109) acknowledges that the potential to absorb technology emerging from FDIs depends on economic sectors. Similarly holds true for potential linkages with the wider host economy. He points out that linkages in agriculture and mining might be weak. He also emphasised that when these two externalities (i.e. technology absorption and economic linkages) are not present, effects of FDIs on host country's growth might be limited. Research by Alfaro (2003) who examined the effects of FDIs on growth came to similar conclusion. Using cross-country data from 1981 to 1999 she finds FDIs in primary sector, including agriculture, to have negative effect on growth whereas FDIs in manufacturing produced positive one.

The reason for such outcome may be the intention of FDIs. Based on framework designed by Dunning (1980) Fruman (2016) states four possible investors' motivations: i) natural resource-seeking investment, ii) market-seeking investment, iii) strategic asset-seeking investment, and iv) efficiency-seeking investment. The nature of the first option,

[5] For general overview of FDIs see *e.g.* De Mello, Jr. (1997), Borensztein, *et al.* (1998), *etc.*

i.e. natural resource-seeking investment where investor seeks to access and exploit natural resources may constrain positive spillovers whereas negative externalities in the form of deteriorated balance of payments for host country and other economic and environmental consequences may occur. Hirschman (1958) attributes this to "enclave" type of development where exported products bypass the economy. Often, FDIs positive externalities come from the use of intermediate goods which boosts production efficiency (Rodriguez-Clare, 1996) however this channel works much better for manufacturing than primary sector of the economy. In primary sector, on one hand efficiency and economies of scale require highly mechanised production, and on the other employment opportunities are often low paid. Barrientos *et al.* (2011) show that in agriculture approximately one third of employment would be small scale, household-based work, another one third of employment would be low-skilled labour intensive, and remaining third of employment would be comprised of moderate skilled, high-skilled, and knowledge-intensive employments. Starting from this, it is easy to see why agricultural FDIs could offer little positive spillovers whether in the technology transfers or human capital enhancements. On the other hand, negative spillover in for example profit exports would most likely occur, especially because the investor's motivation is resource (but at the end profit) seeking investment.

In general, research of the relationship between (agricultural) FDI and economy is most often done on a country by country basis. Nigeria is a good example of such approach. There are numbers of articles which try to establish the influence of FDIs on its economy. Akande and Biam (2013) used inflation based scenario analysis and found no long run causal relationship between FDI in agriculture and agricultural output. Similarly Idowu and Ying (2013) find no significant impact of FDI on agricultural output. Imoughele and Ismaila (2014) find negative and significant effect of FDI in agriculture on Nigerian economic growth. On the other hand, Ogbanje, *et al.* (2010) found positive and strong relationship between FDI in agriculture and agricultural GDP whereas Yusuff, *et al.* (2015) used simple linear regression and found that agricultural FDIs contribute positively and significantly on agricultural GDP growth. Binuyo (2014) found strong and positive relationship between FDI and agricultural output however he used data for total FDI and disregarded specific sector investments. Iddrisu *et al.* (2015) find negative impact of FDI on agricultural sector productivity in the long-run however in the short-run the effect is positive. Similar study on the effects of FDIs on agriculture was conducted by Akpan, *et al.* (2017). They find positive and significant relationship between FDIs and crop sub-sector productivity, whereas the relationship between FDIs and livestock productivity was negative. Relationship between FDIs and fishery and forestry productivity was not significant. Relationship between agricultural sector productivity and FDIs was positive and significant in both short- and long-term.

Although these results might seem discouraging (from research perspective), the results of the analysis depend on the FDIs' data. In general, authors that used total volumes of FDIs usually find positive and significant contribution of FDIs on agriculture whereas authors that used sector specific FDI's find either insignificant or negative relationship.

Study conducted by Animashaun, *et al.* (2015) explored policy strategy whereby country first encourages FDI and then promotes outsourcing to local producers and conclude that such approach would maximise positive technological and other spillovers. They based their assessment on the premise of low level of human capital and high absorption capacity of Nigerian rice production sector. Theoretically such approach would bypass the constraints imposed by agricultural sector employment opportunities (Barrientos, et al., 2011) and would extend the effects of FDIs from one to two thirds of population although that would be done at the expense of economies of scale (at least on production side).

Similar studies were conducted for a number of other countries. Epaphra and Mwakalasya (2017) analysed FDI, agricultural sector and economic growth in Tanzania and found no significant effects of FDIs on agricultural value added to GDP ratio. They argue that because agriculture employs large proportion of total labour force, FDIs should be promoted and used to increase efficiency and productivity in the sector. Iddrisu, *et al.* (2015) found negative impact of FDIs on Ghanaian agricultural sector long-term productivity with short-term positive effects. However, they find positive and significant long-term effects of trade openness on agricultural productivity. Chughtai (2014) finds positive effects of FDI on productivity in Pakistani primary sector. The result of the analysis on the influence of FDIs in Lao PDR shows positive although not significant effect (Phommahaxay, 2013). In India, Chaudhary (2016) finds FDIs' positive spillovers in the form of irrigation, transport links, water supply, and electricity and telecommunication connections. A good source of case studies on the effects of foreign direct investment is Food and Agriculture Organisation of the United Nations; see *e.g.* (FAO, 2010; 2013).

Incentives of host countries for agricultural FDIs include employment, growth, revenue, and food security and expect them to include introduction of new technologies and assist in infrastructure development. Cotula, *et al.* (2009) also point out that some countries see FDI in agriculture as a way to diversify from their resource dependence (*e.g.* Sudan from oil and Zambia from copper). Since the beginning of 1990s, host countries are reforming their national policies to attract foreign investors. Such actions include adoption of investment codes in Mali (1991 and 2005), Mozambique (1993), and Tanzania (1997) and often include for example more favourable sectoral legislations on land, banking, taxation, *etc.* (UNCTAD, 2008).

It should be noted that the volume of agricultural FDIs in developing countries is much smaller compared to domestic investment; see *e.g.* FAO (2013) and that there is comparatively similar number of domestic and foreign investors in large-scale land investments; see *e.g.* Hall (2011). Because of that I will also provide a short overview of the effects of domestic investments (from now on “DI” refers to “domestic investment”) and their comparison to FDIs.

2.1.4 Domestic investments

A large part of DIs studies is concerned with the effects of FDIs on DIs. In this respect academic research focuses on two issues: i) productivity spillovers of FDIs on domestic firms, and ii) what kind effects FDIs have on DIs. I have discussed the former in previous sections of the review. The effects of the latter, on the other hand has two contradictory outcomes (according to the literature). Some argue, that FDIs have “crowding in” effect meaning that FDIs lead to more DIs whereas others view FDIs as having “crowding out” effect which results in less DIs.

In this respect, “crowding in” is mostly seen as positive for economic growth whereas the effects of “crowding out” on economic growth are unclear. The “crowding out” arguments sometimes focus on the fact that FDIs owned firms push domestic firms which are often less efficient out of the market; see *e.g.* Titarenko (2006), Mutenyo, *et al.* (2010), Morrissey and Udomkerdmongkol (2012), *etc.* This effect may be positive for productivity however it leads to lower short-term investments and productive capacity of the economy. In addition potentially higher market concentrations may lead to less efficient market which can subsequently lead to lower growth and investment. Such outcomes more often occur in markets with less investment opportunities as is often the case in predominantly agricultural centred developing countries; see *e.g.* Amsden (2011). The “crowding out” effect is also more likely to happen where absorptive capacity of the economy is limited and because foreign owned firms have better know-how, R&D, managerial practices, higher productivity, *etc.*; see *e.g.* Farla, *et al.* (2016).

On the other hand, “crowding in” studies argue that FDIs stimulate DIs resulting in higher economic growth; see *e.g.* Firebaugh (1992), Borensztein, *et al.* (1998), Bosworth and Collins (1999), de Mello (1999), Ndikumana and Verick (2008), Ramirez (2010), Al-Sadiq (2013), *etc.* However, some studies resulted in mixed results; see *e.g.* Agosin and Mayer (2000), Misun and Tomsik (2002), Agosin and Machado (2005), Wang (2010), Adams (2009), Farla, *et al.* (2016), *etc.*

When comparing the effects of FDIs and DIs on the economy, Borensztein, *et al.* (1998) discovered that FDIs contribute more to economic growth than DIs. Studying China, Xu and Wang (2007) showed positive and significant effect of FDIs on DIs and consequently on economic growth; see also *e.g.* Kippenberg (2005).

On the other hand, de Souza Lopes, *et al.* (2009) found that in Brazil DIs raised production more than FDIs and that they also created more jobs that FDIs (both results depend on sector).

2.1.5 Externalities

In the following two sub-chapters I list and discuss those externalities that were already researched either by exploration of FDIs in general or of FDIs focused on agriculture and agricultural land.

2.1.5.1 Positive externalities

FDIs are often seen as a source of economic development, boosting incomes and employment; see *e.g.* OECD (2002), Loungani and Razin (2001) and many others. The effect is particularly important for developing countries where lack of financial resources hinders faster economic development. To attract FDIs countries often liberalise FDI regimes and other relevant policies; there are many scientific papers published, for some more contemporary ones see *e.g.* Rasekhi and Sayedi (2010), Das T. and Das S. (2012), Shah and Khan, (2016), Gnangnon (2017).

OECD report (2002) recognises that in general FDIs are beneficial[6], however they require appropriate policies and also that host countries are at some minimum level of development (De Mello, Jr., 1997; Borensztein, et al., 1998). Among other outcomes their benefits include technology transfer, development of human capital, integration of host country into international trade, introduction of competitive economic environment, employments, *etc.* The secondary effects may include introduction of more environmentally friendly technologies and more responsible corporate practices. Potential outcomes of these spillovers are higher economic growth, reduced poverty, and inequality, *etc.*

It is argued that FDIs spur growth by increasing resource use efficiency and by raising total factor productivity (OECD, 2002). However, economic effect of FDIs in least developed countries seems to be somewhat muted. Studies suggests that this is due to inadequate initial level of development where countries are unable to effectively incorporate technological and other spillovers into their economy (De Mello, Jr., 1997; Borensztein, et al., 1998). Because of weak financial development, unable to support domestic market, a potential spillover effect in the form of rising domestic competition and development of new enterprises to capture opportunities arising from FDIs may also not materialise (Hermes & Lensink, 2003).

Economic integration into international trade

Although there are mixed results of research, in general and in the long term, FDIs help integrate host country's economy into international trade. In the short term however, host countries may experience heightened pressure on their current accounts and foreign reserves. Nevertheless, as countries become more industrialised, FDIs help further integrate host country's economy into the global economy (Lipsey & Weiss, 1981; Markusen, 1983). This is especially true for countries where financial constraints prevented them from using their natural resources (*e.g.* minerals, land, *etc.*). On the other hand, FDIs may initially increase imports, however in time, positive spillovers in the form of subcontracting, development of human capital, and rise of domestic competition substitute imported goods for locally produced ones.

[6] Gerschewski (2013) provides a comprehensive literature review on spillover effects

Technological transfers

Technological transfers are often seen as the most important positive externality of FDIs. Multinational corporations are the most important source of R&D activity but transfers often rely on context and sector. Vertical linkages, especially with suppliers in the host country, are seen as the most important transmission channel for technological transfers (Javorcik, 2004). In this case, technology transfers mostly occur through technical assistance, training, quality improvements, and modernisation. Other transmission channels (forward looking vertical linkages, horizontal linkages, skilled labour migration, and internationalisation of R&D) usually play minor role in these transfers. Transferred technology also has to be relevant to the host country and the technology gap must be relatively limited (Hirschman, 1958, p. 109; Braunerhjelm & Svensson, 1996; Gundlach & Nunnenkamp, 1996), since if the technology gap is too big, technological spillovers cannot be absorbed by local enterprises (De Mello, Jr., 1997; Borensztein, et al., 1998).

Development of human capital

Although FDIs help develop human capital, in general such development is mostly achieved through government policies. On one hand, FDIs are more likely to materialize where there is at least some human capital available, and on the other, positive spillovers (especially technological ones) are more pronounced when there is a minimum level of human capital present (De Mello, Jr., 1997; OECD, 2002; Borensztein, et al., 1998). Development of human capital by FDIs is mostly achieved in later stages where on-the-job training and learning enhance its development, and when linkages with local enterprises demand them to develop their own practices and skills.

Domestic competition

Competition in host country markets may be severely disturbed although research on this is very limited mainly due to the lack of appropriate measures. Conclusions based on empirical evidence are scarce. Although FDIs and especially the presence of multinational corporations promote local competitions (Braunerhjelm & Svensson, 1996), higher productivity and more efficient resource allocation (Görg & Strobl, 2001), this has been shown to occur mostly in developed countries. On the other hand, in developing countries, the introduction of large multinational corporations may raise concentration levels thus hurt competition; see *e.g.* Aitken and Harrison (1999). Such outcomes are based on “absorptive capacity” (Cohen & Levinthal, 1989) and a number of factors present in the host country, for example barriers to entry, geographical location, multinational corporation's international position, *etc.* Cohen and Levinthal (1989) argue that spillover effect is not present if the technological gap is too large; see also Haddad and Harrison (1993) and others. The other point in this debate is around efficiency where entries of foreign companies and appropriate domestic competition laws require domestic companies to be more efficient (Görg & Strobl, 2001).

Local enterprises
In general FDIs also help in development of local enterprises through synergies, raised efficiency, and development of new activities. Spillover effects help at development even in unrelated enterprises. The highest improvements are achieved in enterprises with economies of scale and in those that were acquired by foreign entities (OECD, 2002).

Social and environmental effects
On the environmental and social front, the results of foreign direct investments can be either positive or negative. Positive results are achieved when spillover effect raise environmental and social standards through good practices and governance, and technologies. On the other hand, if FDIs happen because production practices are no longer permitted in other countries outcomes may be detrimental to environmental and social standards. This holds especially true if the host country is eager to attract FDIs, and for that reason exempts foreign companies from regulation or even freezes or lowers relevant standards (OECD, 2002).

2.1.5.2 Negative externalities
As is often the case with new phenomena (in this case LSLAs) that are not yet properly researched and understood, advertised effects range from extremely positive to extremely negative, depending on the position of researcher and presenter.

As I said above, first studies exploring LSLAs conducted their analyses with dubious data and questionable methods. They would often use qualitative studies and reference interviews however in most cases they would omit necessary supporting information (*e.g.* number of interviewees, sampling process and selection criteria, *etc.*). Some studies provide some information on methods but fail to provide their justification; see *e.g.* Schoneveld, *et al.* (2011). Their reports would also compound areas of deals happening in a host country (although they occurred over many years) and studied their impacts on that basis alone. Studies would also omit the fact that different stakeholders and communities feel different (and sometimes opposing) impacts (Borras Jr., et al., 2012). Research is sometimes accompanied by quick (biased) field survey and employs swift "empirical" research in order to achieve rapid publication.

In contrast to positive externalities which I highlighted above, and which are in most cases derived from studying FDIs, some authors explore case specific outcomes and provide more quantitative analyses of emerging problems, some explore whether effects of LSLAs meet the expectations forecasted by FDIs backed models or conduct surveys searching for other effects they might have on the host economy.

In majority of cases, negative externalities coming from FDIs are most often present when inappropriate policies are put in place. Such negative outcomes may include deteriorated balance of payments, exclusion of local communities, negative environmental impacts, increased commercialization of host countries, negative effect of competition on local firms, market concentration, *etc.* In some cases FDIs may also be perceived a threat to sovereignty (*e.g.* domestic food sovereignty).

Criticism of land deals usually focuses on tendencies of investors to monopolise domestic food markets, crowd out local competitors, but also being export driven, and thus not supplying local markets with crops produced (Pagano, 2009). Additional concerns include reduced biodiversity, water shortages and other environmental impacts, producing biofuels at the expense of food, carbon market, *etc.* In this regard, EU's Renewable energy directive (EC, 2009) is often highlighted by NGOs; see *e.g.* Oxfam International (2016) and ActionAid (Dahlbeck, 2012) for its potentially harmful effect on developing countries, however Hamelinck (2013) conducted a research using Land Matrix as a source of land deals and showed that area of land acquired and signed as a biofuel production for EU market is over-exaggerated.

Besides large environmental impacts that affect large areas of a host country (and sometimes neighbouring ones as well), the majority of day-to-day consequences are felt by population immediately surrounding LSLA lands. Among other such consequences may include reduced water supplies, harder or prevented access to water, access to their lands, air, water and noise pollutions, etc. to positive ones: employment, improved local infrastructure either because it was needed by the investor or because it was part of LSLA negotiations.

Cotula, *et al.* (2009) recommend enabling civil society as to maximise the benefits of such deals. As a key stakeholder that usually bears most of negative consequences of land deals, civil society is often excluded from talks. Even if they are included, political pressure is often used to “persuade” them into such deals (Purdon, 2013). On top of the above mentioned issue of transparency, lack of property rights and poor legal framework including corrupt and/or inefficient institutions are the biggest barriers to achieving more beneficial outcomes (Cotula, et al., 2009). Land is often occupied and used, requiring relocation of local population. Although land is described as “idle” or “wasteland”, these terms reflect assessment of the productivity rather than the existence of current users (Hall, 2011).

In report published by World Bank (2010) and produced in collaboration with FAO, The International Fund for Agricultural Development (IFAD), and United Nations Conference on Trade and Development (UNCTAD) they argue that international agricultural investments could potentially be beneficial providing that aims of investors are compatible with the needs of host countries.

As already mentioned above, the economic effect of FDIs in least developed countries seems subdued. Some of the researches indicate that insufficient development level prevents effective integration of technological and other spillovers into the economy (De Mello, Jr., 1997; Borensztein, et al., 1998). Weak financial development provides little support to domestic market which results in small or absent domestic competition and development of new local enterprises which would be capable of capturing spillovers and thus drive economic growth (Hermes & Lensink, 2003).

2.1.5.3 LSLAs specific externalities

As I already said above, positive externalities usually include infrastructure investment, technology transfers, higher employment, increased production and productivity, utilisation of dormant land, rents, *etc.* (Hallam, 2009). Host countries also see FDI in agriculture as a way to boost growth, revenue and food security (Cotula, et al., 2009). Cotula, *et al.* (2009) acknowledge that although land fees are a possibility they might not be an important source of income. Governments usually see other, long term benefits coming from agro investments (*e.g.* employment, diversification, infrastructure, *etc.*) however they emphasise that annual water fees are often included in contracts.

Taxation is also subject to the host country's underlying strategy. When countries see agriculture as a strategic sector, long-term or even permanent exemptions on custom duties and taxation on income and profits may apply (Cotula, et al., 2009).

Kay (2002) also emphasises possibilities of sustainable development through synergies between agriculture and industry; see also Kay (2009). His research points to the importance of the State to design and implement such synergies, as free market generally does not generate or maximise the synergies between sectors.

Most often LSLA's business model is based on concentrated mono-cropping production for maximum efficiency. However, requirements for employment opportunities, environmental protection, and social investments are becoming accompanied by obligations to include local farmers and small businesses in the supply chain covering everything from outgrowing schemes to joint ventures and even obligatory domestic shareholding in the investment. This emerging trend is seen as a tool for more equal distribution of benefits coming from such investments (Cotula, et al., 2009; Animashaun, et al., 2015). Deuss (2012) for example found that rapid sugarcane expansion coupled with improved infrastructure in some Brazilian districts increased growth rate by 0.5 percentage points compared to districts with no or little expansion. In African context, linking value chains with smallholders will enable more inclusive economic growth, especially because smallholders in African countries are dominating agricultural production.

Although host countries might be food-importing or even recipients of food aid, produce from LSLAs usually end up as exports to investor's home country (Cotula, et al., 2009) especially if the investor is a foreign government concerned with domestic food security situation. Provision to repatriate all or majority of produce may sometimes be included in contracts.

Strong demand for agricultural products both locally as well as globally is likely to continue into the future. Declining world commodity prices in the 1980s and early 1990s countered expectation of the outcomes of liberalisation of many African countries. Economic growth which African countries are experiencing since the 1990s coupled with urbanisation, diversified diets, and demand for higher quality produce as well as rising world commodity prices offer wide market opportunities for African agricultural businesses. However, prospects of gains from these improved market conditions require enhancements in whole supply chain of their agro-business, and include everything from logistics and infrastructure to retail and marketing (World Bank, 2013). WB also suggests that post-harvest aggregate, processing, packaging, and shipping facilitate the enforcement of contracts (*ibid.*).

World Bank report (2013) predicts that for African countries' domestic markets the most dynamic agricultural sectors in the coming years will be rice, feed grains, poultry, diary, vegetable oils, horticulture, and processed foods for import substitutions. On the other hand, they see export markets for traditional tropical crops like cocoa, cashew, rubber, palm oil as well as their processed products and in addition to fish, biofuels, and higher-value horticultural crops.

However, competitiveness of African countries is low, primarily due to low productivity which is often half of average of that in Asia and Latin America. Such low productivity is a direct result of low use of modern inputs in the form of seeds, fertilisers, and irrigation as well as production practices and R&D. In essence, African countries increase production mostly through extnesification rather than intensification at the expense of biodiversity, forests, and soil. Because of this underperformance, many African countries are food importers. And although they might reduce famine, imports usually face tariffs and other charges, reducing disposable income and subsequently economic growth.

World Bank report on African agriculture (2013) states many constraints that African agriculture faces and which will have to be addressed in order to improve its competitiveness. The most important among them are:

- erratic policy interventions on tariffs, price, and taxes,
- property rights and land markets,
- low level of financial development,
- poor infrastructure, high transport costs and low level of border and customs logistics,
- inadequate supply of seeds and fertilisers,
- fragmented, risky, and undeveloped product markets, and

- low use of technology, and unskilled labour force, *etc.*

On top of these domestic constraints, exports, especially of high end agricultural products face barriers in the form of food and health safety and other standards imposed by import markets.

2.1.6 Drivers for large-scale land acquisitions

Although FDIs often play important role in host country's developmental policy they are not the only driver for LSLAs. Depending on the needs of investors, drivers for large scale land acquisitions vary greatly. Countries highly dependent on food imports see LSLAs as their approach to national food security. Others see investment opportunities either through rising land values or increasing prices of agricultural commodities. Some also seek secure supply of agricultural non-food raw materials for their economic development. In this respect Cotula, *et al.* (2009) point out that with increased global economic growth production of certain non-food agricultural commodities is hitting their natural limits. These commodities cannot be replaced by alternatives and therefore require new sources of supply[7].

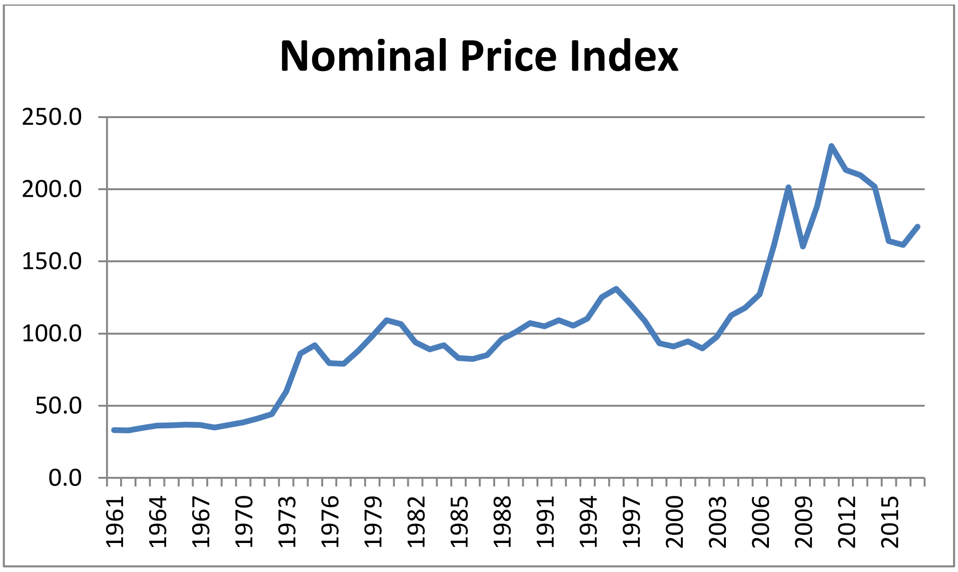

Figure 1: Nominal world food price index
Source: World Food Situation (FAO, 2017) [8]

[7] This group includes: coffee, cocoa, tea, sugar, rubber, cotton, soybeans, *etc.* (Cotula, et al., 2009)

[8] Food price index consists of the average of five commodity group price indices weighted with the average export share of each of the groups for 2002 and 2004.

In general Hall (2011) identified three main drivers on the investment side: food, fuel, and finance. In addition to investors' motivations, host countries have their own incentives in attracting FDIs. As Cotula, *et al.* (2009) state, drivers for any particular land deal vary from case to case.

2.1.6.1 Food

In 2007-2008 and then again in 2011 – 2014 world agricultural food prices spiked (see figure 1) showing vulnerability of food-importing nations to fluctuations in global commodity markets; see *e.g.* Cotula*, et al.* (2009), FAO (2017), etc. Maize and wheat prices increased by 100% between 2003 and 2008 (von Braun, 2008), and although their prices have dropped they rose again between 2011 and 2014.

In fact, all of the commodity groups saw spikes during 2007 and 2009 and then again between 2011 and 2014 (FAO, 2017). Figure 2 shows plot of deflated price index and second order polynomial trendline. Trendline shows that long term deflated world food prices are on the rise ever since they reached minimum levels in the late 1980s. Although it is unclear whether food prices will remain above average, the most recent spikes encouraged food importing countries to take precautionary steps to secure land and water resources and thus improve food security for their domestic markets.

Selby (2009) stated that spikes occurred because of movements in food supply and demand as well as problems in storage and distribution. On the supply side he highlights diminishing agricultural production in some areas due to reduced soil quality and depletion of water supplies. Degradation of soil quality and reduced water supply are mostly the result of intensive agriculture, climate change will only amplify that with the addition of extreme weather events which will affect harvests. On the demand side he states population growth, urbanisation, and changing diet as the most important contributing drivers.

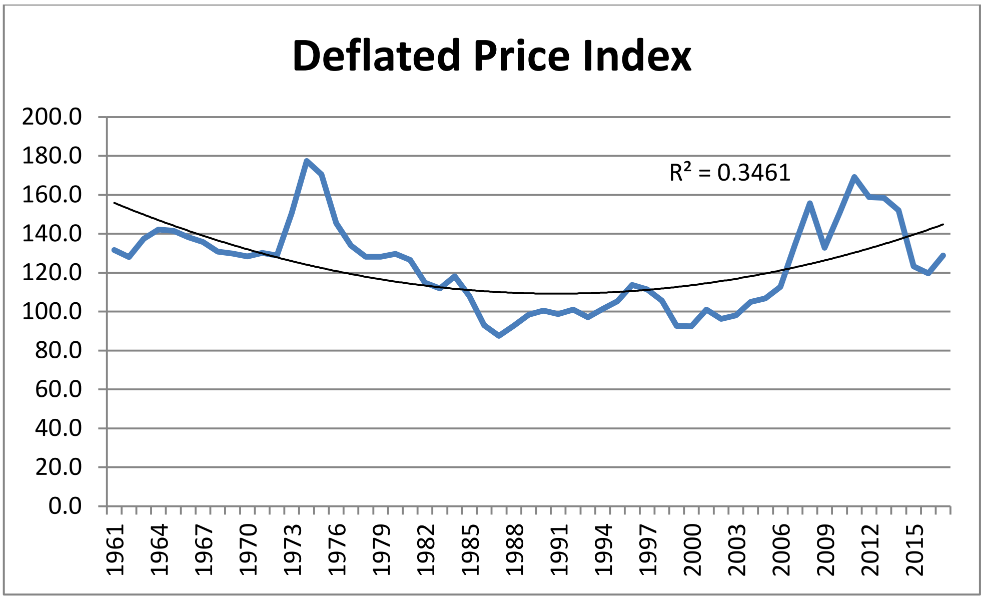

Figure 2: Deflated price index with second order polynomial trend line
Source: Food and Agriculture Organization of the United Nations (FAO, 2017)

2.1.6.2 Fuel

Fuel adds additional factor to the agricultural land deals debate. On the one hand, modern agriculture is highly reliant on fuel, not only for transport but also for the production of nitrogen fertilisers. On the other hand strong public awareness of climate change incentivises companies to acquire land for the production of biofuel crops. In addition, government biofuel targets combined with guaranteed long-term markets and financial incentives in the form of subsidies and tax breaks are boosting biofuel production and consumption. Besides the usual climate change related reasons, biofuel production also provides energy security, helps in rural development, as well as boosts exports (Dufey, et al., 2007). In relation to climate change, agricultural land offers two possible uses; one is biofuel production, while the other uses lands as a carbon sink (Hall, 2011). In the latter case, investors earn carbon credits through the use of agricultural land in appropriate ways. Among them are forestation[9], carbon storage in soil through regenerative agriculture (The Carbon Underground and Regerative Agriculture Initiative, 2017; LaSalle & Hepperly, 2008), *etc.*

[9] At the moment forestry is not included in EU Emissions Trading Scheme although it is in a proposal to be included for 2021 – 30 period. European Commission's proposal for the inclusion of forestry in greenhouse gas emissions and removal scheme Document 52016PC0479 (EC, 2016), see also Land use and forestry proposal for 2021 - 30 (EC, 2017)

2.1.6.3 Finance

The third important driver was the financial crisis in 2008 followed by recession that pushed investors seeking higher yields in more volatile and risky markets. Tangible land together with promised rising demand for food and fuel in the future made such long-term investments very compelling. Although investments in agricultural value chains traditionally focused on processing and distribution and avoided more risky primary production, increasing commodity prices pushed risks of sourcing raw materials to processors and distributors and increased returns on production (Selby, 2009). This rebalancing of value chain boosted attractiveness of agricultural production including land ownership as well as production of fertilisers and other upstream agricultural activities (The Economist, 2009).

2.1.6.4 Speculations

In addition to the above mentioned drivers for food prices increase some argue that speculations also play an important role in food price volatility as well as food price increases. Some researchers find speculation as having significant effect while others argue that they don't influence food prices or that its influence is short-termed.

Speculation in food prices is based on futures trading on commodities exchanges. In principal, futures' trading represents an instrument which reduces price fluctuations by fixing prices at current market levels for purchases and sales of commodities' future deliveries; see *e.g.* Erber, *et al.* (2008).

However futures' trading role of stabilising commodity markets changes when investors seek short-term gains through uncontrolled price variability; see *e.g.* Henn (2011). These investors (also called "noise traders") produce price trends which can lead to speculation bubbles. In general "noise traders" make buy and sell decisions based on limited information. They are usually non-professional investors or technical analysts who overreact to news (good or bad) and therefore follow trends.

Sometimes informed traders use the behavioural reactions of "noise traders" to steer prices in the direction they want. The idea is based on the premise that uninformed traders understand the connection between current prices and the information of some informed agents; see *e.g.* Lucas (1972), Green (1974), Radner (Radner, 1979). By following the trend (set by informed traders) "noise traders" use the information they don't have (and which they believe is reflected in the current prices) to make their decisions. The informed traders can therefore, through their financial power, influence the behaviour of "noise traders" in buy and sell futures for their own financial gains.

For example Erber, *et al.* (2008) argue that it is nearly impossible to evaluate the extent of speculations on food prices[10]. Nevertheless they suggest that structural change in the form of reduced or abolished international trade barriers might help, however the effect of such change may be severely constraint by both traders' market power on the demand side as well as the power of upstream suppliers.

Some suggest that speculations can also increase price volatility; see for example Field (2016) who found positive correlation between food price volatility and index funds.

An econometric research done by Conrad (2014) found neither positive nor negative effects of speculation on futures' prices however they may affect commodities' spot prices.

On the other hand FAO in its report titled "Price surges in food markets - How should organized futures markets be regulated?" (FAO, 2010a) argues that empirical evidence does not confirm the speculation hypothesis. As an example the report highlights index funds as powerful investors who hold between 25 and 35 percent of the futures contracts. However they argue that because they hold those contracts for long time they are less likely to react to changes in market fundamentals. They point out that commodities without futures show the same price volatility as those that do. Their conclusion is that although there might be some effects of speculation they are most likely short-term; see also *e.g.* McPhail, *et al.* (2012), Tadesse, *et al.* (2014).

[10] Literature review can be found for example in Shutes and Meijerink (2012), Glauben, et al. (2012), Will, et al., (2016). Overview of studies from agricultural economics point of view can be found for example in Irwin and Sanders (2012).

2.2 Long-term economic growth and growth rate volatility

As I explained at the beginning, this thesis broadly consists of two parts. The first part is an essay type chapter focused on LSLAs whereas the second part consists of two exploratory chapters which research the effects of agricultural produce on growth rate volatility. The following sub-chapter reviews scientific literature important for the second part of my thesis.

In the early eighties of the last century a set of papers started to explore connection between growth rate volatility and long term growth. First Nelson and Plosser (1982) suggested that movements of GNP appear permanent, while papers published by Kydland and Prescott (1982) and Long and Plosser (1983) explored new economic models which connected growth, business cycles, and volatility. Since then scientific literature examining volatility and growth diverged into two streams. The first one examines international business cycles and tries to find factors that influence output fluctuation at different levels (global, regional, and country-specific). The second strand employs standard econometric techniques in the form of regression analyses to establish factors influencing volatility. The two empirical chapters of my research fall into the second strand and build on the pre-existing findings.

2.2.1 Introduction

Long term growth and growth volatility were explored by Ramey and Ramey (1995) which subsequently influenced a tide of research that looked at the topic from multiple angles. Many researchers established that over the long term developed countries tend to have less short-run volatile growth rates than developing countries; see *e.g.* Nelson and Plosser (1982), Lucas (1988), Easterly, *et al.* (2000), and that high short-run growth volatility results in lower overall (long-term) growth; see *e.g.* Ramey and Ramey (1995), Kose, *et al.* (2003; 2005), Hnatovska and Loayza (2003), Badinger (2010). Easterly, *et al.* (2000b) showed that growth rate volatility depends heavily on the level of financial development. They established that the least developed countries with the most under-developed financial systems suffer from high levels of growth rate volatility. They also discovered that volatility has excessively adverse effects on least developed countries.

However, some researchers also found positive link between volatility and growth, see *e.g.* Saint-Paul (1997)[11].

2.2.2 Agriculture and development

Many authors and institutions; see *e.g.* Lewis (1954), Kuznets (1954), Ranis and Fei (1961), Johnston and Mellor (1961), Singer (1979), Adelman (1984), Matsuyama (1992), The World Bank (2007), IAASTD (2009) see agriculture as a stepping stone for economic development.

The idea of positive externalities of "agricultural demand led industrialisation" was promoted by Singer (1979) who developed a model connecting agricultural linkages and economic development. He viewed increased agricultural productivity as a trigger for industrialisation. Often having the highest share of the economy and providing necessary capital for structural economic shift, agriculture in developing countries is trapped in low productivity; see *e.g.* The World Bank (2007), Dethier and Effenberger (2012)[12]. Because countries rely on underperforming agriculture with lower yields, volatile export revenues lead to less and unsteady resources which then lead to high growth rate volatility and consequently lower long-term economic growth; see *e.g.* UNDP (2011), Ramey and Ramey (1991). Additionally, Dercon (2009), and Dercon and Gollin (2014) suggest that if country is landlocked and therefore more closed to international trade agriculture can be its main development driver; see also *e.g.* Sachs and Warner (1995; 1995a; 1997), Collier (1999).

2.2.3 Point-source resources

Isham, *et al.* (2005) found that economies primarily reliant on revenues from point-sourced resources, including those exporting plantation-based crops (*e.g.* coffee, cocoa, *etc.*) have lower economic growth rates compared to diffuse economies as well as to those that export manufactured goods. They argue that rents coming from point-source resources promote appropriation demands (also called "voracity effect" by Lane and Tornell (1996) or "rentier effect" by Ross (2001)). Sokoloff and Engerman (2000) found that point-source resources promote creation of extractive and non-developmental institutions. Rent seeking is often highlighted as the most important factor in lower long-

[11] Imbs (2007) provides a discussion on volatility-growth link, whereas Döpke (2004) , Norrbin and Yigit (2005), and Imbs (2002) provide an extensive review and discussion of empirical studies.
[12] Krueger (1993) found that in sub-Saharan Africa average taxation is four times larger than taxation in Latin America and ten times that of Asia. In SSA taxation reaches 25 per cent and doubles if indirect taxes (*e.g.* overvalued exchange rates) are included.

term growth; see *e.g.* Lane and Tornell (1996), Ross (2001), Sokoloff and Engerman (2000), *etc.*. It influences creation of biased institutions for easier rent appropriation. Such institutions are less focused on development and more on accommodating various political and economic factions for their own wellbeing which leads to lower long-term economic growth; see *e.g.* Acemoglu, *et al.* (2005), Auty (1997), *etc.* In this respect Acemoglu *et al.* (2005) argue that long-term growth demands well-functioning economic institutions.

Based on export theory, Binswanger (1994) reasons that peasant linkages promote economic development more than those of the plantation, which Baldwin (1956) attributes to the staple production function, and argues that sub-tropical and tropical staples (*e.g.* cotton, sugar cane, *etc.*) require large initial capital investments, offering little scope for incremental advances in productivity, but are vulnerable to price shocks due to their mono-culture production structure.

2.2.4 Diversification

Poor, developing countries specialise in fewer predominantly primary sectors. As was shown by Koren and Tenreyro (2007), primary sectors tend to be more volatile and have high sector-specific risks. They also showed that half of the difference in growth volatility between developed and developing countries can be explained by differences in sectoral composition. In early stages of development, developing countries tend to have high sectoral concentrations; see *e.g.* Acemoglu and Zilibotti (1997), Imbs and Wacziarg (2003), Koren and Tenreyro (2007).

One form of such sectoral concentration in developing countries is agriculture[13]. It usually accounts for largest share in GDP, and is often the only industry of any significance in developing countries. On average it accounts for 29 per cent of GDP, employs around 65 per cent of labour force, and represents the main source of livelihood for 86 per cent of rural households; see *e.g.* The World Bank (2007), Dethier and Effenberger (2012), yet its productivity is very low. Agriculture, being the only significant industry, has to carry the majority of capital demands for structural shift from agriculture to manufacturing and services. Connected to the required capital formation Ramey and Ramey (1991) showed that increased economic volatility can lead to lower accumulation of resources and subsequently to lower growth.

[13] Although not completely the same, point-source natural resources are another such example.

In their research, Brainard and Cooper (1965) propose that diversification can reduce economic volatility in the long-term, while Burns (1960) suggests that diversification reduces volatility by mitigating sector-specific shocks[14]. Acemoglu and Zilibotti (1997) argue that due to indivisibility of investment projects and scarcity of capital, poorer countries tend to have limited opportunities for diversification, and that investing in safer sectors provides a way of insurance; see also *e.g.* Greenwood and Jovanovic (1990), Saint-Paul (1992), Obstfeld (1994). Although Saviotti and Frenken (2008) claim that economic growth immediately emerges from within sector diversification they notice that between sector diversification takes time to materialise.

Diversification also has smoothing effect in regard to volatility; see *e.g.* Mobarak (2005), Klomp and de Haan (2009), Burns (1960). The World Bank (2007) report highlights that 60 percent of rural population in the developing countries has access to markets as well as areas of good agricultural potential. That allows them to diversify into higher-value products like fruits and vegetables as well as vegetable oils, and livestock and horticulture products. This should enable them to offset decline in prices (and exports) of traditional crops which is a result of changing consumer diets. IAASTD (2009) states that market for staple food crops, although larger but with lower value, is perceived less risky than market for higher value crops. At the same time, The World Bank (2007) recognises that although use of cereals in consumer diets is in decline, their use as livestock feed and biofuels production should offset the decline. Papageorgiou, *et al.* (2015) acknowledge that agriculture has lower potential for quality upgrading (*i.e.* upgrading quality of goods produced) than other sectors, and suggest that output diversification, when economies have evenly balanced mix of existing products is one of key factors of economic growth, partly due to reduced output volatility.

Mobarak (2005) and Moore and Walkes (2010) established that diversified production structure lowers output volatility, and Koren and Tenreyro (2007) find sectoral composition of the economy as one of the most important factors in explaining growth volatility; also confirmed by Klomp and de Haan (2009). Koren and Tenreyro (2007) also showed that product diversification increases resilience of developing economies to external shocks. Papageorgiou, *et al.* (2015) although mostly concerned with export

[14] A case study in Gyasi, *et al.* (2004) shoved that crop varietal diversification enhances food security against climate change, crop diseases, and variable market conditions.

diversification also note, that diversification and structural transformation (*i.e.* reallocation of resources from less to more productive sectors and activities) within broader domestic economy play crucial part in economic development.

2.2.4.1 Agricultural diversification

To play its role, agriculture therefore has to diversify in crops and intensify output mix. Extensification, *i.e.* bringing more land under cultivation would not solve the problem of revenue volatility (World Bank, 2007). Agricultural modernisation (*i.e.* intensification) through the use of technology, high yielding crops, irrigation, and the use of fertilisation together with improved infrastructure and supporting institutions would result in agriculture being able to support the economic shifts required for the next stage of development (Singer, 1979) and to offset any shortcomings of urbanisation (migrating workforce) and ageing of farmers.

Majority of policy papers therefore suggest diversification away from agriculture and into manufacturing and service sector, however, developing countries, and especially least developed ones have little choice but to remain with agriculture (International Monetary Fund, 2014). As was stated above such investments often result not in diversification between sectors but instead focus on diversification within sectors.

Based on the fact that agriculture represents such a big part of the economy of developing countries and regarding policy recommendations that promote (within and between sectors) diversification it is surprising that no detailed research in agricultural product and export mix has been done so far. Based on the above stated premise of diversification influencing growth volatility, we should expect that more diversified agriculture should play an important role in countries' policy making

I have stated above that some researchers see agriculture-driven industrialisation as a starting point for development; see *e.g.* Singer (1979), Owens and Wood (1997). However, others promote exports-led growth as the proper development path; see *e.g.* Easterly, *et al.*, (2000), Bloch and Tang (2004), Balavac (2012), *etc.* Although exports bring much needed income, openness also introduces vulnerability of the economy to external shocks. The extent to which such shocks influence domestic economy relies on the degree of the exposure to the international markets; see *e.g.* Briguglio, *et al.* (2009), Rodrik (2010), The World Bank (2010).

Many developing countries have large shares of agricultural exports in GDP (World Bank, 2010). Agricultural exports tend to have high export revenue volatilities which often results in higher growth rate volatility. For example Demas (1987) in his address to the board of governors at the 17th annual meeting of the Caribbean Development Bank stated that Caribbean countries in many cases depend on a small number of export crops, mainly sugar and bananas. In some Caribbean countries sugar represents up to 95% of total agricultural exports while in others bananas' share reached up to 82%. However, such overreliance can be countered by diversified exports; see *e.g.* Bejan (2006), Di Giovanni and Levchenko (2006), Bacchetta, *et al.* (2007), Hesse (2008), Haddad, *et al.*, (2010), Caselli, *et al.*, (2015), *etc.* Demas (1987) for example lists no less than 33 products coming from processed sugar. Chapter 1 in UNDP report (2011) states that diversification has many positive externalities. It can reduce export revenue volatility, increase value added, improve growth through technological improvements, and help the economy through forward and backward linkages.

Research by Joshi, *et al.* (2004) found, that countries in South Asia steadily diversify into high-value as well as labour intensive agricultural commodities, among them fruits and vegetable. They observe that favourable initial conditions (*e.g.* infrastructure, institutions, urbanisation, technological progress, *etc.*) as well as appropriate ecological conditions enabled the shift. Besides increasing farm income, diversification provides greater employment opportunities and help protecting the environment. Wahiduddin, *et al.* (2000) similarly observe that diversification boosts production growth rate but argue that demand forces especially in foreign demand, play crucial role in the process. They argue that demand for high value agricultural products in developing and least developed countries is low and that export-led strategy is the proper development path. There are concerns, especially at the governmental level, that agricultural diversification leads to reduced food security through switching to high value crops (Kumar, et al., 1998) however as Gyasi, *et al.* (2004) shoved that is not necessarily true (see footnote 14). Joshi, *et al.* (2004) notice that dietary patterns in developing societies are changing where cereal consumption is being substituted by fruits, vegetables, fish, and livestock products. They also noticed that low yielding cereals (*e.g.* sorghum, millet) were substituted by high-yielding ones (*e.g.* rice, wheat, *etc.*) which together with higher cropping intensity leads to improved food grains availability.

Short summary of the literature review so far shows that developing countries tend to have higher growth rate volatility than developed ones which causes reduced long term growth. They also often have high shares of agriculture in GDP which is often concentrated in few products and suffers from lower yields. In addition, some of agricultural products tend to increase growth rate volatility which researchers attributed to rent seeking tendencies of investors, large initial investments, and low quality institutions. Although many economists and institutions consider agriculture as a stepping stone on the development ladder they consider diversification (within and between sectors) as well as exports as a proper way to develop the economy.

As I have stated above it is surprising that no studies have been performed on the effects of agricultural crops' production and export structure on growth rate volatility despite clear policy recommendations and scientific research. This is especially worrying when considering contemporary large-scale investments in agricultural land.

3 Overview of LSLAs in Land Matrix database

3.1 Introduction

This is an essay type chapter which provides an overview of LSLA deals recorded in Land Matrix database (Land Matrix, 2017) as of the end of November 2017.

Although there are plenty of published papers conducting overview of land deals and their consequences from the same database; see *e.g.* Cotula, *et al.* (2009), von Braun and Meinzen-Dick (2009), Daniel and Mittal (2009), Oakland Institute (2010), Deininger, *et al.* (2011), and many others, this analysis differs from others because it will thoroughly analyse varieties of crops and other aspects of crop's production (*e.g.* diversification, *etc.*) based on the information provided in the database.

Starting with the study of supply and demand for agricultural land (sub-chapter 3.2) the essay then introduces reader to the Land Matrix database (sub-chapter 3.3) explaining its different expressions and designations. It also addresses the question of quality of the dataset. The following sub-chapter (3.4) conducts he second part (chapter 3.3) provides literature review of the critiques of the database and its deals as well as methodologies used in their research. The third part contains the analysis of land deals in the database, with special intentions paid to land deals that produce agricultural crops whereas the last part concludes this essay.

3.2 Supply of and demand for agricultural land

Before I embark on the exploratory path associated with this chapter I would like to provide some insight into supply and demand factors that shape market for agricultural land in general and large-scale land purchases (or leases) in particular.

As an economic model in microeconomics, supply and demand hypothesises that in a competitive market, price of a unit of traded good settles at a level where supplied quantity equals demanded quantity. For the purpose of this thesis, traded good refers to agricultural land which is economically considered a resource, a space, a property, a factor of production, a capital, and a consumption good. In general, land is also an intermediate good which produces agricultural goods and provides services (*e.g.* as a place for recreation).

From macroeconomic perspective, agricultural land can be considered an asset with three particulars: i) scarcity, ii) immobility, and iii) durability (Dasso, et al., 1995). In addition, its scarcity has two components: i) physical scarcity, and ii) scarcity of emanating products with low production elasticity and products' substitution. Land's price is determined by the capitalisation of future incomes coming from both its productive as well as its speculative use; see *e.g.* Peters (1966), Lloyd, *et al.* (1991), Hallam, *et al.* (1992), Lloyd (1994), *etc.* Its productive income is derived from agricultural products whereas its speculative income comes from its characteristic at holding its value over time. Holding a land for its productive capacity is but only one of many reasons which also include for example its prestige and lifestyle values, family traditions, *etc.* (Ciaian, et al., 2012). However, in general, people purchase land because of the agricultural products and not for the sake of owning the land (Barlowe, 1978).

Both supply of and demand for land are determined by their own factors as well as specifics of geographical area and area's political as well as socio-economic development. Agricultural land's market price is not only a guide for supply of and demand for land but also serves governments in their governing processes (*e.g.* taxation, land access, *etc.*) as well as financial institutions (*e.g.* mortgages). The price therefore not only shows expectations of owners but also enables policy makers to assure efficient economic and social use of land.

It is debatable which determinants are "demand-side" and which "supply-side", however Hertel (2010) based on his analytical framework, lists population growth, rising per capita incomes, bioenergy, and productivity changes as demand determinants.

Determinants of demand for agricultural land

1) Price: one of the main determinants of demand for agricultural land is price which reflects number of determining factors, for example: location, transport links, physical characteristics, distance from market, water sources, cost of development, *etc.*
2) Income (*i.e.* net farm income): Capitalisation theory indicates that the value of land (in effect a capital asset) is determined by its prospective earnings or to put it differently by the discounted present value of the future net income stream. However, Gardner and Nuckton (1979) observed that after 1973 in the case of U.S. farmland real estate land value surpassed its income-generating capability.

Nevertheless, agricultural land productivity has been steadily increasing through technological advances in the form of higher yielding crops, mechanisation, pest control, fertilisation, *etc.* Higher returns from agricultural produce increase the demand for agricultural land and *vice versa*. It is therefore dependent on market conditions for the product and technical conditions for production.

3) Population growth: population growth is usually the most frequently mentioned demand driver for agricultural land. In its medium growth forecast UN is predicting 50% world population increase between 2000 and 2050 (United Nations, 2017a) which will put pressure on demand for agricultural products and consequently on agricultural land.
4) Income growth: Economic growth, particularly in developing countries, resulted in changing diets. Although such changes mostly include higher protein consumption, livestock products also greatly increase crop output which is then used as a feedstock (Tweeten & Thompson, 2008).
5) Alternative land use: Agricultural land can not only be used for agriculture but also for other purposes (as *e.g.* protected areas, recreational location, carbon sink, *etc.*). Although not applicable to every agricultural land (*e.g.* because of regulatory constraints, its profitability potentials, its geographical location, *etc.*) such alternative land usage represents additional demand driver and land value will reflect those potentials; see *e.g.* Plantinga, *et al.* (2002), Ciaian, *et al.* (2012), *etc.*
6) Level of development of financial system: financial system plays important role in land transactions. Loans and credits enable buyers to purchase relatively expensive commodity.
7) Available infrastructure: this includes production infrastructure (*e.g.* irrigation system) as well as more general infrastructure (for example: transportation links, access, distance from markets which lowers transportation costs and enables production of highly perishable crops that need fast market access, *etc.*).
8) Transaction costs (bureaucracy, management costs, *etc.*): Transaction costs are part of price paid for land. Ciaian, *et al.* (2012) distinguish two types of transaction costs: i) the explicit, administrative costs which include registration costs, notary and legal fees, taxes on sale and purchase, *etc.*; see also *e.g.*

Prosterman and Rolfes (2000), World Bank (2001), Swinnen and Vranken (2010), *etc.*, and ii) the implicit costs which include search and negotiation fees, imperfect competition in the land market, property rights, withdrawal costs, unclear boundaries, *etc.*, see also *e.g.* Mathijs and Swinnen (1998), Dale and Baldwin (2000), Ciaian and Swinnen (2006), Ciaian, *et al.* (2012a), *etc.*

9) Socioeconomic and political environment: legal system (is it complex, unstable, *etc.*), are there other investment opportunities (low investment opportunities can lead to increased land prices since land provides high return and security), political stability, other economic factors (*e.g.* energy prices, exchange rates, business cycles, economic policies, subsidies, *etc.*), *etc.* all influence demand for agricultural land; see *e.g.* Borychowski and Czyzewski (2015) .
10) Government agricultural policies including agricultural research, farmers' education, *etc.* all lead to increased land prices. On the other hand institutional restrictions on the utilisation of land, taxes (income, estate and property), and other policy measures often decrease land values. Interest rates also play important role in land transactions since they impact land prices through changing buying costs with lower interest rates increasing land prices whereas higher interest rates decrease them.
11) Technological development: technological development may reduce demand for agricultural land through increases in land productivity.
12) Bioenergy: Tweeten and Thomas (2008) assume an annual growth rate of agricultural demand output of 0.1% for combined bioenergy and fibre crops. When combined with increasing food demand they estimate total annual agricultural demand growth of 0.71% over the next 50 years which amounts to exogenous shock to agricultural demand of 79% between 2000 and 2050. The figure is similar to FAO estimation of 70% increase for the same period (Bruinsma, 2009) however the difference between the two estimates seems to come from the differences in the assumptions about biofuel demands. The United Nations Environment Programme (Bringezu, et al., 2009) estimates 36 million hectares of arable land has been used for biofuel consumption in 2008 and FAO/OECD (OECD - FAO, 2008) projection for the next decade estimates demand growth of 52% for maize and 32% for oilseeds will be due to increased

demand for biofuels. Rise of biofuel use is due to several drivers including: regulation, subsidies, and oil prices (Hertel, et al., 2008).

In the case of LSLAs, demand determinants may put greater emphasis on some of the listed determinants whereas others may be given lesser importance. Hall (2011) identified three main drivers for LSLAs: food, fuel, and finance. Each of these drivers will rank above mentioned drivers based on underlying priorities; for example food driver may be based on (state) investors' domestic food security interests therefore reducing the importance of price, income, financial system development, transactional costs, *etc.* while increasing the importance of for example (domestic) population growth, its income growth, transportation links, *etc.* On the other hand LSLA investments that are driven by finance will emphasise price, infrastructure, (global) population growth and growth of its income, *etc.*

In addition to the above mentioned drivers for LSLAs (*i.e.* food, fuel, and finance), Cotula (2009) also lists other agricultural products that cannot be substituted but are nevertheless required in the industrialisation of some economies. Production of such agricultural commodities (*e.g.* rubber, cotton, sugar, coffee, cocoa, soybeans, *etc.*) is hitting its natural limit. To secure their adequate supply, many state investors acquire land for their production; see *e.g.* China's land acquisitions for rubber production; see *e.g.* Weiyi (2008), Gray (2009).

Supply determinants for agricultural land

1) Natural characteristics: natural characteristics (*i.e.* biophysical availability and geographical limitations) determine physical suitability of land resources. At the moment, around 1.6 billion hectares (or approximately 12 percent) of global land surface (13.4 billion hectares) is used for crop production (Nachtergaele, et al., 2010). Based on Global Agro-Ecological Zone (GAEZ); FAO (2017a), Fischer, *et al.* (2002) estimate that around 30 percent (4.3 billion hectares) of the global land surface is suitable for rain fed agriculture[15,16]. The usual assumption in

[15] In their study of crop production Fischer, et al. (2002) consider soil, terrain, and climate characteristics together with crop production requirements as well as minimum attainable yield levels and some other estimates at three technology levels (low, medium, high).

[16] A number of considerations and constraints should be taken into account in regard to the estimated land availability. In their estimated available area (4.3 billion ha), Fischer, et al. (2002) include: i) land that is currently covered in forest (around 800 million hectares), protected areas (around 200 million hectares), and urban areas (including economic infrastructure) (around 80

connection to the land suitability is that the most productive land which requires the smallest amount of investment is the first to be taken into production.

   a. Biophysical availability (*i.e.* land suitability): biophysical availability is determined on soil conditions as well as climatic circumstances, and determines maximum available agricultural land. Such natural limitations are *e.g.*: sunlight temperature, precipitation, water supplies, *etc.*
   b. Geographical limitations: geographical limitations are another determinant of land supply. They include for example topography (which can limit use of machinery), physical location which influences its accessibility for economic activity (*i.e.* its distance from markets as well as transportation facilities, forest cover, urban areas, *etc.*)

2) Climate change: in most cases climate change reduces available land. Climate change driver has multiple facets through which it may influence agriculture:
   a. Biofuels: Majority of population accept that human activities contribute to climate change; see *e.g.* IPCC Climate Change 2014 Synthesis Report (IPCC, 2014). To mitigate that, governments and other lawmakers introduced biofuel policies to reduce greenhouse gas emissions. However, many reports on LSLAs are concerned with the effects that biofuel production could have on food security; see *e.g.* Friends of the Earth (2010), GRAIN (2013), *etc.* On the other hand the analysis conducted by Hamelinck (2013) showed that many of those reports over-exaggerated land areas acquired for biofuel production for EU markets.
   b. Land as a carbon sink/carbon sequestration/REDD[17]: is often seen as a low cost option in global fight against climate change; see *e.g.* Wise, *et*

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million hectares): see Global land outlook (UNCCD, 2017), 2) suitability classes are estimated based on the most favourable specific crop and/or input level for that particular land, 3) there is uneven global distribution of suitable land; half of the total balance is concentrated in seven countries whereas there is no available suitable land for rain fed crop production in South Asia and the North Africa and Near East, and 4) much of currently unused suitable land suffers from constraints (*e.g.* ecological fragility, low fertility, toxicity, lack of infrastructure, *etc.*); see Nachtergaele, et al. (2010).

[17] REDD stands for “Reducing emissions from deforestation and forest degradation” and is in essence broadened concept of “avoided deforestation”.

al. (2009)[18], Gren and Aklilu (2016), *etc.* Although forests are often used as carbon sinks sometimes that happens at the expense of cropland; see *e.g.* Smith (2004), Gosling, *et al.* (2017), literature review by Deng, *et al.* (2016), *etc.*

   c. Reduced yield: Climate change will have an impact on agriculture in the form of reduced yield or even causing sever soil degradation making agricultural land unsuitable for crop production; see *e.g.* Parry, *et al.* (2004), IPCC (2007), Fischer (2009), Alexandratos (2010, pp. 14 - 15), Nelson *et al.* (2010), Deryng, *et al.* (2011), Lobell, *et al.* (2009), Hertel, *et al.* (2010), Schlenker and Lobell (2010), Chuang, *et al.* (2017), *etc.*
   d. Weather conditions: weather conditions in the sense of occurrences of severe weather conditions (floods, droughts, *etc.*) can cause yield decreases (*i.e.* crop destruction).

3) Alternative land use: alternative land use reduces area of suitable land which would otherwise be used for production of agricultural commodities and diverts them to other uses. Such uses may include social services (*e.g.* recreation), securing biodiversity, urban development, *etc.*[19].
   a. Biodiversity: biodiversity (*i.e.* securing biodiversity) has negative impact on supply of agricultural land since it removes land from production side to natural parks to provide their eco-system services and preserve biodiversity (Green, et al., 2005) however this has proven controversial especially in developing countries (Kristof, 2010) since demand for such services only appears when economies development reaches middle income levels (Barbier, 1997).
   b. Social services: similarly to securing biodiversity, other social services (*e.g.* national parks, recreational areas, *etc.*) would reduce agricultural land area that could otherwise be used for agricultural production. Similar as with biodiversity demand for such other services depends on development level.

[18] Gren and Aklilu (2016) provide literature review on policy design for forest carbon sequestration

[19] Some forms of alternative land use (*e.g.* biofuels, carbon sink, *etc.*) are included in climate change driver above.

    c. Urban development: In their meta-analysis Seto, *et al.* (2011) estimate global urban land cover will increase by 1.5 million sq. km (150 million hectares). Fragkias, *et al.* (2013) estimate 200% increase in global urban land cover between 2000 and 2030; see also *e.g.* Angel, *et al.* (2011). Similarly d'Amour, *et al.* (2017) estimate 1.8 to 2.4 % loss of global croplands by 2030 with 80% of it being located in Asia and Africa. In addition, potentially lost cropland in Africa and Asia is more than twice as productive as national averages. Combined estimated cropland conversion was responsible for 3-4% drop in worldwide crop production in 2000 (the land being on average 1.77 times more productive than global average).

4) Technological determinants: since demand for agricultural land influences peoples' perception of the value of the land, technological development inevitably influences land supply (*e.g.* technological development impacts the relationship between supply and demand).
    a. Technological development influences use of land already in use (*e.g.* increasing its incomes) and thus reducing demand for supply.
    b. On the other hand, technological development also brings new land sources to the supply side since it makes previously economically unsuitable land suitable.
5) Land prices: In general terms, supply relationship between price and land is positive which means that as the price of agricultural land increases so does the supply.
6) Institutional factors: institutional factors include local, regional, and national governments' agricultural policies (*e.g.* subsidies) and laws and regulations covering control, exploitation and use of land resources (Ciaian, et al., 2012). However institutional factors can also include public opinion and customs, urban and environmental policies, *etc.* which may influence agricultural land supply.
7) Number of suppliers: willingness to supply land depends on the number of suppliers since the quantity of supplied land directly translates into its price.

The supply determinants stated above are generally valid for any agricultural land; supply of agricultural land for LSLAs also includes other determinants while some of the above mentioned determinants may be of lesser importance. Additional determinants may include:

8) Foreign direct investment: Foreign direct investment (or FDI) is often regarded as an important driver for supply of agricultural land for LSLAs. FDIs not only bring investments into target countries but also bring better production practices and business models, generate jobs, integrate the economy into global supply chain, improve infrastructure, develop domestic agricultural value chains, *etc.* However, some consider FDIs in LSLAs also as detrimental for host country; see *e.g.* (Anseeuw, et al., 2012; FAO, 2013), with only limited positive spillovers to the local communities; see *e.g.* Hallam (2009), or even damaging socio-ecological, environmental and other aspects of target countries; see *e.g.* Borras *et al.* (2011), Deininger and Byerlee (2011), Anseeuw *et al.* (2012a), Nolte (2014), Suhardiman *et al.* (2015), Thondhlana (2015), *etc.* .
9) Food security: although it is often regarded as an investment to increase food security of investor country, supply of large areas of agricultural land to foreign investors may also be intended to increase domestic food security. In such cases contracts between investors and suppliers may include clauses that oblige investors to provide certain share of agricultural produce to local markets; see *e.g.* World Development Report 2008 (World Bank, 2007).
10) Economic diversification: Based on development strategy some countries supply agricultural land because they want to reduce their dependence on a single commodity (*e.g.* Sudanese reliance on oil, Zambian reliance on copper, *etc.*); see *e.g.* Cotula, *et al.* (2009).

3.3 Introduction to Land Matrix database

Land Matrix database is a land monitoring initiative covering low- and middle-income countries (Land Matrix, 2017). It is independent with a goal to promote transparency and accountability of all parties involved in land investments. It is built through crowdsourcing and is therefore reliant on the open community of citizens, researchers, policy makers and other specialists. It is supported by and collaborates with a number of governmental and non-governmental partners and alliances[20].

3.3.1 Description of expressions

Below is a description of some of the expressions used in Land Matrix database.

Land deal

Land Matrix states four requirements that a deal must fulfil in order to be included in their database (Land Matrix, 2017): *"i) it must entail a transfer of rights to use, control or ownership of land through sale, lease or concession; ii) it must have been initiated since the year 2000, iii) it must cover an area of at least 200 hectares, and iv) there must be an intention of conversion of its use from either smallholder, local community or important ecosystem to commercial".*

Investor, investor country and target country

Investor is an individual acquiring land. Based on the origin of the investment it can be either domestic of foreign. Investor, directly engaged in land deal is called **primary investor**. However, primary investor can be partly or fully funded by **secondary investor**. **Target country** is a country in which land is acquired. **Investor country** is a country from which the investor originates. Figure 3 explains types of investors and shows relationships among them as well as between investor and target country.

Stages of negotiation and implementation

A land deal moves through stages of negotiation, starting with the intention and (if all goes well) finishing with implementation phase. However, during each stage there are different sub-stages, and to have better overview Land Matrix database uses additional designations. Similarly, outcomes from concluded deals can vary. Figure 4 below shows how Land Matrix database treats different stages and post-conclusion states of land deals.

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[20] see About Land Matrix at http://www.landmatrix.org/en/about/

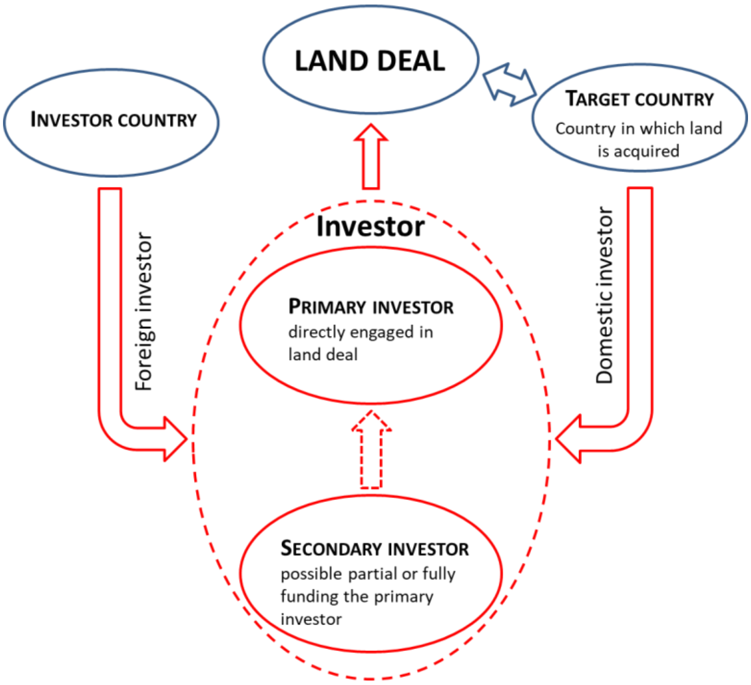

Figure 3: Relationships between investors, investor country and target country
Source: Author's interpretation based on Land Matrix: about (Land Matrix, 2017)

Area of a deal
Area of a deal in Land Matrix is measured in hectares. Areas at different stages of a deal may vary, and the database provides information for the areas at three different stages. **Intended size** is the area size announced during the intended stage (phase 1) of a land deal. **Current size under contract** is the area agreed during negotiations (*i.e.* either when oral agreement is reached or when contract is signed – phase 2). **Current size in operation** is the area that is already operational (phase 3).

Intended size may differ from current size under contract however it may also point to the intention of the investor of future expansion.

Contract farming
In Land Matrix, contract farming (similar to outgrower scheme in World Bank – UNCTAD survey (2014)) refers to an agreed supply contract between smallholders and farmers and the LSLA investor for the supply of agricultural produce.

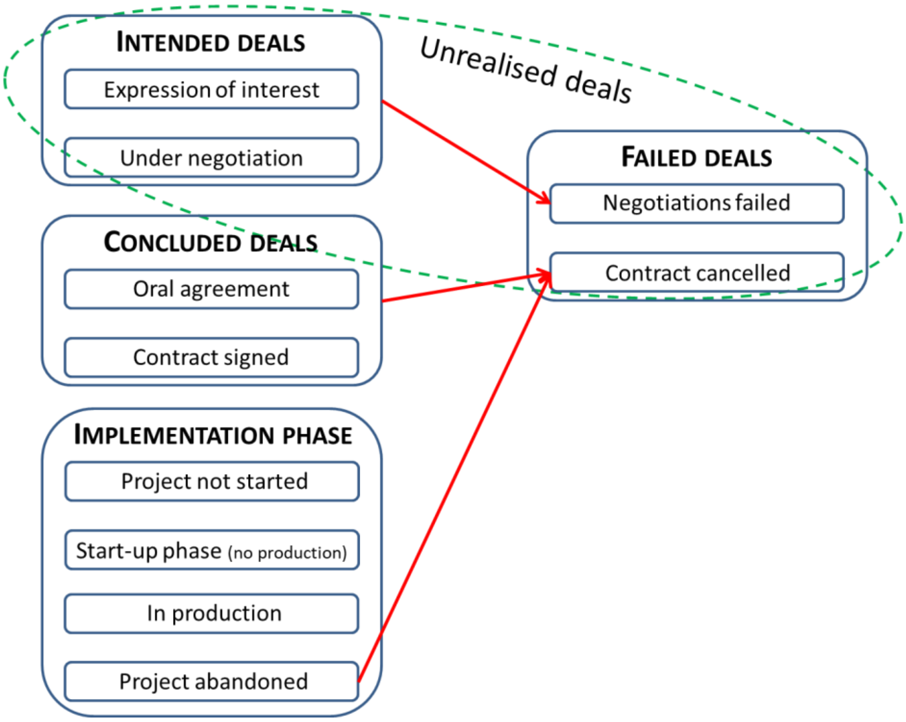

Figure 4: Negotiation and implementation stages of a land deal
Source: Author's interpretation based on Land Matrix: about (Land Matrix, 2017)

3.3.2 Quality of LSLA databases and their use

As I mentioned above LSLAs started gaining extensive media coverage since GRAIN report was published in 2008 (GRAIN, 2008). Since then a fast-growing body of research, or as Oya (2013) puts it *"land grab" literature "rush"*, took place. This part of the essay will look at some of the critiques in relation to data provided in global land databases. Nevertheless, as Scoones, *et al.* (2013) point out, regardless of the limitations of such land databases, their contribution is considerable and significant.

3.3.2.1 Accuracy and reliability of LSLAs database(s)

At the beginning of the "land grab" research, published articles wanted to attract as much general public's attention as possible. To accomplish that they usually employed so called "killer facts" together with seeming precision and an impression of science.

Impression of science would sometimes emerge from using scientific connotation for example in the form of 10^3 rather than thousand however in other times it was much more "efficient" to use millions instead of 10^6. Similarly, area would sometimes be reported in acres and not in hectares; see *e.g.* Pearce (2012), resulting in significantly larger absolute numbers. Although one cannot argue about the use of scientific connotation (or units) it is more worrying whether those numbers actually reflected realities.

Such unscrupulous use of data where author *"extrapolates incorrectly from limited data and thereby creates an appearance of precision that masks the high probable error of its estimates"*[21] was dubbed "false precision" by Pogge and Reddy (2010).

As Oya (2013) observes there are serious problems with the quality of the quantitative evidence provided in global LSLA databases and highlights the importance of accuracy and reliability of that data. Consequently there are also serious problems with publications that some researchers produce.

The most pressing problem is that low quality of the quantitative data available mostly comes from the fact that unlike in other economic areas, evidence in global LSLA databases does not result from large-scale surveys but from sources and reports whose reliability is unknown. "Facts"[22] in LSLA databases are usually a "*mix of actual facts, perceptions, intentions, rumours, guesstimates, and lies*" (Oya, 2013). On its site Land Matrix as well as Land Matrix team (Anseeuw, et al., 2012a; Cotula, 2012) constantly warn that open dataset is "inherently unreliable". Majority of data comes from reports produced by media which seldom have capability and willingness to verify reliability and sources of data published. In addition, numbers could be misunderstood or misreported and often inflated. Although cross-checking and combining them somewhat mitigates that, such actions do not eliminate the reality that at the end all sources are only reliable to a certain degree.

The second problem is that data on LSLA (*e.g.* size, use, *etc.*) are very difficult to collect. Hennerz and Lotsch (2008) show that in Africa discrepancies between different (official) statistical sources in land use often amount to more than 25% of total country area.

The third problem is related to selection of cases (so called "selection bias"). It is claimed that majority of land deals in databases is focused on Africa as a target region (Borras, Jr., et al., 2013). Similarly, larger focus in regard to the country of origin of investor is biased toward China (Brautigam, 2012). The fourth claimed selection bias would be

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[21] Citation from Pogge and Reddy (2010)

[22] As Oya (2013) puts it *"facts in the sense of size of land under confirmed contract which was put to use with all the implications should be verifiable on the ground".*

reporting deals where foreign investors, especially sovereign funds from Middle East and Asia, are included.

The last problem with LSLA databases that Oya (2013) highlights is related to the failure to check sources. Although some authors; see *e.g.* Brautigam (2012), systematically check sources and sometimes succeed in correcting data in the databases however that is often not the case. Scoones, *et al.* (2013) observe that publications based on flawed data start circulating and continue to appear in literature and media; a good example would be *e.g.* Locher and Sulle (2015).

The usual line that data is following is shown in figure 5. The most critical part of this process is that books and academic literature consequently feed back to "land grab" researchers, giving their reports the impression of data accuracy and reliability. However, the fact that data is imprecise and constantly subject to change (even in case of total transparency size of concluded deal might change resulting in changed data in LSLA database, or production structure might change) is often disregarded.

As Edelman (2013) points out, every researcher should be *"obliged to account for the existence of the source she or he employs. Who created it and why? What were the circumstances and context of its production? What accounts for its preservation, its location in an archive or its diffusion? What does it say and what are its silences?"*.

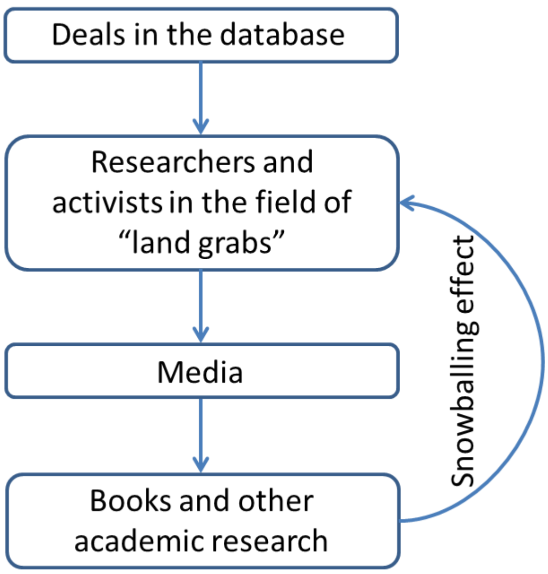

Figure 5: Use of data and snowballing effect
Source: adapted from Oya (2013)

3.3.2.2 Methodological problems in assessment of LSLA database(s)

The first set of studies that emerged after the establishment of land databases mostly based their claims on dubious data. Such data would often reference interviews without giving all the necessary information (*e.g.* number of interviews, sampling process and selection criteria, *etc.*). They would claim post-deal consequences without providing pre-deal status. Although some studies do provide some information on methods they usually don't provide their justification; see *e.g.* Schoneveld, *et al.* (2011). In such cases some categories surveyed were large (*e.g.* households in affected area) whereas others were underrepresented (*e.g.* employed, contract farmers, *etc.*) with findings on the impact of LSLAs in most cases negative.

Because not all land deals in *e.g.* country did (or do) occur at the same time and also because these deals get implemented in stages (*e.g.* pilot phase, start-up, initial production, full production, expanded area, *etc.*) their impacts cannot be compounded. In addition there are different impacts on different stakeholders and communities (Borras Jr., et al., 2012a). Although empirical research trying to discern differentiated impacts would need to be very carefully designed and implemented, "land grab" literature seems to be focused on quick publication. Such approach requires swift "empirical" research and its methodology often results in "corner cutting". Worryingly, none of the "attention grabbing" publications conducted even basic scientific research. The basic approach in for example studying short and medium term effects would compare evidence from before and after the event (with letting enough time to pass after the event). The evidence, on the other hand must be: i) relevant to the topic under study (*e.g.* land use, livelihoods, employment, biodiversity, *etc.*); see *e.g.* Borras, Jr. and Franco (2012), ii) at different levels (*e.g.* individual, household, local, *etc.*), and iii) preferably it should consist of quantitative and qualitative data.

Unfortunately, publications concerning "land grabs" are usually conducted by using data that is not scrutinised and is usually compounded which is sometimes accompanied by quick and dirty (usually biased) field survey.

3.4 Pre-analysis of the Land Matrix database

This chapter will quickly sift through the Land Matrix database in order to eliminate deals that lack certain important information required for this thesis. Before I dive into the analysis I will also provide information on some of the supplementary tools as well as methodology used in this analysis.

3.4.1 Why using data from Land Matrix?

Despite often being used for publicity catching purposes, Land Matrix database is the only database that is still being regularly updated[23]. Of course I acknowledge that data in Land Matrix is often flawed and biased. However, I agree with Scoones, *et al.* (2013) that because of its uniqueness its use should not be avoided.

Nevertheless, because there are problems with data in Land Matrix database, I am trying to mitigate that on two fronts. On the one hand, I am using lists provided by Brautigam (2012) and Brenner (2012) to check whether data that has been shown to be problematic is still present in Land Matrix database. On the other hand, I am trying to avoid using any kind of deeper statistical analyses on the dataset. Regardless of that I will have to use some basic analyses; for example summing (*e.g.* number of deals, intended use, negotiation statuses, *etc.*) or calculating shares. However the main point of this essay is to establish how important agricultural crops are in LSLAs, how do they compare to other investment intentions (*e.g.* livestock, forestry, *etc.*), and of course a more detailed analysis of agricultural crops (*e.g.* plantation crops, food crops, biofuel crops, *etc.*).

3.4.2 Geographical information – regions

To assess geographical spread of deals I divided countries into different regions and sub-regions of the world based on United Nations' Statistical Division methodology (United Nations, 2017). Appendices A3.1 and A3.2 provide list of regional and sub-regional groups of target and investor countries respectively.

3.4.3 Suitable land

Data on suitable land comes from "The state of the world's land and water resources for food and agriculture (SOLAW) - managing systems at risk" report published by FAO (2011a) and FAO GAEZ) (FAO, 2017a).

[23] Another datasets (which is not updated any more) was provided by Grain: https://www.grain.org,

It should be noted that the term “suitable land” refers to a gross extent of land that is deemed suitable for crop cultivation. However the measure is subjective and dependent on numerous assumptions, for example:

- Types of crops based on their characteristics such as: growth cycle length, length of crop development stage, photosynthesis pathways, crop water requirement, thermal requirements, soil and terrain requirements, , *etc.*,
- Acceptable minimum level of output,
- Socially acceptable level of land conversion (from *e.g.* forests) into arable land, *etc.*
- Agro-climatic constraints, *e.g.*: incidence of pests, diseases, and weed; land workability, frost occurrences, *etc.*

Crops are further matched with prevailing temperature regime, rain, and sunlight which all influence yield.

Based on those assumptions and changes of maximum yield, land is then divided into five suitability classes: very suitable, suitable, moderately suitable, marginally suitable, and not suitable. The assumptions made and corresponding calculations, have been performed by Fischer, *et al.* (2002)[24]. Because procedures to calculate land suitability are complicated and are based on assumptions that touch many different scientific fields (*e.g.* agriculture, climatology, geography, sociology, *etc.*) it is beyond the scope of this thesis to perform them. I am therefore reliant on the Fischer, *et al.* (2002) data.

3.4.4 Initial overview

The initial overview takes the first look at the whole database. It also eliminates all deals that are missing initial data required for this thesis.

At the moment (*i.e.* end of November 2017) Land Matrix database lists 2639 deals in 95 target countries. Table A3.3 in the appendix provides target country by country overview of deals (total and per negotiation status) for the whole initial dataset.

[24] See chapter 4.8.1 in Fischer, et al. (2002) for stepwise review of suitability analysis procedures which includes five steps: i) climate analysis, ii) crop-specific agro-climatic assessment and potential biomass calculation, iii) application of agro-climatic constraints, iv) edaphic assessment, and v) various applications (*e.g.* calculation of land with cultivation potential).

There are three important information that need to be included in my dataset; negotiation status, investor country, and intention of investment (*e.g.* agriculture, tourism, industry, *etc.*). When either of this data is missing, the deal is excluded from the initial dataset. Other information (*i.e.* investor name, implementation status, intended, contract, or production size of deals[25], contract farming, and crops[26]) although important do not prevent my dataset analysis[27] and are therefore included in my dataset.

DEALS WITH NO NEGOTIATION STATUS INFORMATION

There are 50 deals in 26 different target countries that have no information (*i.e.* "blank cell") on negotiation status. Table A3.8 in the appendix provides information on per target countries basis of deals that have no negotiation status information provided. Information is required because some deals never materialised and should therefore not contribute information for my crop production analysis. Their exclusion results in 2589 deals happening in 94 countries[28].

DEALS WITH NO INVESTOR COUNTRY INFORMATION

The remaining dataset includes 75 deals that lack information on the investor country. After examination of attached data sources that number is reduced to 54 deals occurring in 18 countries (see table A3.9 in the appendix). After their elimination my dataset includes 2535 deals happening in 94 countries. Some of the deals do provide investor name information, however as they are personal names I cannot assign them to any particular country (as oppose to company names whose headquarters and thus countries of origin can often be found on the internet).

DEALS WITH NO INFORMATION ON THE INTENTION OF INVESTMENT

The last crucial information that is missing in some listed deals is the intention of investment. There are 45 deals in 18 countries that lack the information of the intention

[25] It should be noted that all deals included in my dataset contain data on at least one reported size. However there are many deals that do not provide information on all three options.
[26] Crops overview is required for second stage of my analysis which is considered with crops production structure
[27] Overview of deals with non-essential data missing can be found in the appendices A3.4 to A3.7.
[28] Iraq has only one deal and there is no information on its negotiation status

of investment (see table A3.10 in the appendix). After their exclusion the database includes 2490 deals in 94 countries.

Table 1 below presents quick overview of initial dataset and missing information. It also shows number of deals after elimination.

Table 1: Quick overview of missing data

		Missing data		Remaining	
		No. of deals	No. of countries	No. of deals	No. of countries
Crucial	Initial dataset			2639	95
	Negotiation status	50	26	2589	94
	Investor country	54	18	2535	94
	Intention	45	18	2490	94
Not crucial	Implementation status	582	63		
	Investor name	17	2		

3.5 The analysis

After the pre-analysis conducted above I will now proceed with the analysis of the remaining dataset. After exclusion of deals without essential information my database is reduced to 2490 deals taking place in 94 target countries (from now on this reduced database is database under analysis unless otherwise stated).

3.5.1 Target regions

As I explained I use United Nations' Statistical Division methodology (United Nations, 2017) to assign countries to different regions of the world. I use two regional classifications; one is broad regions (*e.g.* Africa) whereas the second one is more detailed, sub-regional classification (*e.g.* West Africa, Northern Africa, *etc.*).

Table 2 (also figure 6) provides information on number of deals in broad target region. In this respect Africa is preferred target region (with 989 deals or almost 40% of all LSLAs in the database) followed by Asia (709 deals representing 28.5% of all deals) and South America (508 deals or 20.4%) whereas the lowest number of deals happen in Oceania and Polynesia (45 deals) and Central America and the Caribbean (52 deals).

Table 2: Overview of deals in broader target regions

Broad region	No. of deals	Share of deals
Asia	709	28.47%
Africa	989	39.72%
Central America and the Caribbean	52	2.09%
Europe	187	7.51%
Oceania and Polynesia	45	1.81%
South America	508	20.40%
Total no. of deals	2490	100%

Source: Author's calculations based on reduced Land Matrix database (2017) and United Nations' Statistical Division methodology (United Nations, 2017)

Countries with the highest number of deals in each target region are listed in table 3 below. We can see that the country with the highest number of deals in South America is Argentina (191 deals) which is also the highest number of deals of any country in the dataset. The highest number of deals in Asia happens in Cambodia (168 deals) whereas Ethiopia (125 deals) is the country with the highest number of deals in Africa. In Europe the highest numbers of deals happen in Romania (84), country with the highest number of deals in Central America and the Caribbean is Nicaragua (21) while Papua New Guinea in Oceania and Polynesia region experienced 44 deals.

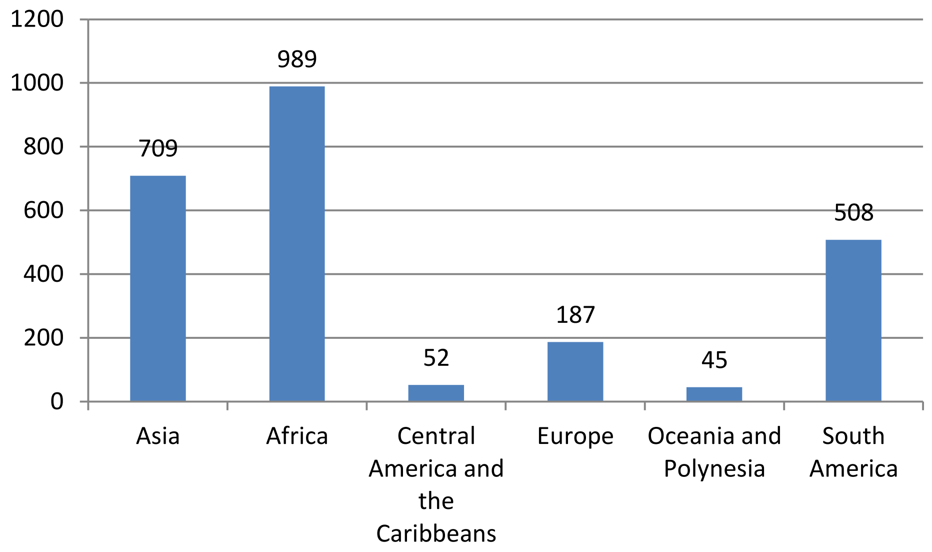

Figure 6: Overview of deals in broad target regions
Source: Author's calculations based on database and United Nations' Statistical Division methodology (United Nations, 2017)

Table 3: Countries with highest number of deals in each target region

Broad region	Country	No. of deals
Asia	Cambodia	168
Africa	Ethiopia	125
Central America and the Caribbean	Nicaragua	21
Europe	Romania	84
Oceania and Polynesia	Papua New Guinea	44
South America	Argentina	191

Source: Author's calculations based on database and United Nations' Statistical Division methodology (United Nations, 2017)

Table 4 (and figure 7) provides a view at sub-regional level. Sub-region with the highest number of LSLAs in the database is Southeast Asia with 578 deals (23.2%) followed by South America (508 deals representing 20.4%) and Eastern Africa (507 deal or 20.4% of all deals).

The lowest number of deals are in Northern Europe (three LSLAs), Western and Central Asia (each with four deals) and Southern Europe (six deals).

Table 4: Overview of number of deals in target sub-regions

Detailed region		No. of deals	Share of deals
Europe			
	Eastern Europe	137	5.50%
	Norther Europe	3	0.12%
	Southern Europe	6	0.24%
	Russian Federation	41	1.65%
Central America and the Caribbean		52	2,09%
South America		508	20.40%
Oceania and Polynesia		45	1.81%
Africa			
	Eastern Africa	507	20.36%
	Middle Africa	128	5.14%
	Northern Africa	57	2.29%
	Southern Africa	35	1.41%
	Western Africa	262	10.52%
Asia			
	Western Asia	4	0.16%
	Southeast Asia	578	23.21%
	South Asia	98	3.94%
	East Asia and Japan	25	1.00%
	Central Asia	4	0.16%
	Total number of deals	2490	100%

Source: Author's calculations based database and United Nations' Statistical Division methodology (United Nations, 2017)

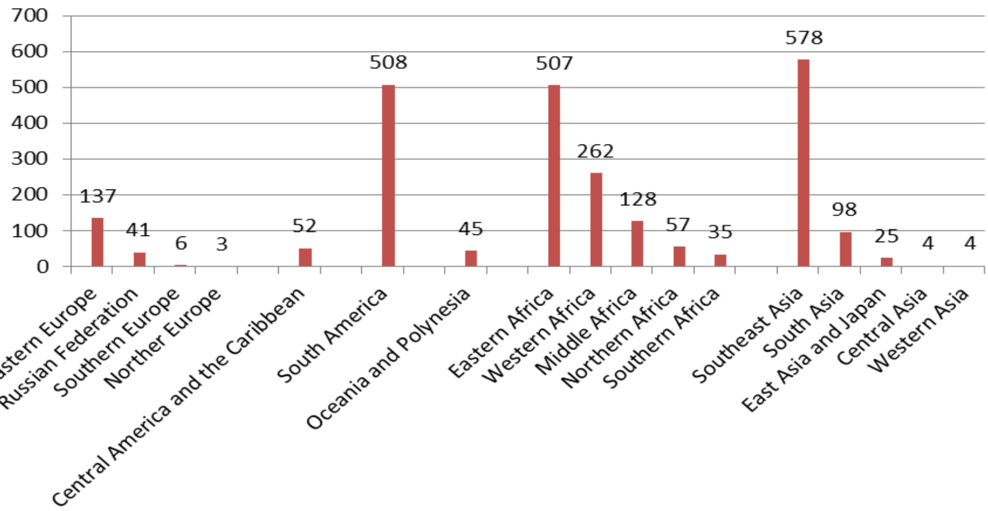

Figure 7: Overview of deals in detailed target regions
Source: Author's calculations based on database and United Nations' Statistical Division methodology (United Nations, 2017)

Table 5 provides list of target countries with the highest number of deals on sub-regional basis.

Table 5: Countries with highest number of deals in each target sub-region

	Detailed region	Country	No. of deals
Europe			
	Eastern Europe	Romania	84
	Norther Europe	Lithuania	3
	Southern Europe	Serbia	4
	Russian Federation	Russian Federation	41
Central America and the Caribbean		Nicaragua	21
South America		Argentina	191
Oceania and Polynesia		Papua New Guinea	44
Africa			
	Eastern Africa	Ethiopia	125
	Middle Africa	Democratic Republic of the Congo	64
	Northern Africa	Sudan	33
	Southern Africa	Namibia	15
	Western Africa	Nigeria	57
Asia			
	Western Asia	Turkey	2
	Southeast Asia	Cambodia	168
	South Asia	India	83
	East Asia and Japan	China	24
	Central Asia	Kazakhstan	2

Source: Author's calculations based on database and United Nations' Statistical Division methodology (United Nations, 2017)

3.5.2 Target countries

As was said above there are 94 target countries. Country with the highest number of deals (191) is Argentina followed by Cambodia (168 deals) and Indonesia (159 deals). On the other hand there are 13 countries listed with only one deal negotiated or under negotiation. Table A3.11 in the appendix provides full list of number of deals per target country.

Figure 8 shows top ten target countries by number of deals. Deals include all negotiation statuses. Among top ten target countries there are four from Asia three of which are from Southeast Asia (Cambodia, Indonesia, and Vietnam) and one from South Asia (India), three are from Africa (Ethiopia, Mozambique, and United Republic of Tanzania); all of them from East Africa. Two countries among the top ten are from South America (Argentina, which is also number one in the list, and Brazil) and there is one target country from Europe (Romania; Eastern Europe).

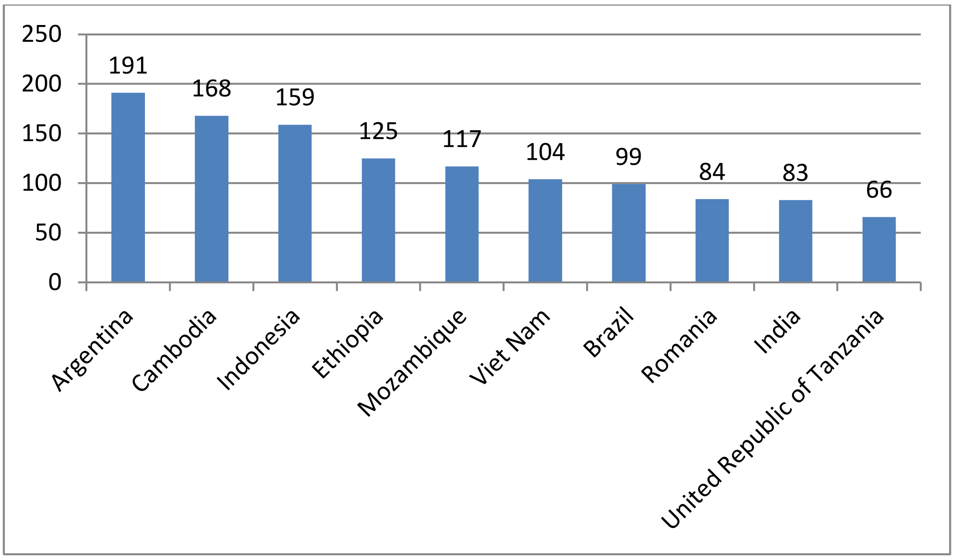

Figure 8: Top ten countries by number of deals
Source: Author's calculations based on database

3.5.3 Investor region

Figure 9 shows number of investments coming from different investor regions. Numbers represent number of times each investor region is involved in a deal (all negotiation stages) either as sole investor or in a group of investors. Table A3.12 in the appendix shows more detailed view of each region's involvement in deals.

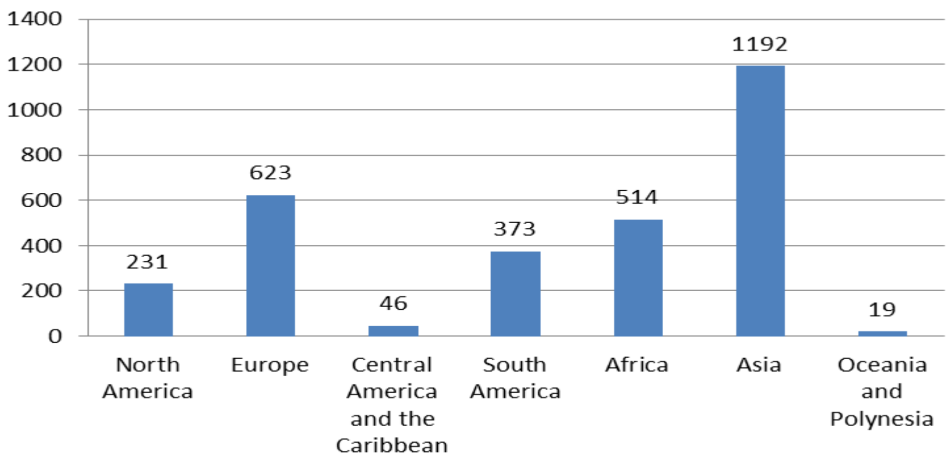

Figure 9: Number of deals of each broad investor region
Source: Authors calculations based on database and United Nations' Statistical Division methodology (United Nations, 2017)

The highest number of investments comes from Asia (1192 deals) followed by Europe (623 deals) and Africa (514 deals). On the other hand, the lowest number of investments come from Oceania and Polynesia (19 deals) and Central America and the Caribbean (46 deals).

Similarly figure 10 (and in more details A3.13 in the appendix) shows number of deals at sub-regional level. In this case, the highest number of deals comes from Southeast Asia (453 deals), followed by East Asia and Japan (391 deals) and South America (373 deals). The lowest number of deals comes from Russian Federation (17 deals), Oceania and Polynesia (19 deals), and Northern Africa (35 deals).

The highest number of deals from Europe, which as a broad region ranks second in number of investments comes from Northern Europe (245 deals) followed by Western Europe (230 deals). In Africa, which as a whole represented the third largest investor region, Eastern Africa ranks number one with 233 deals followed by Western Africa (105 deals).

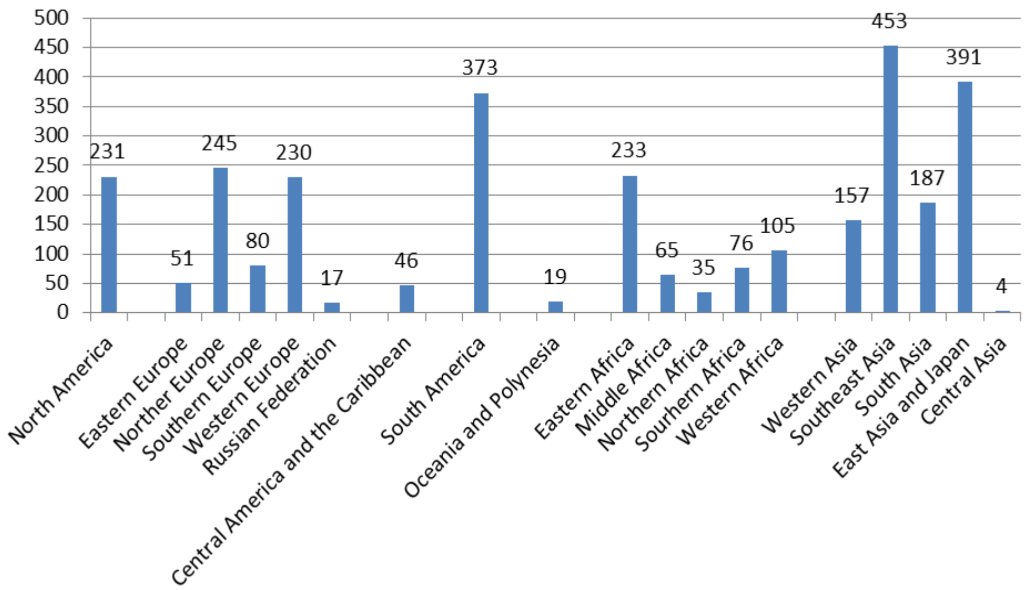

Figure 10: Number of deals of each investor sub-region
Source: Authors calculations based on database and United Nations' Statistical Division methodology (United Nations, 2017)

It is debatable what drives investors in different regions to invest in LSLAs. However we can make informed speculations at least for some of the investor regions' drivers. Table A3.14 in the appendix provides information on area of suitable and available land for rain fed agriculture (Fischer, et al., 2002). It also provides information on hectares of suitable and available land per capita[29]. As was noted by Fischer, *et al.* (2002) that Asia as a broad region and Western Asia, Central Asia, East Asia and Japan, and South Asia at sub-regional level do not have any available land for expansion of rain fed agriculture. From this observation we can make informed speculation that the main driver for land investments for Asian region is lack of available land[30]. On the other hand, investments from North America and Europe are probably based on different drivers (*i.e.* food, fuel, finance, and agricultural commodities used in industry).

3.5.4 Investor country

There are 131 investor countries however there are many LSLAs with more than one investor country. Appendix A3.2 lists investor countries and their classification into regions and sub-regions, while table A3.15 in the appendix lists number of deals per investor country. In the first column of table A3.15 are number of deals per countries where they are either the only investor country or are listed as the first investor (*i.e.* first in the list) whereas column two shows total number of deals in which country is participating (either alone or in consortium with other countries).

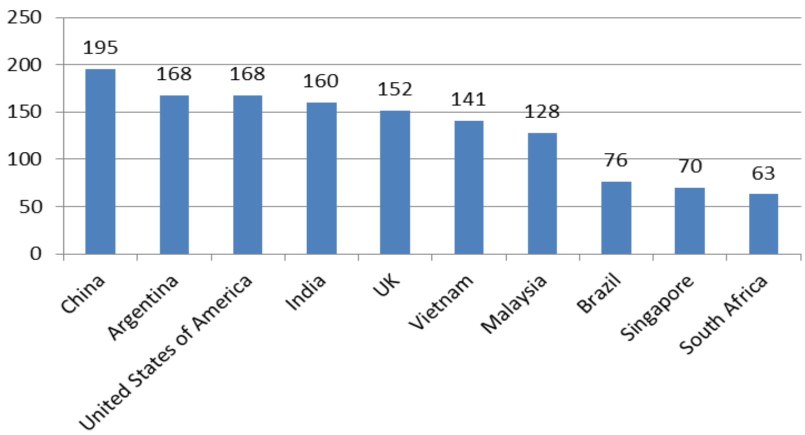

Figure 11: Top ten investor countries, either alone or in consortium, by number of deals
Source: Author's calculations based on database

[29] Population figures are for year 2000 and are sourced from The United Nations Population Division's report (United Nations, 2017a)
[30] At the regional level there is a correlation of 0.61 between hectares of available land per capita and number of deals per capita, however the result is not significant (p=0.15)

Figure 11 shows top ten investor countries by number of deals at all negotiation stages. As can be seen China has the highest number of deals (*i.e.* 195) followed by Argentina and the USA (both 168 deals). On the other hand there are 24 countries with only one deal listed in the database.

As there are number of deals with more than one investor country table 6 below provides an overview of deals based on number of investor countries participating[31] either on their own or in a consortium (table A3.16 and A3.17 in the appendix present an overview at regional and sub-regional levels respectively).

Table 6: Overview of deals based on number of investor countries involved

No. of investor countries in a deal	No. of deals	Share in all deals
1	2081	83.57 %
2	358	14.38 %
3	35	1.41 %
4	5	0.20 %
7	11	0.44 %
Total	2490	100 %

Source: Author's calculations based on database

As is expected the largest number of deals is done by one investor country. Of the eleven deals where there are seven investor countries ten deals are done by the same consortium (*i.e.* investor names are the same)[32].

The last part of the investor country analysis will look whether countries have a preferential target region (and sub-region) in which they invest. I have also calculated Herfindahl-Hirschman index[33] which is a measure indicating the amount of concentration/diversification (from now on HH index refers to Herfindahl-Hirschman index) to see regionally (and sub-regionally) investment diversification. For the sake of

[31] There are no deals with five or six investor countries

[32] Information in the Land Matrix database provides a list of investors: CalyxAgro (primary investor), Pacific Century Group, TRG Management LP ("TRG," d/b/a The Rohatyn Group), Said Holding, Pictet Private Equity Investors, Solvia Investment Management, and Louis Dreyfus Group.
CalyxAgro (est. in 2007) is a subsidiary of LD Commodities which is in turn a subsidiary of Louis Dreyfus (one of the four biggest commodity transnationals – others being Archer Daniels Midland, Bunge, and Cargill). Other investors in the consortium are institutional investors (Una perspectiva desde el sur, 2013).

[33] HH index is calculated by summing squares of shares of measured quantity (*i.e.* share of firm within the industry, share of a crop in agriculture, *etc.*). Its range runs from 0 to 1.0 with smaller values indicating higher diversification (lower concentration).

clarity I will only analyse top ten investor countries. Table 7 below shows preferred target region whereas table 8 shows preferred target sub-region for each of the top ten investor country. Tables A3.18 and A3.19 in the appendix provide detailed regional and sub-regional overview of investment for each of the top ten investor countries.

Table 7: Preferred target region for top ten investor countries

Country	Total number of deals	Region with highest number of deals	No. of deals in a region	Share in all deals	HH index
China	195	Asia	111	56.92%	0.41
Argentina	168	South America	166	98.81%	0.98
United States of America	168	South America	70	41.67%	0.34
India	160	Asia	82	51.25%	0.46
United Kingdom	152	Africa	87	57.24%	0.41
Vietnam	142	Asia	138	97.18%	0.95
Malaysia	128	Asia	83	64.84%	0.48
Brazil	76	South America	64	84.21%	0.73
Singapore	70	Africa	28	40.00%	0.34
South Africa	63	Africa	62	98.41%	0.97

Source: Author's calculations based on database and United Nations' Statistical Division methodology (United Nations, 2017)

At regional level, China, which is number one investor country, conducts almost 57 percent of all deals in Asia. At the sub-regional level its investments in Southeast Asia account for 45 percent of all deals. However, its HH index is 0.41 at regional level and 0.25 at sub-regional level. Regional HH index suggests that although in general China is more concentrated on Asia, its sub-regional HH index indicates that its investments are relatively well spread around the globe. Argentina, the second largest investor country does almost 99 percent of its deals in South America and has regional HH index of 0.98 (highly concentrated in regard to region spread) while for example United Kingdom has HH index at regional level 0.41 (57 percent of its deals are in Africa) and only 0.21 at sub-regional level (Eastern Africa accounts for almost 30 percent of all deals) suggesting relatively well spread sub-regional investment.

As we can see, some investor countries are highly focused in their deal making (*e.g.* Argentina, Vietnam, South Africa) whereas others spread their deals more evenly around the globe (*e.g.* China, United States of America, India, *etc.*).

Table 8: Preferred target sub-region for top ten investor countries

Country	Total number of deals	Sub-region with highest number of deals	No. of deals in a sub-region	Share in all deals	HH index
China	195	Southeast Asia	88	45.13%	0.25
Argentina	168	South America	166	98.81%	0.98
United States of America	168	South America	70	41.67%	0.24
India	160	South Asia	75	46.88%	0.36
United Kingdom	152	Eastern Africa	45	29.61%	0.21
Vietnam	142	Southeast Asia	137	96.48%	0.93
Malaysia	128	Southeast Asia	82	64.06%	0.47
Brazil	76	South America	64	84.21%	0.72
Singapore	70	Southeast Asia	25	35.71%	0.22
South Africa	63	Eastern Africa	41	65.08%	0.48

Source: Author's calculations based on database and United Nations' Statistical Division methodology (United Nations, 2017)

3.5.5 Domestic region investment

The next analysis will try to discover how prevalent is investing in domestic region. Table 9 shows number of deals each investor region does in different target regions. I underlined numbers in cells for investor regions that have the highest number of investments in domestic region. Of the seven investment regions five predominantly invest in their own region.

Table 9: Domestic region investment overview

		Target regions					
		Europe	Central America and the Caribbean	South America	Africa	Asia	Oceania and Polynesia
Investor regions	North America	13	6	106	82	22	2
	Europe	152	17	113	285	56	0
	Central America and the Caribbean	1	<u>32</u>	5	5	3	0
	South America	0	1	<u>358</u>	14	0	0
	Africa	0	0	0	<u>513</u>	1	0
	Asia	33	5	81	292	<u>741</u>	40
	Oceania and Polynesia	0	1	3	2	5	<u>8</u>

Source: Authors calculations based on database and United Nations' Statistical Division methodology (United Nations, 2017)

It is also noticeable that the highest number of investments from North America is in South America followed by Africa. Although South America is not North America's domestic region it is the closest region for North American investors. Europe on the other hand has its investments more evenly spread however it is again the closest region (*i.e.* Africa) that received the highest number of investments.

3.5.6 Domestic vs. foreign investment

Of the 2490 deals in my dataset, 1130 deals (45.4% of all deals) include domestic investors either as sole investor or as part of investment consortium. Table 10 provides an overview of deals depending on the number of investor countries that involve domestic investor.

In total a good 45 percent of investments include domestic investor whereas just under 55 percent of investments are conducted only by foreign investors. With the exception of the investments with 11 investors where no domestic investors are included, share of investments where domestic investors are included increases (when there are four investors share of investments with domestic investors included is 80 percent however the total number of investments with four investors in the database is only five).

Table 10: Overview of deals based on origin of investment

All investments		Domestic		Foreign	
	No	No. of deals	Share	No. of deals	Share
Total number	2490	1130	45.38 %	1360	54.62 %
Sole investor	2082	862	41.40 %	1220	58.60 %
Two	357	235	65.83 %	122	34.17 %
Three	35	29	82.86 %	6	17.14%
Four	5	4	80.00 %	1	20.00 %
Seven	11	0	0.00 %	11	100.00 %

Source: Authors calculations based on database and United Nations' Statistical Division methodology (United Nations, 2017)

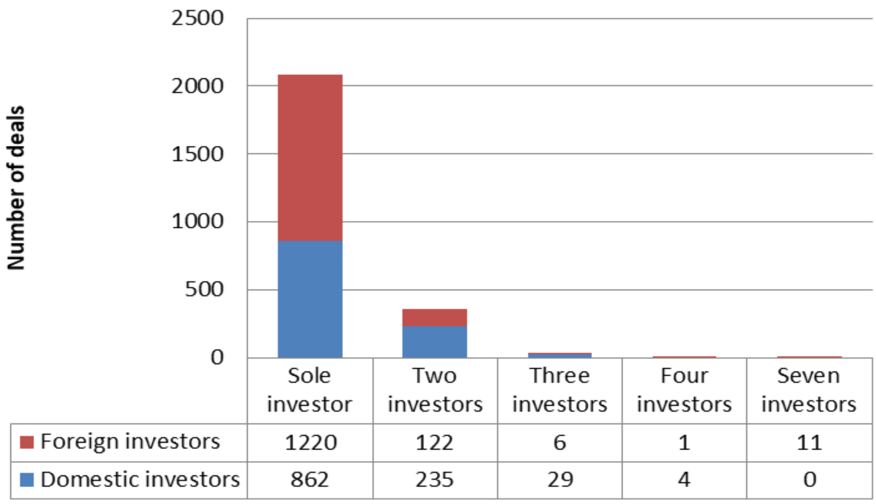

Figure 12: Foreign vs. domestic investors stacked chart based on number of participating countries
Source: Author's calculations based on database

Figure 12 (stacked chart) shows combined number of deals with foreign investors and deals with domestic investors grouped by number of investor countries participating in the investment.

Figure 13 shows share of deals where domestic investors participate in the investment. The highest share of investments with domestic participants happens in South America (almost 60%), followed by Asia (49%) and Central America and the Caribbean (48%) whereas in Oceania and Polynesia only 13% of deals include domestic investors. Table A3.20 in the appendix provides a more detailed overview of deals at regional level.

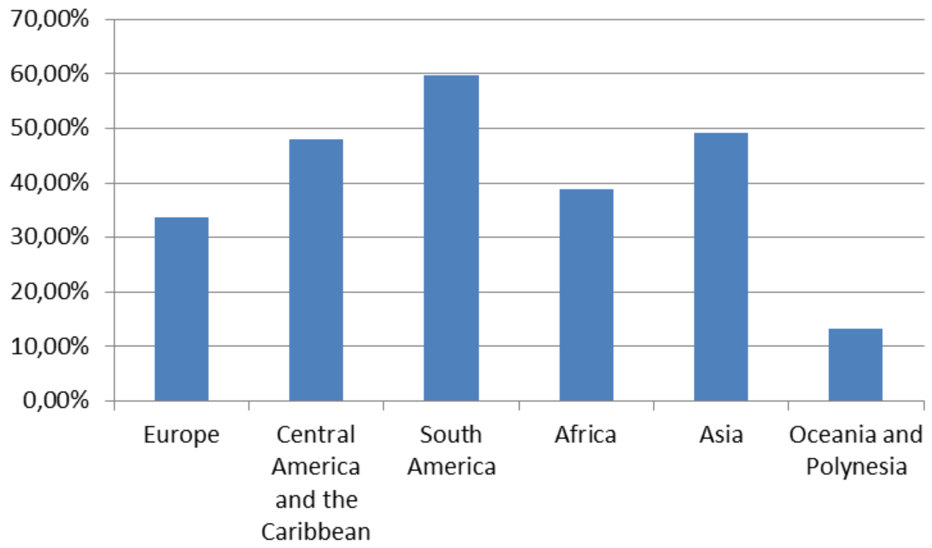

Figure 13: Regional overview of share of deals with domestic investors participating
Source: Author's calculations based on database

Figure 14 provides similar overview of share of deals with domestic investors however in this case at a more detailed, sub-regional level. We can see that the highest share of deals with domestic participants happens in South Asia (80.6%) followed by Central Asia (75%) and East Asia and Japan (68%). In Europe, the highest number of deals with domestic participants happens in Northern Europe (almost 67%). Table A3.21 in the appendix provides thorough overview of this analysis.

When looking at individual target countries, the highest number of deals with domestic participants happen in Argentina (138 deals) followed by Vietnam (83 deals) and India (75 deals).

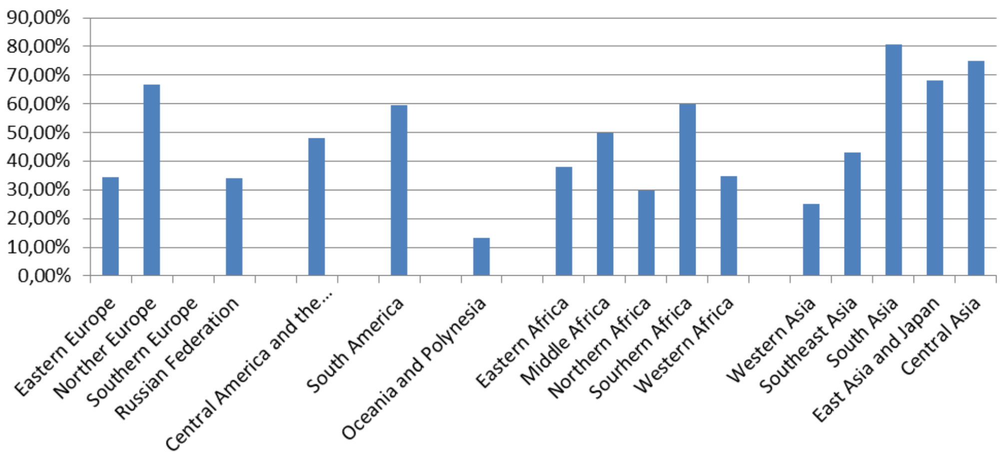

Figure 14: Sub-regional overview of share of deals with domestic investors
Source: Authors calculations based on database

Figure 15 shows top ten countries by number of deals with domestic investors included.

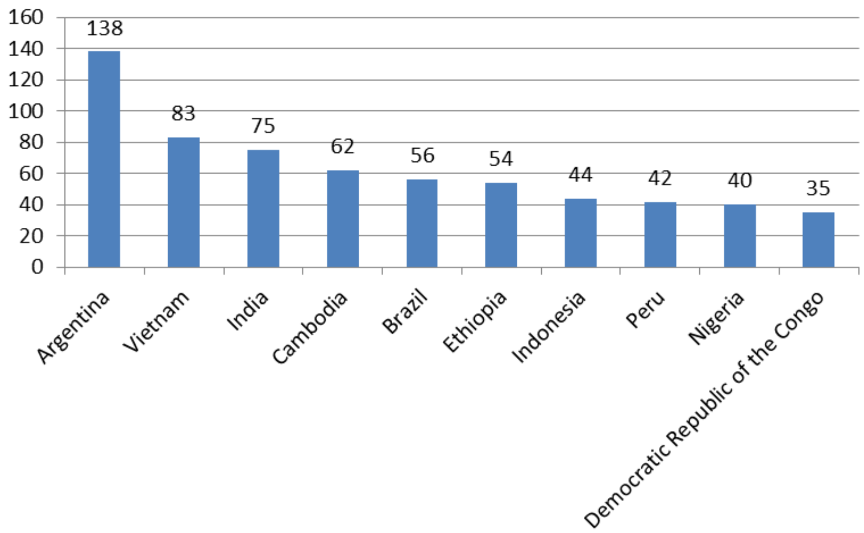

Figure 15: Top ten target countries by number of deals with domestic participants;
Source: Authors calculations based on database

There may be some constraints on foreign ownership of agricultural land which can contribute to increased number of deals in certain regions done by either domestic investors or having domestic investor in joint-venture. To further explore this I sourced data on legislative constraints on foreign ownership of agricultural land from World Bank Investing across borders 2010 report (World Bank, 2010a). Table 11 shows regulatory constraints on foreign ownership of agricultural land in target regions and sub-regions (table A3.22 in the appendix provides information on average regulatory constraints for both broad and detailed regions based on all available data in the report).

We can see that at the regional level the highest constrains on ownership (average value) are placed in Asia with Southeast Asia allowing average foreign ownership of agricultural land at 56.8%. This may partially explain why there is relatively high share of domestic investments[34] in Asia.

Table 11: Overview of allowed share of foreign ownership of agricultural land in target regions and sub-regions

Region		Ownership*
Europe		100.00%
	Eastern Europe	100.00%
	Norther Europe	
	Southern Europe	100.00%
	Western Europe	
	Russian Federation	100.00%
Central America and the Caribbean		89,80%
South America		97.50%
Oceania and Polynesia		100,00%
Africa		96.30%
	Eastern Africa	100.00%
	Middle Africa	100.00%
	Northern Africa	78.75%
	Southern Africa	100.00%
	Western Africa	100.00%
Asia		77.43%
	Western Asia	75.00%
	Southeast Asia	56.80%
	South Asia	100.00%
	East Asia and Japan	N/A
	Central Asia	100.00%

Source: World Bank Investing across borders 2010 report (World Bank, 2010a); * - Percentage represents average share of allowed foreign ownership of agricultural land

[34] There may be differences in defining domestic investment. For example would a company being incorporated by a foreign entity in countries which regulates foreign ownership be deemed domestic and thus being allowed 100% land ownership (*i.e.* would it by-pass the regulation). Similarly joint-ventures may also be deemed domestic with constraints being placed at share of domestic investment in the joint-venture, *etc.*

Table 12: Regulatory constraints on foreign ownership of agricultural land for top ten target countries with domestic investors

Country	Ownership*
Argentina	85 %
Vietnam	100 %
India	100 %
Cambodia	100 %
Brazil	100 %
Ethiopia	100 %
Indonesia	95 %
Peru	100 %
Nigeria	100 %
Democratic Republic of the Congo	100 %

Source: World Bank Investing across borders 2010 report (World Bank, 2010a); * - Percentage represents share of allowed foreign ownership of agricultural land

Table 12 shows regulatory constraints on foreign ownership of agricultural land for top ten target countries. Only Argentina and Indonesia restrain foreign ownership of agricultural land (85 % and 95 % respectively) whereas all others allow 100 percent foreign ownership.

3.5.7 Intention of investment

Intention of investment indicates what an area under the investment will be used for. Majority of deals have only one intended use however there are also deals that include up to five different intended uses. Table 13 provides information on the number of deals based on number of intended uses.

Table 13: Number of deals grouped by number of intended uses

No of intentions stated	No. of deals	Share
One	1616	64.90%
Two	612	24.58%
Three	222	8.92%
Four	36	1.45%
Five	4	0.16%
Total	2490	

Source: Authors calculations based on database

Almost 65 percent of all deals have only one intended use however there are also four LSLAs that state five different intentions.

Table 14: Number of deals with different intended uses based on sole or primary intention

Intention	Sole or primary intention	Share in total number
Agriunspecified[35]	413	16.59 %
Biofuels	450	18.07 %
Conservation	48	1.93 %
Food crops	810	32.53 %
For carbon sequestration/REDD	23	0.92 %
For wood and fibre	203	8.15 %
Forest unspecified	21	0.84 %
Industry	163	6.55 %
Livestock	157	6.31 %
Non-food agricultural commodities	141	5.66 %
Other (please specify)	27	1.08 %
Renewable Energy	12	0.48 5
Tourism	22	0.88 %
Total	2490	100.00 %

Source: Author's calculations based on Land Matrix database (2017)

There are 13 different intentions in the Land Matrix database[36]. Table 14 provides information on number of deals under different intentions that are either the only intention or are stated as the first intention.

The highest number of deals are intended for food crops (810 deals) followed by biofuels (450 deals) and agriunspecified (413 deals).
There are two deals in the database that by definition do not fall under land deals: algae production which is listed under industry and, aquaculture listed under food crops/livestock.

3.5.8 Crop analysis

After the first part of the analysis of LSLA which was considered with target and investor countries and regions I am now moving into analysing crops structure which is the primary concern of this chapter. However, before I go there I have to further filter through my database since there are deals which do not include data that is required for my analysis.

[35] Although there is a suffix "unspecified" added to some intentions it does not mean that there are no information on intended use (*e.g.* under agriunspecified there might be information under crops)
[36] One of the intentions is also "Other (please specify)" which is not really an intention.

3.5.8.1 Deals that are excluded from my crop analysis

Land Matrix database includes 487 deals that do not specify what kind of crops they are intended to produce. These deals will be excluded from my crop analysis which then reduces my dataset to 2001 deals. Table A3.23 in the appendix provides information on number of deals with no specification of crop production grouped by intended use. All other deals, regardless of their intentions include information on crop production and will therefore be included in my analysis.

3.5.8.2 Types of produce

Crops and trees

At the most basic level, there are two types of produce; crops and trees. Table 15 provides information on the number of deals in each of these two categories.

Table 15: Type of products

Type	Number	Share
Crops	3549	89.69%
Trees	408	10.31%
Total	3957	100.00%

Source: Author's calculations based on database

We can see that almost 90 percent of produce are crops whereas trees only represent ten percent of agricultural products. There are 1680 deals (84 percent) that are intended for crops production only whereas 254 deals (or 12.7 percent) are intended solely for growing trees. The remaining deals (67 or 3.3 percent) are intended for mixed production; see table 16.

Table 16: Number of deals based on type of products

Type of products	No. of deals	Share
Only crops	1680	83.96%
Mixed	67	3.35%
Only trees	254	12.69%
Total	2001	100.00%

Source: Authors calculations based on database

Trees

Because this thesis analyses crops I will exclude deals that are intended for tree growth, nevertheless, before I do that I will run a short analysis.

Table 17 provides an overview of number of deals intended for tree growth in different target regions. The highest number of deals is in Africa (126 deals representing almost 50 percent of all deals intended for tree production only). Africa's share of deals intended for trees is higher than its overall share in the database which stands at 40 percent.

Table 17: Number of deals intended for trees grouped by regions

Broad regions	No. of deals	Share
Europe	16	6.30%
Central America and the Caribbean	2	0.79%
South America	64	25.20%
Africa	126	49.61%
Asia	45	17.72%
Oceania and Polynesia	1	0.39%
Total	254	100.00%

Source: Authors calculations based on database

South America's share of deals intended for trees is 25 percent (64 deals). The share is again higher than its share in all deals (20.4 percent). On the other hand shares of deals intended for trees in all other regions is smaller than their share of total deals. Table A3.24 in the appendix provides information on number of deals intended for trees grouped by sub-regions. The table shows that shares of deals intended for trees in every African sub-region (except for Northern Africa which has no deals solely intended for trees) are higher than their share in total deals. On the other hand shares of deals for tree growth in European sub-regions (*i.e.* East Europe and Russian Federation), and Asia (Southeast and South Asia) are smaller than their share of deals in total deals.

Crops

Food and non-food crops

Crops can be divided into two groups: food and non-food crops. Table 18 provides an overview of how many times these two crop types appear in the database.

Compounded, 1680 deals under my analysis are intended to produce 3423 crops of which 2946 or 86 percent are intended for food consumption while 14 percent (477) are intended for non-food use.

Table 19 indicates what kind of crops are deals intended for. Majority of deals (1217 deals) are intended for food crops only while 264 deals are intended for non-food agricultural products. The remaining 199 deals are intended for production of both types of crops.

Table 18: Number of times food and non-food crops appear in the database

Crop type	Number	Share
Food crops	2946	86.06%
Non-food crops	477	13.94%
Total	3423	100.00%

Source: Author's calculations based on database, Number of deals, N = 1680

Table 19: Number of deals grouped by type of crop

Crop production	No. of deals	Share
Food crops only	1217	72.44%
Mixed crops	199	11.85%
Non-food crops only	264	15.71%
Total	1680	100.00%

Source: Author's calculations based on database

The next analysis will look at how food and non-food crops are spread through different target regions and sub-regions (see table 20 below for regional spread with shares of crop types in each region and table 21 for regional spread of crops groups in all dataset; see also A3.25 in the appendix for regional spread with number of deals).

Table 20: Regional overview of shares of different crop groups

Broad regions	Food	Mixed	Non-food	Total
Europe	48.78%	9.15%	42.07%	100.00%
Central America and the Caribbean	90.24%	7.32%	2.44%	100.00%
South America	80.11%	18.47%	1.42%	100.00%
Africa	68.89%	11.76%	19.35%	100.00%
Asia	79.00%	8.90%	12.10%	100.00%
Oceania and Polynesia	69.23%	2.56%	28.21%	100.00%
Total	72.44%	11.85%	15.71%	100.00%

Source: Author's calculations based on database

Of the 1217 deals intended for food crops Africa ranks number one with 445 deals (37 percent of all food deals in the database and 69 percent of deals in African region) followed by Asia (346 deals or 28 percent of all deals in the database and 79 percent of deals in Asia) and South America (282 deals or 23 percent of all deals in database and 80 percent of deals in the region). Together they account for almost 90 percent of all deals in the database intended for food crops.

Table 21: Regional overview of shares of different crop groups in total crop group

Broad regions	Food	Mixed	Non-food	Total crops
Europe	6.57%	7.54%	26.14%	9.76%
Central America and the Caribbean	3.04%	1.51%	0.38%	2.44%
South America	23.17%	32.66%	1.89%	20.95%
Africa	36.57%	38.19%	47.35%	38.45%
Asia	28.43%	19.60%	20.08%	26.07%
Oceania and Polynesia	2.22%	0.50%	4.17%	2.32%
Total	100.00%	100.00%	100.00%	100.00%

Source: Author's calculations based on database

Of the 1217 deals intended for food crops Africa ranks number one with 445 deals (37 percent of all food deals in the database and 69 percent of deals in African region) followed by Asia (346 deals or 28 percent of all deals in the database and 79 percent of deals in Asia) and South America (282 deals or 23 percent of all deals in database and 80 percent of deals in the region). Together they account for almost 90 percent of all deals in the database intended for food crops. Among 264 deals intended for non-food crop production Africa again comes first with 125 deals (or 47 percent of all deals in the database and 19 percent of deals in the region) followed by Europe (69 deals or 26 percent of all deals in the database and 42 percent of all deals in the region) and Asia (53 deals or 20 percent of all deals in the database and 12 percent of deals in the region). Combined they represent almost 95 percent of all deals in the dataset intended for non-food crop production. As in the other two cases Africa ranks number one for land deals intended for mixed crop production with 76 deals (38 percent of all deals in the dataset and 12 percent of all deals in Africa), followed by South America (65 deals or 33 percent of all deals in the database and 18 percent in the region) and Asia (39 deals, 20 percent of all deals in the dataset and 9 percent of deals in the region). Combined they account for over 90 percent of all deals in the dataset intended for mixed crops production.

At the sub-regional level (see appendix tables A3.26 to A3.28 for numerical values and shares in regional number of deals and total number of deals respectively) South America accounts for the highest number of deals intended for food crop production (282 deals or 23 percent of all deals in the dataset and 80 percent of deals in the sub-region) followed by Southeast Asia (250 deals or 21 percent of all deals and 75 percent of deals in the sub-region) and Eastern Africa (211 deals or 17 percent of all deals in the dataset and 69 percent of deals in the sub-region). South America also ranks number one in deals intended for mixed crop production (65 deals or 33 percent of all deals and 18 percent of deals in the sub-region) followed by Eastern Africa (35 deals, 18 percent of all deals in the dataset and 11 percent of deals in the sub-region) and Southeast Asia (34 deals, 17 percent of all deals and 10 percent of deals in the sub-region). The highest number of deals intended for non-food crop production is in Eastern Africa (60 deals or 23 percent of all deals and 20 percent of deals in the sub-region) followed by Eastern Europe (52 deals or 20 percent of all deals and 44 percent of the deals in the sub-region) and Southeast Asia (50 deals or 19 percent of all deals and 15 percent of deals in the sub-region).

Table 22: Share of deals grouped by crop type (food, non-food) for top ten investor countries

Investor countries	Food	Mixed	Non-food	Total
China	72.27 %	9.24 %	18.49 %	100.00 %
Argentina	80.23 %	11.63 %	8.14 %	100.00 %
United States of America	71.93 %	15.79 %	12.28 %	100.00 %
India	65.52 %	11.21 %	23.28 %	100.00 %
United Kingdom	88.68 %	5.66 %	5.66 %	100.00 %
Vietnam	34.02 %	34.02 %	31.96 %	100.00 %
Malaysia	75.70 %	9.35 %	14.95 %	100.00 %
Brazil	73.81 %	2.38 %	23.81 %	100.00 %
Singapore	73.08 %	15.38 %	11.54 %	100.00 %
South Africa	69.23 %	15.38 %	15.38 %	100.00 %

Source: Author’s calculations based on database

As they account for around 90 percent of all deals in the database it is expected that the three regions: Africa, Asia, and South America also top the sub-sets of deals. It therefore comes as no surprise that most of the deals intended for food and mixed crops are in those regions. However, Europe accounts for 7.5 percent of all deals and unusually high share in number of deals intended for non-food crops (26 percent). There is similar trend at sub-regional level where Southeast Asia, South America, and Easter Africa rank top three target destinations. Surprisingly it is South America that has the highest number of food and mixed crop deals although it ranks number two in sub-regional number of all deals (with Southeast Asia being number one). Eastern Europe (target sub-region ranking number five with 5.5. percent of all deals) is again an outlier with almost 20 percent of all deals intended for non-food crop productions.

Table 22 shows shares of intended uses of land for top ten investor countries (see table A3.29 in the appendix for numerical values). Average share of deals for different intentions is similar to shares different crop types have in whole database (see table 19) with the exception of Vietnam where each type of crops accounts for approximately 33 percent (I should note here that Vietnam invests in large number of deals; in total 142 however a lot of those deals miss information on crop type and are therefore excluded from my analysis. If the information was provided shares would probably have been different).

Similarly, table 23 provides information on share of intended uses of land for top ten target countries (table A3.30 in the appendix provides numerical values). Again the average shares of individual crop types match average shares in total database under analysis (see table 19) however there is one outlier; Romania which has more than 50 percent of deals intended for non-food crops.

Table 23: Share of deals grouped by crop type for top ten target countries

Target countries	Food	Mixed	Non-food	Total
Argentina	76.87 %	21.09 %	2.04 %	100.00 %
Cambodia	78.18 %	19.09 %	2.73 %	100.00 %
Indonesia	75.65 %	2.61 %	21.74 %	100.00 %
Ethiopia	54.95 %	20.88 %	24.18 %	100.00 %
Mozambique	94.59 %	1.35 %	4.05 %	100.00 %
Vietnam	66.67 %	13.33 %	20.00 %	100.00 %
Brazil	67.86 %	30.36 %	1.79 %	100.00 %
Romania	33.33 %	800 %	78.67 %	100.00 %
India	98.61 %	0.00 %	1.39 %	100.00 %
United Republic of Tanzania	76.19 %	9.52 %	14.29 %	100.00 %

Source: Author's calculations based on database

Plantation and non-plantation crops

In relation to the thesis there is another important aspect in regard to the crop types; namely whether they are plantation or non-plantation crop.

Table 24 shows number and share of deals in the database based on their intention for plantation; non-plantation; or mixed crop production. The majority of deals is intended for plantation crops only (almost 45 percent of all deals or 748 deals) followed by deals intended for non-plantation crops only (37 percent of all deals or 626 deals). The remainder of deals (306 deals or 18 percent of all deals) are intended for mixed crops.

Table 24: Number and share of deals based on plantation and non-plantation crop type

Intention of deals	No. of deals	Share
Only plantation crops	748	44.52%
Mixed crops	306	18.21%
Only non-plantation crops	626	37.26%
Total	1680	100.00%

Source: Author's calculations based on database

Table 25: Number and share of crops based on plantation and non-plantation crop type

Crop type	No. of crops	Share
Plantation crops	1284	37.51%
Non-plantation crops	2139	62.49%
Total	3423	100.00%

Source: Author's calculations based on database

Table 25 (number and share of plantation and non-plantation crops) on the other hand shows that almost 38 percent of crops (1284) are intended to be plantation crops whereas 62 percent (or 2139 crops) are non-plantation.

The next analysis will look at how plantation and non-plantation crops production is spread through different target regions and sub-regions (see table 26 below for shares of types of crops in each region, table 27 for share of crop types in total of that crop type, and table A3.31 for number of deals of different crop type in each region).

At a regional level, Africa is preferred target region for both plantation (306 deals or 41 percent of all plantation crops in dataset and representing 47 percent of crops in Africa) and non-plantation crops (238 deals or 38 percent of all non-plantation crops deals in dataset and 37 percent of crops in Africa) whereas South America has the highest number of deals intended for mixed crops production (117 deals or 38 percent of mixed crops deals in dataset and 33 percent in the region). The top three regions for plantation crops (Africa, Asia, and South America) account for more than 80 percent of plantation crops in dataset. The same three regions also account for almost 90 percent of all deals for both mixed crop production and non-plantation crops.

Picture is a bit different at the sub-regional level (see tables A3.32 – A3.34 in the appendix for numerical values, share in each sub-region and share in each crop group respectively for plantation, mixed and non-plantation production) where Southeast Asia holds top spot for plantation crops (152 deals or 20 percent of all plantation crops in dataset and 46 percent of deals in the region) while South America receives the highest number of investments for both mixed crop production (117 deals or 38 percent of all mixed crops deals in the dataset and 33 percent of deals in the region) as well as non-plantation crops (139 deals or 22 percent of all non-plantation crops deals in the dataset and 39 percent of deals in the region).

Plantation crops are the most important investments for all of the top ten investor countries except China and India (see table 28 below for shares in their respective investment and table A3.35 in the appendix for corresponding numerical values) which invest more in non-plantation crops (both around 44 percent of their investments).

Table 26: Regional overview of share of deals based on their intended use as plantation, mixed, and non-plantation crops production in each region

Target region	Plantation	Mixed	Non-plantation	Total
Europe	56.71%	12.80%	30.49%	100.00%
Central America and the Caribbean	56.10%	19.51%	24.39%	100.00%
South America	27.27%	33.24%	39.49%	100.00%
Africa	47.37%	15.79%	36.84%	100.00%
Asia	47.26%	12.79%	39.95%	100.00%
Oceania and Polynesia	58.97%	5.13%	35.90%	100.00%

Source: Author's calculations based on database

Table 27: Regional overview of share of deals based on their intended use as plantation, mixed, and non-plantation crops production in each crop type

Target region	Plantation	Mixed	Non-plantation
Europe	12.43%	6.86%	7.99%
Central America and the Caribbean	3.07%	2.61%	1.60%
South America	12.83%	38.24%	22.20%
Africa	40.91%	33.33%	38.02%
Asia	27.67%	18.30%	27.96%
Oceania and Polynesia	3.07%	0.65%	2.24%
Total	100.00%	100.00%	100.00%

Source: Author's calculations based on database

Malaysia has the highest share of investments in plantation crops (65 percent of all investments) with additional two countries investing above average in plantation crops; United Kingdom, and Singapore (49 percent and 48 percent of all investments respectively). On the other hand Vietnam (38 percent of all investments), China, India, United States, and South Africa invest below average in plantation crops. Five countries invest above average in non-plantation crops; India and China (44 percent), United

States, United Kingdom, and Vietnam while Malaysia (25 percent), South Africa, and Singapore invest below average. South Africa has the highest and above average share of investment in mixed crop deals (31 percent of all investments) followed by Vietnam (26 percent of all investments), and Singapore (23 percent of all investments), whereas Malaysia has only nine percent of all deals with mixed crop production followed by United Kingdom (13 percent of all investments) and China (17 percent of all investments).

Table 28: Share of deals grouped by crop type (plantation, non-plantation) for top ten investor countries

Top ten investor countries	Plantation	Mixed	Non-plantation	Total
China	39.50%	16.81%	43.70%	100.00%
Argentina	45.35%	19.77%	34.88%	100.00%
United States of America	41.23%	18.42%	40.35%	100.00%
India	39.66%	16.38%	43.97%	100.00%
United Kingdom	49.06%	13.21%	37.74%	100.00%
Vietnam	38.14%	25.77%	36.08%	100.00%
Malaysia	65.42%	9.35%	25.23%	100.00%
Brazil	45.24%	19.05%	35.71%	100.00%
Singapore	48.08%	43.08%	28.85%	100.00%
South Africa	41.03%	30.77%	28.21%	100.00%
Average	45.27%	19.26%	35.47%	

Source: Author's calculations based on database

Table 29: Share of deals grouped by crop type (plantation, non-plantation) for top ten target countries

Top ten target countries	Plantation	Mixed	Non-plantation	Total
Argentina	5.44%	48.30%	46.26%	100.00%
Cambodia	28.18%	30.00%	41.85%	100.00%
Indonesia	56.52%	3.48%	40.00%	100.00%
Ethiopia	35.16%	21.98%	42.86%	100.00%
Mozambique	68.92%	5.41%	25.68%	100.00%
Vietnam	26.67%	6.67%	66.67%	100.00%
Brazil	12.50%	51.79%	35.71%	100.00%
Romania	58.67%	8.00%	33.33%	100.00%
India	59.72%	1.39%	38.89%	100.00%
Tanzania	52.38%	9.52%	38.10%	100.00%
	40,42%	18,65%	40,93%	

Source: Authors calculations based on database

Table 29 shows similar overview however in this case for target countries (see also table A3.36 in the appendix for numerical values). Number of deals intended for non-plantation crops is the highest in Cambodia (46 deals or 42 percent of all investments), Ethiopia (39 deals or 43 percent of all investments), and Vietnam (10 deals or 67 percent of all investments) whereas plantation crops receive the highest investments in Indonesia (65 deals or 57 percent of all investments), Mozambique (51 deals or 69 percent of all investments), Romania (44 deals or 59 percent of all investments), India (43 deals or 60 percent of all investments), and Tanzania (11 deals or 53 percent of all investments). Argentina (71 deals or 48 percent of all investments) and Brazil (29 deals or 52 percent of all investments) have mixed crop deals with the highest investments.

Above average investments in plantation crops happens in Mozambique (69 percent of all investments), India (60 percent of all investments), Romania (59 percent of all investments), Indonesia (57 percent of all investments), and Tanzania (52 percent of all investments) whereas below average investments in plantation crops happen in Argentina (5 percent of all investments), Brazil (13 percent of all investments), Vietnam (27 percent of all investments), Cambodia (28 percent of all investments), and Ethiopia (35 percent of all investments). Investments in non-plantation crops is above average in Vietnam (68 percent of all investments), Argentina (46 percent of all investments), Ethiopia (43 percent of all investments), and Cambodia (42 percent of all investments) while below average investments happen in Mozambique (26 percent of all investments), Romania (33 percent of all investments), Brazil (36 percent of all investments), Tanzania (38 percent of all investments), and India (39 percent of all investments). Investments in deals with intention for mixed crop production is above average in Brazil (52 percent of all investments), Argentina (48 percent of all investments), Cambodia (30 percent of all investments), and Ethiopia (22 percent of all investments) while it is below average in India (1 percent of all investments), Indonesia (3 percent of all investments), Mozambique (5 percent of all investments), Romania (8 percent of all investments), and Tanzania (10 percent of all investments)

Crop groups
Table A3.37 in the appendix provides overview of agricultural products listed in Land Matrix database. In general there are 81 different agricultural products that I classified at four different layers. The top layer divides agricultural products into two groups: crops and trees. This grouping was analysed above as were the next two divisions which grouped crops into two different subgroups: food crops and non-food crops, and plantation and non-plantation crops.

Food and non-food crops are further divided into sub-sub-groups. Food crops are grouped into: cereals; vegetables; fruits; nuts; coffee, tea, and cocoa; spices; oil crops; and other food crops; whereas non-food crops are grouped into: fibre crops; rubber; tobacco; other non-food crops; and biofuels (trees, that were already analysed are removed from further analysis).

Table 30 shows how many times different food sub-sub-groups appear in my dataset (in this case dataset consists of deals intended for mixed agricultural production or for food production only). Cereals, vegetables, and oil crops are the top three food sub-sub-groups together accounting for almost 90 percent of all food agricultural products.

Table 30: Number of times different food sub-groups appear in Land Matrix database

Food crop	Total	Share
Cereals	1078	36.59%
Vegetables	888	30.14%
Fruits	190	6.45%
Nuts	38	1.29%
Coffee, cocoa, tea	61	2.07%
Spices	15	0.51%
Oil crops	639	21.69%
Other food crops	37	1.26%
Total	2946	

Source: Author's calculations based on database (2017), Number of deals, N = 1416

Similarly table 31 provides information for non-food crops. Two sub-sub-groups of non-food crops, rubber and biofuels account for almost 70 percent of intended investments followed by fibre crops (17 percent).

Table 31: Number of times different non-food sub-groups appear in Land Matrix database

Non-food crops	Total	Share
Fibre crops	82	17.19%
Rubber	158	33.12%
Tobacco	6	1.26%
Other non-food crops	65	13.63%
Biofuels	166	34.80%
Total	477	

Source: Author's calculations based on database (2017), Number of deals, N = 463

Perishable and non-perishable crops

Food crops allow for another type of analysis; namely whether the product is perishable or non-perishable.

Table 32 provides overview of deals grouped by their perishability. We can see that majority of agricultural products produced on LSLA deals are non-perishable (almost 65 percent) while only 35 percent are perishable. A deeper analysis shows that more than 80 percent of perishable crops are vegetables followed by fruits whereas the majority of non-perishable crops are cereals (almost 57 percent) followed by oil crops (almost 34 percent); see table 33.

Table 32: Overview of deals intended for food crop production in regard of their perishability

Food crop	Total	Share
Perishable crops	1042	35.37%
Non-perishable crops	1904	64.63%
Total	2946	

Source: Author's calculations based on database, Number of deals, N = 1416

Table 33: Detailed overview of perishable and non-perishable food crops

Food crop	Total	Share in food crops	Share in perishable food crops
Perishable crops			
Vegetables	834	28.31%	80.04%
Fruits	184	6.25%	17.66%
Other food crops	24	0.81%	2.30%
Non-perishable crops			Share in non-perishable food crops
Cereals	1078	36.59%	56.62%
Vegetables	54	1.83%	2.84%
Fruits	6	0.20%	0.32%
Nuts	38	1.29%	2.00%
Coffee, cocoa, tea	61	2.07%	3.20%
Spices	15	0.51%	0.79%
Oil crops	639	21.69%	33.56%
Other food crops	13	0.44%	0.68%
Total	2946		

Source: Author's calculations based database, Number of deals, N = 1416

Relations between investors and crops

Investor regions and investor countries –crop overview

Table 34 shows the highest shares and numbers of deals for food crops grouped by investor region. Investor region with the highest concentration in crops as well as in all agricultural products is Oceania and Polynesia (HH scores 0.25 and 0.12 respectively). On the other hand, Asia has the lowest concentration in crops (HH score 0.20). In all agricultural products there are three regions with the highest investment diversification (North America, Europe, and South America) with HH index values of 0.05.

Table 34: Numbers of most numerous crop group and corresponding diversification indices grouped by investor region

Investor region	Share of cereals	Vegetables	Total number of crops	Croup groups HH index[37]	All crops HH index[38]
North America	38%(148)		393	0.24	0.05
Europe	36%(242)		1080	0.22	0.05
Central America and the Caribbean	29%(17)	29%(17)	59	0.23	0.08
South America	35%(143)		525	0.22	0.05
Africa	33%(230)		830	0.22	0.06
Asia	27%(490)		1789	0.20	0.06
Oceania and Polynesia		35%(6)	17	0.25	0.12

Source: Author's calculations based on database; Number in parentheses represents number of deals

Looking at the individual crops, Corn (Maize) represents the most numerous crop for North America (41 deals), Europe (125 deals), South America (72), and Africa (103). For Central America and the Caribbean soya beans represent the crop that is most often included in investments (9 deals) while Oceania and Polynesia mostly invests in rubber (4 deals). For Asian countries the most numerous crop is oil palm for food consumption (211 deals).

Table 35 shows similar overview at sub-regional level. Cereals are a crop group that occurs in the highest number of investments for most of sub-regions (15 times out of 19 sub-regions) followed by vegetables (five times). Four sub-regions have two crop groups with equal numbers (Russian federation – vegetables and rubber; Central America and the Caribbean, and Middle Africa – cereals and vegetables; and Central Asia – cereals

[37] Crop group HH index measures diversification among crop groups

[38] All crop HH index measures diversification among all crops

and coffee, tea, and cocoa).

Sub-region that has the most diversified crops investment portfolio is South Asia (HH index 0.19) whereas in all deals four sub-regions share the top spot (North America, Western Europe, South America, and East Asia and Japan) with HH index value of 0.05.

Tables A3.38 through A3.41 in the appendix provide information on the most numerous food and non-food crops in broad and detail region overview respectively.

Table 35: Numbers of most numerous crop group and corresponding diversification indices grouped by investor sub-region

Detail Regions	Cereals	Vegetables	Coffee, cocoa, tea	Oil crops	Rubber	Crop group HH index	All crop HH index
North America	38%(148)					0.24	0.05
Eastern Europe	47%(40)					0.28	0.06
Norther Europe	34%(143)					0.22	0.06
Southern Europe	32%(44)					0.22	0.07
Western Europe	37%(153)					0.23	0.05
Russian Federation		29%(6)			29%(6)	0,24	0.15
Central America and the Caribbean	29%(17)	29%(17)				0.23	0.08
South America	35%(182)					0.22	0.05
Oceania and Polynesia		35%(4)				0,25	0.12
Eastern Africa	34%(141)					0.22	0.06
Middle Africa	28%(25)	28%(25)				0.23	0.07
Northern Africa	42%(19)					0.23	0.08
Southern Africa	34%(41)					0.24	0.07
Western Africa	30%(49)					0.21	0.07
Western Asia	33%(72)					0.23	0.06
Southeast Asia				29%(189)		0,20	0.08
South Asia		27%(68)				0,19	0.06
East Asia and Japan	32%(213)					0.21	0.05
Central Asia	40%(2)		40%(2)			0.36	0.28

Source: Authors calculations based on database; Number in parentheses represents number of deals

For four broad investor regions (North America, Europe, South America, and Africa) corn is included in the highest number of deals among food crops followed by soya beans (Central America and the Caribbean, and Oceania and Polynesia) whereas oil palm is the top food investment crop for Asian Regions. Corn is also the crop that is included in the highest number of deals at the detailed region level (nine out of 19 detailed regions), followed by oil palm (five sub-regions), soya beans (three sub-regions) whereas wheat and coffee plant are the most numerous investment food crops for one region (Eastern Europe and Central Asia respectively)[39].

Among non-food crops rubber is the most important investment in six out of seven regions (North America, Europe, Central America and the Caribbean, South America, Africa, and Oceania and Polynesia) whereas Jatropha is the most important crop for investors from Asia. At the sub-regional level rubber is again present in the highest number of deals in 13 out of 19 sub-regions, followed by Jatropha (Western Africa, Southeast Asia, South Asia, and East Asia and Japan), and cotton (Southern Europe, and Southern Africa)[40].

Table 36: Shares and number of most numerous crop group and corresponding diversification indices for top ten investor countries

Investor countries	Cereals	Vegetables	Oil crops	Total number of crop	Croup groups HH index	All crops HH index
China	33%(78)			234	0.21	0.05
Argentina		33%(67)		206	0.22	0.05
United States	39%(117)			301	0.24	0.05
India	26%(60)	26%(60)		228	0.19	0.06
United Kingdom	33%(85)			261	0.23	0.07
Vietnam			24%(42)	173	0.16	0.07
Malaysia			36%(65)	181	0.25	0.11
Brazil	32%(36)			111	0.19	0.06
Singapore	32%(48)			150	0.21	0.07
South Africa	32%(33)			103	0.22	0.06

Source: Author's calculations based on database; Number in parentheses represents number of deals

Table 36 provides information on crop deals for top ten investor countries. The most important crop group for most of the countries are cereals. India is the only country that has equal number of investments in two crop groups (cereals and vegetables). The most deals done by Argentina is in vegetables whereas Vietnam and Malaysia invest in food oil crops.

HH index for crop groups indicates how diversified are investor country's deals in broad crops. The most diversified investment has Vietnam (HH index 0.16) followed by Brazil

[39] Some crops may have equal number of deals which means that the sum of individual crops in sub-regions might be higher than the actual number of sub-regions
[40] See footnote 39

and India (HH index value of 0.19) whereas Malaysia has the most concentrated investment (HH index 0.25). HH index for all crops (*i.e.* accounting for individual crops) shows different picture. Countries that have the most diversified crop investment portfolio among top ten investor countries are China, Argentina, and the United States of America (HH index 0.05) whereas Malaysia is again investor with the most concentrated crop list with HH index value of 0.11 (a detailed list of investments in different crop groups for top ten investors can be found in table A3.42 in the appendix).

Among all countries Canada holds the top spot in all crop investment diversification (HH index 0.04) followed by Ethiopia and Switzerland (HH index 0.05). Vietnam is the most diversified investment country in regard to crop groups (HH index 0.16), followed by Hong Kong (HH index 0.17) and Brazil (HH index 0.19).

Table 37 shows the most numerous crops for each of the top ten investor country. Both corn and oil palm receive the most investments from three investor countries while soya beans and jathropa are the most invested crop for two countries.

Table 37: Number of deals of the most numerous crops for top ten investor countries

Top ten investor countries	Corn	Soya Beans	Oil Palm	Jathropa
Argentina	12.16%(25)			
Brazil	13.51%(15)			
China		11.54%(27)		
India				11.84%(27)
Malaysia			25.97%(47)	
Singapore			14.00%(21)	
South Africa		14.56%(15)		
United Kingdom			17.62%(46)	
United States of America	11.30%(34)			
Vietnam				15.61%(27)

Source: Author's calculations based on database

Target region and target country – crop overview

Similar to the previous exercise this sub-chapter analyses crop production although at target regions (and sub-regions) and target countries levels.

Table 38 shows an overview of the most numerous crop groups in different target regions. It provides share and number of deals of that particular crop group as well as diversification indices for crop groups and individual crops.

Cereal group is the most numerous crop group happening in three regions: Europe; 57 deals, South America; 496 deals, and Asia; 250 deals. Vegetables account for the highest crop group in two regions: Central America and the Caribbean with 24 deals and Africa with 291 deals while Oil crops represent the most numerous group in Oceania and Polynesia (21 deals).

Table 38: Shares and numbers of most numerous crop group and corresponding diversification indices grouped by target region

	Cereals	Vegetables	Oil crops	HH crop groups	HH all crops
Europe	24%(57)			0.17	0.09
Central America and the Caribbean		31%(24)		0.24	0.08
South America	40%(496)			0.27	0.06
Africa		27%(291)		0.18	0.06
Asia	34%(250)			0.22	0.06
Oceania and Polynesia			47%(21)	0.30	0.28

Source: Author's calculations based on database; Number in parentheses represents number of deals

When looking at individual crops the picture is a bit different. Crop appearing in the highest number of deals in Europe is rubber (52 deals) whereas corn is the crop in the highest number of deals in South America and Asia. In three remaining regions (*i.e.* Central America and the Caribbean, Africa, and Oceania and Polynesia) oil palm appears in the highest number of deals with 16, 149, 21 deals respectively.

When correlating individual crop groups to GDP per capita we get two positive correlation at 10% significance level: other food crops (r=0.145, t=0.096), and rubber (r=0.159; t=0.067), one sat 5% significance level: other non-food crops (r = 0.181, t=0.037), and one at 1% significance level: cereals (r = 0.226; t=0.009). The results of the correlation testing indicate that both food and non-food are important drivers for land investments and that the incentive for investments increases with development levels. At the same time it seems that food is somewhat more important (since cereals have positive correlation at 1% level).

Europe is the most diversified target region at crop group level with HH index value of 0.17 followed by Africa (HH index 0.18). On the other hand, Oceania and Polynesia is the least diversified with HH index value for crop group diversification of 0.30. In regard to individual crops three target regions occupy the top spot for diversification: South

America, Africa, and Asia (HH index value of 0.06) whereas Oceania and Polynesia is again the least diversified target region with the crop HH index value of 0.28.

Table 39: Shares and numbers of most numerous crop group and corresponding diversification indices grouped by target sub-region

Sub-region	Cereals	Vegetables	Oil crops	Rubber	Biofuels	HH crop groups	HH all crops
Eastern Europe	27%(48)					0.18	0.09
Norther Europe					50%(2)	0.38	0.38
Southern Europe		38%(3)				0.28	0.22
Russian Federation				27%(13)		0.16	0.14
Central America and the Caribbean		31%(24)				0.24	0.08
South America	40%(496)					0.27	0.06
Oceania and Polynesia			47%(21)			0.30	0.28
Eastern Africa		27%(122)				0.16	0.06
Middle Africa	38%(92)					0.27	0.09
Northern Africa		48%(32)				0.29	0.08
Southern Africa		50%(13)				0.38	0.23
Western Africa			30%(87)			0.19	0.10
Western Asia	33%(1)	33%(1)	33%(1)			0.33	0.33
Southeast Asia	36%(214)					0.23	0.07
South Asia		48%(47)				0.30	0.11
East Asia and Japan	38%(15)					0.25	0.07
Central Asia		67%(2)				0.56	0.33

Source: Author's calculations based on database; Number in parentheses represents number of deals

Similar overview although at sub-regional level can be found in table 39. The most numerous crop group at the sub-regional level is vegetable (8 sub-regions out of 17) followed by cereals (6 sub-regions), and oil crops for food (3 sub-regions). There are two crop groups that are most numerous one time (rubber and biofuels). Western Asia has three crop groups with equal number of deals (cereals, vegetables, and oil crops).

Tables A3.43 and A3.45 in the appendix provide information on the most important food crop for at target regional and sub-regional level respectively while tables A3.44 and A3.46 in the appendix provide similar information for the most important non-food crop. At the broad target region level two food crops appear as the most important food crops, corn which is the most important in Europe, South America, and Asia, and oil palm which is the most important in Central America and the Caribbean, Africa, and

Oceania and Polynesia. At the target sub-regional level (table 40) corn is included in six out of 17 sub-regions, followed by oil palm (five sub-regions), sugar cane (four sub-regions), and soya beans (two sub-regions) whereas rice, vegetables, sugar and cassava are food crops that are included in the highest number of deals at one sub-region (Northern Europe, Southern Europe, Central Asia, and South Asia respectively)[41].

Table 40: Overview of the most numerous crops in each target sub-region

Sub-region	Most numerous crop	Share in all crops
Eastern Europe	Rubber	21.91% (39)
Norther Europe	Jathropa	50.00% (2)
Southern Europe	Vegetables	37.50% (3)
Russian Federation	Rubber	27.08% (13)
Central America and the Caribbean	Oil Palm	20.78% (16)
South America	Corn	14.14% (175)
Oceania and Polynesia	Oil Palm	46.67% (21)
Eastern Africa	Oil Palm	12.53% (57)
Middle Africa	Corn	21.16% (51)
Northern Africa	Soya Beans/Rubber	each 11.94% (8)
Southern Africa	Sugar cane	34.62% (9)
Western Africa	Oil Palm	25.35% (73)
Western Asia	Corn/Sugar cane/Oil Palm	each 33.33% (1)
Southeast Asia	Corn	15.45% (91)
South Asia	Cassava	24.74% (24)
East Asia and Japan	Corn	15.38% (6)
Central Asia	Corn/Soya Beans, Sugar	each 33.33% (1)

Source: Author's calculations based on database; Number in parentheses represents number of deals

Tables A3.43 and A3.45 in the appendix provide information on the most important food crop for at target regional and sub-regional level respectively while tables A3.44 and A3.46 in the appendix provide similar information for the most important non-food crop. At the broad target region level two food crops appear as the most important food crops, corn which is the most important in Europe, South America, and Asia, and oil palm which is the most important in Central America and the Caribbean, Africa, and Oceania and Polynesia. At the target sub-regional level (table 40) corn is included in six out of 17 sub-regions, followed by oil palm (five sub-regions), sugar cane (four sub-regions), and soya beans (two sub-regions) whereas rice, vegetables, sugar and cassava are food crops that are included in the highest number of deals at one sub-region (Northern Europe, Southern Europe, Central Asia, and South Asia respectively)[42].

[41] See footnote 39

[42] See footnote 39

Jatropha is the non-food crop that is included in four broad target regions (Central America and the Caribbean, Africa, Asia, and Oceania and Polynesia), followed by cotton (Central America and the Caribbean, and South America) whereas rubber is the non-food crop that appears most frequently in Europe.

At the sub-regional level jatropha appears in the highest number of deals in six sub-regions (out of 14), followed by rubber (five), cotton (four) whereas fodder plant is (together with cotton) non-food crop included in the highest number of deals in one sub-region (East Asia and Japan)[43].

Table 41 shows shares and numbers of deals for the most numerous crop groups for the top ten target countries. Cereals are the crop group that appears in five of the top ten target countries followed by vegetables whereas oil crops for food consumption and rubber are the most numerous in one country each.

Table 41: Shares and number of most numerous crop group and corresponding diversification indices for top ten target countries

Target countries	Cereals	Vegetables	Oil crops	Rubber	Croup groups HH index	All crops HH index
Argentina	44%(331)				0.29	0.06
Cambodia	38%(115)				0.26	0.07
Indonesia	29%(40)				0.20	0.11
Ethiopia		23%(35)			0.13	0.05
Mozambique			36%(33)		0.27	0.14
Vietnam	56%(14)				0.37	0.18
Brazil	39%(71)				0.27	0.09
Romania				33%(35)	0.21	0.15
India		57%(44)			0.37	0.16
Tanzania		27%(8)			0.17	0.08

Source: Author's calculations based on Land database; Number in parentheses represents number of crops

Ethiopia is the most diversified target economy in relation to crop groups (HH index 0.13), followed by Tanzania (HH index 0.17) and Indonesia (HH index 0.20) whereas Vietnam and India are the least diversified (HH index 0.37). Ethiopia is also the most diversified when accounting for all crops (HH index 0.05) followed by Argentina (HH index 0.06) and Cambodia (HH index 0.07). On the other hand Vietnam is the most concentrated target economy with HH index value of 0.18, followed by India (HH index 0.16), and Romania (HH index 0.15).

[43] See footnote 39.

Table 42 provides information of the most numerous individual crops for top ten target countries. Individually corn has the highest number of deals in four target countries followed by oil palm (appearing in three target countries). Tanzania has two crops that appear in equal number of deals (each in four).

Table 42: Number of deals of the most numerous crop for top ten target countries

Target countries	Most numerous crop	Share in all crops
Argentina	Corn	14.19 % (106)
Brazil	Corn	17.13 % (31)
Cambodia	Corn	17.06 % (51)
Ethiopia	Jatropha	10.00 % (15)
India	Cassava	31.17 % (24)
Indonesia	Oil Palm	22.63 % (31)
Mozambique	Oil Palm	30.77 % (28)
Romania	Rubber	33.02 % (35)
Tanzania	Sugar cane/ Oil Palm	Each 13.33 % (4)
Vietnam	Corn	36.00 % (9)

Source: Author's calculations based on database; Number in parentheses represents number of crops

3.6 Summary of chapter three

Based on my exploration of the Land Matrix dataset Africa is preferred target region followed by Asia and South America. At the sub-regional level Southeast Asia receives the highest number of investments followed by South America and Eastern Africa. Of the 94 target countries, Argentina is the one with the highest number of deals followed by Cambodia and Indonesia.

Similar analysis for the investor side shows that Asia is by far the biggest investor region followed by Europe, and Africa. At a sub-regional level Southeast Asia leads the list followed by East Asian and Japan with South America concluding the top three. As I highlighted before China is the biggest individual investor followed by Argentina and the United States of America with equal number of deals (there are 131 investor countries).

Each investor country has preferred region in which it invests which for China is Asia at regional and Southeast Asia at sub-regional level. Preferred investment region (and sub-region) for both Argentina and United States of America is South America. In general, my analysis showed that investing in domestic region is preferred (except for Europe which has the highest number of investments in Africa and Northern America which mostly invests in South America).

The highest share of domestic investment happens in South America followed by Asia and Central America and the Caribbean. Individually Argentina has the highest number of domestic investments followed by Vietnam and India however when comparing shares of domestic number of deals in total number of deals and disregarding countries with only handful of deals the picture changes. In that case India leads the board with 90 percent of all investments being made by or at least participating in by domestic investor followed by Peru and Vietnam.

The analysis of the intentions of investments showed that the highest number of deals in the Land Matrix database is intended for food crops followed by biofuels and unspecified agricultural products. In my dataset 84 percent are intended for crops only and 13 percent only for trees. Of the deals intended for crop production, 72 percent for food crops whereas 16 percent are intended for non-food crops production.

Almost 62 percent of all crops are non-plantation crops while plantation crops account for approximately 38 percent of intended investments. Plantation crops are the most important investment for most of the top ten investors except China and India which invest predominantly in non-plantation crops. In target countries picture is a bit more diverse. In three of the top ten target countries (Cambodia, Ethiopia, and Vietnam) non-plantation crops represent the highest share in all deals whereas plantation crops received the most investments in Indonesia, Mozambique, Romania, India, and Tanzania. The most investments in Argentina and Brazil are in mixed crop production.

Among non-food crops biofuels, rubber and fibre crops represent the top three investments, whereas among food crops, cereals, vegetables and food oil crops occupy the top three places. Additional analysis of the food crops revealed that 65 percent of them are non-perishable with cereals and oil crops leading the list whereas perishable crops represent 35 percent of food crops of which majority were fruits.

Cereals (usually corn) have the highest number of deals of all food groups among most of investor regions with only Oceania and Polynesia investing more in vegetables. Cereals are also crop type that occurs in highest number of deals at the sub-regional investment level as well as individual investor countries.

4. Panel data evidence of agricultural production structure on the long-term GDP per capita growth rate volatility

4.1 Introduction to chapter four

The first empirical chapter, *i.e.* chapter four of this thesis, attempts to find an answer to whether and how different crops' production structure in developing countries affects their growth rate volatility. The question is divided into five sub questions related to production of plantation/non-plantation crops, perishable/non-perishable crops, food/non-food crops, crop groups, and different forms of diversification in crop production. Generally, this chapter aims to empirically investigate the effects of crops' production structures and their corresponding significances on growth rate volatility.

First I want to see whether plantation and non-plantation agriculture influence growth rate volatility differently. The reasoning for this question is based on findings of Isham, *et al.* (2005) who discovered that agricultural commodities, produced, distributed, and marketed in a manner similar to the point-source natural resources (*i.e. "resources extracted from narrow geographic or economic base";* (Isham, et al., 2005)), can also be considered point-sourced. Their analysis shows that economies based predominantly on point-source resources experience lower long-term growth rates. They attribute this to increased social and economic divisions and lower institutional quality, which make appropriate responses to shocks unlikely; see also *e.g.* Rodrik (1999), Rigobono and Rodrik (2004), Rodrik (2004), *etc.* High growth rate volatility has been shown to reduce long-term growth therefore I suspect that economies with higher share of plantation based products will experience higher growth rate volatility.

My second exploration wants to establish whether there is a different effect of perishable and non-perishable crops on growth rate volatility. The logical reasoning behind this question is based on the fact that perishable crops have much shorter shelf life than non-perishable ones. This requires their quick resale which leads to market conditions with plenty of perishable crops placed on the market at the same time which in turn should push their prices down although there are pre- and post-peak periods when prices could be higher. I can also argue that consumers base their purchases more on best possible price (of food products) and less on what is desirable and available at that particular moment meaning that at any time consumers will seek the cheapest alternative. Based on this I expect to see higher growth rate volatilities associated with perishable crops than with non-perishable ones.

Thirdly, I am interested whether food crops influence growth rate volatility differently than non-food crops. As I explained before, food prices are on the rise due to population and economic growth, urbanisation, changing diets, *etc.* On the other hand, production of certain non-food crops (or industrial crops) which do not have alternatives and thus rely on new sources is reaching its natural limit (Cotula, et al., 2009).

My fourth question wants to examine the effects of different crop groups on growth rate volatility. The reasoning is partly based on previous three questions; certain crop groups are predominantly plantation based (*i.e.* oil crops), others are food crops (*e.g.* fruits, vegetables) of which some are plantation crops (*e.g.* bananas), while another groups have most of its constituents perishable or non-perishable.

My last question wants to establish whether higher agricultural crop diversification (in different forms) reduces growth rate volatility. IMF (2014) paper pointed out that in Asian countries agricultural diversification was one of the sources of productivity growth, while Brainard and Cooper (1965) proposed that diversification can reduce economic volatility in the long-term; see also *e.g.* (Mobarak, 2005; Koren & Tenreyro, 2007; Moore & Walkes, 2010). In his paper, Burns (1960) suggests that diversification reduces volatility by mitigating sector-specific shocks. Results of Papageorgiou, *et al.* (2015) research suggest that output diversification reduces output volatility in developing countries. Based on this reasoning I expect to see lower growth rate volatilities associated with higher diversification. I use Herfindahl-Hirschman index (Herfindahl, 1950) to determine diversification between different crop groupings.

4.2 Research questions, data, and methodology

Research in this, as well as the next chapter, is based on the findings of Isham, *et al.* (2005). They showed that exports of point-sourced resources severely and negatively affect growth in the exporting countries. In addition their research showed that the negative effect of exports of coffee and cocoa surpasses that of other, more traditional point-sourced resources (i.e. minerals, oil, etc.). Coffee and cocoa are relatively similar crops, both are plantation crops that are non-perishable as well as intended for food consumption. This triggered two additional questions: would other crop groups also have effects on growth and growth rate volatility, and would there be differences between their production and exports. The first question led to the formation of research questions presented below and in sub-chapter 5.2. The second question resulted in the division of my examination between crops' production and their exports. Distinction between them was further strengthened by the fact that LSLAs are intended for local consumption, their exports, or a combination of the two. The two questions initially asked slowly developed and resulted in a number of questions that are then answered in this and the next empirical chapter.

4.2.1 Research questions and hypotheses

Research questions reflect the intention of this thesis which examined the influence of crops on growth rate volatility. This chapter is concerned with the effects of crops' production on growth rate volatility whereas the next chapter examines the effects of their exports.

Below is an overview of questions associated with this chapter that I want to research.

> **Question 1:** *Does production of plantation crops influences growth rate volatility differently than production of non-plantation crops?*
>
> **Question 2:** *Does production of perishable crops influences growth rate volatility differently than production of non-perishable crops?*
>
> **Question 3:** *Does production of food crops influences growth rate volatility differently than production of non-food crops?*
>
> **Question 4:** *How do productions of different crop groups influence growth rate volatility?*
>
> **Question 5:** *Do different forms of crops' production diversifications influence growth rate volatility differently?*

Each main question (*e.g.* plantation and non-plantation crops) regresses share of production value of corresponding explanatory variables in GDP on my dependent variable (*i.e.* standard deviation of growth rate volatility)[44].

1) Plantation and non-plantation crops:

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[44] Name of explanatory variable is in parenthesis. The letter (p) denotes crops' production

a. Share of plantation crops in GDP (ShPLANT(p)),

b. Share of non-plantation crops in GDP (ShNONPLANT(p)), and

c. Ratio of non-plantation to plantation crops (RATIOPLANT(p))

2) Perishable and non-perishable crops:

a) Share of perishable crops in GDP (ShPERISH(p)),

b) Share of non-perishable crops in GDP (ShNONPERISH(p)), and

c) Ratio of non-perishable to perishable crops (RATIOPERISH(p))

3) Food and non-food crops:

a. Share of food crops in GDP (ShFOOD(p))

b. Share of non-food crops in GDP (ShNONFOOD(p))

4) Crop groups:

a. Shares of different crop groups in GDP[45]

5) Agricultural diversification:

a. Value of Inverted Herfindahl-Hirschman index (from now on Inverted HH) for all agricultural products (InvHHPRODUCT(p)),

b. Value of Inverted HH index for agricultural groups (InvHHGROUP(p)), and

c. Value of Inverted HH index for two groups; food and non-food agricultural products (InvHHFOOD(p)).

As it is reasonable to expect that some of the agricultural products are exported, I decided to also run analyses with interaction terms between openness and my explanatory variables. This may indicate whether exports of agricultural products influence growth rate volatility and provides justification for my second exploratory chapter (*i.e.* chapter five of this thesis).

Based on literature review as well as educated guessing I can form a number of hypotheses that I then test in this chapter.

The hypotheses associated with the first question are:

Hypothesis 1: *Increased share of production value of plantation crops in GDP decreases growth rate volatility*

[45] Crop groups are: cereals; vegetables; fruits; nuts; coffee, cocoa, tea; spices; oil food crops; other food crops; fibres; rubber; tobacco; other non-food crops (see tables A4.6 and A4.20 in the appendix)

Hypothesis 2: *Increased share of production value of non-plantation crops in GDP increases growth rate volatility*

Hypothesis 3: *Increased ratio between shares of production values of non-plantation and plantation crops increases growth rate volatility*

The hypotheses associated with the second question are:

Hypothesis 4: *Increased share of production value of perishable crops in GDP increases growth rate volatility*

Hypothesis 5: *Increased share of production value of non-perishable crops in GDP decreases growth rate volatility*

Hypothesis 6: *Increased ration between shares of production values of non-perishable and perishable crops in GDP increases growth rate volatility*

The hypotheses associated with the third question are:

Hypothesis 7: *Increased share of production value of food crops in GDP decreases growth rate volatility*

Hypothesis 8: *Increased share of production value of non-food crops in GDP decreases growth rate volatility*

Hypothesis 9: *Increased ratio between shares of production values of food and non-food crops in GDP increases growth rate volatility*

The hypotheses associated with the fourth question are:

Hypothesis 10: *Increased share of production value of cereals in GDP decreases growth rate volatility*

Hypothesis 11: *Increased share of production value of vegetables in GDP decreases growth rate volatility*

Hypothesis 12: *Increased share of production value of fruits in GDP decreases growth rate volatility*

Hypothesis 13: *Increased share of production value of nuts in GDP increases growth rate volatility*

Hypothesis 14: *Increased share of production value of coffee, cocoa, and tea in GDP increases growth rate volatility*

Hypothesis 15: *Increased share of production value of spices in GDP increases growth rate volatility*

Hypothesis 16: *Increased share of production value of oil food crops in GDP increases growth rate volatility*

Hypothesis 17: *Increased share of production value of other food crops in GDP increases growth rate volatility*

Hypothesis 18: *Increased share of production value of fibres in GDP decreases growth rate volatility*

Hypothesis 19: *Increased share of production value of rubber in GDP decreases growth rate volatility*

Hypothesis 20: *Increased share of production value of tobacco in GDP increases growth rate volatility*

Hypothesis 21: *Increased share of production value of other non-food crops in GDP increases growth rate volatility*

Hypotheses associated with my fifth question are:

Hypothesis 22: *Increased diversification in production of all crops decreases growth rate volatility*

Hypothesis 23: *Increased diversification in production of crop groups decreases growth rate volatility*

Hypothesis 24: *Increased diversification in production between food and non-food crops increases growth rate volatility*

4.2.2 Data

This section provides an overview of data used in the analyses including dependent, control, and explanatory variables as well as interaction variables.

Data for the empirical analyses is comprised of 64 developing countries over the period 1971 – 2010 (lists of developing countries used in my analysis are provided in table A4.1 in the appendix).

Based on questions of my analysis and literature review I collected large number of variables. Table A4.2 in the appendix provides list of variables and data sources, whereas tables A4.3 (for my quick analysis) and A4.4 (for my detailed analysis) in the appendix provide their summary statistics.

4.2.2.1 Choice of countries

The rationale for choosing developing countries as well as time span is based on two reasons[46]. The first reason is based on my initial research question which explores LSLAs by using data from Land Matrix dataset. The Land Matrix compiles, monitors and disseminates data on LSLAs in low- and middle-income countries (Land Matrix, 2017); see also figure 16 below. The second reason is based on the fact that developed countries have well diversified economies with relatively small shares of agriculture in their GDP whereas developing countries' economies depend heavily on agriculture. Understanding the effects of agriculture (including its structure) should therefore be thoroughly understood in order to be able to develop appropriate policies in order to accomplish sustained long-term growth and to reduce the negative effects of large growth rate volatilities.

From the perspective of this thesis, the exploration is therefore on one hand limited by LSLA data availability and on the other hand by the exploration of effects agriculture has on the economies of the most vulnerable countries (i.e. their growth rate volatilities).

[46] Overview of development taxonomy which is provided in appendix A.1 is based on Nielsen's (2011) overview of the classification systems used by International Monetary Fund, United Nations Development Programme, and The World Bank. In all my research I use The World Bank taxonomy, using sub-groups 2 (upper-middle income), 3 (lower-middle income), and 4 (low-income) as a group of developing economies.

Figure 16: Global map of investment by target country
Source: Land Matrix (2017); http://www.landmatrix.org/en/get-the-idea/global-map-investments/

For the empirical examination the final list of 64 countries as well as time span from 1971 – 2010 was determined by data availability as well as by the fact that in order to understand “pure” effects of agriculture on growth rate volatility the data should not be “contaminated” by “distorting”[47] effects of LSLAs. Although LSLAs have been happening prior to 2010, their scale really increased after the global financial crisis in late 2000s.

Data on crops’ production and export is collected from Food and Agricultural Organisation of the United Nations (FAO) database[48], data on growth rate was extracted from United Nations Conference on Trade and Development (UNCTAD)[49] database, data on primary school attendance comes from United Nations Educational, Scientific, and Cultural Organization (UNESCO)[50], data on openness to trade is extracted from The World Bank (WB) and Organisation for Economic Co-operation and Development (OECD) national accounts data files[51], data on democracy comes from The Center for Systemic Peace (CSP)[52], data on armed conflict comes from Uppsala University and Peace

[47] In this case “distorting” effects include negative externalities associated with FDIs, i.e.: deteriorated balance of payments, monopolised domestic food markets, crowding out of local competitions, export driven investment, market concentration, etc.
[48] FAO statistical database is called FAOSTAT; available at: http://www.fao.org/faostat/en/#home
[49] UNCTAD statistical database is called UNCTADSTAT; available at: http://unctadstat.unctad.org/EN/
[50] UNESCO statistical dataset is called UIS.Stat; available at: http://data.uis.unesco.org/
[51] WB and OECD national accounts data is compiled in World Bank DataBank under World Development Indicators; available at: http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators
[52] As being part of CSP, The Integrated Network for Societal Conflict Research coordinates and integrates information resources produced by CSP; see CSP/about at

Research Institute Oslo (UCDP/PRIO)[53], and data on exchange rates comes from The Center for International Data (CID)[54].

4.2.2.2 Dependent variable

Cariolle (2012) compared the results of different methods used to calculate macroeconomic volatility. There are two main groups of volatility indicators: those which measure the variability of a series, and those which measure economic uncertainty (unpredictable parts of variation)[55]. His extensive literature review resulted in no less than ten different measures of macroeconomic volatility (see table A.1 in his paper) roughly divided into three groups based on the process of obtaining the reference value.

In the first group researchers base their indicator on variance of first-difference series, the second is based on the variance of the residual while in the last group researchers establish their indicator on the variance of the cyclical component identified by applying statistical filter (*i.e.* to obtain the reference value). He tested four different methods[56] to calculate macroeconomic volatility of export revenue for 134 countries from 1970 to 2005. Although he observes similar results for all methods when analysing average magnitude distribution (usually second moment *i.e.* standard deviation) around some reference line, he noticed divergent results in two higher moments: extreme deviations (kurtosis[57]) and asymmetrical distributions (skewness[58]).

I use standard deviation of the cyclical component of GDP per capita growth rate as dependent variable. I calculate the variable by deconstructing the actual value of GDP per capita growth rate into two components; namely trend part and the residual part or

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http://www.systemicpeace.org/mission.html. Polity IV: Regime authority characteristics and transitions datasets codes authority characteristics of states in the world system; available at: http://www.systemicpeace.org/inscrdata.html

[53] UCDP/PRIO Armed Conflict Dataset; available at http://ucdp.uu.se/downloads/

[54] CID which collects, enhances, creates, and disseminates international economic data publishes Penn World Tables; see CID/about at http://cid.econ.ucdavis.edu/index.html

[55] Such models (*e.g.* GARCH) are most often applied to high frequency data series (*e.g.* daily) and are not often used in macroeconomic research which usually employs annual data and are therefore excluded from his research (Cariolle, 2012).

[56] Global mixed trend, rolling mixed trend, and two methods using Hodrick-Prescott filter, one with the value of smoothing parameter 6.5 and the other with a value of 100

[57] High kurtosis values are regarded as a risk in finance however because of multiple plausible explanations it should be used with caution when interpreting the results of volatility (Cariolle, 2012).

[58] Skewness presents economies' profile of macroeconomic volatility. Volatility with positive (negative) skewness points to experiences dominated by positive (negative) shocks.

cyclical component (Hyeongwoo, 2004). To decompose the actual value of GDP per capita growth rate I use Hodrick-Prescott filter (1980; 1997) which is often used in macroeconomic studies; see *e.g.* Becker and Mauro (2006), Klomp and de Haan (2009), Afonso and Furceri (2008), *etc.* By applying multiplier (or smoothing parameter), λ, Hodrick-Prescott filter (from now on HP) splits raw data into cyclical and trend components at time t. Modification of the multiplier changes sensitivity of decomposition. In this respect I follow the recommendation of Ravn and Uhlig (2002) who argue that the value of smoothing parameter should vary by the fourth power of the frequency observation ratio and use value of 6.25 for annual data; see also de Jong and Sakarya (2016). Resulting smooth curve is a representation of time series (trend line) which is more sensitive to long-term than short-term fluctuations. The difference between the trend line and actual value represents a cyclical component.

Let Y_t be the value of GDP per capita growth rate at time t. Application of Hodrick-Prescott filter splits this value into trend and cyclical component.

$$Y_t = Y_{Trend,t} + y_t \tag{1}$$

Where $Y_{Trend,t}$ represents trend part, and y_t cyclical part of Y_t.

The variance of the cyclical component is defined as:

$$VAR(y_t) = \sigma_{y,t} = y_{i,t} - \bar{y}_T \tag{2}$$

Where $VAR(y_t)$ represents variance of the cyclical component, y_t, at time t, and $\bar{y}_T$ the mean of cyclical component of the time series from t = 0 to T.

Standard deviation at time t which in my analysis is a measure of growth rate volatility, $SD(y_t)$, is a square root of $VAR(y_t)$:

$$SD(y_t) = \sqrt{VAR(y_t)} \tag{3}$$

4.2.2.3 Control variables

Most of the times, analyses have to consider other effects which might have an impact on the dependent variable and to control them in order to determine whether any of the explanatory variables are significant. Selection of these control variables must be based on previous scientific work and the model a scientist uses.

Based on literature review I included six control variables that have been shown to have significant effect on growth rate volatility; log of GDP per capita, political system, openness, primary school enrolment, inflation, share of agriculture in GDP, and war.

GDP per capita

Some basic characteristics influence country's response to shocks. Most commonly used proxies are the population size and the GDP per capita. Tamirisa (1999), Wolf (2004), Mobarak (2005), and many others showed that GDP per capita is significant most of the time. In my research I use log of GDP per capita as control variable and expect that countries with higher level of GDP per capita exhibit lower GDP per capita growth rate volatility.

Democracy

Many authors argue that institutions play crucial role in long-term economic development; see *e.g.* Acemoglu, *et al.* (2001), Dollar and Kraay (2003), Easterly and Levine (2003), *etc.* My data on this variable comes from Polity IV dataset (The Center for Systemic Peace, 2016). For the purpose of this analysis I employ adapted Polity2 score which combines autocracy and democracy score as a proxy for institutions.

The idea of democracy is based on three elements: i) institutions and procedures that enable citizens to choose preferred policies and political options, ii) institutionalised constraints of the executive government, and iii) guarantee of civil liberties to all citizens. Polity2 data ranges from -10 (fully autocratic) to +10 (fully democratic). Using original Polity 2 from the database would reduce my dataset because some countries are missing scores for early years of the analysis time range. For that reason I adapted the Polity2 score and transformed it into a dummy variable where 0 denotes autocratic political system (all values that have Polity2 values of less than 0) and 1 democratic (all values that have Polity2 values of 0 or more). For the missing data I refer to Papaioannou and Siourounis (2008) paper that covers a period from 1960 to 2003 and in which authors provide information on the actual year of democratisation. Based on previous research I expect democracy to reduce GDP per capita growth rate volatility.

Openness to trade

Easterly, *et al.* (2000) show that openness to trade; represented as ((Import + Export)/GDP), exposes the economy to external shocks however at the same time it insulates it from internal ones. Bejan (2006) showed that increased openness increases output volatility while Di Giovanni and Levchenko (2006) showed that trade a) increases sector risks, b) decreases its correlation with the rest of the economy, and c) increases specialisation. Combined, they showed that openness increases volatility. Based on the literature review I expect positive sign for this control variable which means that with increased openness, GDP per capita growth rate volatility increases.

Primary school enrolment

Primary school enrolment is a measure of human capital. The measure has been found to be significant; see *e.g.* Sala-i-Martin (1997), Fernandez, *et al.*, (2001), and to reduce output volatility; see e.g. Mujahid and Alam (2018). I expect negative value of the corresponding coefficient meaning that increased primary school enrolment should decrease growth rate volatility .

Inflation

I use inflation as a measure of shocks and expect it to have a positive sign, *i.e.* higher inflation should increase GDP per capita growth rate volatility. The measure is often used in growth rate volatility literature and is found significant; see *e.g.* Judson and Orphanides (1999), Mobarak (2005).

Share of agriculture

Share of agriculture in GDP is often used as a measure of economic development; see *e.g.* Bugamelli and Paterno (2008), meaning that higher share of agriculture in GDP indicates lower level of development. Combined with the results of many researchers who found that less developed countries experience higher GDP per capita growth rate volatilities than more developed ones; see *e.g.* Nelson and Plosser (1982), Lucas (1988), Easterly, *et al.* (2000), *etc.* I expect positive sign of the regression coefficient of the share of agriculture in GDP meaning that higher share of agriculture in GDP should increase GDP per capita growth rate volatility.

War

Among others Sala-i-Martin (1997) showed that war decreases growth; see also *e.g.* Blattman and Miguel (2010), Collier (1999), *etc.* My measure of war follows UCDP/PRIO (Gleditsch, et al., 2002; Temner & Wallensteen, 2013) methodology and can have values 0 for peace, 1 for minor conflict (between 25 and 999 battle-related deaths in a given year), and 2 for major conflict (at least 1000 battle-related deaths in a given year). I expect to see higher GDP per capita growth rate volatility with higher values of war variable (*i.e.* coefficient should have positive sign).

4.2.2.4 Explanatory variables

Based on my research questions stated above I use five different groups of explanatory variables[59] in chapter four whose influence on GDP growth volatility I want to explore.

Below is a list of variables used in chapter four. They follow research questions associated with the chapter. However, because it is reasonable to expect effects of crops' exports on growth rate volatility, I decided to also run analyses where I include interaction terms between openness and my explanatory variables. The inclusion of interaction terms will give an indication of whether crops exports might play an important role in growth rate volatility and therefore strengthen rationale for my second exploratory chapter (chapter five in this thesis).

Plantation and non-plantation crops

When examining the first question in chapter three (*i.e.* whether plantation crops and non-plantation crops influence growth volatility differently) I divide agricultural crops into two groups: plantation crops and non-plantation crops, and then calculate their share in GDP. Tiffen and Mortimore (1990) define plantation crops as tropical or sub-tropical crops with an export market that in most cases require some sort of processing, and generate some activity most of the year. Usually they are mono-cropping (permitting production standardisations) and require large investments at the beginning. Table A4.5 in the appendix provides list of plantation crops used in this analysis.

Isham, *et al.* (2005) showed that export of certain (plantation crops) decreases long-term growth. However, this chapter of my thesis explores production of plantation crops and not their exports. Since plantation crops usually constitute the basis of a diet (i.e.

[59] Tables A4.6 and A4.20 in the appendix present crop groups for chapters four and five

they represent large share in a diet – rice, wheat, etc.) governments often control their market prices. This on one hand introduces some kind of safety net for the most vulnerable parts of the population, and on the other hand reduces price volatility of this crop group. Based on this logic I expect to see negative effect of plantation crops (i.e. decreased value plantation crops variable will increase growth rate volatility). On the other hand the effects of non-plantation crops and ratio[60] between non-plantation and plantation crops have not been explored before. I can therefore make only informed speculation on their effects on growth rate volatility. In this respect I would speculate that non-plantation crops have positive effect on growth rate volatility since i) their prices are not controlled (this should have positive effect on volatility), ii) are grown by smallholders (small scale, increased costs – positive effect on volatility), iii) faces increased competition between producers (negative effect on volatility). Evaluating the effect of the ratio variable between non-plantation and plantation crops is even more complicated since it depends on the effects each of the variable constituents has on growth rate volatility. The effect is a combination of effects of crops' exports, crops' self-consumption, its relative size compared to the other group, etc. and is harder to judge. However as the effect of plantation crops on growth rate volatility is muted (i.e. the control prices lag the market price) whereas that of non-plantation crops is the actual price I would speculate that the ratio variable should have similar effect as non-plantation crops i.e. positive.

Perishable and non-perishable agricultural products

For my second question (*i.e.* whether perishable and non-perishable crops influence growth rate volatility differently) I split my data into perishable and non-perishable crops and calculate their share in GDP. The division is based on Food and Agriculture Organization of the United Nations (2011, p. 357) which states that fruits and vegetables (excluding apples and potatoes) are perishable crops. All other agricultural products form a non-perishable group. As I argue above, perishable crops' specifics require their immediate placement on the market (unless processed) whereas non-perishable crops

[60] A ratio variable calculates the relationship between non-plantation and plantation crops. In a way it is a diversification measure however it brings additional information to the research. We can say that when the two variables are equal their production is well diversified however ratio's deviation from this value (i.e. when their relative shares differ) indicates lowered diversification. In addition to this, direction in which ratio moves provides information which of the two variables is larger and which is smaller. For example when the value of the ratio increases, share of non-plantation crops rises relative to that of plantation crops (and *vice versa*).

can be stored for later sales. What this implies is that at any given time, consumers can find produce that is the cheapest at that particular moment (i.e. when producers place bananas on the market at the time of harvest their price will be lower than when they are placed off season however at that time other fruits would be ripe and ready for placement, and consumers would buy the cheapest alternative). Although price of a first produce might be volatile, overall food prices would not. Similar reasoning can be applied to non-perishable crops however in their case there is reduced option of alternatives since their number is smaller (in all food crops, 26 are perishable and 36 are non-perishable however that numbers include oil crops, spices, nuts, etc. On the other hand, when counting cereals, vegetables, and fruits there are 24 perishable ones and only 14 non-perishable ones). Because of these reasons I estimate that prices of perishable crops should be less volatile than those of non-perishable ones and that their effect on growth rate volatility should be positive (i.e. their increased share should decrease growth rate volatility). Although I estimate that non-perishable food crops should also have negative sign their influence on growth rate volatility should be smaller than that of perishable crops. The ratio between non-perishable and perishable crops is again harder to judge and is based on the diet and other factors. I would argue that higher value of the ratio (*i.e.* higher share of non-perishable crops in GDP relative to that of perishable crops) should have less decreasing effect on growth rate volatility.

Food and non-food agricultural products

The third question is analysing whether food crops are influencing growth rate volatility differently than non-food crops. For the purpose of this analysis I split my data into food crops and non-food crops and calculate respective share in GDP. It is harder to judge the estimated effects of food crops' production because it is a mix of the groups outlined above. Food crops include both plantation and non-plantation crops as well as perishable and non-perishable crops. Their effect is therefore again dependent on a variety of factors (their share in a diet, their controlled prices, etc.). However, arguing that consumers base their purchases on the lowest price (providing that the nutritional intakes remain more or less stable) I would argue that food crops contribute negatively to growth rate volatility (i.e. their increased value reduces growth rate volatility). On the other hand non-food crops are mostly used in industry, are often plantation crops (positive effect), are often subject to futures contracts (negative effect), are often exported (positive effect), etc. I would argue that their influence is positive meaning growth rate volatility increases with its increased share. The value of the ratio variable between non-food and food crops again depends on variety of factors however based on the influences of each of the factors I would argue that increased share of non-food crops in GDP relative to that of food crops increases growth rate volatility.

Crop groups – production

The fourth question analyses whether different crop groups influence growth rate volatility differently. In this case I split data into twelve different food groups: cereals; vegetables; fruits; nuts; coffee, cocoa, and tea; spices, other food crops; fibres; oil crops; rubber; tobacco; and other non-food crops. I again calculate individual's share in GDP (see footnote 59). Their influence (apart from some groups – coffee, cocoa, tea; rubber; tobacco – see Isham, *et al.* (2005)) has not been explored before. Estimation of each groups' influence can be based on the share of groups outlined above. From that perspective groups that yield negative effects (i.e. their increased share reduces growth rate volatility) could be cereals, vegetables, and fruits whereas other groups should increase growth rate volatility.

Diversification

My final question tries to determine whether higher diversifications in agricultural products and different product groups lead to lower growth rate volatilities. To test that I introduce Herfindahl-Hirschman Index (1950), which is the most widely used index for calculating concentration variables.

Herfindahl-Hirschman Index

To calculate Herfindahl-Hirschman index (from now on "HH index" refers to "Herfindahl-Hirschman index"), let *n* be the number of products, s_k be the share of product *k* in aggregate value of production in a country, and x_k the production value of product *k*.

HH index is then calculated as:

$$H = \sum_{k=1}^{n} (s_k)^2 \quad (4)$$

$$s_k = \frac{x_k}{\sum_{k=1}^{n} x_k} \quad (5)$$

HH index ranges from 1/*n* to 1. Lower value of index denotes lower concentration (or higher diversification).

Because higher value of the index indicates higher concentration, positive value of the regression coefficient would mean growth rate volatility is increasing with higher level of concentration whereas negative sign would suggest decreasing growth rate volatility with higher level of concentration. The results of such variable would therefore require the reader to switch perception of the meaning of positive and negative sign of coefficients when comparing different parts of this analysis[61]. Another reason why I find this troublesome is that I am talking about something being “more diversified” and not “more concentrated”. For that reason I decided to multiply my index values by -1 (I designated resulting values as “inverted”). The inverted values therefore run from -1.0 (perfect concentration) to -1/*n* (perfect diversification). Negative value of the analysis would therefore indicate that the growth rate volatility decreases with higher levels of diversification whereas positive value would indicate that growth rate volatility increases with higher level of diversification. Based on works of many scientists; see *e.g.* Bejan (2006), Di Giovanni and Levchenko (2006), Bacchetta, *et al.* (2007), Hesse (2008), Haddad, *et al.*, (2010), Caselli, *et al.*, (2015), *etc.* I would speculate that increased diversification in every one of this diversification measures should decrease growth rate volatility.

Interactions

Although I am looking at the effects of crop production structure on growth rate volatility, exports of crops may still influence the results. For that reason I decided to run additional analyses with interaction terms between openness and each of my explanatory variables as additional variables.

The procedure to produce interaction term includes two steps. In the first step I centred variables by subtracting the mean score from each data point for every variable used in interaction terms. Centring variables increases interpretability of interaction term (Aiken, et al., 1991; McClelland & Judd, 1993) as well as eliminates possible multicollinearity problems. In the next step I create interaction terms by multiplying pairs of corresponding centred variables.

[61] That is because I am discussing differentiation and not concentration.

Following is a conceptual form of a two variable regression equation with the addition of interaction term.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 (X_1 * X_2) \quad (6)$$

The effect of X_1on Y is:

$$(\beta_1 + \beta_3 X_2) * X_1 \quad (7)$$

The effect of X_2 on Y is:

$$(\beta_2 + \beta_3 X_1) * X_2 \quad (8)$$

Therefore equation 7 tells us that the value of the coefficient of X_1on Y is a function of the value of X_2. Similarly equation 8 tells us that the value of the coefficient of X_2 on Y is a function of the value of X_1. As an example, if sign of the coefficients β_1 and β_3 are both positive than the effect of X_1 on Y will increase as X_2 gets larger. On the other hand if β_1 is positive and β_3 is negative, the effect of X_1 on Y will decrease as X_2 gets larger.

4.2.3 Methodology and methods

4.2.3.1 Methodology

Chapter four requires econometric analysis to estimate if and what kind of effects crops' production structure has on growth rate volatility.

4.2.3.2 Methods

This part of thesis will describe and defend the choice of method used in my econometric analysis.

4.2.3.2.1 Panel data

Panel data (also known as longitudinal data) is a multidimensional data that consists of numerous phenomena collected from number of observational units over time. In this analysis I collected a large number of variables (phenomena) for 64 different countries (units) from 1971 until 2010 (time range). The dataset is balanced.

For a panel dataset with *i* individual units ($i = 1, \dots, N$) with K observed phenomena (control and explanatory variables) over time range, $t = 1, \dots, T$) a general panel data model takes the following form:

$$y_{it} = \beta_0 + \beta \boldsymbol{X}'_{it} + \varepsilon_{it} \qquad (9)$$

Where y_{it} is dependent variable under investigation, $\beta_0$is the intercept which is independent of *I* and *t*, the slope, β which is a (K x 1) vector which is also independent of *i* and *t*, $\boldsymbol{X}_{it}$ is a $\sum_i T_i x K$matrix of individual phenomena, and ε_{it} is the error term which varies over *i* and *t*.

In rough terms we could divide panel data models into two groups: i) static panel data models, and ii) dynamic panel data models in which lagged values of dependent variable are included as regressor. This procedure violates strict exogeneity requirement since it is necessarily correlated with the idiosyncratic error.

Usually researchers employ two mechanisms to overcome unobserved heterogeneity in static panel data models. The first one is through demeaning (or within) transformation and is employed for example in one-way fixed effects models whereas the second approach uses first differences.

However when we use one-way fixed effects model (and also one-way random effects model) in dynamic panel data, demeaning results in correlation between regressor and error. This is so called dynamic panel bias or Nickell bias (Nickell, 1981) which affects estimates of coefficient of lagged dependent variable as well as coefficients of independent variables (if they are correlated with the lagged dependent variable).

4.2.3.2.1.1 Dynamic panel data analysis

A family of models used for dynamic panel data analysis employ first differencing to remove unobserved heterogeneity and include one or more lagged dependent variables which allow for partial adjustment mechanism.

Anderson-Hsiao estimator

In panel data, a simple general model with lagged dependent variable, $y_{i,t-1}$, and only one regressor, $\boldsymbol{X}$, can be written as follows:

$$y_{it} = \beta_1 + \rho y_{i,t-1} + \beta_2 \boldsymbol{X}_{it} + \varepsilon_{it} \tag{10}$$

In dynamic panel data, the error term, ε_{it}, has two components, the individual fixed effect error, u_i, and the idiosyncratic error term, ϵ_{it}.

$$\varepsilon_{it} = u_i + \epsilon_{it} \tag{11}$$

The equation can then be written as:

$$y_{it} = \beta_1 + \rho y_{i,t-1} + \beta_2 \boldsymbol{X}_{it} + u_i + \epsilon_{it} \tag{12}$$

By taking first differences of the original model we remove both constant term and individual effect:

$$\Delta y_{it} = \rho \Delta y_{i,t-1} + \beta_2 \Delta \boldsymbol{X}_{it} + \Delta \epsilon_{it} \tag{13}$$

Correlation still exists between the differenced lagged dependent variable which contains $y_{i,t-1}$ and the disturbance process (*i.e.* first order moving average process; MA(1)) which contains $\epsilon_{i,t-1}$ however by removing individual fixed effects, u_i, we can construct instrumental variables[62] for the lagged dependent variable from its lags of higher order (second, third, *etc.*). Although those lagged dependent variables of higher order will be highly correlated with the lagged dependent variable $y_{i,t-1}$ they will be

[62] Instrumental variables must be: i) correlated with the explanatory variables in the model, and ii) uncorrelated with the disturbances. A proper instrument should cause changes in the explanatory variable but should have no independent effect on the dependent variable.

uncorrelated with the composite error process of ϵ if ϵ is independent and identically distributed.

Anderson and Hsiao (1982) implemented this strategy to obtain so called Anderson-Hsiao (or AH) estimator. However AH estimator is asymptotically inefficient since asymptotic variance is large. It is also argued that although AH estimator results in consistent estimates they are not efficient because AH estimator doesn't use all of the potential orthogonality conditions; see Arellano and Bond (1991).

Arellano-Bond estimator

The Arellano and Bond (1991)[63] approach is two-step. In its first step the estimation method uses first difference of the regression equation to eliminate the fixed effects whereas the second step utilises higher order lags of dependent variable as instruments for differenced lags of dependent variable. Such approach is known as Arellano-Bond (or AB) estimator and is a generalised method of moments (or GMM) estimator. When using GMM estimator we can construct more efficient estimates of the dynamic panel data model than with AH estimator with smaller asymptotic variance. The method uses both lagged values of the instrumented variable(s) (*i.e.* internal instruments) as well as external instrumental variables. The general equation can be written as:

$$y_{it} = \beta_1 \boldsymbol{X}_{it} + \beta_2 \boldsymbol{W}_{it} + u_i + \epsilon_{it} \tag{14}$$

Where $\boldsymbol{X}_{it}$ includes exogenous independent variables, $\boldsymbol{W}_{it}$ are predetermined regressors including lags of dependent variable as well as endogenous regressor and which may be correlated with unobserved individual (fixed) effects, u_i. The unobserved individual effects (and therefore omitted variables) are then removed from the model through first-differencing the equation. GMM method is appropriate for analyses of problems where there might be unobserved heterogeneity as well as when there is within unit (but not across unit) heteroscedasticity and autocorrelation.

The GMM estimator constructs an equation for each time period from available instruments which means that there are additional lagged values of the instruments available in later time periods. In contrast to AH estimator which loses a time period

[63] Statistical method that included sets of instruments and use of GMM was first developed by Holtz-Eakin, Newey, and Rosen (1988)

used for first-difference transformation[64] (thus reducing the number of equations) GMM constructs a set of instruments from the second lag of dependent variable and at the same time includes zero for any missing value (*i.e.* values used for fist difference step). Through the inclusion of zeros, the method retains degrees of freedom. This approach results in the inclusion of all available lags as instruments, *i.e.* second and all higher lags for endogenous variables and first and all higher lags for variables that are not strictly exogenous. When the instrument matrix is constructed in this way (as was put forward in the notion above that there are additional lagged values of the instruments available in later time periods) we end up with additional orthogonality conditions which leads to improved efficiency of the GMM estimator.

However later theoretical work by Arellano and Bover (1995) and Blundell and Bond (1988) showed that lagged levels are sometimes poor instruments for first differenced variables (the problem occurs when a process, y_{it} is very close to random walk since its lagged variables become weak instruments and do not provide a lot of information about later changes). Out of this shortcoming they developed an estimator that in addition to lagged levels also includes lagged differences. The original estimator is usually dubbed Difference GMM whereas the evolved estimator is called System GMM.

Whereas difference GMM eliminates fixed effects by transforming the regressor, system GMM transforms (*i.e.* differences) the instruments and thus makes them exogenous to the fixed effects (this is appropriate when changes in instruments are uncorrelated with the fixed effects). To put it differently, difference GMM differences instruments with levels whereas system GMM instruments levels with differences (*e.g.* changes in lagged values may predict current values better than lagged values can predict current changes). Difference GMM is not efficient under mean non-stationarity whereas system GMM is efficient under the sufficient condition of mean stationarity. The violation of mean stationarity condition can be detected by Sargan-Hansen test of overidentifying restrictions; see Sargan (1958) and Hansen (1982).

[64] If data requires more differencing we lose additional time period(s)

4.2.3.2.2 Pre-tests

Before I can determine which method to use in my econometric analyses I have to do some pre-analysis tests on my variables. Among other these tests include unit root test, autocorrelation tests, multicollinearity, *etc.*

Unit root test

A unit root test tests whether a time series has unit root (in other words is non-stationary). A unit root, which is a stochastic trend in a time series, is a feature that causes time series to behave unpredictably. In such cases a shock to a unit root process will result in a permanent effect which will not return to the mean (*i.e.* the effect would not decay).

The most common tests are Dickey-Fuller test (or DF test), Phillips-Perron test (or PP test), KPSS test, *etc.* Dickey-Fuller is probably the most widely used test for autoregressive (AR) processes, however inclusion or omission of trend and/or intercept of the variable tested can lead to its reduced power. In order to obtain proper results of the unit root test trend has to be identified and removed (*i.e.* data has to be de-trended) usually through first differencing (for time series) or time-trend regression (for trend stationary time series); see *e.g.* Zivot and Wang (2003). When the knowledge of trend and intercept are unavailable, scientists devised different testing strategies; see *e.g.* Dolado, Jenkinson, and Sosvilla-Rivero (1990), Elder and Kennedy (2001), Enders (2014), Hacker and Hatemi-J (2010), *etc.* Hacker (2010) found that information criterion (*e.g.* Schwarz information criterion) may be used in determining unit root and trend status. Since many time series are more dynamically complicated, AR(1) model (*i.e.* autoregressive model of order 1) might not suffice. For that reason Said and Dickey (1984) proposed augmented Dickey-Fuller test (or ADF test). ADF test augments the basic AR(1) unit root test by applying general ARMA(*p, q*) models (*i.e.* autoregressive (AR) model of order *p* and moving-average (MA) model of order *q*) with unknown orders. Additional complication comes when the stochastic part of the time series is close to 1. In such circumstances model estimation of the deterministic part will be problematic because time series will be close to nonstationary. Elliott, Rothenberg, and Stock (1996) developed a modified ADF test (usually called ADF-GLS test or ERS test) which locally differences the time series.

Due to the nature of my data (*i.e.* panel data) I have to apply panel unit root test to determine whether my variables are non-stationary. The difference between panel unit root test and time series unit root test (from which the panel unit root testing evolved) is that in panel unit root test one has to consider asymptotic behaviours of both time dimension as well as cross-sectional dimension.

In general there are two approaches to the panel data unit root test depending on the criteria used to determine stationarity of the panel data series. The first category imposes strict rule on unit root test results. Its null hypothesis (H0) states that each time series in the data contains unit root whereas alternative hypothesis (H1) states that each time series is stationary. Levin-Lin-Chu (LLC) test (Levin, et al., 2002) is a representative of this category. The test has two disadvantages: a) assumes cross-sectional independence, and b) does not allow cases where some individuals are stationary and others are not.

Im-Pesaran-Shin test (Im, et al., 2003) falls in the second category of tests which is not as restrictive as the LLC test and allows for heterogeneous coefficients. In this category the null hypothesis (H0) requires all individuals to have unit root whereas the alternative hypothesis (H1) allows for some (but not all) of the individuals to have unit roots.

Fisher type tests is a meta-analysis of individual unit root tests which combines p-values to arrive at the combined test statistics. Choi (2001) proposed four methods to combine individual p-values: inverse chi-square transformation, inverse-normal transformation, inverse-logit transformation, and modified inverse chi-square transformation (suitable for datasets where N tends to infinity). In Fisher type tests the null hypothesis (H0) requires that all panels contain unit root.

ADF panel unit root test provides Im-Pesaran-Shin t value whereas both ADF and ADF-GLS panel data unit root tests provide Choi meta-tests: inverse chi-square, inverse normal test, and logit test. Levin-Lin-Chu test provides Levin-Lin-Chu z-score. Choi (2001) simulations indicate the inverse normal Z statistic provides the best balance between size and power.

Table A4.7 in the appendix provides results of unit root tests for all my variables used in this chapter. The first thing to notice is that none of the variables in my dataset has unit root. However, when ADF and ADF-GLS were not able to run the analysis (they treated some variables, especially crop groups as constant) I could only obtain results for LLC test. Another thing is that because LLC has very strict criteria in regard to null and alternative hypotheses some results of LLC test are either not significant or are significant at 5% or 10% (however ADF and ADF-GLS results were always significant).

Multicollinearity

When one independent variable in a regression model can be more or less accurately predicted by other independent variables we talk about multicollinearity. Although multicollinearity does not reduce the predictive power or reliability of the model it affects regression results of individual variables. This happens because effects of individual explanatory variable are estimated while holding the effects of all other explanatory variables constant (and thus disregarding any collective variance between variables). "No multicollinearity" assumption in regression analysis usually means the absence of perfect multicollinearity (*i.e.* correlation between two independent variables is equal to 1 or -1). In real examples perfect multicollinearity is very rare. However, even lesser levels of multicollinearity between variables may lead to unreliable regression analysis results.

To test for multicollinearity researchers sometimes use correlation matrix between independent variables to get indications of potential multicollinearity. Values of 0.4 and more between off-diagonal elements of such correlation matrix are sometimes interpreted as indications of multicollinearity between corresponding variables. However, this procedure can only be used as an indication since the correlation matrix only produces bivariate relationship whereas collinearity is a multivariate phenomenon. Table A4.8 in the appendix provides correlation matrix for my independent variables. Some of the pairwise correlation values are high indicating that two variables are correlated to a high degree. However as this test only indicates possible multicollinearity problems additional tests are needed to determine whether multicollinearity really exists.

To overcome the limitation of the correlation matrix (*i.e.* bivariate relationship) researchers use variance inflation factor (VIF). VIF is a ratio of variance in a multi variable model divided by the variance of a one variable model. VIF returns a value which estimates how much of the variance of a regression coefficient is influenced by the multicollinearity (in other words how "inflated" the variance of the coefficient is when compared to the variance if the coefficient is uncorrelated to any other variable in the model; see Allison (1999, pp. 48 - 50)).

VIF equation is written as:

$$VIF = \frac{1}{1-R_i^2} \tag{15}$$

Where R_i^2 is the multiple R^2 (or the coefficient of determination *i.e.* the proportion of the variance in the dependent variable that can be explained by the independent variables) for the regression of variable *i* on all other predictors in the model. Since R_i^2 can only range from 0 to 1[65], VIF can only have values larger than (or equal) to 1.

There is no multicolinearity when VIF value equals 1. When VIF value is between 1 and 5 we talk about moderate correlation whereas VIF values of more than 5[66] indicate multicollinearity problems; see *e.g.* Sheather (2009).

Table A4.9 provides VIF values for my explanatory variables while table A4.10 provides information for my explanatory variables and interaction terms (both tables are in the appendix).

Table A4.8 indicates presence of some multicollinearity however VIF test of my independent variables suggests there is no serious multicollinearity present in my dataset (all the values are below 5). Multicollinearity is still not problematic even when interaction terms are included. The only VIF factor with value higher than 5 is VIF for interaction term between openness and vegetables (VIF = 5.062) however as Allison (2012) explains in his blog, there is a good chance to encounter multicollinearity when combining two variables in interaction term. However he suggests that as *p*-value for the interaction term is not affected by the multicollinearity higher values of VIF should not be a cause for concern; see also *e.g.* Friedrich (1982).

The third test for multicollinearity is proposed by Belsley, Kuh, and Welsch (1980) and is based on condition number test. A condition number is computed by dividing square root of the maximum eigenvalue with minimum eigenvalue of the matrix of values of

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[65] There are definitions of coefficient of determination that can yield negative values, *e.g.* when fitting non-linear functions, when linear regression does not include an intercept, *etc.*
[66] Some authors use VIF value of 10 as a cut-off point for problematic multicollinearity; see *e.g.* Kutner, et al. (2004), Stevens (2009), *etc.*

the explanatory variables (so called design matrix). Belsley, *et al.* (1980) suggest that the value of condition number above 10 indicates moderate multicollinearity whereas values above 100 indicate serious multicollinearity. In addition to higher value of condition number multicollinearity is present if two or more of the variables associated with that condition number can explain high proportions of variances. Table A4.11 in the appendix provides results for the Belsley, Kuh, and Welsch test for my explanatory variables while table A4.12 (also in the appendix) provides results for the same test with both explanatory variables and interaction terms. In both tables the three bottom rows have condition numbers higher than 10 (but below 100) indicating moderate multicollinearity, however each condition number has only one expalantory variable with high value of variance proportion whereas variance proportion values for all other explanatory variables are small. Similarly as in the case of VIF test I can conclude that there is no multicollinearity present in my dataset.

Autocorrelation

Autocorrelation (or a serial correlation) of a random process is a correlation of the values of the variable at different points in time. Such correlation can be either a function of two different times or of the time difference. Because of this, autocorrelation poses serious problems in time series analysis since value of the variable at time *t* is correlated with its historical (or past) value(s). Theoretically we speak of autocorrelation when we detect correlation in the error terms. The most common type of autocorrelation is of the first order, *i.e.* when an error is influenced by the previous one. Mathematically such first order autocorrelation relationship is specified in the following way:

$$U_t = \rho U_{t-1} + V_t \tag{16}$$

Where ***U*** refers to the error term of the regression function, ρ is the first order autocorrelation coefficient, and ***V*** is an error term (also called white noise error term) which is supposed to be completely random. When the error term, U_t is a function of only the error term U_{t-1}(*i.e.* one immediate past term) we talk about first order autoregression and denote it AR(1).

The presence of autocorrelation violates the assumption of instance independence. When autocorrelation is present there is information that could be used to explain the dependent variable and models that do not include past value(s) of autocorrelated variable(s) are missing important information(s). In such cases missing information can bias the coefficient estimates of the remaining variables and increase variance of the coefficient estimates.

In two published article Durbin and Watson (1950; 1951) proposed a test of errors for independence (so called Durbin-Watson) and provided significance criteria to test for autocorrelation. Their null hypothesis requires the first order autocorrelation coefficient, ρ = 0 in which case the error terms of the regression function are not autocorrelated whereas for the alternative hypothesis, the first order autocorrelation coefficient is different from zero in which case the error terms of the regression function are autocorrelated.

Because residuals in d statistics equation differ only one observation d can be approximated as:

$$d = 2(1 - \rho) \tag{17}$$

The two extreme cases of ρ values are -1 and 1 which means that d can range from 0 to 4 (*i.e.* when: $\rho = 1$, d = 0; when $\rho = 0$, d = 2; and when $\rho = -1$, d = 4). When combined with upper and lower significance levels calculated by Durbin and Watson (1951) we can determine whether autocorrelation is present. Figure 17 below graphically explains decision rules for Durbin Watson test.

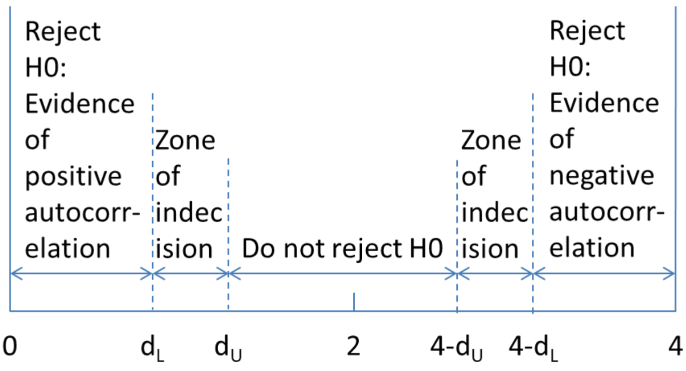

Figure 17: Durbin-Watson test decision rules

Durbin and Watson test was generalised so that it can be used in panel data analysis by Bhargava, *et al.* (1982). The values in their model are dependent on time length of panel data, number of individuals in the panel, and number of regressor.

To test for the presence of autocorrelation in my dataset I ran ordinary least square or OLS panel data regressions as well as panel regressions with fixed and random. F-test for individual effects (F = 5.174, df1 = 63, df2 = 2489, p-value <2.598e-34) indicated that fixed effect model is superior to pooled OLS model. Breusch-Pagan test (LM = 267.301, p-value = 4.398e-60) indicated that random effects model is superior to pooled OLS model. With Hausman test (1978) (H = 41.193, p-value = 7.432e-7) I determined that fixed effect panel data regression gives the best estimates. Panel Durbin Watson test for fixed effect model gives d statistics value of d = 1.383 with p-value < "very small"[67]. The result indicates that alternative hypothesis is correct and that there is serial correlation in idiosyncratic errors.

Heteroscedasticity

Heteroscedasticity refers to a phenomenon where the variance of the residuals depends on the predictor variable. Because of heteroscedasticity, the regression estimates will not have the smallest possible variance (although coefficient estimates will not be biased meaning the relationship between dependent and independent variable will still be correct), the significance tests will be either too high or too low, and standard errors together with corresponding tests statistics and confidence intervals will be biased.

Is heteroscedasticity problematic in my analyses? The answer to this question is based on the autocorrelation test above. Since my data shows autocorrelation I need to conduct dynamic panel data analysis using GMM (generalised method of moments or Arellano-Bond) estimator. GMM uses orthogonality conditions to allow for efficient estimation even when there is unknown heteroscedasticity present[68]; see *e.g.* Arellano (2003)[69], Soto (2009).

4.2.3.2.3 Method used in this analysis

The choice of appropriate method is based on the structure of the data as well as on pre-tests for autocorrelation and heteroscedasticity. Panel data with confirmed autocorrelation means that my panel data is dynamic. The dynamic nature of my panel

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[67] The Imhof integral could not be evaluated so a definite value is not available

[68] Breusch-Pagan test for heteroscedasticity run on the results of a random effects estimator using only lagged dependent variable as explanatory variable returns: Asymptotic test statistics: Chi-square (df = 1) = 82.162 with p-value = less than 0.0001 (null hypothesis is: Variance of the unit-specific error = zero).

[69] See Appendix A to the book. Also available online as class notes at: https://www.cemfi.es/~arellano/gmm-estimation.pdf (last accessed November 2018)

data requires dynamic panel data analysis tools such as Anderson-Hsiao (*i.e.* IV) or Arellano-Bond (*i.e.* GMM) estimator[70].

The decision between Anderson-Hsiao (*i.e.* IV) or Arellano-Bond (*i.e.* GMM) estimator should also be based on heteroscedasticity test. When there is no heteroscedasticity present IV estimator might be preferable because it has better finite sample performance. On the other hand when heteroscedasticity is confirmed then GMM estimator should be used because its results are consistent (even when there is no heteroscedasticity present GMM is asymptotically no worse than IV estimator).

Based on the nature and structure of my data I chose generalised method of moments (*i.e.* Arellano-Bond or GMM) estimator as my analysis method.

4.2.3.2.4 Auxiliary tests

There are three auxiliary test statistics provided when running GMM estimation in Gretl[71] (Cottrell & Lucchetti, 2018): i) two tests for autocorrelation (first- and second-order AR), ii) Sargan test for overidentification, and iii) Wald test for joint significance of the regressor.

Tests for autocorrelation

In the regression model disturbance term (or error term), ε_{it}, has two orthogonal components: the fixed effects, u_i, and the idiosyncratic term, ϵ_{it}. A general model for the disturbance term can be written as:

$$\varepsilon_{it} = u_i + \epsilon_{it} \quad (18)$$

If some lags of dependent variable are autocorrelated with the idiosyncratic disturbance term[72], ϵ_{it}, they would be invalid as instruments. The invalidity of that particular variable would come from the requirement that valid instruments must be orthogonal to (or uncorrelated with) the disturbance's fixed effect part (see footnote 62). Arellano and Bond devised a procedure which tests autocorrelation of lags of dependent

[70] There are of course also other possible methods however maximum likelihood (ML), full information maximum likelihood (FIML), and Feasible GLS all require additional assumptions on initial value of dependent variable (which leads to a problem of interpretation of the model in random-effect methodologies since they are dependent on the assumption of initial observation) whereas least square dummy variable (LSDV) method requires bias correction (Kiviet, 1995)

[71] Gretl is a cross-platform statistical package for econometric analysis

[72] Naturally the full error term, ϵ_{it}, is autocorrelated, however autocorrelation is hopefully "contained" within the individual (or fixed) term, u_i, which is removed by first differencing process in the first step of the estimation.

variable with the idiosyncratic error term, ϵ_{it}. By running test on residuals in differences the procedure checks for first-order serial correlation in levels by analysing second-order correlation in differences. There are two assumptions in the test: i) the regressor must not be correlated with future disturbances (*i.e.* post-determined), and ii) errors are not correlated between units. The null hypothesis of the autocorrelation test is that there is no serial correlation.

The null hypothesis for first-order autocorrelation, AR(1), process in the first difference is usually rejected. This can be expected since the first lag of error term, ϵ_{it-1}, appears in both differences; *i.e.* $\Delta\epsilon_{it} = \epsilon_{it} - \epsilon_{it-1}$ and $\Delta\epsilon_{it-1} = \epsilon_{it-1} - \epsilon_{it-2}$, in other words first-differenced errors are first-order serially correlated. On the other hand a second-order autocorrelation, AR(2), *i.e.* serial correlation in the first-differenced errors at order two, which detects autocorrelation in levels is more important, since its serial correlation would imply that the moment conditions are not valid. Therefore, detecting autocorrelation in AR(1) is not problematic however detecting autocorrelation in AR(2) would suggest that moment conditions used are not valid.

If therefore the autocorrelation test (in Gretl output the test is called Arellano-Bond test AR(x)) shows that AR(2) rejects the null hypothesis, the second lags of endogenous variables are not appropriate instruments

Sargan test

When scientists use IV or GMM estimators they often test if the assumed moments conditions are met since the success of the approach depends on their validity. In other words, the GMM estimation is appropriate when the instruments are exogenous (or to put it differently that there is no correlation between instruments and unobservable error processes). To identify the validity of the instruments Gretl conducts a so called Sargan test of overidentification.

If the equation to be estimated has the same number of instrumental variables as it has explanatory variables (*i.e.* it is exactly identified), it is not possible to verify the validity of instrumental variables. However, when the equation contains more instrumental variables than explanatory variables, we end up with more equations than we have unknowns (*i.e.* coefficients of explanatory variables). In such cases it will not be possible to find coefficients that will set all the sample moment conditions to zero. To overcome this problem GMM uses weighting matrix which minimises the asymptotic variance of the estimator. Sargan test (also known as Hansen-Sargan test) for overidentification evaluates the whole set of overidentifying restrictions. The null hypothesis of the test requires that the overidentifying restrictions are valid (*i.e.* that instruments are valid instruments meaning that they are uncorrelated with the error term, and that the procedure correctly excluded appropriate instruments from the estimation).

Wald test for the joint significance of the regressor

In general Wald test is used for testing the significance of coefficient(s). In general terms it is testing whether coefficient(s) of the independent variable(s) is (are simultaneously) equal to zero[73].

When there is only one variable, x_j, under test, the proposed value of the corresponding coefficient, β_0, is compared to the maximum likelihood estimated coefficient, $\hat{\beta}$. The assumption is that the difference between the two coefficients is approximately normally distributed. The test can be written as:

$$W = \frac{(\hat{\beta}-\beta_0)^2}{var(\hat{\beta})} \tag{19}$$

The result of the test is a chi-square value which is then compared with chi-square distribution[74] from which the associated p-value of that Wald chi-square value can be obtained (to obtain the p-value one must also provide degrees of freedom). If the p-value is less than applied significance criterion the null hypothesis (*i.e.* that the coefficient under analysis equals zero) can be rejected and that that particular variable should be included in the model.

The test can also be used to test joint significance of multiple parameters. In this case the null hypothesis is whether all of the coefficients equal zero (in general if all coefficients equal some value see footnote 73)[75] . Similarly to the previous case, the null hypothesis is rejected when the Wald test exceeds the critical value (*i.e.* when the p value is less than chosen significance level).

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[73] The null hypothesis of the Wald test is *some parameters = some value*. In many cases *some value* equals zero.

[74] The alternative test compares $\hat{\beta}-\beta_0/SE(\hat{\beta})$ to normal distribution ($SE(\hat{\beta})$ is the standard error of the maximum likelihood estimate and can reasonably approximated as: $1/I_n(\hat{\beta})$, where $I_n(\hat{\beta})$ is expected Fisher information).

[75] Joint test is not the same as two separate tests performed on each variable coefficient alone

4.3 Analysis

4.3.1 First look

I start my analysis with some simple regressions of average share of agriculture in GDP (AVAgShGDP) (figure 18a) and average share of crops in GDP (AVShCrGDP) (figure 18b) on growth rate volatility (AVGrVol) which is an average value of my dependent variable[76].

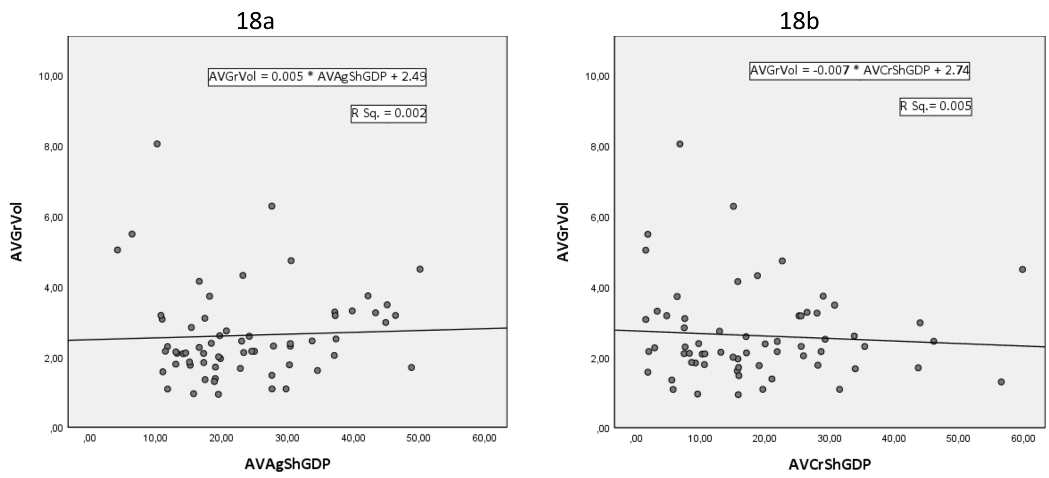

Figure 18: Average shares of agriculture in GDP (AVAgShGDP) – 18a, and crops in GDP (AVCrShGDP) – 18b as a function of average growth rate volatility (AVGrVol) from 1971 to 2010
Source: author’s own calculations

From figure 18a we can observe that increased share of agriculture in GDP decreases growth rate however we should also notice that a) the coefficient values is very small, and b) that the coefficient of determination (*i.e.* R Sq.) is also very small. Figure 18b shows that increased share of crops in GDP also decreases growth rate volatility. The result for agriculture is not in line with scientific literature which established that share of agriculture in GDP declines with increasing development level; see *e.g.* Johnston and Mellor (1961), Stringer and Prabhu (2004), The World Bank (2007), Byerlee, *et al.* (2009), Singariya and Sinha (2015) *etc.* It has also been shown that growth rate volatility is lower in more developed countries; see *e.g.* Nelson and Plosser (1982), Lucas (1988), Imbs (2007). On the other hand and to the best of my knowledge there has been no research done on the influence of share of crops in GDP on either growth or growth rate volatility.

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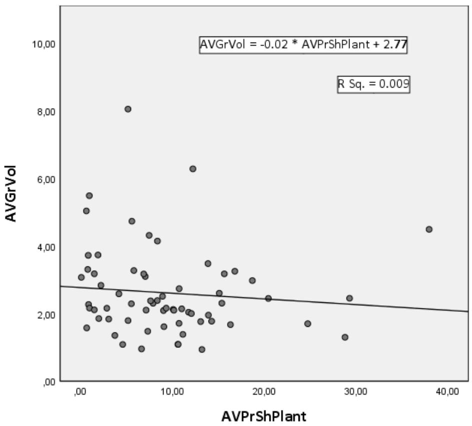
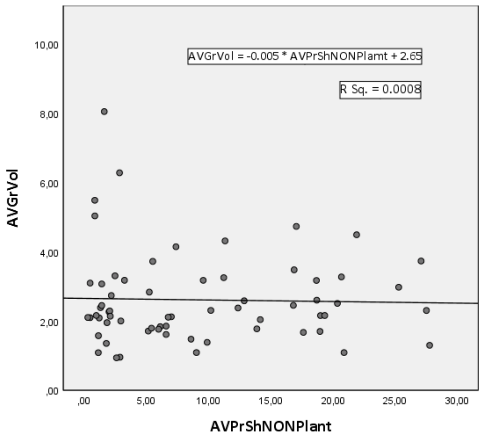
[76] To produce scatter diagrams in this “first look” overview I used IBM SPSS Statistics (IBM Corp., 2017)

Based on the literature, I have therefore expected more volatile growth rates in countries with higher share of agriculture in GDP. Somehow contradictory result in figure 18a can probably be attributed to the use of averages. The result may change when I conduct a more thorough analysis. I should also remind the reader that besides crops, agriculture also includes livestock, fishery, and forestry. Since figure 18b suggests dampening effect of crops on growth rate volatility other three might have positive effect on growth rate volatility, increasing it with their increased share. However, this research will only focus on crops productions and will therefore not answer whether this assumption is correct. I would again like to stress out that in this simple analysis I am only considering averages and detailed analysis further on might change this picture.

19a



19b



19c

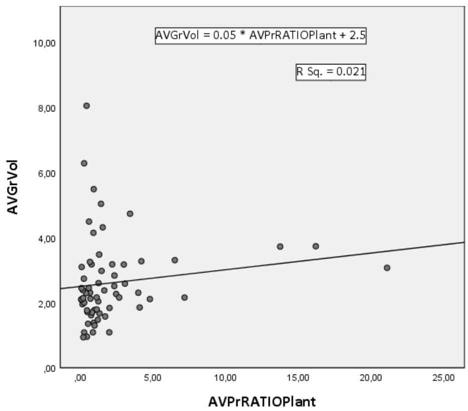


Figure 19: Average shares of production of plantation crops in GDP (AVPrShPlant) – 19a, non-plantation crops in GDP (AVPrShNONPlant) – 19b, and non-plantation to plantation crops ratio (AVPrRATIOPlant) – 19c as a function of average growth rate volatility (AVGrVol) from 1971 to 2010;
Source: author's own calculations

I will now proceed with similar simple regression with averages of my explanatory variables on average growth rate volatility. My explanatory variables fall within the four question stated above, namely different influences on growth rate volatility of plantation and non-plantation crops, of perishable and non-perishable crops, food and non-food crops, as well as the influence of agricultural diversification.

Figure 19 plots average share of plantation crops in GDP (AVShPLANT(p)) (figure 19a), average share of non-plantation crops in GDP (AVShNONPLANT(p)) (figure 19b), and non-plantation to plantation crops ratio (RATIOPLANT(p)) (figure 19c) as a function of average growth rate (AVGrVol; my dependent variable) from 1971 to 2010.

The figures suggest that as the share of plantation crops in GDP as well as the share of non-plantation crops in GDP increase growth rate volatility decreases.

As I argued above, I expect plantation crops to decrease growth rate volatility since they are mostly non-perishable and can therefore be stored for later resale thus stabilising prices. On the other hand the effect of non-plantation crops is harder to envisage. For one, they are mostly perishable and therefore have much shorter shelf life which requires quick resale. Market conditions with plenty of perishable crops available at the same time should push their prices down although there are pre- and post-peak periods when prices could be higher. I can also argue that consumers base their purchases more on best possible price (of food products) and less on what is desirable and available at that particular moment meaning that at any time consumers will seek the cheapest alternative. Figure 19c plots ratio between shares of non-plantation crops and plantation crops on growth rate volatility. The higher the value of the ratio the higher relative share of non-plantation crops in GDP to that of plantation crops. The figure shows that higher ratio (*i.e.* the higher relative share of non-plantation crops) increases growth rate volatility. The figure 19c is in line with figure 19a and figure 19b since we can see that the value of the coefficient for plantation crops is higher than that of non-plantation crops.

Although these figures tell a story that is expected, we should be careful and bear in mind that I am considering averages. A detailed analysis on a full dataset might easily change the picture, especially for the influence of non-plantation crops not least because the explanatory power of the figure 19b is very small (R^2 = RSq = 0.004)

Figure 20 plots average share of perishable crops in GDP (AVShPERISH(p)), average share of non-perishable crops in GDP (AVShNONPERISH(p)), and average value of the ratio between non-perishable to perishable crops in GDP (RATIOPERISH(p)) as a function of average growth rate volatility (AVGrVol) from 1971 to 2010.

Figure 20a indicates that higher share of perishable crops decreases growth rate volatility whereas higher share of non-perishable crops increase it. The result runs contrary to my expectations since I estimated positive effect of perishable crops and negative effect of non-perishable crops on growth rate volatility. The result of this simple analysis suggests otherwise, however a thorough analysis further on might change this result.

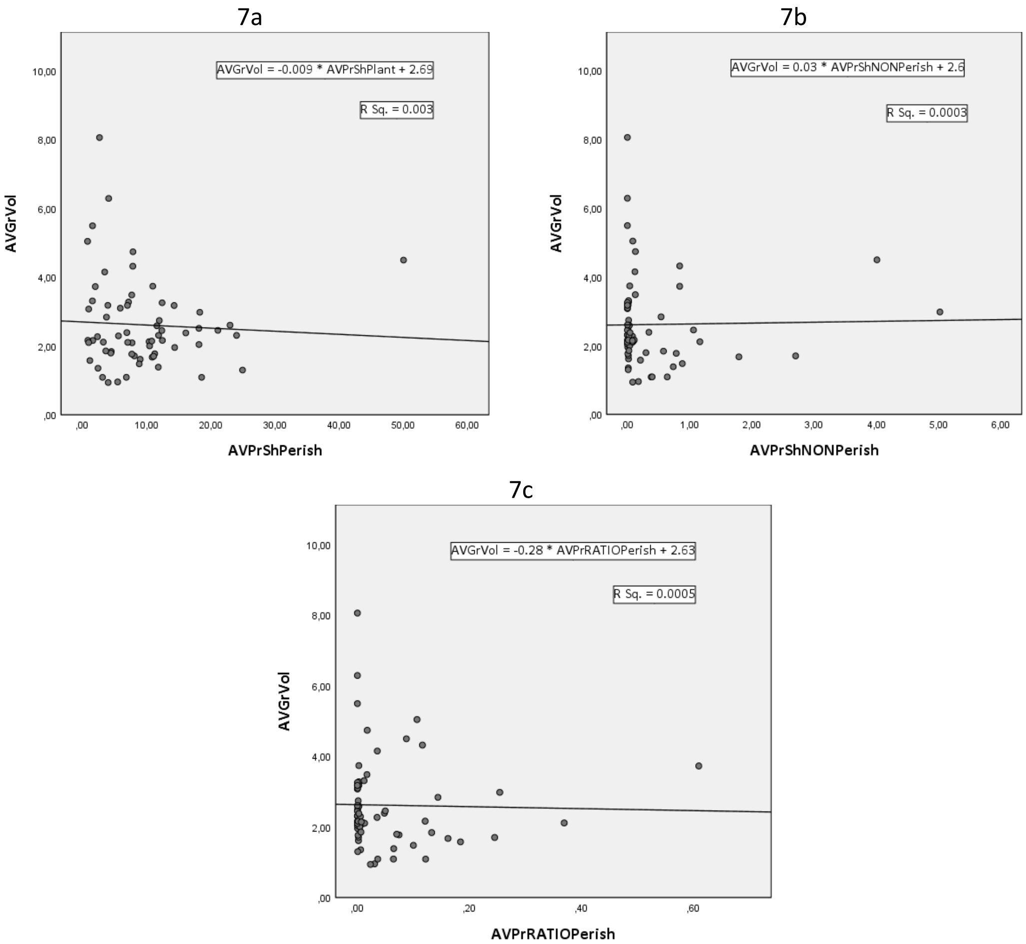
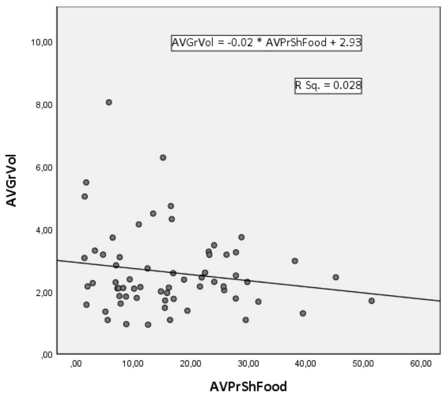


Figure 20: Average shares of production of perishable crops in GDP (AVPrShPerish) – 20a, non-perishable crops in GDP (AVPrShNONPerish) – 20b, and non-perishable to perishable crops production ratio (PrRATIOPerish) – 20c as a function of average standard deviation of GDP per capita growth rate (AVGrVol) from 1971 to 2010
Source: author's own calculations

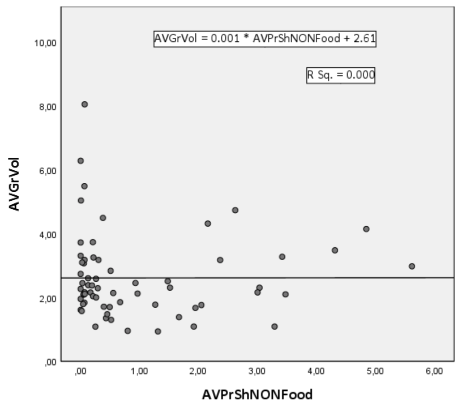
Figure 20c plots the ratio between non-perishable crops and perishable crops. Smaller value of the ratio indicates increasing share of non-perishables relative to perishables. Negative coefficient is in line with results shown in figure 20a and figure 20b. Although one (figure 20a) has negative sign while the other (figure 20b) has positive sign, their coefficients of determination indicate higher explanatory power of figure 20a and thus it stronger influence on the ratio.

The next part shown in figure 21 analyses relationships between average production share of food crops in GDP (AvShFOOD), average production share of non-food crops in GDP (AVShNonFOOD), and average ratio between productions of non-food and food crops (AVRATIOFOOD) and average growth rate volatility (AVGrVol).

21a



21b



21c

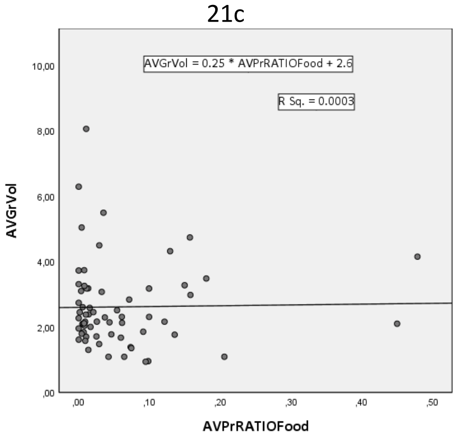


Figure 21: Average shares of production of food crops in GDP (AVPrShFood) – 21a, non-food crops in GDP (AVPrShNonFood) – 21b, and non-food to food crops production ratio (AVPrRATIOFood) – 21c as a function of average growth rate volatility (AVGrVol) from 1970 to 2010
Source: author’s own calculations

Figure 21a shows that growth rate volatility declines with higher share of food crops in GDP and is in line with my expectations.

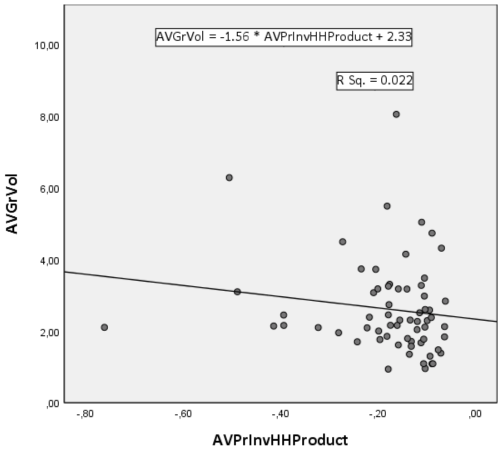
The analysis of non-food crops on growth rate volatility in figure 21b shows different picture. As can be seen average share of non-food crops in GDP has almost zero influence on average growth rate volatility (coefficient for average share of non-food crops in GDP is 0.001 while coefficient of determination is very close to zero). The result is again in line with my expectation.

The last figure below (figure 21c) shows relationship between average ratio of non-food crops to food crops on average growth rate volatility. The figure suggests that higher value of the ratio (*i.e.* either higher share of non-food crops in GDP or lower share of food crops in GDP) increases growth rate volatility. The result is again in line with my expectation.

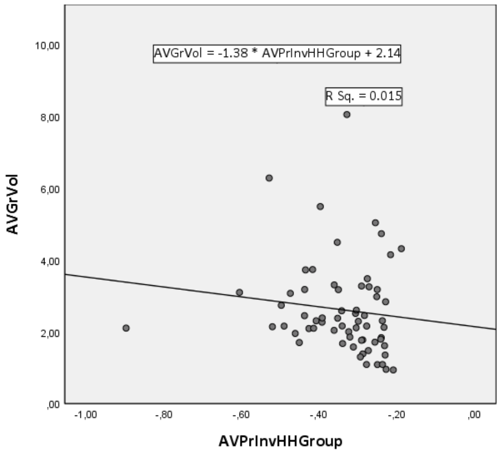
The last part of this quick analysis looks at the influence of agricultural diversification on the growth rate volatility. In figure 22 I plot averages of inverted values of Herfindahl-Hirschman indices as a function of average growth rate volatility for three different groupings; all agricultural products (AVInvHHProduct) , groups of agricultural products (AVInvHHGroup), and two-member food and non-food group (AVInvHHFood).

All three figures of this quick analysis confirm that higher concentration leads to higher growth rate volatility which is in line with the findings of for example: Mobarak (2005), Moore and Walkes (2010), Papageorgiou, *et al.*, (2015). To put it differently growth rate volatility tends to be lower in countries with higher diversification. Figure 22a plots average value of inverted HH index for all products against average growth rate volatility. The figure suggests that countries that on average produce larger collection of different products experience lower growth rate volatility. Similarly figure 22b, which plots average value of inverted HH index for groups of agricultural products against average growth rate volatility, indicates that countries that produce crops from more different groups tend to have lower growth rate volatility. Figure 22c on the other hand plots average diversification between food and non-food crops against average growth rate volatility. The figure indicates that the more balanced production between food and non-food crops is the lower is growth rate volatility.

22a



22b



22c

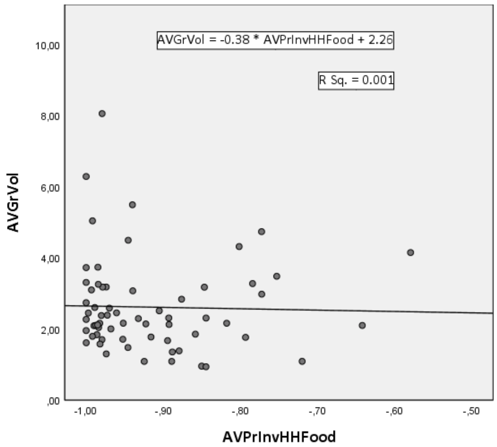


Figure 22: Average values of inverted Herfindahl-Hirschman indices for production of all agricultural products (AVPrInvHHProduct) – 22a, agricultural groups (AVPrInvHHGroup) – 22b, and food and noon food agricultural product (AVPrInvHHFood) – 22c as a function of average standard deviation of GDP per capita growth rate volatility (AVGrVol) from 1970 to 2010;
Source: author's own calculations

Although the results of the analysis are mostly confirming my expectation we should bear in mind that we are using averages. The result may change when I perform a more detailed analysis.

4.3.2 In depth analysis

I will now take a deeper look at my data. It is clear that it is necessary to control for other effects which could have an impact before I can conclude whether any of the explanatory variables influence growth rate volatility. Research done in this field so far has identified a number of other influential factors that affect the volatility. I will follow the usual approach and include a number of most influential factors as control variables and run them in conjunction with my explanatory variables to establish whether the relationship observed in my “first look” at the data above is preserved.

To test my hypotheses I use generalised method of moments (GMM) estimator on panel data of 64 countries between 1971 and 2010. My model for the analysis is:

$$GrVol_{i,t} = \alpha + \rho GrVol_{i,t-1} + \beta_{1i}\boldsymbol{X}_{i,t} + \beta_{2j}\boldsymbol{Y}_{j,t} + \varepsilon_{i,t} \quad (20)$$

GrVol represents my measure of volatility which is a standard deviation of detrended GDP per capita growth rate. Remaining components are: constant term, α, coefficient ρ, for the lag of my dependent variable, $GrVol_{t-1}$, coefficients, β_{1i}, for my vector of control variables, $\boldsymbol{X}_{i,t}$, vector of my explanatory variables, $\boldsymbol{Y}_{j,t}$, and corresponding coefficients, $\beta_{2,j}$, and error term,$\varepsilon_{i,t}$.

The next part of this chapter will steadily deepen the analysis of my dataset. It will first look at the influences of production of agriculture in general and crops in particular on growth rate volatility. The next analysis will include all my control variables into the regression model. This will be followed by five analyses that will answer my five questions stated at the beginning of this chapter.

4.3.2.1 Agriculture and crops

I first explore whether share of agriculture in GDP (ShAgGDP) and share of crops in GDP (ShCrGDP) significantly influence growth rate volatility (table 43). Figure 18 of my quick analysis above showed that increased average share of each of the variables decreases growth rate volatility.

My detailed analysis confirms negative value of the regression coefficient for share of crops in GDP however the value of the coefficient for the share of agriculture in GDP turned positive. Its positive value was expected since higher share of agriculture indicates lower level of development which is in turn associated with higher growth rate volatilities. Nevertheless, both results are statistically not significant (the p-value for share of crops in GDP is just over ten percent; p= 0.103, whereas that of share of agriculture in GDP is p = 0.149).

Table 43: GMM estimates for shares of agriculture in GDP and share of crops in GDP and lag of dependent variable as explanatory variables on growth rate volatility

	(1)	(2)
Constant	2.458***	3.373***
	(6.090)	(9.067)
Lag_1GrVol	-0.147	-0.156*
	(-1.521)	(-1.668)
ShAgGDP	0.020	
	(1.444)	
ShCrGDP		-0.022
		(-1.631)
Sum of sq. res.	32006.84	32223.26
S.E. of regression	3.566	3.552
No. of countries	64	64
No. of observations	2496	2496
No. of instruments	78	78
Arellano-Bond test AR(1)	-2.574	-2.575
AR(1) p-value	0.010	0.010
Arellano-Bond test AR(2)	-0.062	-0.137
AR(2) p-value	0.951	0.891
Sargan test df	75	75
Sargan test Chi-sq.(df)	61.902	62.168
Sargan test Chi-sq p-value	0.861	0.855
Wald (joint) test df	2	2
Wald (joint) test Chi-sq.(df)	3.112	7.761**

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

However when I run the GMM analysis without constant terms [77] both variables become significant (see table A4.13 in the appendix). In this case both variables have positive values indicating that increased share of each variable in GDP increases growth rate volatility. The removal of the intercept term however forces the regression line to cross zero value. This action results in steeper slopes and thus higher values of the corresponding regression coefficient.

[77] The intercept term is removed from the model when the model undergoes first-differencing however the model with the intercept term can be estimated using the system GMM estimator (*i.e.* by using level equations). In scientific research the constant term is usually omitted from the instrument set in GMM estimation of dynamic panel data models however as Han and Kim (2014) show the omission of the constant term results in increased bias and loss of efficiency.

4.3.2.2 Control variables

I now resume my analysis with all the control variables included.

Table 44 shows result of my regression analysis with all control variables included (table A4.14 in the appendix presents results of my regression analysis for each control variable separately).

Table 44: GMM estimates for lag of dependent variable and all control variables on growth rate volatility

Constant	-7.539*
	(-1.829)
Lag_1GrVol	-0.176*
	(-1.929)
lnGDP	0.650*
	(1.699)
Democracy	-1.350***
	(-3.366)
Openness	1.171**
	(2.454)
Schooling	-0.003
	(-0.388)
INFL	0.068**
	(2.320)
ShAgGDP	0.059**
	(2.309)
WAR	-0.100
	(-0.413)
Sum of sq. res.	34461.04
S.E. of regression	3.709
No. of countries	64
No. of observations	2496
Total no. of instruments	84
Arellano-Bond test AR(1)	-2.763
AR(1) p-value	0.006
Arellano-Bond test AR(2)	-0.446
AR(2) p-value	0.656
Sargan test df	75
Sargan test Chi-sq.(df)	56.709
Sargan test Chi-sq p-value	0.943
Wald (joint) test df	8
Wald (joint) test Chi-sq.(df)	42.521***

Signif. codes: 0.01 ‘***’, 0.05 ‘**’, 0.1 ‘*’;
Dependent variable: growth rate volatility (GrVol)

When taken individually, two of my control variables are significant: democracy (*Democracy*) which has coefficient with negative value and significance level below five percent, and inflation (*INFL*) with positive coefficient value and again significance level below five percent.

When all my control variables are included there are five with significance level less than ten percent. Variables with negative sign, *i.e.* those that decrease growth rate volatility with their increase are: democracy (*Democracy*), primary school enrolment (*Schooling*), and armed conflict (*War*). The only statistically significant variable among them is democracy whereas the other two are not. The result for democracy is in line with my expectation and has been found by *e.g.* Acemoglu, *et al.* (2001), Dollar and Kraay (2003), Easterly and Levine (2003), *etc.* to be negatively correlated with growth rate volatility. The democracy variable measures development of institutions in general. At the same time researchers established that higher quality institutions play an important and positive role in long-term economic development.

On the other hand, there are four variables with positive sign: GDP per capita (*lnGDP*), openness (*Openness*), inflation (*INFL*), and share of agriculture in GDP (*ShAgGDP*). Their positive sign indicates that as their values increase so does growth rate volatility. Of the four variables with positive sign three are statistically significant at five percent level (openness, inflation, and share of agriculture in GDP) whereas log of GDP per capita is significant at ten percent level. The positive sign for openness, inflation, and share of agriculture is in line with my expectations as well as with previous research however positive sign for log of GDP per capita was not expected. Based on previous research higher values of GDP per capita are associated with lower levels of growth rate volatility; see *e.g.* Tamirisa (1999), Wolf (2004), Mobarak (2005), *etc.*

4.3.2.3 Plantation and non-plantation crops

I am now moving to the heart of this research. I started this part of the analysis by including variables that are important for my first question into the regression analysis (*i.e.* in addition to my control variables).table 45 are production share of plantation crops in GDP (*ShPLANT(p)*), production share of non-plantation crops in GDP (*ShNONPLANT(p)*), and ratio between non-plantation and plantation crops (*RATIOPLANT(p)*).

Table 45: GMM estimates for lag of dependent variable, all control variables, and share of plantation and non-plantation crops in GDP as well as ratio between non-plantation and plantation crops as exploratory variables on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	-6.304	-8.642	-8.844**	-10.900
	(-1.380)	(-1.388)	(-2.038)	(-1.455)
Lag_1GrVol	-0.177*	-0.178*	-0.182*	-0.188**
	(-1.919)	(-1.950)	(-1.925)	(-2.018)
lnGDP	0.465	0.763	0.783*	0.968
	(1.002)	(1.323)	(1.874)	(1.289)
Democracy	-1.206***	-1.336***	-1.338***	-1.294***
	(-2.763)	(-3.309)	(-3.224)	(-3.186)
Openness	1.198**	1.191**	0.979*	1.085**
	(2.446)	(2.284)	(1.942)	(2.026)
Schooling	0.000	-0.002	0.004**	0.004
	(0.022)	(-0.283)	(0.535)	(0.654)
INFL	0.069**	0.066**	0.066**	0.060**
	(2.308)	(2.212)	(2.187)	(1.986)
ShAgGDP	0.066**	0.059**	0.069**	0.077***
	(2.561)	(2.263)	(2.422)	(2.683)
WAR	-0.047	-0.052	0.024	0.113
	(-0.181)	(-0.194)	(0.092)	(0.407)
ShPLANT(p)	-0.058**			-0.014
	(-2.036)			(-0.373)
ShNONPLANT(p)		0.020		0.032
		(0.461)		(0.645)
RATIOPLANT(p)			0.133**	0.120*
			(2.496)	(1.719)
Sum of sq. res.	34300.69	34231.02	33982.97	33674.55
S.E. of regression	3.717	3.698	3.705	3.679
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	85	85	85	87
Arellano-Bond test AR(1)	-2.781***	-2.738***	-2.723***	-2.677***
AR(1) p-value	0.005	0.006	0.007	0.007
Arellano-Bond test AR(2)	-0.469	-0.453	-0.489	-0.531
AR(1) p-value	0.639	0.650	0.625	0.596
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	58.743	56.432	57.175	54.026
Sargan test Chi-sq. p-value	0.917	0.946	0.938	0.968
Wald (joint) test df	9	9	9	11
Wald (joint) test Chi-sq.(df)	46.003***	45.489***	50.776***	59.992***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Among the explanatory variables associated with my first question two are significant at five percent (share of production of plantation crops in GDP and ratio between nonplanation to plantation crops; columns 1 and 3 respectively) whereas share of production of non-plantation crops in GDP is statistically not significant (column 2). Share of production of plantation crops in GDP coefficient has negative value while that of ratio of non-plantation to plantation crops has positive value. Both results are in line with my expectations.

Negative value of the coefficient associated with the plantation crop variable indicates that as share of production of plantation crops in GDP increases growth rate volatility decreases.

The positive value of the ratio variable indicates that as its value increases so does growth rate volatility. Increased value of the ratio can be the result of increased share of non-plantation crops relative to that of plantation crops. In other words increased ratio means that there is a relative increase of the share of non-plantation crops in GDP to that of plantation crops. Therefore the result suggests that if relative share of production of non-plantation crops in GDP to that of plantation crops increases so does growth rate volatility. I can equally state that growth rate volatility decreases when relative share of plantation crops in GDP to that non-plantation crops increases.

The fourth column in table 45 presents the results of the regression analysis with all three explanatory variables included.

In this case the only statistically significant variable is the ratio variable (at ten percent level) whereas the other two are not significant[78].

The next step in my analysis is to include interaction variables between openness and individual explanatory variables. All of the interaction terms in my analysis are statistically not significant. The only statistically significant result (at five percent level) among my explanatory variables is share of production of plantation crops in GDP. As main effects, results for openness as well as share of plantation crops in GDP are statistically significant however the result for the interaction term is statistically not significant. Because of the insignificance of most of my results I present the table in the appendix (table A4.15).

[78] When I discuss results of the analyses I focus on explanatory variables only and do not discuss control variables.

In short, on its own, share of plantation crops in GDP and ratio between non-plantation and plantation crops have statistically significant effects on growth rate volatility whereas share of non-plantation crops in GDP doesn't have statistically significant effect on growth rate volatility. When interaction terms between openness and each individual explanatory variable is included none of the results (save for the share of production of plantation crops in GDP) are statistically significant.

4.3.2.4 Perishable and non-perishable crops

The second question tries to explore whether perishable crops influence growth rate volatility differently than non-perishable crops, and what kind of effects those groups have on volatility.

The only statistically significant result in table 46 is the influence of share of perishable crops in GDP (ten percent significance level). Its value is negative meaning that as the share of perishable crops in GDP increases growth rate volatility decreases. The result is in line with my quick analysis above (see figure 20) however it runs counter to my expectations. The results for all other explanatory variables are statistically not significant.

When I include interaction terms (see table 47) between my explanatory variables, share of production of perishable crops in GDP becomes statistically not significant however its interaction term is significant (at ten percent level) and has negative value. The result suggests that growth rate volatility decreasing effect of the higher share of perishable crops in GDP is strengthened with higher levels of openness (*i.e.* with increased share of perishable crops in GDP and more open economy growth rate volatility would decrease more).

Neither share of production of non-perishable crops nor its interaction term with openness is statistically significant (column 2) however both ratio between non-perishable crops and its interaction term with openness (column 3) are statistically significant (both at ten percent level). The value of the coefficient for the ratio has negative value whereas that of the interaction term is positive. The result suggest that although higher value of the ratio (*i.e.* higher share of production of non-perishable crops in GDP relative to that of perishable crops) decreases growth rate volatility, the influence of ratio declines with higher level of openness.

Table 46: GMM estimates for lag of dependent variable, all control variables, and share of perishable and non-perishable crops in GDP as well as ratio between non-perishable and perishable crops as exploratory variables on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	-5.454	-7.596	-7.262*	-5.700
	(-1.249)	(-1.544)	(-1.684)	(-0.933)
Lag_1GrVol	-0.180*	-0.176*	-0.180*	-0.185**
	(-1.948)	(-1.910)	(-1.958)	(-1.998)
lnGDP	0.446	0.612	0.591	0.428
	(1.032)	(1.297)	(1.523)	(0.694)
Democracy	-1.254***	-1.346***	-1.346***	-1.272***
	(-3.122)	(-3.326)	(-3.413)	(-2.952)
Openness	1.127**	1.123**	1.170**	1.162**
	(2.463)	(2.288)	(2.320)	(2.386)
Schooling	-0.003	0.002	0.000	0.002
	(-0.426)	(0.227)	(0.059)	(0.187)
INFL	0.069**	0.069**	0.072**	0.074**
	(2.274)	(2.258)	(2.447)	(2.330)
ShAgGDP	0.059**	0.065**	0.057**	0.061*
	(2.421)	(2.123)	(2.089)	(1.869)
WAR	-0.166	-0.083	-0.104	-0.159
	(-0.637)	(-0.321)	(-0.410)	(-0.512)
ShPERISH(p)	-0.059*			-0.066
	(-1.708)			(-1.430)
ShNONPERISH(p)		-0.281		0.114
		(-1.308)		(0.357)
RATIOPERISH(p)			-2.862	-4.702
			(-1.292)	(-1.419)
Sum of sq. res.	34407.95	34538.79	34751.25	34812.29
S.E. of regression	3.711	3.716	3.723	3.730
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	85	85	85	87
Arellano-Bond test AR(1)	-2.759***	-2.772***	-2.760***	-2.771***
AR(1) p-value	0.006	0.006	0.006	0.006
Arellano-Bond test AR(2)	-0.471	-0.442	-0.482	-0.520
AR(2) p-value	0.638	0.659	0.630	0.603
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	56.167	55.949	55.442	54.564
Sargan test Chi-sq. p-value	0.949	0.951	0.956	0.964
Wald (joint) test df	9	9	9	11
Wald (joint) test Chi-sq.(df)	43.289***	47.305***	45.316***	54.564***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

In short, without including the interaction term, of the three explanatory variables analysed the only statistically significant variable is share of production of perishable crops in GDP. The analysis suggests that as the share of perishable crops in GDP increases growth rate volatility decreases. The result does not follow my expectation.

When I include the interaction terms into my regression the main effect (*i.e.* share of production of perishable crops in GDP) becomes insignificant however its interaction term with openness is significant (negative coefficient value).

The result suggests that higher level of openness of the economy strengthens the growth rate volatility decreasing effect of higher share of production of perishable crops in GDP. The other significant results in table 47 are associated with the ratio variable. Both the main effect and interaction term are significant at ten percent level however the value of the main effect is negative whereas that of the interaction term is positive. The result indicates that higher level of openness counters growth rate volatility decreasing effect of higher ratio variable (*i.e.* higher share of production of perishable crop in GDP relative to share of non-perishable crops in GDP). This indicates that exports of perishable crops might have less decreasing or possibly even increasing effect on growth rate volatility. This will be explored in my second exploratory chapter (i.e. chapter five of this thesis).

Table 47: GMM estimates for lag of dependent variable, all control variables, and share of perishable crops in GDP, share of non-perishable crops in GDP, ratio between non-perishable and perishable as well as the interaction variables between openness and each of the explanatory variables

	(1)	(2)	(3)	(4)
Constant	-7.079	-7.992	-6.980*	-6.772
	(-1.493)	(-1.599)	(-1.934)	(-0.971)
Lag_1GrVol	-0.185**	-0.179*	-0.177**	-0.186**
	(-2.009)	(-1.937)	(-1.964)	(-2.045)
lnGDP	0.578	0.653	0.738**	0.673
	(1.244)	(1.349)	(1.966)	(0.957)
Democracy	-1.240***	-1.315***	-1.309***	-1.221***
	(-3.085)	(-3.323)	(-3.509)	(-2.774)
Openness	1.245***	1.173**	0.847*	1.004*
	(2.649)	(2.365)	(1.705)	(1.946)
Schooling	-0.004	0.000	0.000	-0.001
	(-0.636)	(0.058)	(0.032)	(-0.082)
INFL	0.074**	0.063**	0.070**	0.072*
	(2.346)	(2.157)	(2.224)	(1.819)
ShAgGDP	0.070***	0.068**	0.056**	0.070*
	(2.603)	(2.153)	(2.263)	(1.714)
WAR	-0.194	-0.064	-0.012	-0.131
	(-0.722)	(-0.258)	(-0.045)	(-0.385)
ShPERISH(p)	-0.057			-0.071
	(-1.586)			(-0.966)
Openness * ShPERISH(p)	-0.391*			-0.275
	(-1.741)			(-0.569)
ShNONPERISH(p)		-0.220		0.109
		(-0.882)		(0.133)
Openness * ShNONPERISH(p)		-0.377		-1.460
		(-0.280)		(-0.381)
RATIOPERISH(p)			-5.518*	-7.552
			(-1.715)	(-0.793)
Openness * RATIOPERISH(p)			78.114*	96.232
			(1.746)	(1.513)
Sum of sq. res.	35063.65	34129.56	35178.04	35730.49
S.E. of regression	3.726	3.686	3.765	3.787
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	86	86	86	90
Arellano-Bond test AR(1)	-2.755***	-2.722***	-2.782***	-2.758***
AR(1) p-value	0.006	0.007	0.005	0.006
Arellano-Bond test AR(2)	-0.498	-0.458	-0.495	-0.578
AR(2) p-value	0.618	0.647	0.621	0.563
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	55.170	54.355	55.579	53.600
Sargan test Chi-sq. p-value	0.959	0.965	0.955	0.971
Wald (joint) test df	10	10	10	14
Wald (joint) test Chi-sq.(df)	44.689***	49.578***	57.703***	51.331***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

4.3.2.5 Food and non-food crops

The third question explores the effects of food and non-food crops on growth rate volatility. My quick analysis (see figure 21) indicated that increased share of production of food crops in GDP decreases growth rate volatility whereas non-food crops and ratio between non-food and food crops increase it.

All regression analyses which included my explanatory variables as well as analyses which included interaction terms between my explanatory variables and openness returns non-significant results. Because results of both analyses are statistically not significant they can be found in the appendix (results for explanatory variables only in table A4.16 and results for explanatory variables and their interaction terms with openness in table A4.17).

When I remove constant term from my regression analysis food crops become significant. In addition to that both sum of squared residuals and S.E. of the regression become smaller. The results of this regression are in column 1 of table 48 (results for all explanatory variables as well as the analyses which includes interaction terms can be found in the appendix in tables A4.18 and A4.19 respectively). The significance level is at one percent and corresponding constant has negative value which means that as share of food crops in GDP increases growth rate volatility decreases. The variable remains significant (although at five percent level) when all explanatory variables are included at the same time (column 4 in table 48).

Table 49 shows results of the regression analysis without constant term for share of food crops in GDP (column 1) and the same variable with corresponding interaction term in column 2. Share of food crops in GDP has coefficient with negative value and significance level below one percent. Again results indicate that as share of food crops in GDP increases growth rate volatility decreases.

Table 48: GMM estimates without constant term for all my control variables and food crops, non-food crops, and ratio between non-food and food crops on growth rate volatility

	(1)	(2)	(3)	(4)
Constant				
Lag_1GrVol	-0.176*	-0.165*	-0.163*	-0.176*
	(-1.875)	(-1.769)	(-1.745)	(-1.871)
lnGDP	-0.035	0.066	0.055	-0.069
	(-0.165)	(0.353)	(0.301)	(-0.317)
Democracy	-1.120***	-1.132***	-1.115***	-1.046**
	(-2.794)	(-2.688)	(-2.612)	(-2.541)
Openness	0.727**	0.600*	0.582*	0.703**
	(2.022)	(1.817)	(1.838)	(1.982)
Schooling	-0.000	-0.003	-0.002	0.001
	(-0.051)	(-0.461)	(-0.357)	(0.173)
INFL	0.066**	0.057**	0.060**	0.067**
	(2.235)	(2.223)	(2.248)	(2.225)
ShAgGDP	0.042**	0.013	0.012	0.043**
	(2.346)	(0.800)	(0.756)	(2.253)
WAR	-0.223	-0.263	-0.317	-0.270
	(-0.905)	(-1.104)	(-1.239)	(-1.135)
FOOD(p)	-0.052***			-0.052**
	(-2.877)			(-2.227)
NONFOOD(p)		0.011		0.007
		(0.091)		(0.018)
RATIOFOOD(p)			1.493	1.864
			(0.539)	(0.263)
Sum of sq. res.	34444.76	33472.91	33605.22	34543.04
S.E. of regression	3.704	3.662	3.672	3.710
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	84	84	84	86
Arellano-Bond test AR(1)	-2.706	-2.699	-2.718	-2.708
AR(1) p-value	0.007	0.007	0.007	0.007
Arellano-Bond test AR(2)	-0.434	-0.304	-0.294	-0.432
AR(2) p-value	0.664	0.761	0.769	0.665
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	57.789	57.911	57.459	56.157
Sargan test Chi-sq. p-value	0.930	0.928	0.934	0.949
Wald (joint) test df	9	9	9	11
Wald (joint) test Chi-sq.(df)	215.451***	214.000***	215.927***	224.844***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table 49: GMM estimates without constant term for share of food crops in GDP as well as its interaction term with openness on growth rate volatility

	(1)	(1)
Constant		
Lag_1GrVol	-0.176*	-0.182**
	(-1.875)	(-1.978)
lnGDP	-0.035	-0.086
	(-0.165)	(-0.386)
Democracy	-1.120***	-1.034***
	(-2.794)	(-2.673)
Openness	0.727**	0.829**
	(2.022)	(2.278)
Schooling	-0.000	-0.002
	(-0.051)	(-0.278)
INFL	0.066**	0.072**
	(2.235)	(2.367)
ShAgGDP	0.042**	0.048***
	(2.346)	(2.652)
WAR	-0.223	-0.322
	(-0.905)	(-1.307)
ShFOOD(p)	-0.052***	-0.062***
	(-2.877)	(-3.374)
Openness * ShFOOD(p)		-0.188
		(-1.113)
Sum of sq. res.	34444.76	36541.92
S.E. of regression	3.704	3.803
No. of countries	64	64
No. of observations	2496	2496
No. of instruments	84	85
Arellano-Bond test AR(1)	-2.706	-2.746
AR(1) p-value	0.007	0.006
Arellano-Bond test AR(2)	-0.434	-0.446
AR(2) p-value	0.664	0.656
Sargan test df	75	75
Sargan test Chi-sq.(df)	57.789	55.934
Sargan test Chi-sq. p-value	0.930	0.951
Wald (joint) test df	9	10
Wald (joint) test Chi-sq.(df)	215.451***	194.976***

Signif. codes: 0.01 ‘***’, 0.05 ‘**’, 0.1 ‘*’, Dependent variable: growth rate volatility (GrVol)

4.3.2.6 Crop groups

The fourth question tries to determine whether there is different influence of various crop groups on growth rate volatility.

The main driver to include crop groups into my analysis came from Isham, *et al.* (2005) who discovered that exports of certain crops (coffee, cocoa, bananas) lead to lower long term growth. At the moment there is no research that would look at crop groups' influence on growth rate volatility. However, based on findings of Isham, *et al.* (2005) and also because of the spread of LSLAs in developing countries producing variety of crops (including plantation or point-sourced ones) there clearly is a need to thoroughly understand the effects they have on growth.

Table 50 presents results of my regression analyses on different crop groups. It holds only significant results whereas table A4.21 in the appendix contains all regression analyses.

There are five crop groups that have significant effect on growth rate volatility, of which four are food crops (vegetables; nuts; coffee, cocoa, tea; and oil crops) and one is non-food crop (rubber).

Vegetables, nuts, and coffee, cocoa, and tea groups have coefficients with negative value. This indicates that as their share in GDP increases growth rate volatility decreases. Vegetables are significant at ten percent level; coffee, cocoa, and tea are significant at five percent level, while nuts are significant at one percent level.

Value of coefficient for oil crops is positive meaning that as its share in GDP increases so does growth rate volatility. Its significance level is five percent.

The only non-food crop, rubber, has significance level at ten percent and its coefficient has negative value indicating that as rubber's share in GDP increases growth rate volatility decreases.

Table 51 shows results for my regression analysis which also includes interaction term. The table again shows only significant results whereas table A4.22 in the appendix presents all regressions.

When I include interaction terms into my estimator there are four crop groups that have significant effect on growth rate volatility. Three are food crops (fruits; coffee, cocoa, tea; and oil crops) and one is non-food crop (tobacco).

Table 50: GMM estimates for all my control variables and shares of significant crops groups in GDP on growth rate volatility

	(1)	(2)	(3)	(4)	(5)
Constant	-5.215	-7.948*	-8.316**	-8.967**	-8.040*
	(-1.163)	(-1.956)	(-2.081)	(-1.974)	(-1.936)
Lag_1GrVol	-0.182**	-0.177*	-0.185**	-0.181*	-0.19*
	(-1.966)	(-1.935)	(-2.065)	(-1.940)	(-1.952)
lnGDP	0.390	0.678*	0.712*	0.756*	0.693*
	(0.858)	(1.772)	(1.826)	(1.763)	(1.791)
Democracy	-1.300***	-1.402***	-1.374***	-1.578***	-1.302***
	(-3.392)	(-3.429)	(-3.268)	(-3.483)	(-3.293)
Openness	1.063**	1.192**	1.256***	1.202**	1.204**
	(2.348)	(2.491)	(2.680)	(2.521)	(2.516)
Schooling	0.000	-0.002	-0.003	0.002	-0.003
	(0.064)	(-0.292)	(-0.454)	(0.219)	(-0.387)
INFL	0.071**	0.071**	0.069**	0.073**	0.066**
	(2.299)	(2.323)	(2.366)	(2.336)	(2.257)
ShAgGDP	0.059**	0.063**	0.070***	0.053*	0.063**
	(2.305)	(2.389)	(2.945)	(1.930)	(2.360)
WAR	-0.160	-0.089	-0.082	-0.091	-0.025
	(-0.612)	(-0.350)	(-0.345)	(-0.341)	(-0.098)
Vegetables(p)	-0.079*				
	(-1.744)				
Nuts(p)		-0.155***			
		(-2.876)			
Coffee, cocoa, tea(p)			-0.287**		
			(-2.192)		
Oil crops(p)				0.197**	
				(2.392)	
Rubber(p)					-0.309*
					(-1.726)
Sum of sq. res.	34780.03	34687.38	34414.96	34664.56	34294.27
S.E. of regression	3.720	3.723	3.705	3.732	3.697
No. of countries	64	64	64	64	64
No. of observations	2496	2496	2496	2496	2496
No. of instruments	85	85	85	85	85
Arellano-Bond test AR(1)	-2.753	-2.779	-2.730	-2.753	-2.731
AR(1) p-value	0.006	0.006	0.006	0.006	0.006
Arellano-Bond test AR(2)	-0.489	-0.462	-0.540	-0.484	-0.467
AR(2) p-value	0.625	0.644	0.589	0.628	0.641
Sargan test df	75	75	75	75	75
Sargan test Chi-sq.(df)	55.224	57.036	55.566	57.046	56.230
Sargan test Chi-sq. p-value	0.958	0.939	0.955	0.939	0.948
Wald (joint) test df	9	9	9	9	9
Wald (joint) test Chi-sq.(df)	42.116***	43.395***	44.723***	33.330***	45.894***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table 51: GMM estimates for all my control variables, and different crop groups as well as their corresponding interaction terms on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	-6.657	-9.312**	-9.113**	-11.302***
	(-1.626)	(-2.117)	(-2.054)	(-3.020)
Lag_1GrVol	-0.187**	-0.210***	-0.181*	-0.219**
	(-2.019)	(-2.899)	(-1.953)	(-2.373)
lnGDP	0.564	0.760*	0.785*	1.009***
	(1.368)	(1.711)	(1.812)	(2.689)
Democracy	-1.161***	-1.416***	-1.507***	-1.370***
	(-2.911)	(-3.445)	(-3.398)	(-3.147)
Openness	1.075**	1.414***	1.167**	1.423***
	(2.399)	(2.738)	(2.548)	(3.226)
Schooling	-0.001	-0.004	0.001	-0.010
	(-0.188)	(-0.558)	(0.177)	(-1.382)
INFL	0.069**	0.072**	0.073**	0.082**
	(2.244)	(2.380)	(2.310)	(2.359)
ShAgGDP	0.066***	0.077***	0.055**	0.082***
	(2.578)	(2.810)	(2.022)	(3.481)
WAR	-0.128	-0.063	-0.081	-0.080
	(-0.530)	(-0.263)	(-0.316)	(-0.306)
Fruits(p)	-0.098*			
	(-1.723)			
Openness x Fruits(p)	-0.697			
	(-1.544)			
Coffee, cocoa, tea(p)		-0.319**		
		(-2.210)		
Openness x Coffee, cocoa, tea(p)		-4.119***		
		(-2.928)		
Oil(p)			0.200**	
			(2.414)	
Openness x Oil(p)			-0.243	
			(-0.187)	
Tobacco(p)				0.278
				(1.055)
Openness x Tobacco(p)				-25.814***
				(-3.293)
Sum of sq. res.	34749.64	34935.08	34572.78	43146.14
S.E. of regression	3.727	3.728	3.731	4.020
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	85	86	86	86
Arellano-Bond test AR(1)	-2.793	-2.930	-2.740	-2.925
AR(1) p-value	0.005	0.003	0.006	0.003
Arellano-Bond test AR(2)	-0.441	-0.775	-0.462	-0.698
AR(2) p-value	0.659	0.438	0.644	0.485
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	57.108	55.958	56.077	54.986
Sargan test Chi-sq. p-value	0.938	0.951	0.950	0.960
Wald (joint) test df	9	10	10	10
Wald (joint) test Chi-sq.(df)	46.872***	54.996***	35.895***	58.449***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Only coffee, cocoa, and tea crop group have significant both main effect (at five percent level) and its interaction term (at one percent level), and both have negative coefficient value. The interpretation of the main effect therefore indicates that as share of coffee, cocoa, and tea in GDP increases growth rate volatility decreases and that the effect is further strengthened with increased openness.

Fruits also have negative coefficient (significant at five percent) meaning as their share in GDP increases growth rate volatility decreases. Its interaction term has negative coefficient however it is not significant.

Oil crops have positive coefficient and are significant at five percent. As before positive coefficient indicates its growth volatility increasing effect with higher share in GDP. Its interaction term is negative however it is not significant.

Tobacco also has positive coefficient however the result is not significant. Its interaction term has negative coefficient and is significant at one percent level. This means that the effect of growth rate volatility increasing effect of tobacco decreases with increased openness.

4.3.2.7 Diversification

The last question tries to determine whether agricultural diversification influences growth rate volatility. I am using three different agricultural diversification groupings: i) all agricultural products (*i.e.* each agricultural product represents a unit), ii) agricultural groups (*i.e.* vegetables, fruits, *etc.* – see footnote 59), and iii) food/non-food diversification.

None of the results for diversifications, either on their own or in combination with interaction are statistically significant. For that reason I included tables for the two regressions in the appendix (see table A4.23 for main exploratory variables and table A4.24 for the results of the regression analysis which in addition to diversification indices also includes interaction terms).

In addition to the GMM estimates with constant term I also ran the regression without one. In this case diversification between food and non-food crops became statistically significant variable whereas all others remained non-significant (see table 52 for the results of the regression analyses without constant term for food diversification index as well as its interaction term with openness and tables A4.25 and A4.26 in the appendix for the regression analyses without constant terms for all my diversification variables and their interaction terms).

Value of the coefficient for food/non-food crop diversification has positive sign which means that as the agriculture diversifies between these two crop groups growth rate volatility increases. The results are surprising and contrary to my quick analysis (see *figure 22*) which showed that higher diversification leads to lower growth rate volatility

In short, my analysis showed that none of the diversification variables I used is statistically significant. However, if I remove intercept term from my analysis diversification between food and non-food crops becomes significant (at ten percent level). Its value is positive which surprisingly indicates that when agriculture is more diversified between food and non-food crops growth rate volatility increases.

Table 52: GMM estimates without constant term for inverted diversification index for food/non-food as well as its interaction term with openness on growth rate volatility

	(1)	(2)
Constant		
Lag_1GrVol	-0.169*	-0.169*
	(-1.819)	(-1.829)
lnGDP	0.327	0.356
	(1.464)	(1.497)
Democracy	-1.162***	-1.162***
	(-2.648)	(-2.650)
Openness	0.817**	0.792*
	(2.115)	(1.950)
Schooling	-0.000	-0.000
	(0.036)	(-0.039)
INFL	0.070**	0.067**
	(2.354)	(2.214)
ShAgGDP	0.030*	0.032**
	(1.938)	(1.985)
WAR	-0.292	-0.281
	(-1.120)	(-1.133)
InvHHFOOD(p)	3.794*	3.954*
	(1.704)	(1.754)
Openness * InvHHFood(p)		-2.592
		(-0.088)
Sum of sq. res.	34527.84	34339.91
S.E. of regression	3.714	3.704
No. of countries	64	64
No. of observations	2496	2496
No. of instruments	84	85
Arellano-Bond test AR(1)	-2.754	-2.752
AR(1) p-value	0.006	0.006
Arellano-Bond test AR(2)	-0.371	-0.366
AR(2) p-value	0.711	0.715
Sargan test df	75	75
Sargan test Chi-sq.(df)	57.838	56.712
Sargan test Chi-sq. p-value	0.929	0.943
Wald (joint) test df	9	10
Wald (joint) test Chi-sq.(df)	210.661***	219.172***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

4.4 Summary of chapter four

The first exploratory chapter examines the effects of production of crops on growth rate volatility. Some of the results are consistent with while some run contrary to my expectations.

There were five sub-questions stated at the beginning of the chapter. Each of the sub-questions explored different crops' production structure and tried to determine the influence they have on growth rate volatility. The questions were partially based on research done by Isham, et al. (2005) who while exploring the effects of exports of natural resources (point- source resources) on economic growth discovered that certain crops severely retard long-term economic growth. Crops in question were coffee and cocoa and their effect on long-term economic growth showed even worse results than other point-sourced resources (i.e. oil and minerals). Both coffee and cocoa are in essence very similar produce both are plantation crops, non-perishable as well as food crops.

In all regressions, the effects of control variables remained the same (both in the value of the regression coefficient as well as its significance) however there were two variables whose effect (although they remained the same in terms of magnitude and significance) were not in line with my expectations (primary school enrolment and armed conflict). I will discuss observed paradox in the discussion sub-chapter 6.3.1.

The first three questions of this chapter explore the effects of the production of the three groupings.

Question number one tried to determine whether production of plantation crops influences growth rate volatility differently than that of non-plantation crops. My exploratory variables in this questions regressed shares of production of plantation and non-plantation crops in GDP on growth rate volatility.

The results show that neither production of plantation crops nor non-plantation crops wields significant effect on growth rate volatility thus not confirming my first and second hypotheses. The only significant variable is the ratio between non-plantation and plantation crops. Its coefficient value is positive (significant at ten percent level) indicating that increased share of production of non-plantation crops in GDP relative to that of plantation crops increases growth rate volatility. The result is confirming my third hypothesis.

When entered separately there are two significant variables (both at five percent). The coefficient for share of production values of plantation crops in GDP has negative value showing that increased share of plantation crops in GDP decreases growth rate volatility (consistent with hypothesis one) whereas the positive value of the coefficient for the ratio between non-plantation and plantation crops indicates that as relative share of non-plantation crops to that of plantation crops in GDP increases, growth rate volatility also increases. Both results are consistent with my expectations.

My second question tried to determine whether production of perishable crops influences growth rate volatility differently than that of non-plantation crops.

The results show that neither shares of perishable and non-perishable crops nor their relative shares to each other in GDP significantly influence growth rate volatility. However when included individually share of production values of perishable in GDP is significant and has negative value thus confirming my fourth hypothesis. The other two variables relevant to this research question remain insignificant even when included in my analysis thus refuting my hypothesis.

My third question tries to determine whether production of food crops influences growth rate volatility differently than that of non-food crops.

The results show that neither has any significant effect on growth rate volatility either on their own or in combination with other relevant exploratory variables. The only significant result is obtained when I exclude the intercept from my regression analysis. In this case, food crops become significant with negative value of the coefficient. Individually, share of production values of food crops in GDP is significant at one percent level when included individually and at five percent when included in combination with other relevant variables.

My fourth question in this chapter tried to determine whether any of the crop groups wields significant effect on growth rate volatility.

Among food crops there are four crops groups whose production significantly influences growth rate volatility; vegetables (significant at ten percent), nuts (significant at one percent level). Coefficients for vegetables, nuts, and coffee, cocoa, and tea have negative value whereas that of oil food crops has positive value. Negative value indicates growth rate volatility decreasing effect with crops groups' increasing value whereas coefficient's positive value indicates that growth rate volatility increases with its increasing value. The results for vegetables and oil food crops are consistent with my expectations however the results for nuts and coffee, cocoa, and tea are not consistent with my expectations. This analysis therefore confirms my hypotheses 11 and 16, whereas all other hypotheses are not confirmed.

The only significant (at ten percent level) result of my analysis for non-food crop groups on growth rate volatility is associated with rubber. Its coefficient value is negative thus confirming my hypothesis number 19 which states that increased share of production value of rubber in GDP decreases growth rate volatility. The result was expected since its production quantity is hitting its natural limit; see footnote 7).

My fifth and last question in this chapter explored the effects of diversification on growth rate volatility. My variables in this question were diversification in all crops, diversification between crop groups, and diversification between food and non-food crops.

The only significant result of the regression analysis is obtained for food crops diversification and only if intercept is removed. In that case its significance is at ten percent level and its coefficient has positive value. Based on previous analyses (i.e. analyses of shares of food and non-food crops in GDP) the result is expected since there is only share of food crops in GDP that is significant with coefficient's having negative value (confirming hypothesis number 24). The result would suggest that for reducing growth rate volatility the economy should remain producing food crops and avoid non-food ones. Why would that be so? I would argue that the economy, so heavily reliant on agriculture with small manufacturing sector (which would consume non-food crops) is better off focusing on food crops only. Exporting (since there is no internal market) of non-food crops would therefore import external shocks and increase growth rate volatility. This speculation is supported with the results of regression which includes interaction term of the food diversification variable with openness. The variable is again significant at ten percent level and its coefficient value is again positive.

As I said above, openness to trade might influence the effects crops production might have on growth rate volatility. For that reason I ran another set of analyses where I included interaction term between openness to trade and relevant exploratory variable. We also have to bear in mind that the less relevant the crop is to the overall economy the more important its export might be. Food crops, having large internal market, are therefore less reliant on exports whereas non-food crops in combination with small or even non-existent manufacturing sector and thus only small internal market rely heavily on exports.

The analyses which include interaction terms showed that when I included the variables individually there are two pairs (i.e. significance of both main effect as well as the interaction term) who significantly affect growth rate volatility: ratio between non-perishable and perishable crops (the coefficient for ratio variable has negative value whereas that of the interaction term has positive one – both at ten percent level), and coffee, cocoa and tea group (again both coefficients have negative value with the main effect having five percent significance level and that of the interaction term at one percent significance level). There are also five with either main effect or the interaction term wielding significant influence over growth rate volatility: plantation crops (at five percent level with negative value of the coefficient), interaction term between openness and share of perishable crops production values in GDP (ten percent significance level, negative value), fruits (ten percent significance level and negative coefficient level), oil food crops (five percent significance level and positive coefficient value), and interaction term with openness and tobacco (one percent significance level and negative coefficient level).

The results indicate that the openness boosts growth rate volatility decreasing effect of increasing share of perishable crops in GDP. Similar argument applies to coffee, cocoa, and tea. This group's decreasing effect on growth rate volatility is also strengthened with increased openness. Situations where main effect is significant but its interaction term with openness is not include: plantation crops - their increased share in GDP decreases growth rate volatility and openness strengthening that effect (although not significantly), fruits (same effect – the influence of the main effect is (not significantly) boosted by openness), and oil for food consumption (in this case the main effect's growth rate increasing influence is (not significantly) reduced by openness). The other two analyses with significant results are: perishable crops whose growth rate volatility decreasing effect (not significant) is strengthened with openness, and tobacco, whose main effect increases growth rate volatility with increased share but the effect is reduced by openness).

In addition there are two variables that become significant if intercept is removed: share of production values of food crops in GDP has negative coefficient value and one percent significance level (the interaction term is insignificant), and diversification between food and non-food crops with positive coefficient value at ten percent level. Individually, interaction term between share of food crops in GDP and openness boosts (not significantly) the effect of growth rate volatility decreasing effect of food crops on growth rate volatility but in combination with other relevant variables becomes positive indicating that increased openness increases growth rate volatility (although not significantly). On the other hand growth rate volatility increasing effect of increased diversification between food and non-food crops is reduced (not significantly) by increased openness.

The analyses results are presented below. Table 53 presents the results for my explanatory variables while table 54 presents the results where interaction term is included.

Table 53: Overview of expected effects as well as obtained effects according to my analysis

Exploratory variables[2]	Expected effect[1]	Calculated effect[1]			
		With intercept		Without intercept	
		Individually	Combined	Individually	Combined
Plantation/non-plantation crops					
ShPLANT(p)	-	-**	-		
ShNONPLANT(p)	+	+	+		
RATIOPLANT(p)	+	+**	+*		
Food/non-food crops					
ShFOOD(p)	-	-	-	-***	-**
ShNONFOOD(p)	+	+	-	+	+
RATIOFOOD(p)	+	+	+	+	+
Perishable/non-perishable crops					
ShPERISH(p)	-	-*	-		
ShNONPERISH(p)	-	-	+		
RATIOPERISH(p)	-	-	-		
Diversification					
InvHHProduct(p)	-	-	+	-	+
InvHHGroup(p)	-	-	-	-	-
InvHHFood(p)	+	+	+	+*	+

Table 53: continued

Exploratory variables[2]	Expected effect[1]	Calculated effect[1]			
		With intercept		Without intercept	
		Individually	Combined	Individually	Combined
Crop groups					
Cereals(p)	-	-			
Vegetables(p)	-	-*			
Fruits(p)	-	-			
Nuts(p)	+	-***			
Coffee, cocoa, tea(p)	-	-**			
Spices(p)	+	-			
Oil(p)	+	+**			
Other food(p)	+	-			
Fibres(p)	-	+			
Rubber(p)	-	-*			
Tobacco(p)	+	+			
Other non-food(p)	+	+			

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

[1] Negative (-) effects means with its increased value, variable decreases growth rate volatility whereas positive (+) effect indicates increased growth rate volatility with variable's increased value.

[2] Analyses which confirmed my hypotheses are lightly shaded

Table 54: Expected and obtained results for main effects and their interaction terms with openness

Exploratory variables[2]	Expected effect[1]	Calculated effect[1]			
		With intercept		Without intercept	
		Individually	Combined	Individually	Combined
Interaction terms					
ShPLANT(p)	-	-**	-		
Openness x ShPLANT(p)	-	-	-		
ShNONPLANT(p)	+	+	+		
Openness x ShNONPLANT(p)	+	-	+		
RATIOPLANT(p)	+	+	+		
Openness x RATIOPLANT(p)	+	-	-		
ShFOOD(p)	-	-	-	-***	-**
Openness x ShFOOD(p)	+	-	+	-	+
ShNONFOOD(p)	-	+	-	-	-
Openness x ShNONFOOD(p)	-	-	-	-	-
RATIOFOOD(p)	+	+	+	+	+
Openness x RATIOFOOD(p)	+	+	+	+	+
ShPERISH(p)	-	-	-		
Openness x ShPERISH(p)	-	-*	-		
ShNONPERISH(p)	-	-	+		
Openness x ShNONPERISH(p)	-	-	-		
RATIOPERISH(p)	-	-*	-		
Openness x RATIOPERISH(p)	-	+*	+		

Table 54: continued

Exploratory variables[2]	Expected effect[1]	Calculated effect[1]			
		With intercept		Without intercept	
		Individually	Combined	Individually	Combined
Interaction terms					
InvHHProduct(p)	-	-	+	-	+
Openness x InvHHProduct(p)	-	+	-	+	-
InvHHGroup(p)	-	-	-	-	-
Openness x InvHHGroup(p)	-	+	+	+	+
InvHHFood(p)	+	+	+	+*	+*
Openness x InvHHFood(p)	-	+	-	-	-
Cereals(p)	-	-			
Openness x Cereals(p)	+	-			
Vegetables(p)	-	-			
Openness x Vegetables(p)	+	+			
Fruits(p)	-	-*			
Openness x Fruits(p)	-	-			
Nuts(p)	+	-			
Openness x Nuts(p)	-	+			
Coffee, cocoa, tea(p)	-	-**			
Openness x Coffee, cocoa, tea(p)	+	-***			
Spices(p)	+	-			
Openness x Spices(p)	-	-			

Table 54: continued

Exploratory variables[2]	Expected effect[1]	Calculated effect[1]			
		With intercept		Without intercept	
		Individually	Combined	Individually	Combined
Interaction terms					
Oil(p)	+	+**			
Openness x Oil(p)	+	-			
Other food(p)	+				
Openness x Other food(p)	+				
Fibres(p)	-	+			
Openness x Fibres(p)	-	-			
Rubber(p)	-	-			
Openness x Rubber(p)	-	-			
Tobacco(p)	+	+			
Openness x Tobacco(p)	-	-***			
Other non-food(p)	+	+			
Openness x Other non-food(p)	+	+			

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'

[1] Negative (-) effects means with its increased value, variable decreases growth rate volatility whereas positive (+) effect indicates increased growth rate volatility with variable's increased value.

[2] Analyses which confirmed my hypotheses are lightly shaded

5 Panel data evidence on the role of agricultural export structure on the long-term GDP per capita growth rate volatility

5.1 Introduction to chapter four

The second empirical chapter, *i.e.* chapter five of this thesis, attempts to find an answer to whether and how different crops' export structure in developing countries affects their growth rate volatility. The question is divided into six sub questions related to production of plantation/non-plantation crops, perishable/non-perishable crops, processed/unprocessed crops, food/non-food crops, crop groups, and different forms of diversification in crop exports. Generally, this chapter aims to empirically investigate the effects of crops' export structures and their corresponding significances on growth rate volatility.

Isham, *et al.* (2005) argue that certain plantation crops behave similarly to point-source natural resources and that they impact societies in similar ways while Auty (1997) points out that point-source natural resources lead to divisive country and lower quality of institutions. These impede country's ability to respond to economic shocks resulting in improper handling of those shocks and leading to reduced long-term growth; see also *e.g.* Rodrik (1999), Rodrik, *et al.* (2004), Rigobono and Rodrik (2004), *etc.* Auty (1997) blamed large share of primary sector in GDP for observed (political) outcomes and argued that rents and all social and economic linkages attributable to point-source natural resources guide country's macro policy. Based on stated arguments I estimate that high share of agriculture relative to other economy sectors in developing countries and composition of agriculture in regard to its produce should influence countries' growth rate volatility and consequently their long term economic growth.

Because of confirmed negative effects of certain crops (coffee and cocoa both are plantation, non-perishable, and food crops) that are deemed point-sourced[79] my first examination tries to uncover whether shares of export in GDP of plantation and non-plantation agricultural products influence growth rate volatility differently. Based on the work of Isham, *et al.* (2005) I hypothesise that plantation crops have negative effect on growth rate volatility whereas non-plantation crops have positive one.

[79] According to Isham, et al. (2005) point-source resources are *"resources extracted from narrow geographic or economic base".* I can argue that interpretation of *"narrow geographical base"* could mean products from plantations.

Second, I want to establish whether and how exports of perishable and non-perishable crops influence growth rate volatility. I argue that because of their short shelf life perishable crops have to be placed on the market quickly swamping the market whereas non-perishable ones can be kept in storage for longer and placed on the market at sellers' discretion and under more favourable market conditions.

Based on the previous two questions the third part of this chapter wants to determine the influence of exports of processed and unprocessed agricultural products on growth rate volatility. In my logical reasoning I argue that transforming agricultural crops into other products introduces at least three factors that should influence growth rate volatility; a) it involves at least some form of manufacturing, b) it diversifies exports where country exports original raw material and additional transformed versions (*i.e.* it takes one agricultural crop and transforms it, sometimes in more than one additional products), and c) processing, especially perishable crops, extends their shelf life thus enabling more balanced market placement throughout the year.

The fourth question is interested in discovering whether food and non-food crops influence growth rate volatility differently. Because of increasing global demand for both food and non-food agricultural products and their rising prices on global markets they may have growth rate volatility decreasing effect.

The fifth question tries to determine if shares of exports of different crop groups in GDP have any effect on growth rate volatility. Examining this kind of groupings is based on the fact that each crop group may be comprised of specific kind of crops (*e.g.* fruits are mostly perishable whereas other are mostly plantation ones (*e.g.* coffee, cocoa, tea; rubber, *etc.*).

My final exploration in this chapter wants to establish whether more diversified export of agricultural products reduces growth rate volatility. Diversification has been shown to be significant factor in reducing growth rate volatility; see *e.g.* Brainard and Cooper (1965), Koren and Tenreyro (2007), Bacchetta, *et al.* (2007), Moore and Walkes (2010), Cadot, *et al.* (2009), *etc.*

5.2 Research questions, data, and methodology

The emergence of research questions related to this chapter is explained in sub-chapter 4.2.

5.2.1 Research questions and hypotheses

This chapter attempts to find an answer to whether and how different crops' export structure in developing countries affects their growth rate volatility. Because of additional information provided in FAO database I was able to expand my set of sub questions in this chapter. Specifically, because FAO provides information on exports of raw materials as well as exports of processed crops' products I was able to sub-divide each group into processed and unprocessed subgroup. So, my primary question is divided into six sub- questions which are related to exports of plantation/non-plantation crops and their processed and unprocessed parts, perishable/non-perishable crops and their processed and unprocessed parts, processed/unprocessed crops, food/non-food crops, crop groups, and finally different forms of crops exports diversifications.

> **Question 1:** *Is the influence of exports of plantation crops on growth rate volatility different than exports of non-plantation crops and does processing change that influence?*
>
> **Question 2:** *Is the influence of exports of perishable crops on growth rate volatility different than exports of non-perishable crops and does processing change that influence?*
>
> **Question 3:** *Is the influence of exports of processed crops on growth rate volatility different than exports of unprocessed crops?*
>
> **Question 4:** *Is the influence of exports of food crops on growth rate volatility different than exports of non-food crops?*
>
> **Question 5:** *Do different forms of crops' export diversifications influence growth rate volatility differently?*
>
> **Question 6:** *Do different forms of crops' export diversifications influence growth rate volatility differently?*

Below is an overview of variables used in sub-questions associated with this chapter that I want to research. Each main question (*e.g.* plantation and non-plantation crops) regresses share of corresponding explanatory variables on my dependent variable (*i.e.* standard deviation of growth rate volatility)[80]. It also divides each variable into its processed and unprocessed part.

1) Plantation and non-plantation crops:
    a. Share of plantation crops' exports in GDP (ShPLANT(e)),
        i. Share of exports of processed plantation crops in GDP (ShProcPLANT(e)),
        ii. Share of exports of unprocessed plantation crops in GDP (ShUnprocPLANT(e)),
    b. Share of non-plantation crops' exports in GDP (ShNONPLANT(e)),
        i. Share of exports of processed non-plantation crops in GDP (ShProcNONPLANT(e)),
        ii. Share of exports of unprocessed non-plantation crops in GDP (ShUnprocNONPLANT(e))
2) Perishable and non-perishable crops:
    a. Share of perishable crops' exports in GDP (ShPERISH(e)),
        i. Share of exports of processed perishable crops in GDP (ShProcPERISH(e)),
        ii. Share of exports of unprocessed perishable crops in GDP (ShUnprocPERISH(e)),
    b. Share of non-perishable crops' exports in GDP (ShNONPERISH(e)),
        i. Share of exports of processed non-perishable crops in GDP (ShProcNONPERISH(e)),
        ii. Share of exports of unprocessed non-perishable crops in GDP (ShUnprocNONPERISH(e))
3) Processed and unprocessed crops:
    a. Share of processed crops' exports in GDP (ShPROC(e)),
    b. Share of unprocessed crops' exports in GDP (ShUNPROC(e))

[80] Name of explanatory variable is in parenthesis. Letter (e) denotes that the variable refers to crops exports.

4) Food and non-food crops:
    a. Share of food crops in GDP (ShFOOD(e))
    b. Share of non-food crops in GDP (ShNONFOOD(e))
5) Crop groups:
    a. Shares of different crop groups in GDP[81]
6) Agricultural diversification:
    a. Value of Inverted Herfindahl-Hirschman index (from now on Inverted HH) for exports of all agricultural products (InvHHPRODUCT(e)),
    b. Value of Inverted HH index for exports of agricultural groups (InvHHGROUP(e)),
    c. Value of Inverted HH index for two groups; exports of plantation and non-plantation products (InvHHPlant(e)),
    d. Value of Inverted HH index for two groups; exports of perishable and non-perishable products (InvHHPerish(e)),
    e. Value of Inverted HH index for two groups; exports of processed and unprocessed products (InvHHProc(e)),
    f. Value of Inverted HH index for two groups; exports of food and non-food agricultural products (InvHHFood(e)).

Based on literature review as well as educated guessing I can form a number of hypotheses that I then test in this chapter.

The hypotheses associated with the first question are:

Hypothesis 25: *Increased share of exports of plantation crops in GDP increases growth rate volatility*

Hypothesis 26: *Increased share of exports of processed plantation crops in GDP decreases growth rate volatility*

Hypothesis 27: *Increased share of exports of unprocessed plantation crops in GDP increases growth rate volatility*

Hypothesis 28: *Increased share of exports of non-plantation crops in GDP increases growth rate volatility*

[81] Crop groups are: cereals; vegetables; fruits; nuts; coffee, cocoa, tea; spices; oil food crops; other food crops; fibres; rubber; tobacco; other non-food crops (see table A4.5 in the appendix)

Hypothesis 29: *Increased share of exports of processed non-plantation in GDP decreases growth rate volatility*

Hypothesis 30: *Increased share of exports of unprocessed non-plantation crops in GDP increases growth rate volatility*

The hypotheses associated with the second question are:

Hypothesis 31: *Increased share of exports of perishable crops in GDP increases growth rate volatility*

Hypothesis 32: *Increased share of exports of processed perishable crops in GDP decreases growth rate volatility*

Hypothesis 33: *Increased share of exports of unprocessed perishable crops in GDP increases growth rate volatility*

Hypothesis 34: *Increased share of exports of non-perishable crops in GDP decreases growth rate volatility*

Hypothesis 35: *Increased share of exports of processed non-perishable crops in GDP decreases growth rate volatility*

Hypothesis 36: *Increased share of exports of unprocessed non-perishable crops in GDP decreases growth rate volatility*

The hypotheses associated with the third question are:

Hypothesis 37: *Increased share of exports of processed crops in GDP decreases growth rate volatility*

Hypothesis 38: *Increased share of exports of unprocessed crops in GDP decreases growth rate volatility*

The hypotheses associated with the fourth question are:

Hypothesis 39: *Increased share of exports of food crops in GDP increases growth rate volatility*

Hypothesis 40: *Increased share of exports of non-food crops in GDP decreases growth rate volatility*

The hypotheses associated with the fifth question are:

Hypothesis 41: *Increased share of exports of cereals in GDP increases growth rate volatility*

Hypothesis 42: *Increased share of exports of vegetables in GDP increases growth rate volatility*

Hypothesis 43: *Increased share of exports of fruits in GDP increases growth rate volatility*

Hypothesis 44: *Increased share of exports of nuts in GDP decreases growth rate volatility*

Hypothesis 45: *Increased share of exports of coffee, cocoa, and tea in GDP increase growth rate volatility*

Hypothesis 46: *Increased share of exports of spices in GDP decreases growth rate volatility*

Hypothesis 47: *Increased share of exports of oil food crops in GDP decreases growth rate volatility*

Hypothesis 48: *Increased share of exports of other food crops in GDP decreases growth rate volatility*

Hypothesis 49: *Increased share of exports of fibres in GDP decreases growth rate volatility*

Hypothesis 50: *Increased share of exports of rubber in GDP decreases growth rate volatility*

Hypothesis 51: *Increased share of exports of tobacco in GDP decreases growth rate volatility*

Hypothesis 52: *Increased share of exports of other non-food crops in GDP decreases growth rate volatility*

Hypotheses associated with my sixth question are:

Hypothesis 53: *Increased diversification in exports of all crops decreases growth rate volatility*

Hypothesis 54: *Increased diversification in exports of crop groups decreases growth rate volatility*

Hypothesis 55: *Increased diversification in exports between plantation and non-plantation crops decreases growth rate volatility*

Hypothesis 56: *Increased diversification in exports between perishable and non-perishable crops decreases growth rate volatility*

Hypothesis 57: *Increased diversification in exports between processed and unprocessed crops decreases growth rate volatility*

Hypothesis 58: *Increased diversification in exports between food and non-food crops decreases growth rate volatility*

5.2.2 Data

This section provides an overview of data used in the analyses including dependent, control, and explanatory variables as well as interaction variables.

Data for the empirical analyses is comprised of 64 developing countries over the period 1971 – 2010 (lists of developing countries used in my analysis are provided in table A5.1 in the appendix).

Based on questions of my analysis and literature review I collected large number of variables. Table A5.2 in the appendix provide list of variables and data sources, whereas table A5.3 (for my quick analysis) and table A5.4 (for my detailed analysis) in the appendix provide their summary statistics.

5.2.2.1 Choice of countries

The rationale for choosing developing countries as well as time span is the same in previous chapter (see chapter 4.2.2.1).

The final dataset again contains of 64 countries and accounts for years from 1971 – 2010. Both were determined by data availability.

Data on crops' export is collected from Food and Agricultural Organisation of the United Nations (FAO) database, data on growth rate was extracted from United Nations Conference on Trade and Development (UNCTAD) database, data on primary school attendance comes from United Nations Educational, Scientific, and Cultural Organization (UNESCO), data on openness to trade is extracted from The World Bank (WB) and Organisation for Economic Co-operation and Development (OECD) national accounts data files, data on democracy comes from The Center for Systemic Peace (CSP), data on armed conflict comes from Uppsala University and Peace Research Institute Oslo (UCDP/PRIO), and data on exchange rates comes from The Center for International Data (CID).

5.2.2.2 Dependent variable

Dependent variable in this chapter is again standard deviation of the cyclical component of GDP per capita growth rate. See chapter 4.2.2.2 for explanation of its calculation. As in chapter four it is a standard deviation of the cyclical components of detrended GDP per capita growth rate.

5.2.2.3 Control variables

In addition to the control variables used in chapter four (*i.e.* log of GDP per capita, democracy, openness, primary school enrolment, inflation, share of agriculture in GDP, and military conflict) I also use standard deviation of exchange rate as a control variable.

The rationale for inclusion of the primary set of control variables is the same as above and can be found in chapter 4.2.2.3.

Exchange rate

Exchange rate is an additional control variable used in this chapter. Sokolov *et al.* (2011) find that free floating exchange regime decrease growth rate volatility while Karras and Song (1996) find that exchange rate variability relates positively to output volatility. Bleaney and Greenaway (2001) studying 14 sub-Saharan countries find real exchange rate instability decreasing investment. Bailey (1987) found that exchange rate volatility increases exports while Yougbare (2008) finds that pegged exchange systems strengthen the negative effects of growth volatility. Although the results of scientific research in the influence of exchange rate variable are mixed I will, based on Sokolov *et al.* (2011) include exchange rate volatility (standard deviation of exchange rate) as my control variable and estimate that its higher volatility will have negative effect on growth rate volatility.

5.2.2.4 Explanatory variables

Based on my research questions stated above I use six different groups[82] whose influence on growth volatility I want to explore in this chapter.

Plantation and non-plantation crops

My first question is trying to determine whether export of plantation crops influences growth rate volatility differently than export of non-plantation crops. For that purpose I divide exports of crops products into two subgroups; namely plantation and non-plantation crops. I than sum up export values of all products[83] in each subgroups and calculate their share in GDP. Additionally I divide each subgroup into two additional groups based on whether products are the result of processing or not. By doing that I can see in more detail how each of these groups contributes to growth rate volatility. Plantation crops are the same as in chapter four and are listed in table A5.5 in the appendix.

[82] Table A5.5 in the appendix presents crop groups for chapter five

[83] In each subgroup I include the original crop as well as all processed products of that crop.

Perishable and non-perishable crops
I use similar procedure while testing my second question of the chapter however I divide crops based on whether they are perishable or non-perishable as well as whether they are processed or not. In the first instance (perishable and non-perishable subgroups) products included are processed and unprocessed alike. By summing up export values in each subgroup I am then able to calculate their respective shares in GDP. As in chapter four I follow Food and Agriculture Organization of the United Nations (2011, p. 357) to decide whether crop is perishable crops or non-perishable.

Processed and unprocessed crops
Because of data availability I was able to include my third question which explores different effects of processed and unprocessed crops exports on growth rate volatility. Again, I divide my crops products into two groups based on whether particular product has been at least partially processed or not and then using the same procedure as before to obtain shares of processed and unprocessed crops exports in GDP.

Food and non-food agricultural products
The fourth question is analysing whether food crops are influencing growth rate volatility differently than non-food crops. For the purpose of this analysis I split my data into food crops and non-food crops and calculate respective share in GDP.

Crop groups – export
The fourth question analyses whether different crop groups influence growth rate volatility differently. In this case I split data into twelve different food groups: cereals; vegetables; fruits; nuts; coffee, cocoa, and tea; spices, other food crops; fibres; oil crops; rubber; tobacco; and other non-food crops. I again calculate individual's export share in GDP.

Diversification
As in chapter four I use Herfindahl-Hirschman Index (1950) to calculate diversification variables (see chapter 4.2.2.4 for calculation). To obtain a more detailed understanding of the influences of diversification I use six different diversification variables; i) diversification of exports in all available products, ii) diversification in product groups, and additionally how split between iii) plantation and non-plantation products, between iv) perishable and non-perishable products, between v) processed and non-processed products, and between vi) food and non-food products influence growth rate volatility.

To avoid confusion in interpretation I again use inverted HH index (*i.e.* HH index value multiplied by minus 1). Interpretation of gained coefficients will result in clearer understanding (*e.g.* negative value of the coefficient will indicate growth rate volatility decreasing effect of increased diversification of corresponding variable).

5.2.3 Methodology and methods

5.2.3.1 Methodology

As in chapter four I use econometric analysis to estimate if and what kind of effects crops' export structure has on growth rate volatility.

5.2.3.2 Methods

This part is based on the same considerations as chapter four of this thesis. Because of that I will not repeat the same but refer the reader to chapter 4.2.3.2 for its justification. However, where required I will provide necessary inputs.

5.2.3.2.1 Panel data

Because I again collected a large number of variables for 64 different countries from 1971 until 2010 my data falls into the panel data category. The dataset is again balanced.

5.2.3.2.2 Pre-tests

As in chapter four I have to run some pre-analysis tests on my variables in order to determine which method to use in my econometric analyses. These tests are the same as in chapter four and include unit root test, autocorrelation tests, multicollinearity, *etc.*

Unit root test

Table A5.6 in the appendix provides results of unit root tests for all my variables used in this chapter. The first thing to notice is that none of the variables in my dataset has unit root. However, when ADF and ADF-GLS were not able to run the analysis (they treated some variables, especially crop groups as constant) I could only obtain results for LLC test. All the results are statistically significant at one percent level

Multicollinearity

Table A5.7 in the appendix provides correlation matrix for my independent variables used in this chapters. Some of the pairwise correlation values are high indicating that two variables are correlated to a high degree. However as this test only indicates at possible multicollinearity problems additional tests are needed to determine whether multicollinearity really exists.

The limitation of the correlation matrix (*i.e.* bivariate relationship) is often overcome by the use variance inflation factor (VIF) which is a ratio of variance in a multi variable model divided by the variance of a one variable model; see *e.g.* Allison (1999, pp. 48 - 50)). Results of this test can be found in A5.8 in the appendix

Although correlation matrix indicated some multicollinearity problems VIF test of my variables suggests there is no serious multicollinearity present in my dataset. The highest VIF value shows for inverted HH group index (value of 6.008) and only when all diversification variables are included in my analysis. In all other cases, VIF values are below 5.0. Some researchers suggest VIF value of 5.0 as a cutoff point for confirming multicollinearity in the dataset others suggest VIF cut-off value of 10.0; see also *e.g.* Friedrich (1982), Kutner, *et al.* (2004), Stevens (2009), *etc.*

Belsley, Kuh, and Welsch (1980) which is based on condition number test is another multicolliearity test. In this test condition number exceeding 10 indicates moderate multicollinearity whereas values above 100 indicate serious multicollinearity; see Belsley, *et al.* (1980). If in addition to the higher value of condition number two or more of the variables have large values multicollinearity is present. Table A5.9 in the appendix provides results for Belsley, Kuh, and Welsch test for my variables for chapter five. There usually are three bottom rows with value condition number higher than 10 but all values are below 100. I can again conclude that ther is no serious multicollinearity present in my data.

Autocorrelation

Test of errors for independence (so called Durbin-Watson test) provides significance criterion to test for autocorrelation in my data. If present, autocorrelation violates the assumption of instance independence.

To test for the presence of autocorrelation in my dataset I ran ordinary least square or OLS panel data regressions as well as panel regressions with fixed and random effects. I used F-test for individual effects (F = 6.536, df1 = 63, df2 = 2495, p-value < 2.2e-16), Breusch-Pagan test (LM = 260.523, p-value = 4.378e-60) indicated that random effects model is superior to pooled OLS model, and Hausman test (1978) (chisq. = 0.0013, df = 1, p-value = 0.972) and determined that fixed effect panel data regression gives best estimates. Panel Durbin Watson test for fixed effect model gives d statistics value of d = 1.467 with p-value < 2.2e-16. The result indicates that alternative hypothesis is correct and that there is serial correlation in idiosyncratic errors.

Heteroscedasticity

In regard to the heteroscedasticity the fact that I have dynamic panel data and therefore use GMM (generalised method of moments or Arellano-Bond) estimator for my analysis unknown heteroscedasticity is not problematic; see *e.g.* Arellano (2003)[84], Soto (2009). Breusch-Pagan test for heteroscedasticity run on the results of a random effects estimator using only lagged dependent variable as explanatory variable returns: Asymptotic test statistics: Chi-square (df = 1) = 44.142 with p-value = less than 0.0000 (null hypothesis is: Variance of the unit-specific error = zero).

5.2.3.2.3 Method used in this analysis

The choice of appropriate method is based on the structure of the data as well as on pre-tests for autocorrelation and heteroscedasticity. Panel data with confirmed autocorrelation means that my panel data is dynamic. The dynamic nature of my panel data requires dynamic panel data analysis tools such as Anderson-Hsiao (*i.e.* IV) or Arellano-Bond (*i.e.* GMM) estimator.

The decision between Anderson-Hsiao (*i.e.* IV) or Arellano-Bond (*i.e.* GMM) estimator should also be based on heteroscedasticity test. When there is no heteroscedasticity present IV estimator might be preferable because it has better finite sample performance. On the other hand when heteroscedasticity is confirmed then GMM estimator should be used because its results are consistent (even when there is no heteroscedasticity present GMM is asymptotically no worse than IV estimator).

Based on the nature and structure of my data I chose generalised method of moments (*i.e.* Arellano-Bond or GMM) estimator as my analysis method.

5.2.3.2.4 Auxiliary tests

There are three auxiliary test statistics provided when running GMM estimation in Gretl (Cottrell & Lucchetti, 2018): i) two tests for autocorrelation (first- and second-order AR), ii) Sargan test for overidentification, and iii) Wald test for joint significance of the regressor.

[84] See Appendix A to the book. Also available online as class notes at: https://www.cemfi.es/~arellano/gmm-estimation.pdf (last accessed November 2018)

5.3 Analysis

This part of the chapter will provide the analysis. In the beginning I will conduct a short analysis dubbed first look. It will indicate the influences of my explanatory variables on growth rate volatility. The second part contains an in depth analysis of my dataset.

5.3.1 First look

The first look plots average values of crops production and export share in GDP and all of my explanatory variables against average growth rate volatility. In figure 23 I explore the influence of average share of agriculture in GDP (AVAgPrShGDP) (23a), average share of crops in GDP (AVCrPrShGDP) (23b), average share of agricultural exports in GDP (AVAgExShGDP) (23c) and average share of crops exports in GDP (AVCrExShGDP) (23d) on average growth rate volatility (AVGrVol).

This simple analysis suggests that higher share of agriculture in GDP increases growth rate volatility. The result is expected because share of agriculture is often used as a proxy for country's development level since share of agriculture in GDP declines with increased development level. At the same time, growth rate volatility declines with higher development level. From this then logically comes that higher share of agriculture in GDP would suggest lower development level and therefore higher growth rate volatility.

Similarly, we could argue for share of crops in GDP. Although the value of the coefficient is low it is still positive suggesting higher growth rate volatility with higher share of crops in GDP.

Figures 23c and 23d look at shares of exports of agricultural and crops products in GDP respectively. In both cases higher share results in lower growth rate volatility. The value of the coefficients suggests that the influence of exports of agricultural products (including livestock, fish and forestry products) is smaller than that of crops alone. This might suggest that other agricultural products (*i.e.* livestock, fish and forestry) may have opposite (or at least lower growth rate volatility decreasing) effect on growth rate volatility compared to crops. In regard to this thesis I have to stress out two points; first, my research focuses on crops exports and does not analyses the effects of livestock, fish and forestry exports on growth rate volatility, and second, data for exports of agricultural products and crops products include raw materials as well as processed materials. Nevertheless, figures 23a and 23b indicate positive relationship

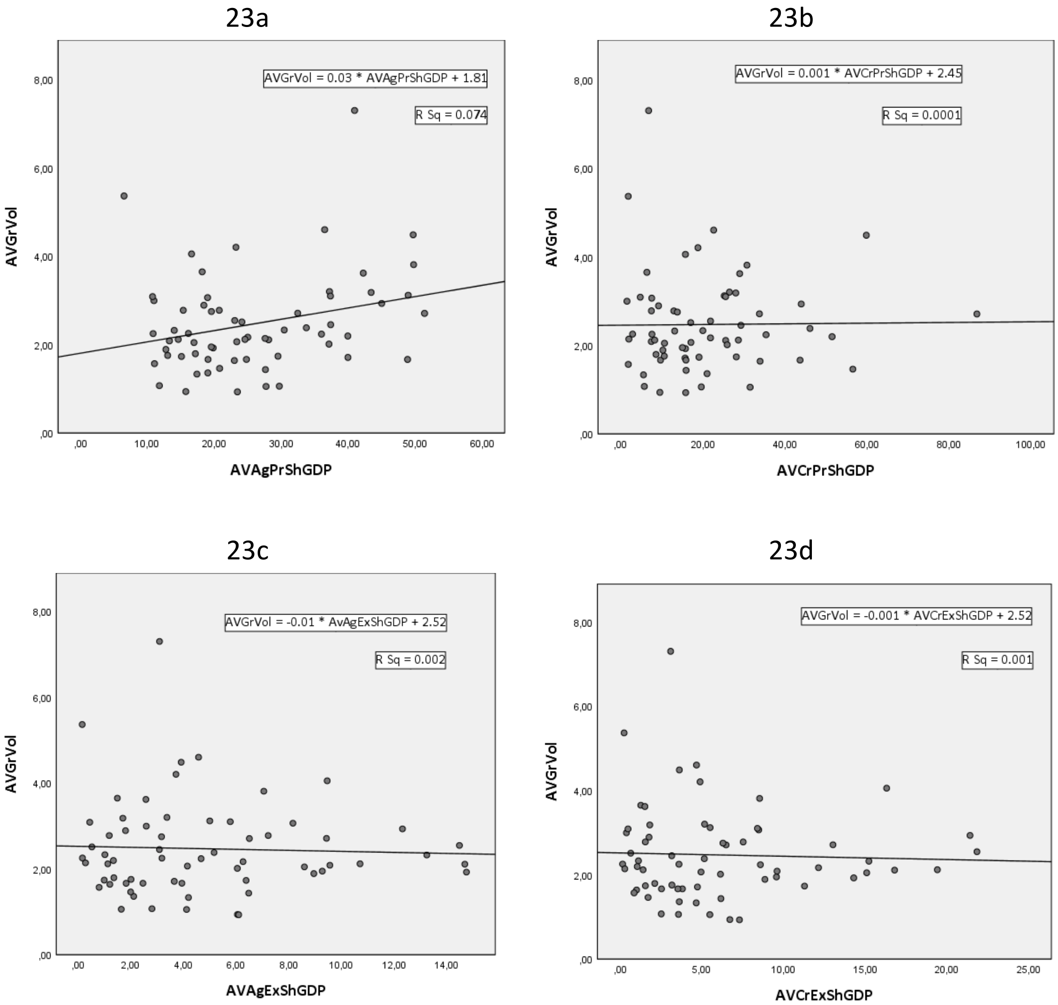


Figure 23: Average shares of agriculture production in GDP (AVAgPrShGDP) – 23a, crops production in GDP (AVCrPrShGDP) – 23b, agricultural exports in GDP (AVAgExShGDP) – 23c, and crops exports in GDP (AVCrExShGDP) – 23d as a function of average standard deviation of GDP per capita growth rate (AVGrVol) from 1971 to 2010
Source: author's own calculations

between shares of agriculture and crops in GDP and growth rate volatility and negative relationship between growth rate volatility and share of exports of agriculture in GDP as well as share of exports of crops in GDP.

I will now proceed with the same type of simple analysis for other explanatory variables on growth rate volatility. My explanatory variables fall within the five questions stated above[85], namely differing influences on growth rate volatility of exports of plantation and non-plantation crops (figure 24), of perishable and non-perishable crops (figure 25), of processed and unprocessed crops (figure 26), and of food and non-food crops (figure 27) as well as the influence of crops diversification (figure 28).

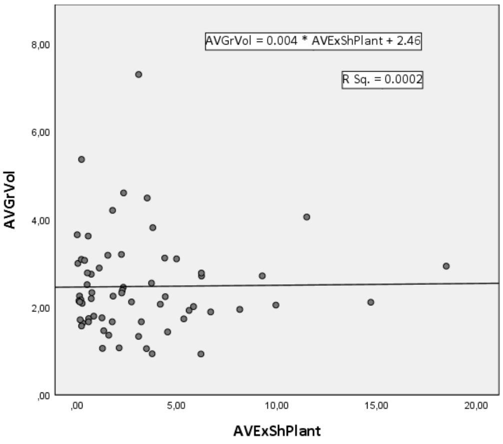
[85] First look does not plot shares of crop groups exports in GDP on growth rate volatility

Figure 24 plots average share of plantation crops exports in GDP (AVShPLANT(e)) and average share of non-plantation crops exports in GDP (AVShNONPLANT(e)) as well as data split into processed and unprocessed subgroups of corresponding plantation/non-plantation groups as a function of average standard deviation of growth rate volatility (AVGrVol) from 1971 to 2010.

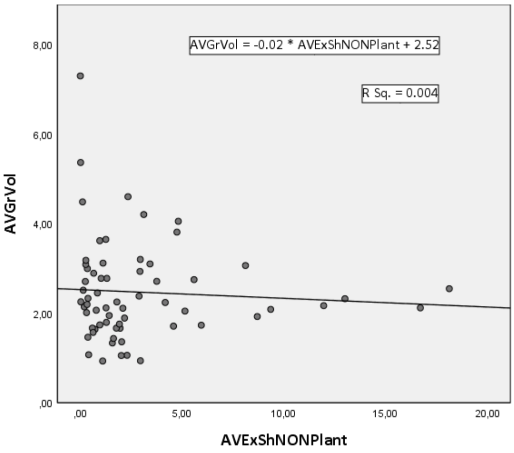
We can observe that average growth rate volatility decreases with increasing average share of non-plantation crops exports in GDP as well as their processed and unprocessed forms. On the other hand growth rate volatility increases with increasing share of plantation crops exports in GDP (and both of its sub-groups). The influence of plantation crops exports on growth rate volatility is unexpected and not in-line with my reasoning above. I argue that plantation crops are mostly non-perishable which should reduce price volatility and consequently growth rate volatility. In addition plantation crops require at least minimal processing after harvesting it is quite likely that processing results in additional products as well as higher added value. Broader set of plantation products (*i.e.* individual crops diversified in more products) also increases diversification of the sector therefore help reduce income volatility resulting in lower growth rate volatility. On the other hand decreasing effect of non-plantation crops which in majority of cases are perishable should result in increased growth rate volatility. Although processed non-plantation crops should be less detrimental, unprocessed non-plantation crops should yield the most sever results on growth rate volatility. Surprisingly this simple analysis indicates that all forms of non-plantation crops have growth rate volatility decreasing effect.

Figure 25 plots average share of perishable crops exports in GDP (AVShPERISH(e)) and average share of non-perishable crops exports in GDP (AVShNONPERISH(e)) as well as corresponding splits into processed and unprocessed subgroups as a function of average standard deviation of growth rate volatility (AVGrVol) from 1971 to 2010.

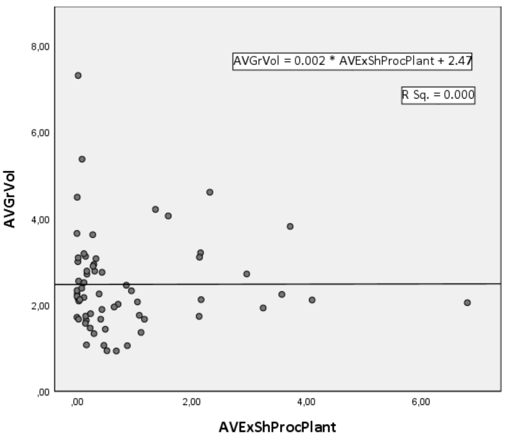
24a



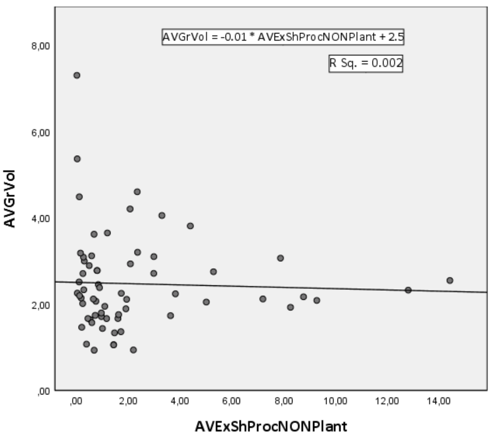
24b



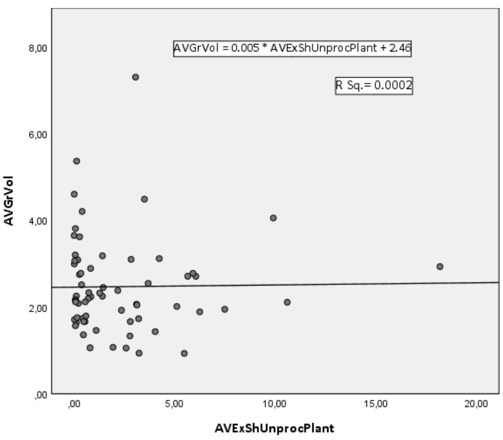
24c



24d



24e



24f

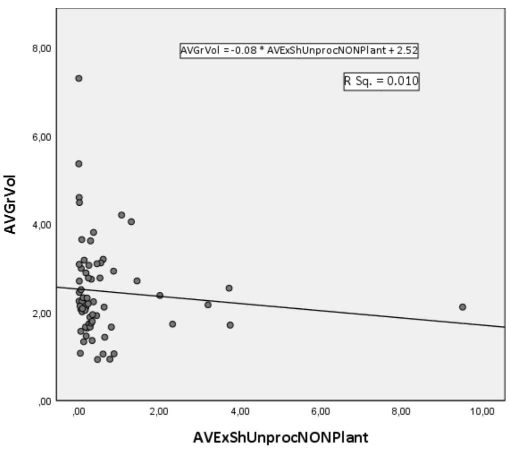


Figure 24: Average shares of plantation crops exports in GDP (AVExShPlant) – 24a, non-plantation crops exports in GDP (AVExShNONPlant) – 24b, processed plantation crops exports in GDP (AVExShProcPlant) – 24c, processed non-plantation crops exports in GDP (AVExShUnprocNONPlant) – 24d, unprocessed plantation crops exports in GDP (AVExShUnprocPlant) – 24e, and unprocessed non-plantation crops exports in GDP (AVExShUnprocNONPlant) – 24f as a function of average standard deviation of growth rate volatility (AVGrVol) from 1971 to 2010
Source: author's own calculations

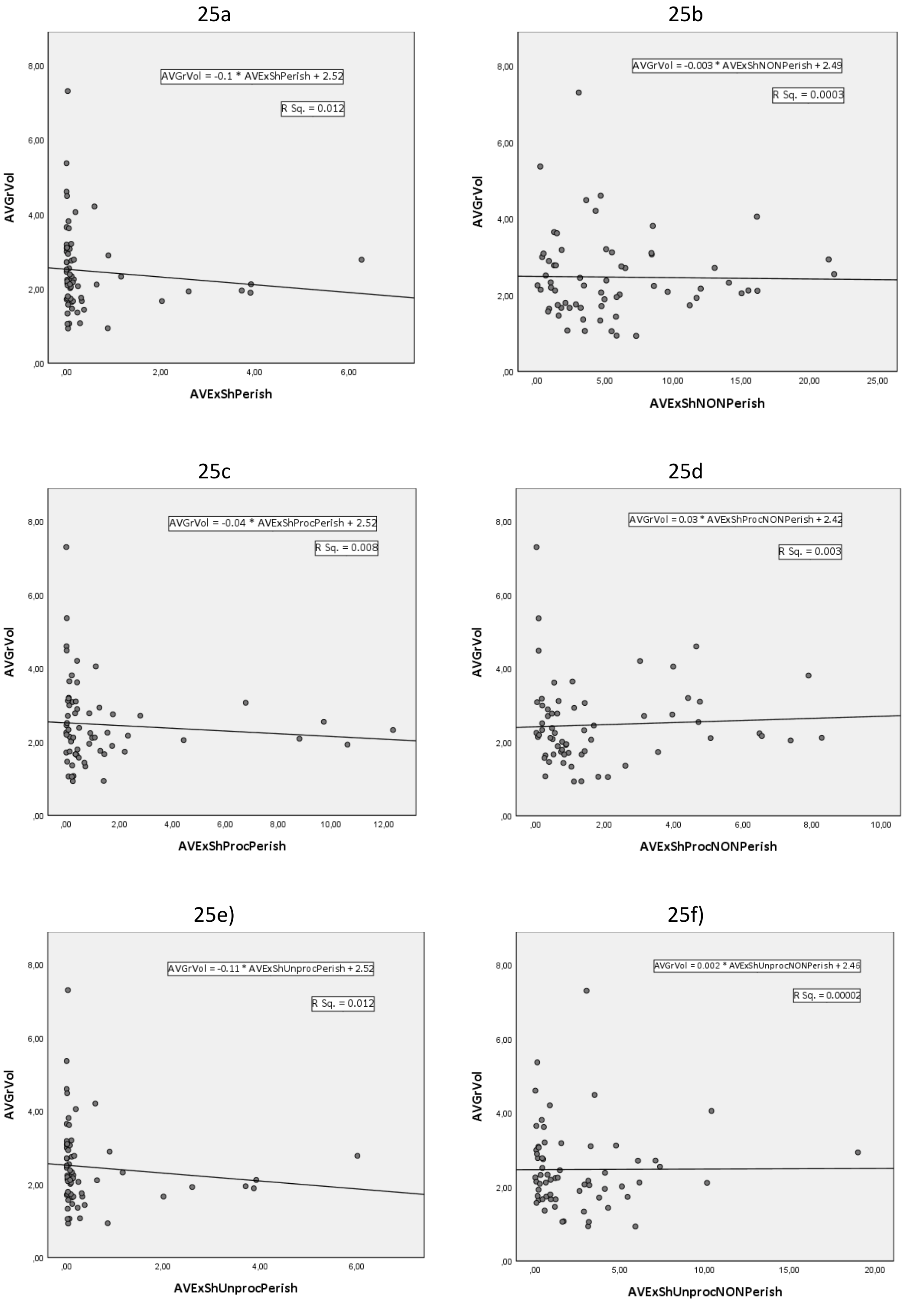


Figure 25: Average shares of perishable crops exports in GDP (AVExShPerish) – 25a, processed perishable crops exports in GDP (AVExShProcPerish) – 25b, unprocessed perishable crops exports in GDP (AVExShUnprocPerish) – 25c, non-perishable crops exports in GDP (AVExShNONPerish) – 25d, processed non-perishable crops exports in GDP (AVExShProcNONPerish) – 25e, and unprocessed non-perishable crops exports in GDP (AVExShUnprocNONPerish) – 25f as a function of average standard deviation of growth rate volatility (AVGrVol) from 1971 to 2010
Source: author’s own calculations

We can observe declining growth rate volatility for increasing export shares of both perishable and non-perishable crops in GDP with perishable crops having stronger effect.

Based on my reasoning, the result for perishable crops is counterintuitive. I expected to see growth rate volatility to increase with increased share of perishable crops exports in GDP. I also expected to see processing of perishable crops to decrease the expected detrimental effect of perishable crops. Based on figure 25c we can observe that processing indeed results in better results in regard to growth rate volatility effect of perishable crops since its coefficient is of higher absolute value than that of either perishable crops as well as unprocessed perishable crops subgroup (figure 25e).

Although result for the effects of non-perishable crops exports on growth rate volatility is in line with my expectations, results for unprocessed and particularly processed non-perishable crops are not.

I expected to see some positive (*i.e.* growth rate volatility declining) influence of processed non-perishable crops exports since transformation makes them non-perishable and at the same time diversifies products. However, my quick analysis indicates that processing of non-perishable crops results in even worse results in relation to growth rate volatility than exporting unprocessed non-perishable crops (figures 25d and 25f). According to my reasoning processing increases number of products exported and also adds value. Increasing growth rate volatility with increasing share of unprocessed non-perishable crops is again a bit troublesome. Although they are unprocessed, non-perishable crops can still be held in storage and sold when export market prices are high and do not necessitate their sales as is the case with perishable crops. We would expect their influence to be smaller than that of processed non-perishable crops we would nevertheless expect them to have decreasing effect on growth rate volatility. However, we can observe that the fitting line is relatively flat and the result may change when I switch from the analysis of averages to the analysis of the full data set later in this chapter.

Figure 26 plots average share of processed crops exports in GDP (AVShPROC(e)) and average share of unprocessed crops exports in GDP (AVShUNPROC(e)) as a function of average standard deviation of growth rate volatility (AVGrVol) from 1971 to 2010.

Surprisingly, quick analysis in figure 26 indicates that in both cases higher average shares in GDP decrease average growth rate volatility.

The results are again mixed in relation to my expectations. Although I was expecting to get negative relationship between processed crops exports and growth rate volatility I was also expecting to get positive relationship between exports of unprocessed crops and growth rate volatility. Surprisingly, even exports of unprocessed crops decrease growth rate volatility.

26a 26b

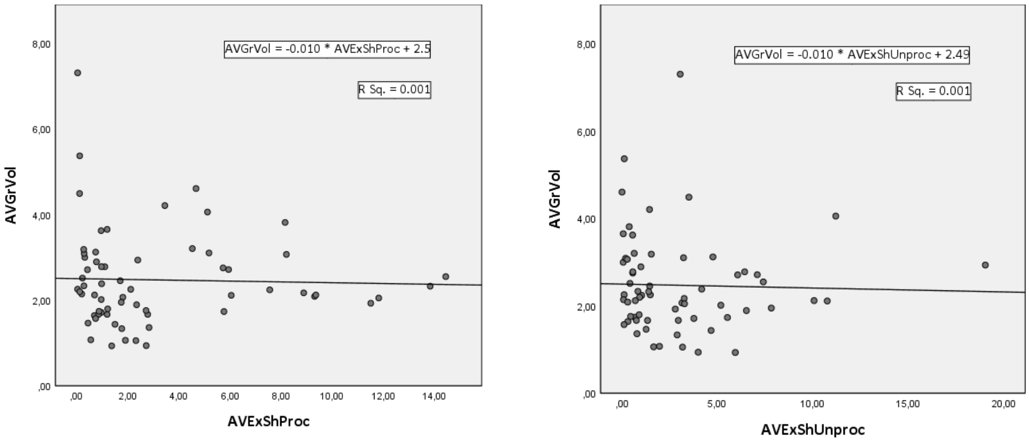


Figure 26: Average shares of processed crops exports in GDP (AVExShProc) – 26a and unprocessed crops exports in GDP (AVExShUnproc) – 26b as a function of average standard deviation of GDP per capita growth rate (AVGrVol) from 1971 to 2010
Source: author's own calculations

Figure 27 shows plots of average shares of food crops exports (AVShFOOD(e)) and non-food crops exports (AVShNonFOOD(e)) on average growth rate volatility (AVGrVol).

Plot 27a indicates growth rate volatility decreasing effect of higher share of food crops exports in GDP. On the other hand, increased share of non-food crops exports in GDP increases growth rate volatility. I was expecting to see negative effects of both groups on growth rate volatility.

Finally, figure 28 includes quick analysis of diversification on growth rate volatility. I explore five different types of diversification: diversification in exports of all products (AVInvHHProduct), diversification in exports of product groups (AVInvHHGroup(e)), diversification between exported perishable and non-perishable crops (AVInvHHPerish(e)), diversification between exported plantation and non-plantation crops (AVInvHHPlant(e)), diversification between exported processed and unprocessed crops exports (AVInvHHProc(e)), and diversification between exported food and non-food crops (AVInvHHFood(e)).

27a) 27b)

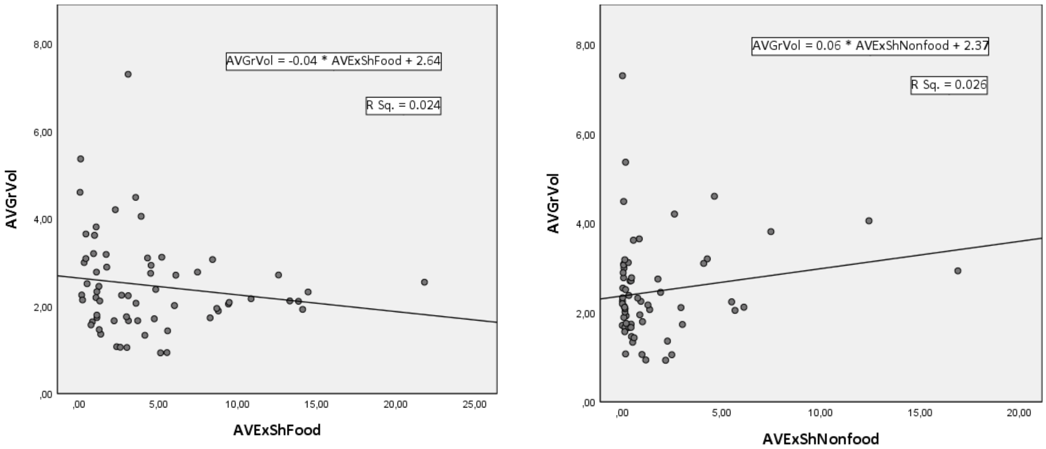


Figure 27: Average shares of food crops exports in GDP (AVExShFOOD) – 27a and non-food crops exports in GDP (AVExShNonFOOD) – 27b as a function of average standard deviation of GDP per capita growth rate (AVGrVol) from 1971 to 2010
Source: author's own calculations

In figure 28a we can see that in every subgroup that I analysed higher diversification leads to lower growth rate volatility. We can also observe that diversification in crops groups (*e.g.* vegetables, fruits, oil, *etc.*) – 28b results in the highest growth rate volatility reducing effect. The second diversification with the highest effect on reducing growth rate volatility is diversification in general (*i.e.* all products) – 28a. Processed and unprocessed diversification has similar effect as diversification in plantation and non-plantation crops followed by diversification in perishable and non-perishable crops results in the smallest drop in growth rate volatility. The smallest drop in growth rate volatility is observed in diversification between food and non-food crops – 28f. All the results confirm the influence of diversification on growth rate volatility. Mobarak (2005), Moore and Walkes (2010), Papageorgiou, *et al.*, (2015) and many others found that higher diversification of the economy leads to lover volatility however to the best of our knowledge no other research has analysed the influence of crops export diversification on growth rate volatility.

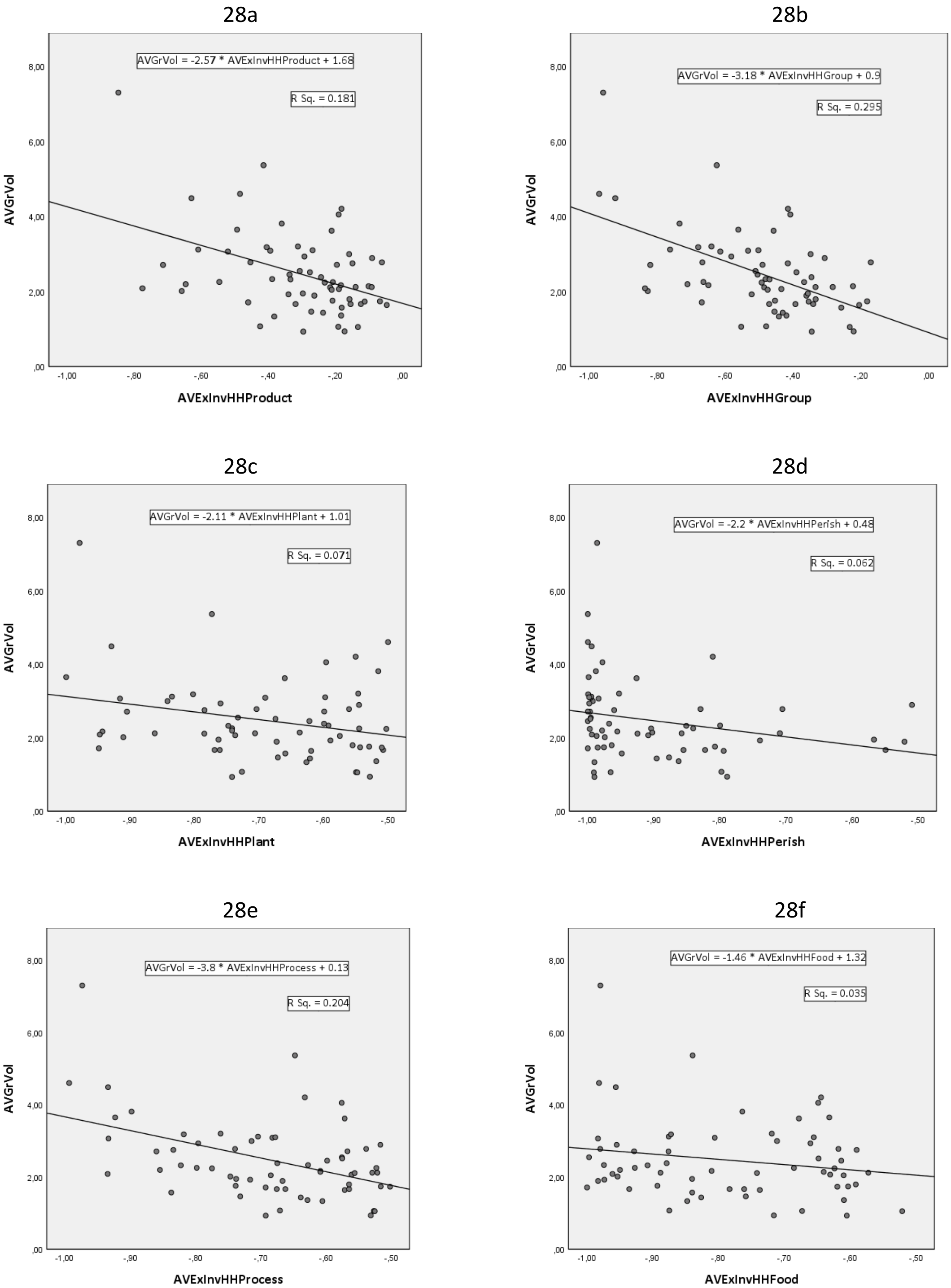


Figure 28: Average values of Inverted Herfindahl-Hirschman indices for exports of all agricultural products (AVHHPRODUCT) – 28a, agricultural groups (AVHHGROUP) – 28b, plantation and non-plantation crops (AVHHPLANT) – 28c, perishable and non-perishable crops (AVHHPERISH) – 28d, and processed and non-processed crops (AVHHPROCES) – 28e and f as a function of average growth rate volatility (AVGrVol) from 1971 to 2010
Source: author's own calculations

5.3.2 In depth analysis

This chapter will conduct a more thorough analysis of the influence of different agricultural crops on growth rate volatility. As in chapter four it is obvious that additional factors are influencing the growth rate volatility therefore I have to include them in my analysis. Scientific research found a large set of factors and it is not possible or practical to include them all in the analysis. I will follow the usual approach and include a number of most influential factors as control variables and run them in conjunction with my explanatory variables to establish whether the relationship observed in first look at the data above is preserved once control variables are included.

5.3.2.1 Lagged dependent variable

Pre-test showed presence of autocorrelation in my dataset. To test the importance of the lagged dependent variable I will run the regression analysis that includes only this variable. Table 55 below shows the result of this analysis. Although I have to include lagged dependent variable in my regression analyses the variable on its own is not significant.

Table 55: GMM estimates for lagged dependent variable on growth rate volatility

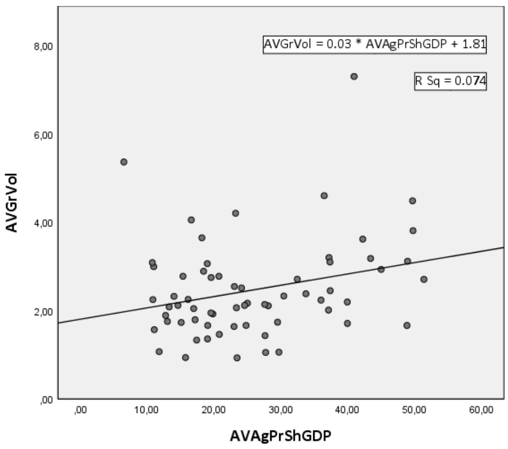
	(1)
Constant	2.514***
	(11.990)
Lag_1GrVol	-0.026
	(-0.300)
Sum of sq. res.	28248.18
S.E. of regression	3.619
No. of countries	64
No. of observations	2496
No. of instruments	77
Arellano-Bond test AR(1)	-3.105
AR(1) p-value	0.002
Arellano-Bond test AR(2)	-0.150
AR(2) p-value	0.881
Sargan test df	75
Sargan test Chi-sq.(df)	60.588
Sargan test Chi-sq p-value	0.886
Wald (joint) test df	1
Wald (joint) test Chi-sq.(df)	0.090

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

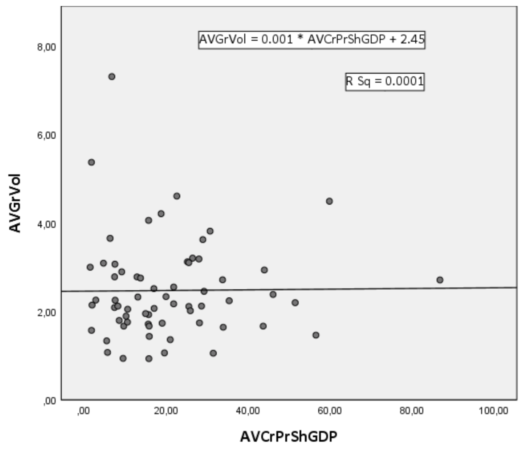
5.3.2.2 Agriculture and crops

My next step in the analysis will explore whether production and export shares of agriculture and crops in GDP significantly influence growth rate volatility.

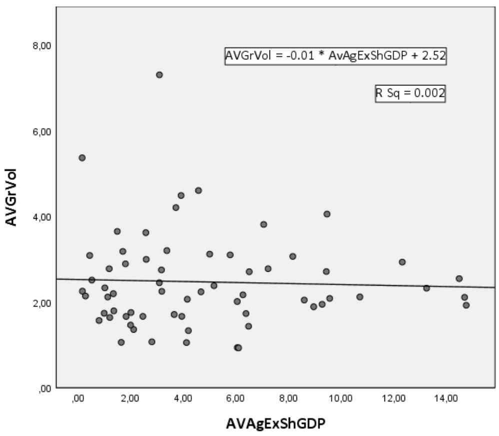
23a



23b



23c



23d

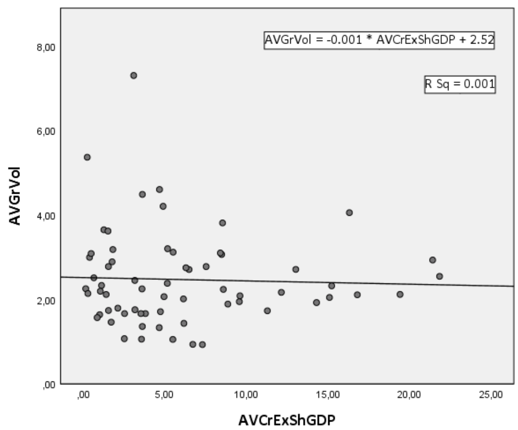


Figure 23 in my quick analysis above showed that higher shares of both agriculture and crops in GDP increase growth rate volatility whereas higher shares of exports of both agriculture and crops in GDP decrease growth rate volatility.

My detailed analysis presented in table 56 shows that neither of the variables tested is significant.

Share of agriculture in GDP is often used as a proxy for economic development with lower share of agriculture in GDP in more developed countries; see *e.g.* Anderson (1987), Bugamelli and Paterno (2008), van Arendonk (2015).

Table 56: GMM estimates for shares of production and exports of agriculture and crops in GDP on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	2.458***	3.373***	2.424***	2.500***
	(6.090)	(9.067)	(9.898)	(9.739)
Lag_1GrVol	-0.147	-0.156*	-0.026	-0.028
	(-1.521)	(-1.668)	(-0.307)	(-0.320)
AgPrShGDP	0.020			
	(1.444)			
CrPrShGDP		-0.022		
		(-1.631)		
AgExShGDP			0.813	
			(0.392)	
CrExShGDP				-0.228
				(-0.131)
Sum of sq. res.	32006.84	32223.26	28280.15	28308.43
S.E. of regression	3.566	3.552	3.619	3.616
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	78	78	78	78
Arellano-Bond test AR(1)	-2.574	-2.575	-3.093	-3.085
AR(1) p-value	0.010	0.010	0.002	0.002
Arellano-Bond test AR(2)	-0.062	-0.137	-0.155	-0.166
AR(2) p-value	0.951	0.891	0.876	0.868
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	61.902	62.168	58.919	59.119
Sargan test Chi-sq p-value	0.861	0.855	0.914	0.911
Wald (joint) test df	2	2	2	2
Wald (joint) test Chi-sq.(df)	3.112	7.761**	0.183	0.160

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Nelson and Plosser (1982), Lucas (1988), Tamirisa (1999), Wolf (2004), Mobarak (2005), Koren and Tenreyro (2007)Imbs (2007) and many others showed that developed countries have lower growth rate volatilities than developing ones.

5.3.2.3 Control variables

Table 57 shows regression analysis of all of my control variables in addition to the lagged dependent variable. Table A5.10 in the appendix holds results for the regression of each of the control variables separately.

Taken individually there are four significant control variables: democracy which is significant at one percent level with negative sign, inflation significant at ten percent level with positive sign, share of agriculture in GDP significant at five percent level and also having positive sign, and standard deviation of exchange rate which is significant at five percent level having negative sign.

When I include all of them in my regression analysis there are five significant variables: democracy, openness, inflation, share of agriculture in GDP, and standard deviation of exchange rate. Democracy is significant at one percent level and its coefficient has negative sign. Negative sign indicates that, ceteris paribus, growth rate volatility decreases with increased value of the variable. Democracy variable in my analysis is a general variable that measures quality of institutions. Higher quality institutions have been shown to play an important role in reduction of growth rate volatility; see *e.g.* Acemoglu, *et al.* (2001), Dollar and Kraay (2003), Easterly and Levine (2003).

Openness has positive sign and its significance level is five percent. Positive sign indicates that with more open economy growth rate volatility increases. Openness to trade exposes economy to external shocks while insulating it from internal ones; see *e.g.* Easterly, *et al.* (2000), *etc.*

Inflation coefficient also has positive sign and is significant at five percent level. The result suggests that as inflation increases so does growth rate volatility. Higher inflation which is used as a measure of shocks was found to increase GDP per capita growth rate volatility; see *e.g.* Judson and Orphanides (1999), Mobarak (2005). The result is therefore in line with previous research as well as my expectations.

Share of agriculture in GDP has positive sign and is significant at five percent level (see also chapter 5.3.2.2). Its positive sign indicates that higher share of agriculture in GDP results in higher growth rate volatility.

In my research standard deviation of exchange rate is significant at one percent level with coefficient having negative sign. Many authors conducted research on the influence of exchange rate volatility; see *e.g.* Sokolov *et al.* (2011), Karras and Song (1996), Bleaney and Greenaway (2001), Bailey (1987), Yougbare (2008), *etc.* but their results are not conclusive and are often contradictory.

Although I expected to see higher growth rate volatility with higher standard deviation of exchange rate negative sign of the coefficient indicates that growth rate volatility decreases with increased value of the variable. However I have to point out that although the coefficient has negative sign, when using original value of the SD of exchange rate its value is very low (-0.000218 when taken individually and -0.000470 when included with other control variables)[86].

Table 57: GMM estimates for all my control variables on growth rate volatility

	(1)
Constant	-6.400
	(-1.459)
Lag_1GrVol	-0.074
	(-0.923)
lnGDP	0.466
	(1.217)
Democracy	-1.260***
	(-2.959)
Openness	1.059**
	(2.336)
Schooling	-0.002
	(-0.323)
INFL	0.091**
	(2.190)
WAR	-0.056
	(0.112)
AgPrShGDP	0.055**
	(2.009)
SDExchRate	-0.464***
	(-2.597)
Sum of sq. res.	33879.84
S.E. of regression	3.902
No. of countries	64
No. of observations	2496
No. of instruments	85
Arellano-Bond test AR(1)	-3.189
AR(1) p-value	0.001
Arellano-Bond test AR(2)	-0.838
AR(2) p-value	0.402
Sargan test df	75
Sargan test Chi-sq.(df)	54.641
Sargan test Chi-sq p-value	0.963
Wald (joint) test df	9
Wald (joint) test Chi-sq.(df)	57.923***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

All other control variables have no significant effects on growth rate volatility.

[86] To avoid writing its value as -0.000 I divided SD exchange rate variable by 1000 so that the coefficient value in the regression analysis reads for example as -0.464 when all control variables are included. Overall the significance levels and test results remain more or less the same.

5.3.2.4 Plantation and non-plantation crops

After establishing the effects of my control variables I am now moving to the heart of research of this chapter. I started this part of the analysis by including variables that are important for my first question into the regression analysis (*i.e.* in addition to my control variables).

The explanatory variables included in the regression analysis are share of plantation crops exports in GDP (*ShPLANT*(e)), share of non-plantation crops exports in GDP (*ShNONPLANT*(e)), as well as shares of their processed and unprocessed parts (ShProcPLANT(e), ShUnprocPLANT(e), ShProcNONPLANT(e), and ShUnprocNONPLANT(e)) exports in GDP.

Table 58 below provides results of the analyses. The table provides only the results for two regressions, one with plantation and non-plantation crops (column 1) and another one with processed and unprocessed parts of both plantation and non-plantation crops included (column 2). Table A5.11 in the appendix provides results for each of the explanatory variables connected to this question.

Previous chapter established that share of produced plantation crops in GDP has significant (at five percent level) growth rate volatility decreasing effect. In addition it established that higher relative share of non-plantation crops in GDP to that of plantation crops increases growth rate volatility (coefficient has positive value and is also significant at five percent level).

Interaction term between share of produced plantation crops in GDP and openness is statistically not significant.

My quick analysis (see figure 19) indicated that higher share of exports of plantation crops in GDP increases growth rate volatility whereas higher share of exports of non-plantation crops in GDP decreases it.

My analysis in this chapter showed that none of my explanatory variables associated with the first question are significant (even when I remove constant term).

Table 58: GMM estimates for all my control variables and shares of plantation and non-plantation crops exports in GDP as well as their processed and unprocessed parts on growth rate volatility

	(7)	(8)
Constant	-7.732*	-7.833
	(-1.665)	(-1.601)
Lag_1GrVol	-0.082	-0.081
	(-1.020)	(-1.024)
lnGDP	0.533	0.494
	(1.432)	(1.317)
Democracy	-1.232***	-1.298***
	(-2.868)	(-2.862)
Openness	1.259*	1.281*
	(1.883)	(1.812)
Schooling	-0.002	0.001
	(-0.291)	(0.071)
INFL	0.090**	0.089**
	(2.039)	(2.161)
WAR	-0.002	-0.008
	(-0.004)	(-0.018)
AgPrShGDP	0.068**	0.070**
	(2.214)	(2.081)
SDExchRate	-0.509***	-0.585**
	(-2.789)	(-2.387)
ShPLANT(e)	-4.680	
	(-0.623)	
ShProcPLANT(e)		7.594
		(0.268)
ShUnprocPLANT(e)		-9.248
		(-0.743)
ShNONPLANT(e)	-0.673	
	(-0.081)	
ShProcNONPLANT(e)		-1.508
		(-0.163)
ShUnprocNONPLANT(e)		8.860
		(0.327)
Sum of sq. res.	33856.58	33746.13
S.E. of regression	3.891	3.892
No. of countries	64	64
No. of observations	2496	2496
No. of instruments	87	89
Arellano-Bond test AR(1)	-3.194	-3.213
AR(1) p-value	0.001	0.001
Arellano-Bond test AR(2)	-0.893	-0.924
AR(2) p-value	0.372	0.356
Sargan test df	75	75
Sargan test Chi-sq.(df)	54.389	53.822
Sargan test Chi-sq p-value	0.965	0.969
Wald (joint) test df	11	13
Wald (joint) test Chi-sq.(df)	65.126***	69.299***

Signif. codes: 0.01 ‘***’, 0.05 ‘**’, 0.1 ‘*’, Dependent variable: growth rate volatility (GrVol)

5.3.2.5 Perishable and non-perishable crops

Table 59 looks at the influence of perishable and non-perishable crops exports on growth rate volatility. Again I use combined share of perishable crops exports in GDP and combined share of non-perishable crops exports in GDP as well as more detailed processed and unprocessed subgroups of each.

My second set of questions is trying to establish how exports of two groups of agricultural crops, perishable and non-perishable, influence growth rate volatility. The results provided in table 59 cover regression analyses with shares of perishable and non-perishable crops exports in GDP (column 1) and shares in GDP of exports of processed and unprocessed parts of each group (column 2). Table A5.12 in the appendix provides results of regression analyses for each individual explanatory variable separately.

My reasoning for this analysis is based on my expectation that perishable crops, being subject to immediate resell due to their perishable nature, would encounter export market conditions with plenty of perishable crops being sold at the same time. I also stated that processing perishable crops might help reduce the volatility by enable placing the products on the market under more favourable conditions.

Results in previous chapter indicate that the only significant effect on growth rate volatility comes from share of perishable crops in GDP. Its coefficient has negative value indicating that growth rate volatility decreases with higher share of the variable. When I included interaction term between shares of produced perishable crops in GDP the main effect became insignificant whereas its interaction term is significant. Its coefficient value is negative that higher level of openness of the economy strengthens the growth rate volatility decreasing effect of higher share of perishable crops in GDP[87].

My quick analysis above indicated that higher share of exports of both perishable and non-perishable crops in GDP decrease growth rate volatility with perishable crops having bigger effect.

Surprisingly none of the explanatory variables in my detailed analyses in this chapter prove to be significant either with or without constant term included in the regression.

[87] In addition ratio variable and its interaction term also became significant (both at ten percent) however the value of the coefficient for main effect is negative whereas that of the interaction term is positive. The result indicates that higher level of openness counters growth rate volatility decreasing effect of higher ratio variable (*i.e.* higher share of perishable crop in GDP relative to share of non-perishable crops in GDP).

5.3.2.6 Processed and unprocessed crops

As I explained above that processing agricultural products introduces at least three factors that should influence growth rate volatility: a) it involves at least some form of manufacturing, b) it diversifies exports where country exports original raw material and additional transformed versions (*i.e.* it takes one agricultural crop and transforms it, sometimes in more than one additional products), and c) processing, especially perishable crops, extends their shelf life thus enabling more balanced market placement throughout the year. To explore my question I divided agricultural products into two groups: processed[88] agricultural products (ShPROC(e)) and unprocessed agricultural products (ShUNPROC(e)). The variables represent shares of each subgroup's exports in GDP.

Table 60 shows results for regression analysis of shares of both processed and unprocessed crops exports in GDP whereas table A5.13 in the appendix provides results for each individual explanatory variable.

Due to data limitation I was not able to perform such analysis in my previous chapter however my first look indicated that higher share of exports of both of my variables in GDP decreases growth rate volatility with perishable crops having bigger effect.

The results are again not significant for any of the two exploratory variables (in both with and without constant term included).

5.3.2.7 Food and non-food crops

Table 61 shows results of the regression analysis with both variables under investigation included (table A5.14 in the appendix holds results for each of the variables included separately).

Regression analysis in my previous chapter indicated growth rate volatility decreasing effect of higher share of food crops in GDP.

None of the variables used in the regression in this chapter has significant effect on growth rate volatility. They remain insignificant even when constant term is excluded from regression analysis.

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[88] I must emphasise that I only used data on agricultural products included in FAO database (*e.g.* cotton seed, cotton cake, cotton lint and linter, cotton waste, carded cotton). Although I do not doubt they are relevant, I do not include many other products with higher added values that use agricultural raw materials or their transformed versions as inputs (*e.g.* garments) and which might change the outcome of the analysis.

5.3.2.8 Crop groups

Penultimate set of questions in this chapter is concerned with effects of different crop groups on growth rate volatility.

Regression analysis in previous chapter indicated significant effect of five crop groups (vegetables; nuts; coffee, cocoa, tea; and oil crops; and rubber). Four of them (vegetables; nuts; coffee, cocoa, tea; and rubber) have coefficients with negative value indicating growth rate volatility decreasing effect with their increased share. Oil crops have positive coefficient which means that growth rate volatility increases with increased share of produced oil crops in GDP.

There were also two significant interaction terms (coffee, cocoa, and tea; and tobacco). Both, main effect and its corresponding interaction term for coffee, cocoa, and tea crop group, have negative coefficient value. This means that growth rate volatility decreasing effect of higher share of coffee, cocoa, and tea production in GDP is strengthened with increased openness. The main effect of tobacco crop group has positive coefficient however the result is not significant. Its interaction term has negative coefficient and is significant at one percent level. This means that the effect of growth increasing effect of tobacco decreases with increased openness.

Because of insignificant results you can find the results of my regression in the appendix table A5.15.

5.3.2.9 Diversification

My last analysis tries to determine whether different types of diversifications in exports of agricultural crops influence growth rate volatility differently. I use six different diversification variables[89]: i) diversification index for all products (InvHHProduct(e)), ii) diversification index for product groups (InvHHGroup(e)), iii) diversification index for plantation – non-plantation crops (InvHHPlant(e)), iv) diversification index for perishable – non-perishable crops (InvHHPerish(e)), v) diversification index for processed – unprocessed crops (InvHHProcess(e)), and vi) diversification index for food – non-food crops (InvHHFood(e)).

Table 62 below shows only significant results of my regression analyses: diversification in all products (column 1), diversification in product groups (column 2), diversification between processed and unprocessed crops (column 3), and diversification between food

[89] As I explained in chapter 5.3.1.3 under diversification variables I am using inverted HH indices as variables for diversification

and non-food crops (column 4) on growth rate volatility. Table A5.16 in the appendix provides results for all diversification indices.

Diversification has been shown to decrease growth rate volatility; see *e.g.* Mobarak (2005), Moore and Walkes (2010), Papageorgiou, *et al.*, (2015) however research usually focus on economy wide diversification and does not look at the agricultural product diversification. Joshi, *et al.* (2004) looked at gradual diversification into high value agricultural products in South Asian countries and tried to determine drivers that promote diversification in agriculture. Wahiduddin, *et al.* (2000) emphasise the potential of agricultural diversification into high-value products for accelerating growth rates in production while Culas and Mahendrarajah (2005) argue that the main drivers for optimal diversification are risk and uncertainties. Similarly Singh, *et al.* (2006) noticed that diversification is not only used for higher incomes but also for risk mitigation.

Nevertheless, none of the above mentioned researches looked at the influence of diversification on growth rate volatility. In column 1 of table 62 we can see the results for product diversification. Product diversification is the broadest measure I use and includes all possible products of agricultural crops being exported. In total there are 314 different products in FAO statistical database of agricultural crops exports. The result of my analysis is significant at five percent significance level and has negative coefficient.

As I explained in chapter 5.2.2.4 negative value of the coefficient indicates that higher diversification reduces growth rate volatility. The result in column 1 therefore indicates that the higher the diversification in all products the lower the growth rate volatility.

Table 59: GMM estimates for all my control variables and shares of perishable and non-perishable crops exports in GDP as well as their processed and unprocessed parts on growth rate volatility

	(1)	(2)
Constant	-7.196	-8.104
	(-1.449)	(-1.622)
Lag_1GrVol	-0.078	-0.077
	(-0.984)	(-0.968)
lnGDP	0.513	0.462
	(1.320)	(1.237)
Democracy	-1.228***	-1.264**
	(-2.915)	(-2.500)
Openness	1.182*	1.315*
	(1.794)	(1.836)
Schooling	-0.003	0.004
	(-0.411)	(0.378)
INFL	0.088**	0.094**
	(1.992)	(2.194)
WAR	0.014	-0.062
	(0.027)	(-0.124)
AgPrShGDP	0.064*	0.072**
	(1.935)	(2.060)
SDExchRate	-0.465**	-0.564***
	(-2.225)	(-2.875)
ShPERISH(e)	-1.030	
	(-0.134)	
ShProcPERISH(e)		-6.361
		(-0.543)
ShUnprocPERISH(e)		5.913
		(0.189)
ShNONPERISH(e)	-2.901	
	(-0.426)	
ShProcNONPERISH(e)		10.670
		(0.675)
ShUnprocNONPERISH(e)		-11.517
		(-0.980)
Sum of sq. res.	33521.32	34085.87
S.E. of regression	3.878	3.932
No. of countries	64	64
No. of observations	2496	2496
No. of instruments	87	89
Arellano-Bond test AR(1)	-3.184	-3.225
AR(1) p-value	0.002	0.001
Arellano-Bond test AR(2)	-0.862	-0.967
AR(2) p-value	0.389	0.334
Sargan test df	75	75
Sargan test Chi-sq.(df)	53.370	53.852
Sargan test Chi-sq p-value	0.972	0.969
Wald (joint) test df	11	13
Wald (joint) test Chi-sq.(df)	63.720***	62.665***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table 60: GMM estimates for all my control variables and shares of processed and unprocessed crops exports in GDP on growth rate volatility

	(1)
Constant	-6.822
	(-1.436)
Lag_1GrVol	-0.077
	(-0.971)
lnGDP	0.467
	(1.238)
Democracy	-1.225***
	(-2.904)
Openness	1.139*
	(1.672)
Schooling	-0.001
	(-1.122)
INFL	0.090**
	(2.109)
WAR	-0.072
	(-0.163)
AgPrShGDP	0.061*
	(1.875)
SDExchRate	-0.472**
	(-2.203)
ShPROC(e)	1.016
	(0.135)
ShUNPROC(e)	-4.915
	(-0.600)
Sum of sq. res.	33672.89
S.E. of regression	3.896
No. of countries	64
No. of observations	2496
No. of instruments	87
Arellano-Bond test AR(1)	-3.210
AR(1) p-value	0.001
Arellano-Bond test AR(2)	-0.865
AR(2) p-value	0.387
Sargan test df	75
Sargan test Chi-sq.(df)	54.192
Sargan test Chi-sq p-value	0.967
Wald (joint) test df	11
Wald (joint) test Chi-sq.(df)	61.544***

Signif. codes: 0.01 ‘***’, 0.05 ‘**’, 0.1 ‘*’,
Dependent variable: growth rate volatility (GrVol)

Table 61: GMM estimates for all my control variables and shares of food and non-food crops exports in GDP on growth rate volatility

	(1)
Constant	-6.797
	(-1.12)
Lag_1GrVol	-0.081
	(-1.024)
lnGDP	0.499
	(1.073)
Democracy	-1.188***
	(-2.831)
Openness	1.100
	(1.379)
Schooling	-0.001
	(-0.183)
INFL	0.088*
	(1.937)
WAR	-0.118
	(-0.256)
AgPrShGDP	0.055
	(1.393)
SDExchRate	-0.439**
	(-2.147)
FoodExShGDP	-2.534
	(-0.277)
NonfoodExShGDP	6.255
	(0.657)
Sum of sq. res.	33312.82
S.E. of regression	3.875
No. of countries	64
No. of observations	2496
No. of instruments	87
Arellano-Bond test AR(1)	-3.156
AR(1) p-value	0.002
Arellano-Bond test AR(2)	-0.952
AR(2) p-value	0.341
Sargan test df	75
Sargan test Chi-sq.(df)	53.994
Sargan test Chi-sq p-value	0.968
Wald (joint) test df	11
Wald (joint) test Chi-sq.(df)	61.383***

Signif. Codes: 0.01 '***', 0.05 '**', 0.1 '*',
Dependent variable: growth rate volatility (GrVol)

In column 2 I present the result for diversification between different agricultural crops' groups. Group diversification looks at how are different agricultural groups represented in exports. Well-diversified exports would include more groups than less diversified one and with similar export values. Again, the coefficient value is negative (and significant at 1% level) indicating that higher concentration in agricultural groups leads to higher growth rate volatility.

Result for diversification between processed and unprocessed crops exports is shown in column 3. In this case there are only two groups; processed and unprocessed crops. Lower value of diversification index indicates one group's higher share of exports in GDP than the other. The result is significant at five percent level with negative coefficient value suggesting that the more balanced the export between processed and unprocessed agricultural products the smaller growth rate volatility.

Finally, column 4 looks at diversification between food and non-food crops. It is significant at ten percent level and again has coefficient with negative value. Similarly to the previous result, higher imbalance between shares of food and non-food crops exports in GDP leads to reduced growth rate volatility.

The remaining two diversification indices (*i.e.* between plantation and non-plantation crops and between perishable and non-perishable crops) are statistically not significant.

In short my research showed that for the country to reduce growth rate volatility it is best to have diversification in total number of agricultural products, as well as in different product groups. It is also preferable to have balanced exports of processed and unprocessed agricultural products as well as exports of food and non-food crops.

Table 62: GMM estimates for all my control variables and significant diversification indices on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	-3.982	-4.226	-6.264	-6.181
	(-0.789)	(-0.910)	(-1.197)	(-1.453)
Lag_1GrVol	-0.092	-0.099	-0.086	-0.081
	(-1.250)	(-1.328)	(-1.085)	(-1.020)
lnGDP	0.370	0.283	0.344	0.297
	(0.817)	(0.622)	(0.716)	(0.809)
Democracy	-1.065***	-1.042***	-1.184***	-1.343***
	(-2.744)	(-2.715)	(-2.736)	(-2.967)
Openness	0.655	0.605	0.663	0.997**
	(1.366)	(1.307)	(1.558)	(2.197)
Schooling	-0.006	-0.001	-0.003	-0.004
	(-0.783)	(-0.166)	(-0.416)	(-0.613)
INFL	0.082*	0.086**	0.090**	0.088**
	(1.936)	(1.985)	(2.054)	(2.109)
WAR	-0.241	-0.222	-0.152	-0.106
	(-0.409)	(-0.414)	(-0.297)	(-0.221)
AgPrShGDP	0.025	0.007	0.033	0.040
	(0.672)	(0.198)	(0.990)	(1.566)
SDExchRate	-0.647***	-0.545**	-0.617***	-0.532**
	(-2.623)	(-2.097)	(-2.887)	(-2.271)
InvHHProduct(e)	-3.604**			
	(-1.971)			
InvHHGroup(e)		-4.401***		
		(-2.903)		
InvHHProcess(e)			-4.269**	
			(-2.495)	
InvHHFood(e)				-2.415*
				(-1.685)
Sum of sq. res.	32471.40	32514.65	33437.04	33467.01
S.E. of regression	3.821	3.849	3.885	3.878
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	86	86	86	86
Arellano-Bond test AR(1)	-3.232	-3.225	-3.161	-3.193
AR(1) p-value	0.001	0.001	0.002	0.001
Arellano-Bond test AR(2)	-0.920	-1.062	-0.927	-0.863
AR(2) p-value	0.357	0.288	0.354	0.388
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	56.217	58.112	54.995	55.634
Sargan test Chi-sq p-value	0.948	0.926	0.960	0.954
Wald (joint) test df	10	10	10	10
Wald (joint) test Chi-sq.(df)	53.767***	49.520***	58.333***	47.695***

Signif. codes: 0.01 ‘***’, 0.05 ‘**’, 0.1 ‘*’, Dependent variable: growth rate volatility (GrVol)

5.4 Summary of chapter five

The chapter explored the effects of exports of different crop's groups as well as export diversifications on growth rate volatility.

The analyses show that the only significant influence comes from different forms of diversifications. Coefficients for all variables have negative value indicating that as diversifications increase growth rate volatility decreases. The most significant effect (at one percent level) comes from crops' export diversification into different crop groups. The effects of export diversification between all products as well as diversification between processed and unprocessed crops are significant at five percent level whereas the effect of export diversification between food and non-food crops is significant at one percent level.

6 Conclusion

The final chapter of this thesis is divided into three sub-chapters. The first one focuses on the limitations of the study and includes proposals for further research. The second sub-chapter summarises the research and results of the analysis whereas the last sub-chapter discusses the results in broader context and includes policy recommendations for relevant government bodies in affected countries.

6.1 Limitations of the study and proposed further research

As is often the case there are many limitations to this research. Some are unavoidable because the data is seen questionable by some (as in the case of the Land Matrix database) whereas others are set out by the thesis design. In both cases the limitations cannot be avoided. However further work on the topics can broaden the knowledge base and shed light on some of the problems associated with the questions ask which were not addressed in this thesis and which were either known from the beginning or emerged during my studies.

In relation to the LSLAs the most pressing problem is the quality of the dataset (Oya, 2013). As highlighted by many researchers, open sourced dataset is inevitably questionable affecting both its accuracy and its reliability especially when sources are not checked (Oya, 2013). The second problem in relation to LSLAs is the difficulty in collecting the data. Although investment data is included in other datasets (e.g. UNCTAD, INTRACEN, IMF – see footnote 4), it is of no use to the research of LSLAs in this thesis since it only covers monetary values and does not include other information in particular its production structure. The third problem with the dataset is a selection bias (i.e. selection of cases included). In relation to this bias researchers voice their concern over dataset being focused on Africa as a target region (Borras, Jr., et al., 2013) or China as an investor country (Brautigam, 2012). Some also complain that it is geared toward foreign investors (Hall, 2011).

On the other hand data used in my exploratory chapters is (at least in general) not questionable. However in this case limitations are set either by requirements set out by the faculty on the length of the thesis or by the design of the thesis. In the latter case the design set boundaries which limited the scope of research and led to gaps in the knowledge gained. In this regard for example the effects of crops' production and export structure in developed countries could also be included in my research, however as I am interested in LSLAs and the effects their business activities might have on target countries examination of developed countries seemed out of the scope of the thesis. Nevertheless, such studies would definitely cover some knowledge gaps and could be of use to policymakers in relevant economies. However, I should note that the design of my research, if I wanted to include developed countries as well, would require redesign of methods used and inclusion of additional variables. It is therefore obvious that regardless of gained knowledge, their inclusion is beyond this thesis.

On the other hand, some of the results obtained during the empirical examination proved surprising. Although I explain and reflect on those results further investigation would be beneficial. I am here particularly referring to the growth rate volatility increasing effect of increased diversification between food and non-food.

6.2 Summary of research and its results

This thesis is comprised of three articles and is a mixture of an essay type chapter (chapter three of this thesis) and an empirical research conducted in two chapters (i.e. four and five).

The aim of this thesis was to explore what kinds of agricultural produce are grown on lands acquired and to understand what effects crops have on growth rate volatility. The second (i.e. empirical part) is in general not concerned about what crops produced on LSLAs are used for but is focused on what kind effects they have on country's economy. Because I use wide range of countries (in terms of development level) some of which are food wise self-sufficient whereas others rely on food imports or even food aid I decided to examine the effects of both options; crops' production and their exports. As can be seen in the tables that summarise the results of my research (see the end of sub-chapter 6.2 – table 63, table 64) such division was justified since the effects of crops' production differ from those of their exports.

On the other hand the division between different crop groups was based on two reasons. The first one, and probably the most important one, was based on the work of Isham, *et al.* (2005) which showed the effects of coffee and cocoa on growth. Although different, coffee and cocoa are also very similar produce. Both are grown on plantations, both are non-perishable, and both are food crops. From that perspective their influence could be expected to be very similar. However it is easy to see that inclusion of bananas for example introduces another aspect, besides being plantation crop as well as food crop it is also a perishable crop. Would the fact that bananas are perishable change their influence on growth rate volatility. Inclusion of other crops adds additional crop groups into the equation. One could devise other possible crop groups but it seemed reasonable that I somehow limit the possibilities and settle for the three groups (or group-pairs) mentioned above. The other reason is a question of diversification. Diversification in general has been found to be beneficial to growth rate volatility reduction. It again seemed reasonable to include several different variants of diversification and the most natural way was to follow the same grouping pattern. Again, the logic and reasoning behind my decisions proved to be correct. Although some of the groupings don't significantly affect my dependent variable, the diversification between them does.

6.2.1 Research

The initial idea for the thesis was to explore the economic consequences of LSLAs with a focus on crops production. However during the first exploratory steps of my research one of the fields I studied was concerned with economic consequences of natural resources. Relevant literature highlighted the idea that in majority of cases abundance of natural resources leads to meagre economic growth; see *e.g.* Sachs and Warner (1995; 1997; 2001), Rodriquez and Sachs (1999), Leite and Weidemann (1999), Gylfason (2000; 2001), Papyrakis and Gerlagh (2004), *etc.* Because of the disappointing outcome of resource abundance, they named the phenomenon "resource curse" hypothesis. Among those studies, the one from Isham, *et al.* (2005) found out that certain plantation crops (*e.g.* coffee, cocoa, bananas, *etc.*) yield similar economic results as more traditional natural resources (*e.g.* oil and minerals); see also Woolcock, *et al.* (2001).

Combination of the "resource curse" studies which are focused on classical types of natural resources (*e.g.* oil) and comparatively devastating effects of some types of agricultural products indicated that there exists a knowledge gap. Namely, no other research tried to understand the economic consequences of agricultural production and export structure.

In addition published studies of notorious practices of LSLAs accompanied by popular media indicated that there exists a phenomenon of which economic consequences are poorly understood precisely because of aforementioned knowledge gap.

To better understand these connecting topics and to fill the observed knowledge gap my initial research resulted in three-topic approach. My first topic covered study of LSLAs in order to better understand their crops production structure while the two remaining topics were intended to cover the effects of crops production and export structure on growth rate volatility.

Throughout my thesis I tried to follow a similar template of analysis in order to be able to compare and combine results of my exploratory chapters. However because of the nature of my essay chapter the template could in that instance not be completely follow.

The template of the analysis moved from studying the effects of plantation and non-plantation crops followed by study of the effects of perishable and non-perishable crops. Study of the effects of food and non-food crops was my next item in the template which then moved to the study of crop groups and finished with the study of the effects of different forms of diversification. When studying diversification I again tried to follow a template whereby I first explored the effects of diversification in all crops, followed by diversification in crop groups, and concluding with the studies of the effects of binary diversifications (plantation and non-plantation crops, perishable and non-perishable crops, food and non-food crops). Because of data availability I was able to expand studies of the effects of crops' exports with additional sub-groups, namely processed and unprocessed crops. When exploring crop production composition of LSLAs I tried to follow the previous template as closely as possible.

6.2.1.1 Contribution of the study

Contribution of this study to the knowledge base is twofold. The first part of the thesis (i.e. LSLA chapter) explores the occurrences of LSLAs in developing countries between 2000 and 2017. In this regard parts of the exploration were already covered in scientific literature (e.g. investor/target countries and regions, sizes of deals, etc.) however most of the study of the topic brings understanding of previously unexplored information provided in used dataset. This novel understanding includes information on crops production structure which includes exploration of different groups of crops (e.g. plantation/non-plantation, perishable/non-perishable, food/non-food, etc.) as well as the breath of different crops produced and diversification of their production.

The contribution provides previously unknown knowledge of the subject and forms basis for further research. In this regard, information gained would be extremely valuable in understanding intentions of investments from different actors (if for example correlation between country's (previous) food imports and crops' production structure on lands acquired (results from this study) is found one could assume such investments were made for food security reasons). The study could also help explore alleged selection biases included in the Land Matrix dataset.

Empirical chapter of the study on the other hand contribute knowledge to understanding of growth rate volatility. Although there is extensive scientific literature on the topic covering multiple different potentially significant variables (a literature review of only 25 articles exploring the effects on growth rate volatility counted no less than 105 different variables used) none studied the effects of crops' production and export structure on growth rate volatility. Considering that agriculture represents major part of the economy in most of the developing countries such examination seemed necessary. In this view, large-scale land acquisitions which are occurring in a number of developing countries only add additional reason on why such study is relevant and in deed required. The study therefore covered the knowledge gaps identified during literature review, added new knowledge about the influences variables have on growth rate volatility, and maybe even more importantly provided guidance and policy recommendations to relevant bodies in order to reduce growth rate volatility and ensure long-term growth of their economies.

6.2.2 Large-scale land acquisitions

The essay type chapter of my thesis explores LSLAs and tries to understand its general occurrences and its crops production structure.

The analysis started with target region and target country analysis. Based on the number of deals in the database Africa is preferred target region followed by Asia and South America however at sub-regional level Southeast Asia receives the highest number of investments followed by South America and Eastern Africa. Among 94 individually target countries, Argentina is the one with the highest number of deals followed by Cambodia and Indonesia.

Similar analysis for the investor side shows that Asia is by far the biggest investor region followed by Europe, and Africa. At a sub-regional level Southeast Asia leads the list followed by East Asian and Japan with South America concluding the top three. As I highlighted before China is the biggest individual investor followed by Argentina and the United States of America with equal number of deals (there are 131 investor countries).

Each investor country has preferred region in which it invests which for China is Asia at regional and Southeast Asia at sub-regional level. Preferred investment region (and sub-region) for both Argentina and United States of America is South America. In general, my analysis showed that investing in domestic region is preferred (except for Europe which has the highest number of investments in Africa and Northern America which mostly invests in South America).

The highest share of domestic investment happens in South America followed by Asia and Central America and the Caribbean. Individually Argentina has the highest number of domestic investments followed by Vietnam and India however when comparing shares of domestic number of deals in total number of deals and disregarding countries with only handful of deals the picture changes. In that case India leads the board with 90 percent of all investments being made by or at least participating in by domestic investor followed by Peru and Vietnam.

The final part of my analysis looked at intentions of investments. The highest number of deals in the Land Matrix database is intended for food crops followed by biofuels and unspecified agricultural products. In my dataset 84 percent are intended for crops only and 13 percent only for trees. Of the deals intended for crop production, 72 percent for food crops whereas 16 percent are intended for non-food crops production.

Almost 62 percent of all crops are non-plantation crops while plantation crops account for approximately 38 percent of intended investments. Plantation crops are the most important investment for most of the top ten investors except China and India which invest predominantly in non-plantation crops. In target countries picture is a bit more diverse. In three of the top ten target countries (Cambodia, Ethiopia, and Vietnam) non-plantation crops represent the highest share in all deals whereas plantation crops received the most investments in Indonesia, Mozambique, Romania, India, and Tanzania. The most investments in Argentina and Brazil are in mixed crop production.

Among non-food crops biofuels, rubber and fibre crops represent the top three investments, whereas among food crops, cereals, vegetables and food oil crops occupy the top three places. Additional analysis of the food crops revealed that 65 percent of them are non-perishable with cereals and oil crops leading the list whereas perishable crops represent 35 percent of food crops of which majority were fruits.

Cereals (usually corn) have the highest number of deals of all food groups among most of investor regions with only Oceania and Polynesia investing more in vegetables.

Cereals are also crop type that occurs in highest number of deals at the sub-regional investment level as well as individual investor countries.

The analysis of the Land Matrix database showed some commonalities between investors. It seems that investors prefer to invest in domestic region (except Europe and Northern America which invest in the closest appropriate region). The majority of deals are intended for crop production of which majority is intended for food. In that regard non-plantation crops are preferred over plantation crops. Most of food crops are non-perishable (mostly cereals). Among non-food crops the top two are biofuels and rubber.

6.2.3 Crops' production structure

In my first empirical chapter (i.e. chapter four of this thesis) I examined five relationships between growth rate volatility and: i) effects of production of plantation and non-plantation crops, ii) effects of production of perishable and non-perishable crops, iii) effects of production of food and non-food crops, iv) effects of production of crop groups, and v) effects of different forms of crop production diversification. Because exports of crops might still influence the results of my studies of the effects of crop production structure on growth rate volatility I conducted additional examinations where I included interaction terms between openness and each of my explanatory variables as additional variables.

When I studied the effects of plantation and non-plantation crops' production on growth rate volatility I discovered two significant explanatory variables. The first one is share of plantation crops in GDP is significant at five percent level and has negative coefficient value. The negative value indicates that as share of plantation crops in GDP increases growth rate volatility decreases. The second significant variable is ratio between shares of non-plantation crops and plantation crops. It has positive coefficient value and is also significant at five percent level. Positive value of the coefficient indicates that as the value of the ratio increases so does growth rate volatility. Increased value of the ratio is a result of increased relative share of non-plantation crops to that of plantation crops. Analyses of plantation and non-plantation variables which included interaction terms found no significant results.

My second question of the first exploratory chapter studied the effects of perishable and non-perishable crops on growth rate volatility. At ten percent significance level share of perishable crops in GDP is the only statistically significant result. Its negative value indicates that as its share in GDP increases growth rate volatility decreases. When interaction terms between my explanatory variables and openness are included, share of perishable crops in GDP becomes statistically not significant however its interaction term is significant (at ten percent level) and has negative value. The result suggests that the growth rate volatility decreasing effect of the higher share of perishable crops in GDP is strengthened with higher levels of openness (*i.e.* with increased share of perishable crops in GDP and more open economy growth rate volatility would decrease more). In addition both, ratio between non-perishable and perishable crops and their interaction term with openness are statistically significant (both at ten percent level). The value of the coefficient for the ratio has negative value whereas that of the interaction term is positive. The result suggest that although higher value of the ratio (*i.e.* higher share of non-perishable crops in GDP relative to that of perishable crops) decreases growth rate volatility, the influence of ratio declines with higher level of openness.

My third question tried to discover the effects of food and non-food crops on growth rate volatility. Share of food crops in GDP is the only significant variable (at one percent) with negative coefficient. The variable stayed significant when I included interaction term as my regressor.

The fourth question was exploring the effects of different crop groups on growth rate volatility. Five crop groups have significant effect on growth rate volatility. Four of them are food crops: vegetables; nuts; coffee, cocoa, tea; and oil crops and one is non-food crop: rubber. Vegetables (significant at ten percent level), nuts (significant at one percent level), and coffee, cocoa, and tea (significant at five percent level) groups have coefficients with negative value. This indicates that as their share in GDP increases growth rate volatility decreases. Value of coefficient for oil crops is positive meaning that as its share in GDP increases so does growth rate volatility. Its significance level is five percent. The only non-food crop, rubber, has significance level at ten percent and its coefficient has negative value indicating that as rubber's share in GDP increases growth rate volatility decreases.

Interaction term between coffee, cocoa, and tea and openness is significant at one percent level (its main effect is significant at five percent level with negative coefficient value) and its coefficient has negative value. The interpretation of the main effect therefore indicates that as share of production of coffee, cocoa, and tea in GDP increases growth rate volatility decreases and that the effect is further strengthened with increased openness. Tobacco also has positive coefficient however the result is not significant. Its interaction term has negative coefficient and is significant at one percent level. This means that the effect of growth rate volatility increasing effect of tobacco decreases with increased openness.

My last set of questions in the fourth chapter tried to understand the effects of different forms of diversification on growth rate volatility. In short, my analysis showed the only significant variable is diversification between food and non-food crops (at ten percent level). Its value is positive which indicates that when agriculture is more diversified between food and non-food crops growth rate volatility increases.

6.2.4 Crops' export structure

In my second empirical chapter (i.e. chapter five of this thesis) I examined six relationships between growth rate volatility and: i) effects of exports of plantation and non-plantation crop, ii) effects of exports of perishable and non-perishable crops, iii) effects of exports of processed and unprocessed crops, iv) effects of exports of food and non-food crops, v) effects of exports of different crop groups, and vi) effects of different crop groups of export diversification. Because of data availability I was able to do additional examinations through sub-grouping appropriate groups into processed and unprocessed part.

The analyses of plantation and non-plantation crops exports which also included its sub-groups of processed and unprocessed crops didn't return any significant variables. Although not completely the same there were hints for this result in the analyses in the previous chapter in which I included the interaction terms between relevant variables and openness to trade. In this regard (also relevant to subsequent analyses) production of crops combined with openness (i.e. the interaction) is not the same as export of crops. Openness to trade is relevant to all sectors of the economy whereas export of crops is focused on one particular part of the economy. Therefore the interaction term would be more aligned with export of processed and unprocessed crops.

Analyses of relationship between growth rate volatility and exports of perishable and non-perishable crops (including the results for their processed and unprocessed sub-groups) returned no significant results. This came as a little surprise since the analyses in chapter four which included interaction terms between my explanatory variables and openness showed that the interaction term between openness and share of perishable crops in GDP is significant (share of production values of perishable crops in GDP as a main effect is statistically not significant) with coefficient's value being negative value. There clearly is some relationship between perishable and non-perishable crops and growth rate volatility however there are some other factors at play especially since the analyses which included the ratio between non-perishable and perishable crops' production and their interaction term with openness were statistically significant (both at ten percent level). Hints to the hidden influence are the values of the coefficients; negative for the ratio, and positive for the interaction term. This suggest that although higher value of the ratio (*i.e.* higher share of non-perishable crops in GDP relative to that of perishable crops) decreases growth rate volatility, the influence of ratio declines with higher level of openness.

Similar, not significant results were obtained when examining the effects of exports of food and non-food crops neither on their own nor when I included the interaction term.

Interaction term between coffee, cocoa, and tea and openness is significant at one percent level (its main effect is significant at five percent level with negative coefficient value) and its coefficient has negative value. The interpretation of the main effect therefore indicates that as share of coffee, cocoa, and tea in GDP increases growth rate volatility decreases and that the effect is further strengthened with increased openness. Tobacco also has positive coefficient however the result is not significant. Its interaction term has negative coefficient and is significant at one percent level. This means that the effect of growth rate volatility increasing effect of tobacco decreases with increased openness. Surprisingly none of the crop groups were significant when studying the effects of their exports on growth rate volatility.

Results of the analysis of the effects of different forms of crop export diversifications show that diversification in all agricultural products, diversification in agricultural product groups, as well as diversification between processed and unprocessed crops, and between food and non-food crops are significant. All of significant results (although at different levels) have negative coefficient values.

The meanings of diversification for the first two diversification indices state that in order to decrease growth rate volatility economies should strive to export as many agricultural products as well as agricultural product groups as possible. On the other hand the meanings of diversification for the remaining two diversification indices state that in order to decrease growth rate volatility economies should try to balance their exports of processed and unprocessed agricultural crops as well as their exports of food and non-food crops.

Tables below summarise the results. Table 63 includes results for control variables as well as lagged dependent variable whereas table 64 includes results for production and exports of relevant explanatory variables. Table 6.1 in the appendix provides results of my analysis with interaction term included

Table 63: Summary of results for lagged dependent variable and all control variables

Variables	Hypothesised effects	Calculated effect			
		Production		Exports	
		Individually	Combined	Individually	Combined
Lag1_GrVol		-	-*	-	-
Control variables					
GDP per capita	-	+	+*	-	+
Democracy	-	-**	-***	-***	-***
Openness to trade	+	+	+**	+	+**
Primary school enrolment	-	-	-	-	-
Inflation	+	+**	+**	+*	+**
Share of agriculture in GDP	+	+(+***)	+**	+**	+**
War	-	-	-	-	-
SD exchange rate	+			-**	-***
Share of crops in GDP	+	- (+***)		+	
Share of agricultural exports in GDP	+			+	
Share of crops' exports in GDP	-			-	

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'; Negative (-) effects means with its increased value, variable decreases growth rate volatility whereas positive (+) effect indicates increased growth rate volatility with variable's increased value; Results in parenthesis are for analyses without the intercept term; Shaded variable indicates confirmed hypothesis

Table 64: Summary of results for production and exports of all my explanatory variables

Exploratory variables	Hypothesised effect		Calculated effect			
	Production	Export	Production		Exports	
			Individually	Combined	Individually	Combined
Plantation/non-plantation crops						
ShPLANT[1]	-	-	-**	-	-	-
ShNONPLANT	+	+	+	+	+	-
RATIOPLANT	+		+**	+*		
ShProcPLANT		-			-	+
ShUnprocPLANT		+			-	-
ShProcNONPLANT		-			+	-
ShUnprocNONPLANT		+			+	+
Perishable/non-perishable crops						
ShPERISH	-	+	-*	-	-	-
ShNONPERISH	-	-	-	+	-	-
RATIOPERISH	-		-	-		
ShProcPERISH		-			-	-
ShUnprocPERISH		+			+	+
ShProcNONPERISH		-			+	+
ShUnprocNONPERISH		-			-	-

Table 64: Continued

Exploratory variables	Hypothesised effect		Calculated effect			
	Production	Export	Production		Exports	
			Individually	Combined	Individually	Combined
Processed/unprocessed crops						
ShPROC		-			+	+
ShUNPROC		-			-	-
Food/non-food crops						
ShFOOD[1]	-	+	- (-***)	- (-**)	-	-
ShNONFOOD	+	-	+	-	+	+
RATIOFOOD	+		+	+		
Crop groups						
Cereals	-	+	-		-	
Vegetables[1]	-	+	-*		-	
Fruits	-	+	-		+	
Nuts[1]	-	-	-***		-	
Coffee, cocoa, tea[1]	-	+	-**		-	
Spices	+	-	-		+	
Oil[1]	+	-	+**		+	
Other food	+	-	-		+	
Fibres	-	-	+		+	
Rubber[1]	-	-	-*		-	
Tobacco	+	-	+		+	
Other non-food	+	-	+		+	

Table 64: Continued

Exploratory variables	Hypothesised effect		Calculated effect			
	Production	Export	Production		Exports	
			Individually	Combined	Individually	Combined
Diversification						
InvHHProduct[2]	-	-	-	+	-**	
InvHHGroup[2]	-	-	-	-	-***	
InvHHPlant		-			-	
InvHHPerish		-			-	
InvHHProc[2]		-			-**	
InvHHFood	+	-	+ (+*)	+	-*	

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'; negative (-) effects means with its increased value, variable decreases growth rate volatility whereas positive (+) effect indicates increased growth rate volatility with variable's increased value; results in parenthesis are for analyses without the intercept term; shaded variable indicates confirmed hypothesis; [1] the hypothesis is confirmed for effects of production only, [2] the hypothesis is confirmed for effects of exports only

6.3 Discussion, policy recommendations, and further research

This part of concluding chapter will first discuss the results of the thesis. Some of the results were expected while some were not. In the latter case I will try to understand why such results were obtained and what additional information would be needed to understand them. Policy recommendation chapter will summarise the results in a way to help relevant bodies adopt policies which will help them navigate complex landscape of agricultural policies in particular and broad economic structure in general in their countries. Chapter on further research will (in combination with the limitations of this study) highlight what kind of further research is needed to better understand the topics studied in this chapter as well as possible other aspects that were omitted from it.

6.3.1 Discussion

This discussion will be done in two parts. The first one will look at results whose effects run contrary to hypothesised results. The second part will discuss the significant results and their implication.

Let us first look at the control variables. Most of the results obtained in my analyses confirm widely accepted and agreed effects. However, some of the variables were either insignificant or were found to have results that are contrary to results found in scientific literature.

Primary school enrolment falls within the first group. As a proxy for human capital it is accepted that higher levels of human capital significantly affects growth and output volatility, however (and at least in this study) growth rate volatility is not affected by this variable. Research on growth rate volatility doesn't usually include variable for the level of human capital I considered its inclusion necessary since processing (and thus manufacturing) is reliant on human capital. Although my results confirmed the general effect of this variable (i.e. higher level of human capital reduces growth rate volatility) it did not confirm its significance. This may be explained by the fact that agricultural sector is not heavily dependent on higher levels of human capital and that manufacturing is not overly important in my studied country group.

The effect of GDP per capita on the other hand runs contrary to the effect usually found in scientific literature. When I entered the variable individually (in addition to the lagged dependent variable) its effect is not significant but significant at ten percent when used in combination with other variables. Bugamelli and Paterno (2008) find similar effect; see also Mobarak (2005). Bejan (2006) finds the variable insignificant for less developed countries. The explanation for my unexpected result could be down to four factors: i) list of countries used - low income, lower middle income and upper middle income countries were combined. Such combination could weight higher influence on certain group where growth rate volatility seems less influenced by the variable, ii) the way growth rate volatility was measured. In his literature review Cariolle (2012) found ten different measures of macroeconomic volatility depending on the process of obtaining the reference value. I use standard deviation of the cyclical component of GDP per capita growth rate as dependent variable and that might influence the results. iii) The third possible cause of my result could be down to the method used (i.e. System GMM). Growth rate volatility is usually examined using OLS (ordinary least square) regression, regression with fixed effects or regression with IV (instrumental variables). And iv) the result could also be dependent on other variables used in other regressions.

In my analyses some results confirm my hypotheses, some, although having expected effect (i.e. their coefficient value has the right sign), were found not significant, and some whose influence (sign of the regression coefficient) runs contrary to my hypotheses and which can either be significant or not. The most important results requiring further discussion are the third kind. I should state here that I cannot compare my results to other studies since to the best of my knowledge none has been done before.

There are two variables that are significant but their effects run contrary to my hypotheses. Both are interaction terms: one is the ratio between non-perishable and perishable crops and openness to trade, and the other one is interaction term of coffee, cocoa, and tea and openness to trade. My intention with inclusion of interaction terms was to see if there is any hint of effects that main variables' exports may have on growth rate volatility. As I have already stated above, interaction term between variable and openness to trade is not the same as exports. Openness to trade variable is covering both exports as well as imports which means that both influence country's economy. In the case of ratio between perishable and non-perishable crops the main effect is significant and negative however its interaction term with openness is positive and significant. At the same time, regression analysis which only included the ratio variable was negative but insignificant. So, the main exploratory variable on its own has only limited effect on growth rate volatility whereas if openness is also considered the main effect becomes significant but openness reduces its effect. Clearly there has to be some variable (most likely imports) of non-perishable crops that has this growth rate volatility increasing effect. To confirm this, another study should be undertaken with the aim of understanding if my speculation is correct. The second significant result in this group of anomalous results is the interaction term between coffee, cocoa, and tea. Based on the work of Isham, *et al.* (2005) I expected to see positive value of this variable. However the obtained result indicates that openness to trade in combination with production of coffee, cocoa, and tea reduces growth rate volatility. Again I can only speculate that imports play an important role and that further work should be done in this regard. Another factor could also be at play here since the work of Isham, *et al.* (2005) explored the effects of point-sourced resources on growth and not growth rate volatility as was explored in this thesis.

The second part of the discussion is focused on the whole research. In relation to plantation crops, their production significantly reduces growth rate volatility whereas their exports either processed or not have no significant effect. The ratio variable indicates that the agronomy should be focused more on production of plantation crops than non-plantation crops since higher share of non-plantation crops in GDP increases growth rate volatility. However, higher diversification of exports between plantation and non-plantation crops reduces growth rate volatility (although not significantly).

In short, from growth rate volatility reducing point of view, plantation crops' production is better than non-plantation crops' however some kind of diversification in exports of these two groups is required. My analysis didn't set any number on the ratio between non-plantation and plantation crops but it is reasonable to believe that it is dependent on development level (size of other parts of the economy, disposable income, imports, etc.).

In relation to perishable/non-perishable group my analysis indicates that higher production of perishable crops significantly reduces growth rate volatility whereas neither non-perishable crops nor exports of each of them significantly influence growth rate volatility. Interaction term between the ratio variable and openness indicates that higher share of production of non-perishable crops in GDP relative to that of perishable increases growth rate volatility. As I said above, imports probably play part in this effect. In short, countries should prefer production of perishable crops however with higher levels of openness they should steer their production as well as exports in a way to balance their respective shares (i.e. to diversify between the two groups).

The analysis of food and non-food crops showed that increased share of production of food crops significantly reduces growth rate volatility whereas production of non-food crops wields no significant effects on growth rate volatility. On the other hand higher diversification of production between food and non-food crops increases growth rate volatility whereas in exports reduces it. In short, countries should strive for adequate food production to reduce growth rate volatility and only diversify into non-food crops when sufficient food supply is assured. From then on, diversification in exports between the two groups should be increased.

The only significant results in crop groups are obtained for their production whereas their exports have no significant effects on growth rate volatility. For of the significant crops groups are food crops (confirming results in previous paragraph) with three having growth rate volatility reducing effects (vegetables, nuts, and coffee, cocoa, and tea) and one having increasing effect (oil crops for human consumption). The only significant non-food crop is production of rubber. Its increased share reduces growth rate volatility. In short, countries should increase production of food crops in order to reduce growth rate volatility. Their exports on the other hand have no effect on growth rate volatility.

In relation to diversification, the only significant result is obtained for diversification between food and non-food crops. In this case higher diversification increases growth rate volatility. In all other forms (i.e. all products and product groups), production diversifications have no significant effect. The picture changes when exports come into play. In that case higher diversification in all forms reduces growth rate volatility. During initial stages of their development, when exports play only minor roles in their economies, countries should focus on production of food crops in order to reduce growth rate volatility, however when exports become important, countries should try and diversify their production between their different forms (i.e. all crops, all crop groups, processed and unprocessed crops, and food crops; diversifications between plantation and non-plantation crops and between perishable and non-perishable crops have no significant effects however their effect still reduces the volatility).

In short, there are three sets of possible further research. The first set should explore why some of the control variables proved insignificant. Although results from some other studies confirm their hypothesised influence majority found opposite or significant effects of those variables. Because of this this set should be further researched and should include exploration of the effects of method used both in the way dependent variable is calculated as well as the regression analysis. Another influencing factor could be the list of countries.

The second set should look at the results of production diversification between food and non-food crops. This is an interesting paradox worthy of a deeper examination. The found effect runs contrary to most recommendations and could prove very important for its policy recommendations. I refer here specifically to my reasoning that adequate food supply frees or enables the economy and results in its diversification away from providing food.

The third set of research should focus on the influence of coffee and cocoa. In this respect I see two possible ways of examination. The first one should see if their effect is drowned by their inclusion in plantation crops group. Other plantations may exert opposite effect thus supressing the effects they have on growth rate volatility. The second examination should consider the fact that Isham, *et al.* (2005) looked at their effect on growth and not growth rate volatility. Further research should therefore see if there are hidden variables that if included would make the effects of coffee and cocoa significant in relation to growth rate volatility. However if that investigation still doesn't find any significant effects of the two crops on growth rate volatility further investigation to understand why they are significant in relation to growth should be conducted.

6.3.2 Policy recommendations

My research provides policy recommendations for both developing countries that are experiencing LSLAs as well as for those that do not.

The first take of the study is that in order to reduce their growth rate volatility countries should strive to provide enough food for their populace. Only when this is assured they can move and diversify their production into other crop groups.

When they invite direct investments (either domestic or foreign) adequate food supplies should be maintained or if increased food security is the reason for the invitation of investments supplies should be diverted onto domestic market. What this means is that they either have to supply idle land for such investments or their contracts should include provisions which oblige investors to place required quantitates of food crops to domestic (i.e. target) market. Countries should avoid supplying food producing land to investors without proper provisions (i.e. allowing produce to be exported thus reducing food supply to domestic market).

As countries develop and increase their secondary economic sector as well as exports can they start changing their crops' production structures. The only condition in this regard is that supply of food crops remains adequate (either through self-production or imports). In regard to such changes the most important seems to be diversification between different groupings, particularly between crop groups and all crop products (and to a certain extent also between food and non-food crops). They should also increase shares of plantation crops and perishable crops in GDP.

6.3.3 Further research

The first task in expanding the work on LSLAs should cover concerns highlighted above (see chapter 6.1 – limitations of the study). In regard to the first two problems mentioned (open-source dataset and data collection by international bodies) there is little individual can do. It is beyond hope that one could change the data gathering practices be it because it doesn't fall within the domain of relevant bodies or because such ambiguity serves some other purposes. On the other hand some efforts should be placed in addressing the problems of selection biases in the dataset. Such research could be based on the work done in this thesis especially in regard to target and investor country and region as well as size and origin of investments. I have already done some work in addressing these questions however I have decided to exclude them from my thesis since it would require some additional work and would fall outside of the scope of my thesis.

Another aspect of research in regard to LSLAs should cover temporal dimension of LSLAs. For the most part, my thesis only covered geographical dimension whereas I avoided the time variable. That is partly based on the questions I asked at the beginning of my thesis. All in all, my primary concern in regard to LSLAs was their crops' production structure. As such, the question clearly avoids the temporal aspect of deals. On the other hand, if one wanted to explore the actual effects of LSLAs on target (and investor countries) time dimension will inevitably have to come into play.

The exploratory chapters of the thesis which cover the effects of crops' production and export structures on growth rate volatility could be expanded to cover developed countries as well. Such expansion of work would require addition of variables that are absent in my thesis. The most obvious ones are the inclusion of manufacturing and service sectors. The GDP per capita variable used in my research indirectly includes those sectors however the variable is only a proxy. Although on average it does address some of the leakages of the effects (i.e. some of the effects that work through manufacturing) crops' production and export structures have on the economy, direct inclusion of other sectors of the economy into research would reveal more information about their influence as well as connections between primary and secondary and tertiary sectors of the economy.

Additional research could also be more specific. By that I mean that the effects of crops' production and export structure could be narrowed down and cover each group separately (by each group I mean groups of countries by development level – underdeveloped, low middle incomes, upper middle income; landlocked countries; groups based on region, etc.). Such analysis would probably yield more relevant information for each group. The research could also narrow down on the processing part of my variables. In my research I included all products that required some form of processing as one group, however it is easy to see that spinning a yarn exporting it and exporting clothing are completely different things. The first one requires one processing step whereas the second one requires additional steps; e.g. making textiles, colouring, cutting and sewing, etc.

Although my research provided some interesting insights and gained knowledge it still is limited nevertheless I consider that it does expand the knowledge base and provides basis for additional research.

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Appendices

A.1: Development taxonomy

Country classification systems in selected international organisations

Nielsen (2011) highlights three classification systems used by selected international organisations: International Monetary Fund (IMF), United Nations Development Programme (UNDP), and The World Bank (WB).

To obtain a clear view of a development level of a country, one has to employ an explicit system with criterion to test in which category a country falls. Such classification system is called "development taxonomy", and criterion used "development threshold". Although widely accepted and used term many alternative terminologies exist[90] with some employing two while others use more than two categories.

It is very difficult to define a development concept. Classical economists focus on economic development (*i.e.* sustained increases in per capita real income), while neoclassical economists never paid much attention to its issue. After the WWII, decolonisation led to many new independent countries leading to the emergence of development economics.

Charter of the United Nations called for the organisation to "promote social progress and better standards of life in larger freedom". For that purpose a UN "Report on International Definition and Measurement of Standards and Levels of Living" (Committee of experts on international definition and measurement of standards and levels of living, 1954) was published. It first used levels of living as criteria and later moved to more reliable purchasing power parities and per capita income. Still later, the focus of development economics shifted to more humanistic approach, *e.g.* Sen (1999) argued that development expands freedom by removing unfreedoms, which led to exploring what constitutes acceptable minimum level conditions and later moved to minimum income needed to achieve them (*i.e.* absolute poverty lines) which vary greatly from one country to another (they are country-specific). Nevertheless, they are always arbitrary. Empirical work on taxonomy and related poverty issues later led the UN to adopting Millennium Declaration together with Millennium Development Goals.

[90] Poor/rich, backward/advanced, underdeveloped/developed, undeveloped/developed, North/South, late-comers/pioneers, Third World/First World, and developing/industrialised. For the purpose of this research, any terminology is as good as any other (Nielsen, 2011).

Equally tough as defining the concept of development, is constructing the development threshold. It must have a numerical value and can be either absolute (*i.e.* has a value that is fixed over time) or relative (*i.e.* based on contemporaneous outcomes).

All three international organisations in Nielsen's (2011) article divide countries into groups.

IMF (International Monetary Fund, 2014) has two groups and calls them: i) advanced countries, and ii) emerging and developing countries. Emerging and developing countries are sub-grouped into: a) "emerging and other developing countries", and b) "low-income developing countries". Development threshold is not explicit, and is most likely absolute (Nielsen, 2011). Out of 184 countries, 36 countries are in advanced *i.e.* "the developed" group (i), 94 countries are in the "emerging and other developing countries" sub-group (ii/a), while the rest (59 countries) are in the "low-income developing countries" subgroup (ii/b).

UNDP (United Nations Develoment Programme, 2014) also has two groups and calls them: i) developed countries, and ii) developing countries. Developing countries are subdivided into: a) high human development countries, b) medium human development countries, and c) low human development countries. Its relative development threshold is set at 75 percentile in the HDI (Human Development Index) distribution. There are 49 countries in the developed group (i), 52 countries in high human development countries (ii/a), 41 countries in medium human development countries (ii/b), and 42 countries in low human development countries (ii/c). There is also a list of 8 countries that cannot be classified owing to lack of data.

World Bank's (2018) has four groups: i) high-income countries, ii) upper-middle income countries, iii) lower-middle income countries, and iv) low income countries. Low and both middle-income countries are referred to as developing economies. Its absolute development threshold is US$ 12,616 GNI per capita, which puts country into high-income group. Its high-income countries group (i) has 75 members. There are 55 countries in upper-medium income group (ii), 50 in lower-medium income groups (iii), while the remaining 34 countries fall into low-income group (iv).

The World Bank: List of developing countries (from July 1st, 2014)

Upper middle income economies (GNI - $4,126 to $12,745) – 55 countries

Angola	Fiji	Palau
Albania	Gabon	Panama
Algeria	Grenada	Peru
American Samoa	Hungary	Romania
Argentina	Iran, Islamic Republic of	Serbia
Azerbaijan	Iraq	Seychelles
Belarus	Jamaica	South Africa
Belize	Jordan	St. Lucia
Bosnia and Herzegovina	Kazakhstan	St. Vincent and the Grenadines
Botswana	Lebanon	Suriname
Brazil	Libya	Thailand
Bulgaria	Macedonia, FYR	Tonga
China	Malaysia	Tunisia
Colombia	Maldives	Turkey
Costa Rica	Marshall Islands	Turkmenistan
Cuba	Mauritius	Tuvalu
Dominica	Mexico	Venezuela, RB
Dominican Republic	Montenegro	
Ecuador	Namibia	

Lower-middle income economies ($1,046 to $4.125) – 50 countries

Armenia	Kiribati	Sao Tome and Principe
Bhutan	Kosovo	Senegal
Bolivia	Kyrgyz Republic	Solomon Islands
Cameroon	Lao PDR	South Sudan
Cabo Verde	Lesotho	Sri Lanka
Congo, Rep.	Mauritania	Sudan
Cote d'Ivoire	Micronesia, Fed. Sts.	Swaziland
Djibouti	Moldova	Syrian Arab Republic
Egypt, Arab Republic	Mongolia	Timor-Leste
El Salvador	Morocco	Ukraine
Georgia	Nicaragua	Uzbekistan
Ghana	Nigeria	Vanuatu
Guatemala	Pakistan	Vietnam
Guyana	Papua New Guinea	West Bank and Gaza
Honduras	Paraguay	Yemen, Rep.
Indonesia	Philippines	Zambia
India	Samoa	

The World Bank: List of developing countries: Continued

Low-income economies ($1,045 or less) – 34 countries

Afghanistan	Gambia, The	Nepal
Bangladesh	Guinea	Niger
Benin	Guinea-Bissau	Rwanda
Burkina Faso	Haiti	Sierra Leone
Burundi	Kenya	Somalia
Cambodia	Korea, Dem. Rep.	Tajikistan
Central African Republic	Liberia	Tanzania
Chad	Madagascar	Togo
Comoros	Malawi	Uganda
Congo, Dem. Rep.	Mali	Zimbabwe
Eritrea	Mozambique	
Ethiopia	Myanmar	

Source: The World Bank, 2014

Table A3.1: Regional and sub-regional classification of target countries based on United Nations' Statistical Division methodology

Broad region	Sub-region	Country
A	CA	Kazakhstan
A	CA	Tajikistan
A	EA	China
A	EA	Mongolia
A	SA	Bangladesh
A	SA	India
A	SA	Pakistan
A	SA	Sri Lanka
A	SEA	Cambodia
A	SEA	Indonesia
A	SEA	Lao, People's Democratic Republic
A	SEA	Malaysia
A	SEA	Myanmar
A	SEA	Philippines
A	SEA	Thailand
A	SEA	Timor-Leste
A	SEA	Viet Nam
A	WA	Armenia
A	WA	Georgia
A	WA	Iraq
A	WA	Turkey
AF	CAF	Angola
AF	CAF	Cameroon
AF	CAF	Central African Republic
AF	CAF	Congo
AF	CAF	Democratic Republic of the Congo
AF	CAF	Gabon
AF	CAF	Sao Tome and Principe
AF	EAF	Ethiopia
AF	EAF	Kenya
AF	EAF	Madagascar
AF	EAF	Malawi
AF	EAF	Mauritius
AF	EAF	Mozambique
AF	EAF	Rwanda
AF	EAF	South Sudan
AF	EAF	Uganda
AF	EAF	United Republic of Tanzania
AF	EAF	Zambia
AF	EAF	Zimbabwe
AF	NAF	Algeria
AF	NAF	Egypt
AF	NAF	Libya
AF	NAF	Morocco
AF	NAF	Sudan
AF	NAF	Tunisia
AF	SAF	Botswana
AF	SAF	eSwatini (formerly Swaziland)
AF	SAF	Namibia

Table A3.1: Continued

Broad region	Sub-region	Country
AF	SAF	South Africa
AF	WAF	Benin
AF	WAF	Burkina Faso
AF	WAF	Côte d'Ivoire
AF	WAF	Gambia
AF	WAF	Ghana
AF	WAF	Guinea
AF	WAF	Guinea-Bissau
AF	WAF	Liberia
AF	WAF	Mali
AF	WAF	Mauritania
AF	WAF	Niger
AF	WAF	Nigeria
AF	WAF	Senegal
AF	WAF	Sierra Leone
CAC	CAC	Belize
CAC	CAC	Costa Rica
CAC	CAC	Cuba
CAC	CAC	Guatemala
CAC	CAC	Honduras
CAC	CAC	Jamaica
CAC	CAC	Mexico
CAC	CAC	Nicaragua
CAC	CAC	Panama
E	EE	Belarus
E	EE	Bulgaria
E	EE	Romania
E	EE	Ukraine
E	NE	Lithuania
E	RF	Russian Federation
E	SE	Northern Macedonia (formerly FYROM)
E	SE	Serbia
OP	OP	Papua New Guinea
OP	OP	Solomon Islands
SAM	SAM	Argentina
SAM	SAM	Bolivia, Plurinational State of
SAM	SAM	Brazil
SAM	SAM	Chile
SAM	SAM	Colombia
SAM	SAM	Ecuador
SAM	SAM	Guyana
SAM	SAM	Paraguay
SAM	SAM	Peru
SAM	SAM	Suriname
SAM	SAM	Uruguay
SAM	SAM	Venezuela, Bolivarian Republic of

Broad regions: E-Europe, CAC-Central America and the Caribbean, SAM-South America, AF-Africa, A-Asia, OP-Oceania and Polynesia
Sub-regions: EE-Eastern Europe, NE-Norther Europe, SE-Southern Europe, WE-Western Europe, RF-Russian Federation; CAC-Central America and the Caribbean; SAM-South America; OP-Oceania and Polynesia; EAF-Eastern Africa, CAF-Middle (Central) Africa, NAF-Northern Africa, SAF-Southern Africa, WAF-Western Africa; WA-Western Asia, SEA-Southeast Asia, SA-South Asia, EA-East Asia and Japan, CA-Central Asia

Table A3.2: Regional and sub-regional classification of investor countries based on United Nations' Statistical Division methodology

Detail regions	Broad regions	All countries
NAF	AF	Algeria
CAF	AF	Angola
SAM	SAM	Argentina
OP	OP	Australia
WE	E	Austria
WA	A	Bahrain
SA	A	Bangladesh
CAC	CAC	Barbados
WE	E	Belgium
CAC	CAC	Belize
WAF	AF	Benin
NAM	NAM	Bermuda
SAM	SAM	Bolivia, Plurinational State of
SAF	AF	Botswana
SAM	SAM	Brazil
CAC	CAC	British Virgin Islands
EE	E	Bulgaria
WAF	AF	Burkina Faso
SEA	A	Cambodia
CAF	AF	Cameroon
NAM	NAM	Canada
WAF	AF	Cape Verde
CAC	CAC	Cayman Islands
CAF	AF	Central African Republic
SAM	SAM	Chile
EA	A	China
SAM	SAM	Colombia
CAF	AF	Congo
CAC	CAC	Costa Rica
WAF	AF	Côte d'Ivoire
SE	E	Croatia
WA	A	Cyprus
EA	A	Democratic People's Republic of Korea
CAF	AF	Democratic Republic of the Congo
NE	E	Denmark
EAF	AF	Djibouti
SAM	SAM	Ecuador
NAF	AF	Egypt
NE	E	Estonia
EAF	AF	Ethiopia
NE	E	Finland
WE	E	France
CAF	AF	Gabon
WE	E	Germany
WAF	AF	Ghana
SE	E	Gibraltar
CAC	CAC	Guadeloupe
CAC	CAC	Guatemala
NE	E	Guernsey
WAF	AF	Guinea

Table A3.2: Continued

Detail regions	Broad regions	All countries
CAC	CAC	Honduras
EA	A	Hong Kong, Special Administrative Region
EE	E	Hungary
NE	E	Iceland
SA	A	India
SEA	A	Indonesia
SA	A	Iran, Islamic Republic of
WA	A	Iraq
NE	E	Ireland
NE	E	Isle of Man
WA	A	Israel
SE	E	Italy
EA	A	Japan
WA	A	Jordan
CA	A	Kazakhstan
EAF	AF	Kenya
WA	A	Kuwait
SEA	A	Lao, People's Democratic Republic
WA	A	Lebanon
WAF	AF	Liberia
NAF	AF	Libya
WE	E	Liechtenstein
NE	E	Lithuania
WE	E	Luxembourg
EAF	AF	Madagascar
EAF	AF	Malawi
SEA	A	Malaysia
WAF	AF	Mali
EAF	AF	Mauritius
CAC	CAC	Mexico
EA	A	Mongolia
NAF	AF	Morocco
EAF	AF	Mozambique
SEA	A	Myanmar
SAF	AF	Namibia
WE	E	Netherlands
OP	OP	New Zealand
CAC	CAC	Nicaragua
WAF	AF	Niger
WAF	AF	Nigeria
NE	E	Norway
SA	A	Pakistan
CAC	CAC	Panama
OP	OP	Papua New Guinea
SAM	SAM	Paraguay
SAM	SAM	Peru
SEA	A	Philippines
SE	E	Portugal
WA	A	Qatar
EA	A	Republic of Korea
EAF	AF	Réunion
EE	E	Romania

Table A3.2: Continued

Detail regions	Broad regions	All countries
RF	E	Russian Federation
EAF	AF	Rwanda
CAF	AF	Sao Tome and Principe
WA	A	Saudi Arabia
WAF	AF	Senegal
WAF	AF	Sierra Leone
EA	A	Singapore
SAF	AF	South Africa
EAF	AF	South Sudan
SE	E	Spain
SA	A	Sri Lanka
NAF	AF	Sudan
NE	E	Sweden
WE	E	Switzerland
WA	A	Syrian Arab Republic
CA	A	Tajikistan
SEA	A	Thailand
SEA	A	Timor-Leste
WA	A	Turkey
EAF	AF	Uganda
EE	E	Ukraine
WA	A	United Arab Emirates
NE	E	United Kingdom of Great Britain and Northern Ireland
EAF	AF	United Republic of Tanzania
NAM	NAM	United States of America
SAM	SAM	Uruguay
SEA	A	Vietnam
EAF	AF	Zambia
EAF	AF	Zimbabwe

Broad regions: NAM-North America, E-Europe, CAC-Central America and the Caribbean, SAM-South America, AF-Africa, A-Asia, OP-Oceania and Polynesia

Sub-regions: EE-Eastern Europe, NE-Norther Europe, SE-Southern Europe, WE-Western Europe, RF-Russian Federation; CAC-Central America and the Caribbean; SAM-South America; OP-Oceania and Polynesia; EAF-Eastern Africa, CAF-Middle (Central) Africa, NAF-Northern Africa, SAF-Southern Africa, WAF-Western Africa; WA-Western Asia, SEA-Southeast Asia, SA-South Asia, EA-East Asia and Japan, CA-Central Asia

Table A3.3: Number of deals per country overview; total number and negotiation status

No.	Countries	Total number of deals	No negotiation status	Intended - Expression of interest	Intended - Under negotiation	Conclude - Oral agreement	Concluded - Contract signed	Failed - Negotiations failed	Failed - Contract cancelled
1	Algeria	5		1	2		2		
2	Angola	28		2	4		2		2
3	Argentina	195				1	192	1	1
4	Armenia	1			1				
5	Bangladesh	1				1			
6	Belarus	1		1					
7	Belize	2					2		
8	Benin	9		1	1		6		1
9	Bolivia (Plurinational State of)	4					4		
10	Botswana	1					1		
11	Brazil	103	4		3	1	94		1
12	Bulgaria	6					6		
13	Burkina Faso	3					3		
14	Cambodia	174	1	1	1	4	156	11	
15	Cameroon	20		2	2		13		3
16	Central African Republic	2					2		
17	Chile	14			1		13		
18	China	27	3				23		1
19	Colombia	53			1		52		
20	Congo	12			2		1		
21	Costa Rica	2					2		
22	Côte d'Ivoire	12		1		1	1		
23	Cuba	2					2		
24	Democratic Rep. of the Congo	65		2			63		
25	Ecuador	2					2		
26	Egypt	11		2			9		

Table A3.3: Continued

No.	Countries	Total number of deals	No negotiation status	Intended - Expression of interest	Intended - Under negotiation	Conclude - Oral agreement	Concluded - Contract signed	Failed - Negotiations failed	Failed - Contract cancelled
27	Ethiopia	126			15		11	6	4
28	Gabon	7			1		6		
29	Gambia	2			1		1		
30	Georgia	1					1		
31	Ghana	55		3	6	2	44		
32	Guatemala	10	1			2	7		
33	Guinea	8			3		5		
34	Guinea-Bissau	1					1		
35	Guyana	7					6		1
36	Honduras	5					5		
37	India	85	1	1	8	14	54	6	1
38	Indonesia	162	3	3	4	11	138	1	2
39	Iraq	1	1						
40	Jamaica	1					1		
41	Kazakhstan	2					2		
42	Kenya	26	1	5	3	1	9	1	6
43	Lao People's Democratic Republic	71	5	1	1	19	44	1	
44	Liberia	23			1		2	2	
45	Libya	1							1
46	Lithuania	3					3		
47	Madagascar	50		1		1	19		29
48	Malawi	14		1			11		2
49	Malaysia	19	2	1	1		15		
50	Mali	29	1	3	7		11	5	2
51	Mauritania	5			1		4		
52	Mauritius	2					2		

Table A3.3: Continued

No.	Countries	Total number of deals	No negotiation status	Intended - Expression of interest	Intended - Under negotiation	Conclude - Oral agreement	Concluded - Contract signed	Failed - Negotiations failed	Failed - Contract cancelled
53	Mexico	8				1	6		1
54	Mongolia	2	1				1		
55	Morocco	7			2		5		
56	Mozambique	147	1	1	35	3	12	2	3
57	Myanmar	8	1	3			3		1
58	Namibia	15		3	4		6	1	1
59	Nicaragua	21				1	2		
60	Niger	5		1	1		1	2	
61	Nigeria	62	1	1	8		51	1	
62	Pakistan	13	2	1	3	1	4	1	1
63	Panama	2					2		
64	Papua New Guinea	47	1				45	1	
65	Paraguay	35	1		1		33		
66	Peru	61	1			1	58	1	
67	Philippines	60	9	6	18	12	13	1	1
68	Romania	86	2	1		2	81		
69	Russian Federation	41		1	1	9	3		
70	Rwanda	8			1		7		
71	Sao Tome and Principe	1					1		
72	Senegal	34	1		3	2	25	1	2
73	Serbia	4					4		
74	Sierra Leone	33		2	5	1	25		
75	Solomon Islands	1					1		
76	South Africa	15			1		13		1
77	South Sudan	22			9	4	9		
78	Sri Lanka	4	1				3		

Table A3.3: Continued

No.	Countries	Total number of deals	No negotiation status	Intended - Expression of interest	Intended - Under negotiation	Conclude - Oral agreement	Concluded - Contract signed	Failed - Negotiations failed	Failed - Contract cancelled
79	Sudan	36		5	2	4	22		3
80	Suriname	1					1		
81	Swaziland	5			1		4		
82	Tajikistan	3	1				2		
83	Thailand	6	1	2	1		2		
84	FYROM*	2					2		
85	Timor-Leste	4			3		1		
86	Tunisia	2					2		
87	Turkey	2			2				
88	Uganda	27		2			23		2
89	Ukraine	46		1		4	4	1	
90	United Republic of Tanzania	67		6	9	5	4	1	6
91	Uruguay	62					62		
92	Venezuela (Bolivarian Republic of)	1					1		
93	Viet Nam	107	3		4	1	97	2	
94	Zambia	46		1	4	2	31	2	6
95	Zimbabwe	9			1		7	1	
Total		2639	50	69	189	111	2083	52	85

* The Former Yugoslav Republic of Macedonia; Source: Author’s own calculations based on Land Matrix database

Table A3.4: Overview of deals with no investor name information

Target country	Investor country	Intention of investment
Cambodia	Canada, China	Food crops, For wood and fibre, Livestock
Cambodia	China	Agriunspecified, Forest unspecified
Cambodia	China	Agriunspecified, Forest unspecified
Cambodia	China	Agriunspecified, Non-food agricultural commodities
Cambodia	China	Agriunspecified, Non-food agricultural commodities
Cambodia	China	Non-food agricultural commodities
Cambodia	China	Non-food agricultural commodities
Cambodia	Singapore	Non-food agricultural commodities
Cambodia	Thailand	Non-food agricultural commodities
Cambodia	Viet Nam	Agriunspecified, Food crops, Non-food agricultural commodities
Cambodia	Viet Nam	Agriunspecified, Food crops, Non-food agricultural commodities
Cambodia	Viet Nam	Livestock, Non-food agricultural commodities
Cambodia	Viet Nam	Non-food agricultural commodities
Cambodia	Viet Nam	Non-food agricultural commodities
Cambodia	Viet Nam	Non-food agricultural commodities
Cambodia	Viet Nam	Non-food agricultural commodities
Mozambique	Republic of Korea	Biofuels, Food crops, Renewable energy

Source: Author's own calculations based on Land Matrix database

Table A3.5: Per country overview of deals with no information on the implementation status

Algeria	1	Mauritania	1
Angola	12	Morocco	4
Argentina	3	Mozambique	36
Belarus	1	Namibia	8
Benin	5	Niger	3
Brazil	7	Nigeria	16
Burkina Faso	1	Pakistan	2
Cambodia	69	Papua New Guinea	14
Cameroon	7	Paraguay	2
Chile	1	Peru	2
Congo	2	Philippines	24
Costa Rica	1	Romania	3
Côte d'Ivoire	4	Russian Federation	1
Cuba	1	Rwanda	3
Democratic Republic of the Congo	36	Senegal	9
Egypt	4	Serbia	1
Ethiopia	55	Sierra Leone	13
Gabon	1	South Africa	2
Gambia	1	South Sudan	9
Ghana	15	Sri Lanka	1
Guatemala	1	Sudan	12
Guinea	4	Thailand	3
Guyana	1	Timor-Leste	1
India	6	Tunisia	1
Indonesia	42	Uganda	7
Kazakhstan	1	Ukraine	4
Kenya	13	United Republic of Tanzania	24
Lao People's Democratic Republic	18	Viet Nam	2
Liberia	3	Zambia	14
Libya	1	Zimbabwe	2
Madagascar	24	Total number of deals	582
Malawi	4	Total number of countries	63
Mali	13		

Source: Author’s own calculations based on Land Matrix database

Table A3.6: Overview of deals with no information on contract farming

Intention of investment	No. of deals
Agriunspecified	379
Biofuels	398
Conservation	43
Food crops	758
For carbon sequestration/REDD	21
Livestock	156
Non-food agricultural commodities	132
Total	1887

Source: Author’s own calculations based on Land Matrix database

Table A3.7: Overview of deals with no information on crops produced (or intended)

It might seem strange that there is tourism included in this list however there are deals intended for tourism that also produce crops.

Intention of investment	No of deals
Agriunspecified	39
Biofuels	19
Conservation	24
Food crops	29
For carbon sequestration/REDD	3
For wood and fibre	11
Forest unspecified	2
Industry	159
Livestock	143
Non-food agricultural commodities	2
Other (please specify)	24
Renewable Energy	11
Tourism	22
Total	488

Source: Author's own calculations based on Land Matrix database

Table A3.8: Country overview of number of deals with no negotiation status.

	Target country	No. of deals
1	Brazil	4
2	Cambodia	1
3	China	3
4	Guatemala	1
5	India	1
6	Indonesia	3
7	Iraq	1
8	Kenya	1
9	Lao People's Democratic Republic	5
10	Malaysia	2
11	Mali	1
12	Mongolia	1
13	Mozambique	1
14	Myanmar	1
15	Nigeria	1
16	Pakistan	2
17	Papua New Guinea	1
18	Paraguay	1
19	Peru	1
20	Philippines	9
21	Romania	2
22	Senegal	1
23	Sri Lanka	1
24	Tajikistan	1
25	Thailand	1
26	Viet Nam	3
	Total	50

Source: Author’s own calculations based on Land Matrix database

Table A3.9: Overview of deals with no investor country information

	Target country	No. of deals
1	Angola	1
2	Argentina	3
3	Benin	1
4	Cambodia	2
5	Congo	2
6	Democratic Republic of the Congo	1
7	Ethiopia	1
8	Ghana	1
9	India	1
10	Lao People's Democratic Republic	3
11	Madagascar	2
12	Mali	1
13	Mozambique	29
14	Nigeria	2
15	Papua New Guinea	1
16	Paraguay	1
17	South Africa	1
18	United Republic of Tanzania	1
	Total	54

Source: Author's own calculations based on Land Matrix database

Table A3.10: Overview of deals with no information on the intention of investment

	Target countries	No. of deals
1	Algeria	2
2	Angola	2
3	Benin	1
4	Cambodia	3
5	Colombia	2
6	Congo	1
7	Ethiopia	1
8	Ghana	1
9	Mali	3
10	Mauritania	2
11	Niger	1
12	Nigeria	2
13	Papua New Guinea	7
14	Peru	9
15	Senegal	1
16	South Sudan	2
17	Sudan	3
18	United Republic of Tanzania	1
19	Zambia	1
	Total	45

Source: Author's own calculations based on Land Matrix database

Table A3.11: Number of deals per target country

	Country	No. of deals		Country	No. of deals
1	Argentina	191	48	Guinea	8
2	Cambodia	168	49	Mexico	8
3	Indonesia	159	50	Rwanda	8
4	Ethiopia	125	51	Benin	7
5	Mozambique	117	52	Gabon	7
6	Viet Nam	104	53	Guyana	7
7	Brazil	99	54	Morocco	7
8	Romania	84	55	Myanmar	7
9	India	83	56	Bulgaria	6
10	Tanzania	66	57	Honduras	5
11	DR of the Congo	64	58	Swaziland	5
12	Lao PDR	63	59	Thailand	5
13	Uruguay	62	60	Bolivia	4
14	Nigeria	57	61	Niger	4
15	Ghana	53	62	Serbia	4
16	Peru	52	63	Timor-Leste	4
17	Philippines	51	64	Algeria	3
18	Madagascar	48	65	Burkina Faso	3
19	Ukraine	46	66	Lithuania	3
20	Zambia	45	67	Mauritania	3
21	Papua New Guinea	44	68	Sri Lanka	3
22	Colombia	42	69	Belize	2
23	Russian Federation	41	70	Central African Republic	2
24	Paraguay	33	71	Costa Rica	2
25	Sierra Leone	33	72	Cuba	2
26	Sudan	33	73	Ecuador	2
27	Senegal	32	74	Gambia	2
28	Uganda	27	75	Kazakhstan	2
29	Angola	25	76	Mauritius	2
30	Kenya	25	77	Panama	2
31	China	24	78	Tajikistan	2
32	Mali	24	79	FYR Macedonia	2
33	Liberia	23	80	Tunisia	2
34	Nicaragua	21	81	Turkey	2
35	South Sudan	21	82	Armenia	1
36	Cameroon	20	83	Bangladesh	1
37	Malaysia	17	84	Belarus	1
38	Namibia	15	85	Botswana	1
39	Chile	14	86	Georgia	1
40	Malawi	14	87	Guinea-Bissau	1
41	South Africa	14	88	Jamaica	1
42	Côte d'Ivoire	12	89	Libya	1
43	Egypt	11	90	Mongolia	1
44	Pakistan	11	91	Sao Tome and Principe	1
45	Congo	9	92	Solomon Islands	1
46	Guatemala	9	93	Suriname	1
47	Zimbabwe	9	94	Venezuela	1

Source: Author’s own calculations based on Land Matrix database

Table A3.12: Overview of deals from different broad investor regions

			In consortium			
	Total no. of investments	As sole investor	Two investors	Three investors	Four investors	Seven investors
North America	231	136	62	9	2	22
Europe	623	414	148	21	7	33
Central America and the Caribbean	46	30	12	3	1	0
South America	373	291	70	10	2	0
Africa	514	340	148	24	2	0
Asia	1192	856	272	36	6	22
Oceania and Polynesia	19	15	2	2	0	0
Total number of deals	2998	2082	714	105	20	77

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.13: Overview of deals from different detailed investor regions

			In consortium			
	Total investments	As sole investor	Two investors	Three investors	Four investors	Seven investors
North America	231	136	62	9	2	22
Eastern Europe	51	45	5	1	0	0
Norther Europe	245	143	81	9	1	11
Southern Europe	80	67	10	3	0	0
Western Europe	230	145	50	7	6	22
Russian Federation	17	14	2	1	0	0
Central America and the Caribbean	46	30	12	3	1	0
South America	373	291	70	10	2	0
Oceania and Polynesia	19	15	2	2	0	0
Eastern Africa	233	140	79	14	0	0
Middle Africa	65	47	15	3	0	0
Northern Africa	35	24	9	1	1	0
Southern Africa	76	53	20	3	0	0
Western Africa	105	76	25	3	1	0
Western Asia	157	108	39	7	3	0
Southeast \Asia	453	362	84	7	0	0
South Asia	187	165	20	2	0	0
East Asia and Japan	391	220	126	20	3	22
Central Asia	4	1	3	0	0	0
	2998	2082	714	105	20	77

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.14: Information on suitable and available land and corresponding hectares per capita values

	Suitable land [m ha]	Used land	Available land	% of available of available land	Population in 2000	ha of suitable land per capita	ha of available land per capita
North America	366.3	225.3	141	9.43%	312.845.026	1.17	0.45
Europe	502.3	314.1	188.2	12.58%	727.200.939	0.69	0.26
Eastern Europe	121.9	81.7	40.2	2.69%	157.561.038	0.77	0.26
Norther Europe	43.8	21.6	22.2	1.48%	94.543.861	0.46	0.23
Southern Europe	46.5	45.6	0.9	0.06%	145.657.350	0.32	0.01
Western Europe	64.2	35.1	29.1	1.95%	183.042.176	0.35	0.16
Russian Federation	225.9	130.1	95.8	6.40%	146.396.514	1.54	0.65
Central America and the Caribbean	58.8	43.5	15.3	1.02%	176.396.212	0.33	0.09
South America	669.2	114.8	554.4	37.06%	349.398.761	1.92	1.59
Oceania and Polynesia	101.8	53.2	48.6	3.25%	31.229.422	3.26	1.56
Africa	812.6	197.7	614.9	41.11%	817.566.004	0.99	0.75
Eastern Africa	240.9	46	194.9	13.03%	261.113.890	0.92	0.75
Middle Africa	270.3	24.8	245.5	16.41%	96.098.868	2.81	2.55
Northern Africa	94	44.1	49.9	3.34%	172.558.870	0.54	0.29
Southern Africa	28.8	17.4	11.4	0.76%	52.286.079	0.55	0.22
Western Africa	178.6	65.4	113.2	7.57%	235.508.297	0.76	0.48
Asia	490	556.6	-66.6	-4.45%	3.730.370.625	0.13	-0.02
Western Asia	31.7	46.1	-14.4	-0.96%	185.018.877	0.17	-0.08
Southeast \Asia	102	89.6	12.4	0.83%	524.657.117	0.19	0.02
South Asia	196	231.6	-35.6	-2.38%	1.452.757.699	0.13	-0.02
East Asia and Japan	144.8	144.1	0.7	0.05%	1.512.377.595	0.10	0.00
Central Asia	15.5	45.2	-29.7	-1.99%	55.559.337	0.28	-0.53

Source: Author's own calculations based on Fischer, at al. (2002)

Table A3.15: Number of deals per investor country

No.	All countries	Sole or primary investor	Total investments
1	Algeria	3	3
2	Angola	12	17
3	Argentina	152	168
4	Australia	9	11
5	Austria	8	9
6	Bahrain	2	2
7	Bangladesh	4	4
8	Barbados	1	1
9	Belgium	20	22
10	Belize	2	2
11	Benin	1	2
12	Bermuda	0	11
13	Bolivia (Plurinational State of)	1	1
14	Botswana	0	1
15	Brazil	48	76
16	British Virgin Islands	2	5
17	Bulgaria	5	5
18	Burkina Faso	1	1
19	Cambodia	61	62
20	Cameroon	4	6
21	Canada	41	52
22	Cape Verde	2	2
23	Cayman Islands	3	3
24	Central African Republic	1	1
25	Chile	23	24
26	China	176	195
27	Colombia	28	28
28	Congo	1	2
29	Costa Rica	2	2
30	Côte d'Ivoire	7	7
31	Croatia	1	1
32	Cyprus	12	13
33	Democratic People's Republic of Korea	1	1
34	Democratic Republic of the Congo	30	35
35	Denmark	20	21
36	Djibouti	3	3
37	Ecuador	2	2
38	Egypt	13	16
39	Estonia	3	4
40	Ethiopia	37	55
41	Finland	9	21
42	France	43	47
43	Gabon	2	3
44	Germany	27	34
45	Ghana	10	17
46	Gibraltar	1	1
47	Guadeloupe	1	1

Table A3.15: Continued

No.	All countries	Sole or primary investor	Total investments
48	Guatemala	8	8
49	Guernsey	1	1
50	Guinea	0	1
51	Honduras	3	4
52	Hong Kong Special Administrative Region	0	37
53	Hungary	1	1
54	Iceland	1	1
55	India	151	160
56	Indonesia	34	53
57	Iran (Islamic Republic of)	4	4
58	Iraq	0	1
59	Ireland	3	3
60	Isle of Man	1	1
61	Israel	14	14
62	Italy	33	35
63	Japan	35	45
64	Jordan	1	1
65	Kazakhstan	2	3
66	Kenya	17	18
67	Kuwait	1	2
68	Lao People's Democratic Republic	10	16
69	Lebanon	12	13
70	Liberia	7	7
71	Libya	4	4
72	Liechtenstein	6	6
73	Lithuania	3	3
74	Luxembourg	28	30
75	Madagascar	9	12
76	Malawi	3	5
77	Malaysia	126	128
78	Mali	5	8
79	Mauritius	15	20
80	Mexico	6	7
81	Mongolia	0	1
82	Morocco	2	2
83	Mozambique	21	36
84	Myanmar	0	1
85	Namibia	8	12
86	Netherlands	46	61
87	New Zealand	2	2
88	Nicaragua	9	10
89	Niger	2	2
90	Nigeria	40	45
91	Norway	19	22
92	Pakistan	2	3
93	Panama	1	3
94	Papua New Guinea	5	6

Table A3.15: Continued

No.	All countries	Sole or primary investor	Total investments
95	Paraguay	18	19
96	Peru	40	42
97	Philippines	24	29
98	Portugal	20	22
99	Qatar	18	20
100	Republic of Korea	39	42
101	Réunion	1	1
102	Romania	33	36
103	Russian Federation	16	17
104	Rwanda	4	5
105	Sao Tome and Principe	0	1
106	Saudi Arabia	37	40
107	Senegal	7	9
108	Sierra Leone	3	4
109	Singapore	55	70
110	South Africa	58	63
111	South Sudan	7	9
112	Spain	21	21
113	Sri Lanka	16	16
114	Sudan	8	10
115	Sweden	15	16
116	Switzerland	9	21
117	Syrian Arab Republic	1	1
118	Tajikistan	0	1
119	Thailand	17	21
120	Timor-Leste	1	1
121	Turkey	9	10
122	Uganda	8	10
123	Ukraine	8	9
124	United Arab Emirates	38	40
125	United Kingdom of Great Britain and Northern Ireland	116	152
126	United Republic of Tanzania	16	29
127	United States of America	125	168
128	Uruguay	13	13
129	Vietnam	135	142
130	Zambia	9	13
131	Zimbabwe	9	17
	Total number of deals	2490	2998

Source: Author’s own calculations based on Land Matrix database

Table A3.16: Overview of number of deals at regional level in regard to the number of countries in investing consortium

	Total investments	Sole investor	Two investors	Three investors	Four investors	Seven investors
North America	231	136	62	9	2	22
Europe	623	414	148	21	7	33
Central America and the Caribbean	46	30	12	3	1	0
South America	373	291	70	10	2	0
Africa	514	340	148	24	2	0
Asia	1192	856	272	36	6	22
Oceania and Polynesia	19	15	2	2	0	0
Total	2998	2082	714	105	20	77

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.17: Overview of number of deals at sub-regional level in regard to the number of countries in investing consortium

	Total	Sole investor	Two investors	Three investors	Four investors	Seven investors
North America	231	136	62	9	2	22
Europe						
Eastern Europe	51	45	5	1	0	0
Norther Europe	245	143	81	9	1	11
Southern Europe	80	67	10	3	0	0
Western Europe	230	145	50	7	6	22
Russian Federation	17	14	2	1	0	0
Central America and the Caribbean	46	30	12	3	1	0
South America	373	291	70	10	2	0
Oceania and Polynesia	19	15	2	2	0	0
Africa						
Eastern Africa	233	140	79	14	0	0
Middle Africa	65	47	15	3	0	0
Northern Africa	35	24	9	1	1	0
Southern Africa	76	53	20	3	0	0
Western Africa	105	76	25	3	1	0
Asia						
Western Asia	157	108	39	7	3	0
Southeast Asia	453	362	84	7	0	0
South Asia	187	165	20	2	0	0
East Asia and Japan	391	220	126	20	3	22
Central Asia	4	1	3	0	0	0
Total	2998	2082	714	105	20	77

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.18: Regional spread of deals for top ten investor countries*

	Total	Europe	Central America and the Caribbean	South America	Africa	Asia	Oceania and Polynesia	Regional HH index
China	195	6 (3.08%)	3 (1.54%)	20 (10.26%)	52 (26.67%)	111 (56.92%)	3 (1.54%)	0.41
Argentina	168	0 (0.00%)	0 (0.00%)	166 (98.81%)	2 (1.19%)	0 (0.00%)	0 (0.00%)	0.98
United States of America	168	13 (7.74%)	4 (2.38%)	70 (41.67%)	66 (39.29%)	13 (7.74%)	2 (1.19%)	0.34
India	160	2 (1.25%)	0 (0.00%)	5 (3.13%)	71 (44.38%)	82 (51.25%)	0 (0.00%)	0.46
United Kingdom	152	3 (1.97%)	1 (0.66%)	32 (21.05%)	87 (57.24%)	29 (19.08%)	0 (0.00%)	0.41
Vietnam	142	0 (0.00%)	0 (0.00%)	0 (0.00%)	4 (2.82%)	138 (97.18%)	0 (0.00%)	0.95
Malaysia	128	0 (0.00%)	0 (0.00%)	2 (1.56%)	14 (10.94%)	83 (64.84%)	29 (22.66%)	0.48
Brazil	76	0 (0.00%)	1 (1.32%)	64 (84.21%)	11 (14.47%)	0 (0.00%)	0 (0.00%)	0.73
Singapore	70	1 (1.43%)	0 (0.00%)	12 (17.14%)	28 (40.00%)	27 (38.57%)	2 (2.86%)	0.34
South Africa	63	0 (0.00%)	0 (0.00%)	0 (0.00%)	62 (98.41%)	1 (1.59%)	0 (0.00%)	0.97

* Region with highest number of deals for each country is highlighted; Share of regionals deals in total deals per country is in parenthesis

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.19: Sub-regional spread of deals for top ten investor countries*

	China	Argentina	USA	India	UK	Vietnam	Malaysia	Brazil	Singapore	South Africa
Total number of deals	195	168	168	160	152	142	128	76	70	63
Eastern Europe	4	0	12	0	2	0	0	0	1	0
	(2.05%)	(0.00%)	(7.14%)	(0.00%)	(1.32%)	(0.00%)	(0.00%)	(0.00%)	(1.43%)	(0.00%)
Norther Europe	0	0	0	0	0	0	0	0	0	0
	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)
Southern Europe	0	0	0	2	0	0	0	0	0	0
	(0.00%)	(0.00%)	(0.00%)	(1.25%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)
Russian Federation	2	0	1	0	1	0	0	0	0	0
	(1.03%)	(0.00%)	(0.60%)	(0.00%)	(0.66%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)
Central America and the Caribbean	3	0	4	0	1	0	0	1	0	0
	(1.54%)	(0.00%)	(2.38%)	(0.00%)	(0.66%)	(0.00%)	(0.00%)	(1.32%)	(0.00%)	(0.00%)
South America	20	166	70	5	32	0	2	64	12	0
	(10.26%)	(98.81%)	(41.67%)	(3.13%)	(21.05%)	(0.00%)	(1.56%)	(84.21%)	(17.14%)	(0.00%)
Oceania and Polynesia	3	0	2	0	0	0	29	0	2	0
	(1.54%)	(0.00%)	(1.19%)	(0.00%)	(0.00%)	(0.00%)	(22.66%)	(0.00%)	(2.86%)	(0.00%)
Eastern Africa	29	0	36	59	45	0	2	2	12	41
	(14.87%)	(0.00%)	(21.43%)	(36.88%)	(29.61%)	(0.00%)	(1.56%)	(2.63%)	(17.14%)	(65.08%)
Middle Africa	5	0	13	0	5	1	5	3	6	1
	(2.56%)	(0.00%)	(7.74%)	(0.00%)	(3.29%)	(0.70%)	(3.91%)	(3.95%)	(8.57%)	(1.59%)
Northern Africa	2	0	1	1	1	0	0	1	0	1
	(1.03%)	(0.00%)	(0.60%)	(0.63%)	(0.66%)	(0.00%)	(0.00%)	(1.32%)	(0.00%)	(1.59%)
Southern Africa	2	1	4	0	2	0	0	0	0	14
	(1.03%)	(0.60%)	(2.38%)	(0.00%)	(1.32%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(22.22%)
Western Africa	14	1	12	11	34	3	7	5	10	5
	(7.18%)	(0.60%)	(7.14%)	(6.88%)	(22.37%)	(2.11%)	(5.47%)	(6.58%)	(14.29%)	(7.94%)
Western Asia	0	0	0	0	0	0	0	0	0	1
	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(1.59%)
Southeast Asia	88	0	9	7	26	137	82	0	25	0
	(45.13%)	(0.00%)	(5.36%)	(4.38%)	(17.11%)	(96.48%)	(64.06%)	(0.00%)	(35.71%)	(0.00%)

Table A3.19: Continued

	China	Argentina	USA	India	UK	Vietnam	Malaysia	Brazil	Singapore	South Africa
Total number of deals	195	168	168	160	152	142	128	76	70	63
	(45.13%)	(0.00%)	(5.36%)	(4.38%)	(17.11%)	(96.48%)	(64.06%)	(0.00%)	(35.71%)	(0.00%)
South Asia	2	0	4	75	3	1	1	0	1	0
	(1.03%)	(0.00%)	(2.38%)	(46.88%)	(1.97%)	(0.70%)	(0.78%)	(0.00%)	(1.43%)	(0.00%)
East Asia and Japan	18	0	0	0	0	0	0	0	1	0
	(9.23%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(1.43%)	(0.00%)
Central Asia	3	0	0	0	0	0	0	0	0	0
	(1.54%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)
HH index	0.25	0.98	0.24	0.36	0.21	0.93	0.47	0.72	0.22	0.48

* Region with highest number of deals for each country is highlighted; share of regionals deals in total deals per country is in parenthesis

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.20: Regional overview of deals with domestic investors

Broad region	Total	Domestic investors	Only foreign investors	Share of deals with domestic investors
Europe	187	63	124	33.69%
Central America and the Caribbean	52	25	27	48.08%
South America	508	303	205	59.65%
Africa	989	385	604	38.93%
Asia	709	348	361	49.08%
Oceania and Polynesia	45	6	39	13.33%
Total number of deals	2490	1130	1360	45.38%

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.21: Sub-regional overview of deals with domestic investors

Detailed region	Total	Domestic investors	Only foreign investors	Share of deals with domestic investors
Eastern Europe	137	47	90	34.31%
Norther Europe	3	2	1	66.67%
Southern Europe	6	0	6	0.00%
Russian Federation	41	14	27	34.15%
Central America and the Caribbean	52	25	27	48.08%
South America	508	303	205	59.65%
Oceania and Polynesia	45	6	39	13.33%
Eastern Africa	507	192	315	37.87%
Middle Africa	128	64	64	50.00%
Northern Africa	57	17	40	29.82%
Southern Africa	35	21	14	60.00%
Western Africa	262	91	171	34.73%
Western Asia	4	1	3	25.00%
Southeast Asia	578	248	330	42.91%
South Asia	98	79	19	80.61%
East Asia and Japan	25	17	8	68.00%
Central Asia	4	3	1	75.00%
Total	2490	1130	1360	45.38%

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.22: Overview of allowed share of foreign ownership of agricultural land in regions and sub-regions based on data from the report

Region	Sub-region	Ownership*	
North America		100.00%	
Europe		100.00%	
	Eastern Europe		100.00%
	Norther Europe		100.00%
	Southern Europe		100.00%
	Western Europe		100.00%
	Russian Federation		100.00%
Central America and the Caribbean		92,71%	
South America		98.13%	
Oceania and Polynesia		100.00%	
Africa		96.96%	
	Eastern Africa		100.00%
	Middle Africa		100.00%
	Northern Africa		83.00%
	Southern Africa		100.00%
	Western Africa		100.00%
Asia		89.10%	
	Western Asia		90.00%
	Southeast Asia		69.14%
	South Asia		100.00%
	East Asia and Japan		100.00%
	Central Asia		100.00%

* - Percentage represents share of allowed foreign ownership of agricultural land

Source: Author’s own calculations based on Land Matrix database, World Bank Investing across borders 2010 report (World Bank, 2010a), and United Nations’ Statistical Division methodology (United Nations, 2017)

Table A3.23: Number of deals with no information on crop production grouped by intention

Intended use	No. of deals
Agriunspecified	14
Biofuels	16
Conservation	1
Food crops	304
For carbon sequestration/REDD	0
For wood and fibre	74
Forest unspecified	2
Industry	18
Livestock	16
Non-food agricultural commodities	34
Other (please specify)	2
Renewable Energy	0
Tourism	6
Total number of deals	487

Source: Author's own calculations based on Land Matrix database (2017)

Table A3.24: Number of deals intended for trees grouped by sub-regions

	Detail Regions	No. of deals	Share
Europe			
	Eastern Europe	13	5.12%
	Russian Federation	3	1.18%
Central America and the Caribbean		2	0.79%
South America		64	25.20%
Oceania and Polynesia		1	0.39%
Africa			
	Eastern Africa	71	27.95%
	Middle Africa	22	8.66%
	Southern Africa	3	1.18%
	Western Africa	30	11.81%
Asia			
	Southeast Asia	43	16.93%
	South Asia	2	0.79%
	Total	254	

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.25: Regional overview of number of deals grouped by type of crop (food, mixed, non-food)

Broad regions	Food	Mixed	Non-food	Total crops
Europe	80	15	69	164
Central America and the Caribbean	37	3	1	41
South America	282	65	5	352
Africa	445	76	125	646
Asia	346	39	53	438
Oceania and Polynesia	27	1	11	39
Total	1217	199	264	1680

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.26: Sub-regional overview of number of deals grouped by type of crop (food, mixed, non-food)

	Detail Regions	Food	Mixed	Non-food	Total
Europe					
	Eastern Europe	53	12	52	117
	Norther Europe	1	0	2	3
	Southern Europe	6	0	0	6
	Western Europe	0	0	0	0
	Russian Federation	20	3	15	38
Central America and the Caribbean		37	3	1	41
South America		282	65	5	352
Oceania and Polynesia		27	1	11	39
Africa					
	Eastern Africa	211	35	60	306
	Middle Africa	65	12	13	90
	Northern Africa	29	6	9	44
	Southern Africa	23	0	1	24
	Western Africa	117	23	42	182
Asia					
	Western Asia	3	0	0	3
	Southeast Asia	250	34	50	334
	South Asia	81	0	3	84
	East Asia and Japan	11	5	0	16
	Central Asia	1	0	0	1
Total		1217	199	264	1680

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

A3.27: Sub-regional overview of shares of deals grouped by type of crop in individual region (food, mixed, non-food)

	Detail Regions	Food	Mixed	Non-food	Total
Europe					
	Eastern Europe	45.30%	10.26%	44.44%	100 %
	Norther Europe	33.33%	0.00%	66.67%	100 %
	Southern Europe	100.00%	0.00%	0.00%	100 %
	Western Europe	0.00%	0.00%	0.00%	100 %
	Russian Federation	52.63%	7.89%	39.47%	100 %
Central America and the Caribbean		90.24%	7.32%	2.44%	100 %
South America		80.11%	18.47%	1.42%	100 %
Oceania and Polynesia		69,23%	2.56%	28.21%	100 %
Africa					
	Eastern Africa	68.95%	11.44%	19.61%	100 %
	Middle Africa	72.22%	13.33%	14.44%	100 %
	Northern Africa	65.91%	13.64%	20.45%	100 %
	Southern Africa	95.83%	0.00%	4.17%	100 %
	Western Africa	64.29%	12.64%	23.08%	100 %
Asia					
	Western Asia	100.00%	0.00%	0.00%	100 %
	Southeast Asia	74.85%	10.18%	14.97%	100 %
	South Asia	96.43%	0.00%	3.57%	100 %
	East Asia and Japan	68.75%	31.25%	0.00%	100 %
	Central Asia	100.00%	0.00%	0.00%	100 %

Source: Author’s own calculations based on Land Matrix database and United Nations’ Statistical Division methodology (United Nations, 2017)

A3.28: Sub-regional overview of shares of deals grouped by type of crop in all database (food, mixed, non-food)

	Detail Regions	Food	Mixed	Non-food	Total
Europe					
	Eastern Europe	4.35%	6.03%	19.70%	6.96%
	Norther Europe	0.08%	0.00%	0.76%	0.18%
	Southern Europe	0.49%	0.00%	0.00%	0.36%
	Western Europe	0.00%	0.00%	0.00%	0.00%
	Russian Federation	1.64%	1.51%	5.68%	2.26%
Central America and the Caribbean		3.04%	1.51%	0.38%	2.44%
South America		23.17%	32.66%	1.89%	20.95%
Oceania and Polynesia		2,22%	0.50%	4.17%	2.32%
Africa					
	Eastern Africa	17.34%	17.59%	22.73%	18.21%
	Middle Africa	5.34%	6.03%	4.92%	5.36%
	Northern Africa	2.38%	3.02%	3.41%	2.62%
	Southern Africa	1.89%	0.00%	0.38%	1.43%
	Western Africa	9.61%	11.56%	15.91%	10.83%
Asia					
	Western Asia	0.25%	0.00%	0.00%	0.18%
	Southeast Asia	20.54%	17.09%	18.94%	19.88%
	South Asia	6.66%	0.00%	1.14%	5.00%
	East Asia and Japan	0.90%	2.51%	0.00%	0.95%
	Central Asia	0.08%	0.00%	0.00%	0.06%
Total		100 %	100 %	100 %	100 %

Source: Author’s own calculations based on Land Matrix database and United Nations’ Statistical Division methodology (United Nations, 2017)

Table A3.29: Number of deals grouped by crop type (food, mixed, non-food) for top ten investor countries

Investor countries	Food	Mixed	Non-food	Total
China	86	11	22	119
Argentina	69	10	7	86
United States of America	82	18	14	114
India	76	13	27	116
United Kingdom	94	6	6	106
Vietnam	33	33	31	97
Malaysia	81	10	16	107
Brazil	31	1	10	42
Singapore	38	8	6	52
South Africa	27	6	6	39
Average share in all deals	70,45%	13,00%	16,55%	

Source: Author's own calculations based on Land Matrix database

Table A3.30: Number of deals grouped by crop type for top ten target countries

Target countries	Food	Mixed	Non-food	Total
Argentina	113	31	3	147
Cambodia	86	21	3	110
Indonesia	87	3	25	115
Ethiopia	50	19	22	91
Mozambique	70	1	3	74
Vietnam	10	2	3	15
Brazil	38	17	1	56
Romania	25	6	44	75
India	71	0	1	72
United Republic of Tanzania	16	2	3	21
Average share in total	72,29%	12,62%	15,09%	

Source: Author's own calculations based on Land Matrix database

Table A3.31: Regional overview of number of deals grouped by crop type (plantation, mixed, and non-plantation)

Target region	Plantation	Mixed	Non-plantation	Total
Europe	93	21	50	164
Central America and the Caribbean	23	8	10	41
South America	96	117	139	352
Africa	306	102	238	646
Asia	207	56	175	438
Oceania and Polynesia	23	2	14	39
Total	748	306	626	1680

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.32: Sub-regional overview of number of deals grouped by type of crop (plantation, mixed, non-plantation)

Detail Regions	Plantation	Mixed	Non-plantation	Total
Eastern Europe	63	15	39	117
Norther Europe	0	1	2	3
Southern Europe	2	1	3	6
Western Europe	0	0	0	0
Russian Federation	28	4	6	38
Central America and the Caribbean	23	8	10	41
South America	96	117	139	352
Oceania and Polynesia	23	2	14	39
Eastern Africa	144	48	114	306
Middle Africa	17	23	50	90
Northern Africa	21	8	15	44
Southern Africa	18	0	6	24
Western Africa	106	23	53	182
Western Asia	2	0	1	3
Southeast Asia	152	46	136	334
South Asia	50	2	32	84
East Asia and Japan	3	8	5	16
Central Asia	0	0	1	1
Total	748	306	626	1680

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

A3.33: Sub-regional overview of share of deals grouped by type of crop (plantation, mixed, non-plantation) in each sub-region

Detail Regions	Plantation	Mixed	Non-plantation	Total
Eastern Europe	53.85 %	12.82 %	33.33 %	100.00 %
Norther Europe	0.00 %	33.33 %	66.67 %	100.00 %
Southern Europe	33.33 %	16.67 %	50.00 %	100.00 %
Western Europe	0.00 %	0.00 %	0.00 %	100.00 %
Russian Federation	73.68 %	1053 %	15.79 %	100.00 %
Central America and the Caribbean	56.10 %	19.51 %	24.39 %	100.00 %
South America	27.27 %	33.24 %	39.49 %	100.00 %
Oceania and Polynesia	59.97 %	5.13 %	35.90 %	100.00 %
Eastern Africa	47.06 %	15.69 %	37.25 %	100.00 %
Middle Africa	18.89 %	25.56 %	55.56 %	100.00 %
Northern Africa	47.73 %	18.18 %	34.09 %	100.00 %
Southern Africa	75.00 %	0.00 %	25.00 %	100.00 %
Western Africa	58.24 %	12.64 %	29.12 %	100.00 %
Western Asia	66.67 %	0.00 %	33.33 %	100.00 %
Southeast Asia	45.51 %	13.77 %	40.72 %	100.00 %
South Asia	59.52 %	2.38 %	38.10 %	100.00 %
East Asia and Japan	18.75 %	50.00 %	31.25 %	100.00 %
Central Asia	0.00 %	0.00 %	100.00 %	100.00 %

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.34: Sub-regional overview of share of deals grouped by type of crop (plantation, mixed, non-plantation) in each crop group

Detail Regions	Plantation	Mixed	Non-plantation
Eastern Europe	8.42 %	4.90 %	6.23 %
Norther Europe	0.00 %	0.33 %	0.32 %
Southern Europe	0.27 %	0.33 %	0.48 %
Western Europe	0.00 %	0.00 %	0.00 %
Russian Federation	3.74 %	1.31 %	0.96 %
Central America and the Caribbean	3.07 %	2.61 %	1.60 %
South America	12.83 %	38.24 %	22.20 %
Oceania and Polynesia	3.07 %	0.65 %	2.24 %
Eastern Africa	19.25 %	15.69 %	18.21 %
Middle Africa	2.27 %	7.52 %	7.99 %
Northern Africa	2.81 %	2.61 %	2.40 %
Southern Africa	2.41 %	0.00 %	0.96 %
Western Africa	14.17 %	7.52 %	8.47 %
Western Asia	0.27 %	0.00 %	0.16 %
Southeast Asia	20.32 %	15.03 %	21.73 %
South Asia	6.68 %	0.65 %	5.11 %
East Asia and Japan	0.40 %	2.61 %	0.80 %
Central Asia	0.00 %	0.00 %	0.16 %
Total	100.00 %	100.00 %	100.00 %

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.35: Number of deals grouped by crop type (plantation, mixed, and non-plantation crops) for top ten investor countries

Top ten investor countries	Plantation	Mixed	Non-plantation	Total
China	47	20	52	119
Argentina	39	17	30	86
United States of America	47	21	46	114
India	46	19	51	116
United Kingdom	52	14	40	106
Vietnam	37	25	35	97
Malaysia	70	10	27	107
Brazil	19	8	15	42
Singapore	25	12	15	52
South Africa	16	12	11	39
Average share in investments	45,27%	19,26%	35,47%	

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.36: Number of deals grouped by crop type (plantation and non-plantation crops) for top ten target countries

Top ten target countries	Plantation	Mixed	Non-plantation	Total
Argentina	8	71	68	147
Cambodia	31	33	46	110
Indonesia	65	4	46	115
Ethiopia	32	20	39	91
Mozambique	51	4	19	74
Vietnam	4	1	10	15
Brazil	7	29	20	56
Romania	44	6	25	75
India	43	1	28	72
Tanzania	11	2	8	21
	40,42%	18,65%	40,93%	

Source: Author’s own calculations based on Land Matrix database

Table A3.37: Product classification into different product types and sub-types

Crops or trees	Crop type	Food - non-food	Perishable	Plantation – non-plantation	Product
CR	CE	F	NP	NPL	Barley
CR	CE	F	NP	NPL	Buckwheat
CR	CE	F	NP	NPL	Cereals
CR	CE	F	NP	NPL	Grains
CR	CE	F	NP	NPL	Corn (Maize)
CR	CE	F	NP	NPL	Pulses
CR	CE	F	NP	PL	Rice
CR	CE	F	NP	PL	Rice (hybrid)
CR	CE	F	NP	NPL	Rye
CR	CE	F	NP	NPL	Sorghum
CR	CE	F	NP	NPL	Teff
CR	CE	F	NP	NPL	Wheat
CR	VE	F	P	NPL	Bean
CR	VE	F	P	PL	Cassava (Manioc)
CR	VE	F	P	NPL	Lentils
CR	VE	F	P	NPL	Onion
CR	VE	F	P	NPL	Peas
CR	VE	F	P	NPL	Soya Beans
CR	VE	F	P	NPL	Sugar beet
CR	VE	F	P	PL	Sugar cane
CR	VE	F	P	NPL	Sugar
CR	VE	F	P	NPL	Sweet potatoes
CR	VE	F	P	PL	Tomatoes
CR	VE	F	P	NPL	Vegetables
CR	VE	F	NP	PL	Potatoes
CR	FR	F	P	PL	Banana
CR	FR	F	P	NPL	Cherries
CR	FR	F	P	PL	Citrus Fruits

Table A3.37: Continued

Crops or trees	Crop type	Food - non-food	Perishable	Plantation – non-plantation	Product
CR	FR	F	P	NPL	Fig
CR	FR	F	P	NPL	Fruit
CR	FR	F	P	NPL	Grapes
CR	FR	F	P	NPL	Mango
CR	FR	F	P	NPL	Papaya
CR	FR	F	P	NPL	Passion fruit
CR	FR	F	P	PL	Pineapple
CR	FR	F	P	NPL	Pomegranate
CR	FR	F	P	NPL	Vineyard
CR	FR	F	NP	NPL	Apple
CR	N	F	NP	NPL	Almond
CR	N	F	NP	PL	Cashew
CR	N	F	NP	NPL	Nut
CR	N	F	NP	NPL	Peanut
CR	CTC	F	NP	PL	Cacao
CR	CTC	F	NP	PL	Coffee Plant
CR	CTC	F	NP	PL	Tea
CR	S	F	NP	NPL	Dill
CR	S	F	NP	NPL	Herbs
CR	S	F	NP	PL	Pepper
CR	O	F	NP	NPL	Canola
CR	O	F	NP	NPL	Castor Oil Plant
CR	O	F	NP	PL	Coconut
CR	O	F	NP	NPL	Mustard
CR	O	F	NP	NPL	Oil Seeds
CR	O	F	NP	PL	Oil Palm
CR	O	F	NP	NPL	Oleaginous plant
CR	O	F	NP	PL	Olives

Table A3.37: Continued

Crops or trees	Crop type	Food - non-food	Perishable	Plantation – non-plantation	Product
CR	O	F	NP	NPL	Rapeseed
CR	O	F	NP	NPL	Sesame
CR	O	F	NP	NPL	Sun Flower
CR	OT	F	P	NPL	Crops
CR	OT	F	NP	NPL	Seed Production
CR	OT	F	P	NPL	Food crops
CR	FI	NF		PL	Cotton
CR	FI	NF		PL	Sisal
CR	R	NF		PL	Rubber
CR	T	NF		PL	Tobacco
CR	OTH	NF		NPL	Alfalfa
CR	OTH	NF		NPL	Aloe Vera
CR	OTH	NF		NPL	Flowers
CR	OTH	NF		NPL	Fodder Plants
CR	OTH	NF		NPL	Roses
TR	TR	NF		NPL	Acacia
TR	TR	NF		NPL	Bamboo
TR	TR	NF		NPL	Eucalyptus
TR	TR	NF		NPL	Pine
TR	TR	NF		NPL	Teak
TR	TR	NF		NPL	Trees
CR	B	NF		NPL	Croton
CR	B	NF		NPL	Jatropha

Table A3.37: Continued

Crops or trees	Crop type	Food - non-food	Perishable	Plantation – non-plantation	Product
TR	B	NF		NPL	Palms
CR	B	NF		NPL	Pongamia Pinnata

List is based on product list in dataset;
Crops or trees: CR – crops, TR – trees;
Crop type: CE – cereals, VE – vegetables, FR – fruit, N – nuts, CTC – coffee, tea, cocoa, S – spices, O – oil crops, OT – other food crops, FI – fibre crops, R – rubber, T – tobacco, OTH – other non-food crops, TR – trees, B – biofuels;
Food – non-food type: F – food, NF – non-food;
Perishable type: (for food crops only): P – perishable crops, NP – non-perishable crops;
Plantation – non-plantation type: PL – plantation, NPL – non-plantation

Table A3.38: List of the most numerous food crops grouped by broad investor region

Broad region	Most numerous food crop	Number of deals	Number of all food crops	Number of all crops	Share in all food crops	Share in all crop
North America	Corn (Maize)	41	347	393	11.82%	10.43%
Europe	Corn (Maize)	125	953	1080	13.12%	11.57%
Central America and the Caribbean	Soya Beans	9	54	59	16.67%	15.25%
South America	Corn (Maize)	72	461	525	15.62%	13.71%
Africa	Corn (Maize)	103	721	830	14.29%	12.41%
Asia	Oil Palm	211	1477	1789	14.29%	11.79%
Oceania and Polynesia	Soya Beans	3	12	17	25.00%	17.65%

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.39: List of the most numerous non-food crops grouped by broad investor region

Broad region	Most numerous non-food crop	Number of deals	Number of all non-food crops	Number of all crops	Share in all non-food crop	Share in all crops
North America	Rubber	13	46	393	28.26%	3.31%
Europe	Rubber	58	127	1080	45.67%	5.37%
Central America and the Caribbean	Rubber	3	5	59	60.00%	5.08%
South America	Rubber	18	64	525	28.13%	3.43%
Africa	Rubber	40	109	830	36.70%	4.82%
Asia	Jatropha	145	312	1789	46.47%	8.11%
Oceania and Polynesia	Rubber	4	5	17	80.00%	23.53%

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.40: List of the most numerous food crops grouped by investor sub-region

Detailed region	Most numerous food crop	Number of deals	Number of all food crops	Number of all crops	Share in all food crops	Share in all crop
North America	Corn (Maize)	41	347	393	11.82%	10.43%
Europe						
Eastern Europe	Wheat	9	76	86	11.84%	10.47%
Norther Europe	Oil Palm	53	380	418	13.95%	12.68%
Southern Europe	Soya Bean	22	119	137	18.49%	16.06%
Western Europe	Corn (Maize)	46	365	418	12.60%	11.00%
Russian Federation	Corn (Maize) / Soya Beans	3	13	21	23.08%	14.29%
Central America and the Caribbean	Soya Bean	9	54	59	16.67%	15.25%
South America	Corn (Maize)	72	461	525	15.62%	13.71%
Oceania and Polynesia	Soya Bean	3	12	17	25.00%	17.65%
Africa						
Eastern Africa	Corn (Maize)	57	364	413	15.66%	13.80%
Middle Africa	Oil Palm	14	82	88	17.07%	15.91%
Northern Africa	Corn (Maize)	7	37	45	18.92%	15.56%
Southern Africa	Corn (Maize)	18	105	121	17.14%	14.88%
Western Africa	Oil Palm	20	133	163	15.04%	12.27%
Asia						
Western Asia	Corn (Maize)	25	189	216	13.23%	11.57%
Southeast Asia	Oil Palm	121	514	652	23.54%	18.56%
South Asia	Sugar Cane / Oil Palm	27	208	251	12.98%	10.76%
East Asia and Japan	Corn (Maize)	67	561	665	11.94%	10.08%
Central Asia	Coffee plant	2	5	5	40.00%	40.00%

Source: Author’s own calculations based on Land Matrix database and United Nations’ Statistical Division methodology (United Nations, 2017)

Table A3.41: List of the most numerous non-food crops grouped by investor sub-region

Detailed region	Most numerous non-food crop	Number of deals	Number of non-food crops	Number of all crops	Share in all non-food crop	Share in all crops
North America	Rubber	13	46	393	28.26%	3.31%
Europe						
Eastern Europe	Rubber	6	10	86	60.00%	6.98%
Norther Europe	Rubber	13	38	418	34.21%	3.11%
Southern Europe	Cotton	9	18	137	50.00%	6.57%
Western Europe	Rubber	26	53	418	49.06%	6.22%
Russian Federation	Rubber	6	8	21	75.00%	28.57%
Central America and the Caribbean	Rubber	3	5	59	60.00%	5.08%
South America	Rubber	18	64	525	28.13%	3.43%
Oceania and Polynesia	Rubber	4	5	17	80.00%	23.53%
Africa						
Eastern Africa	Rubber	17	49	413	34.69%	4.12%
Middle Africa	Rubber	3	6	88	50.00%	3.41%
Northern Africa	Rubber	5	8	45	62.50%	11.11%
Southern Africa	Cotton/Rubber	5	16	121	31.25%	4.13%
Western Africa	Jatropha	11	30	163	36.67%	6.75%
Asia						
Western Asia	Rubber	11	27	216	40.74%	5.09%
Southeast Asia	Jatropha	63	138	652	45.65%	9.66%
South Asia	Jatropha	27	43	251	62.79%	10.76%
East Asia and Japan	Jatropha	48	104	665	46.15%	7.22%

Source: Author’s own calculations based on Land Matrix database and United Nations’ Statistical Division methodology (United Nations, 2017)

Table A3.42: Overview of share of deals for top ten investor countries grouped by crop group (crop group with the highest number of deals is highlighted)

Top ten investor countries	Cereals	Vegetables	Fruits	Nuts	Coffee, cocoa, tea	Spices	Oil crops	Other food crops	Fibre crops	Rubber	Tobacco	Other non-food crops	Biofuels
China	0.33	0.26	0.06	0.02	0.02	0.00	0.15	0.02	0.02	0.05	0.00	0.01	0.07
Argentina	0.28	0.33	0.14	0.00	0.02	0.00	0.13	0.00	0.03	0.03	0.01	0.02	0.01
United States of America	0.39	0.24	0.05	0.00	0.00	0.00	0.16	0.02	0.02	0.03	0.00	0.05	0.03
India	0.26	0.26	0.04	0.04	0.01	0.00	0.19	0.01	0.01	0.01	0.00	0.04	0.12
United Kingdom	0.33	0.20	0.12	0.01	0.02	0.00	0.26	0.01	0.00	0.02	0.00	0.02	0.01
Vietnam	0.16	0.16	0.02	0.01	0.01	0.00	0.24	0.01	0.10	0.10	0.00	0.02	0.16
Malaysia	0.22	0.25	0.01	0.01	0.02	0.00	0.36	0.01	0.01	0.04	0.00	0.01	0.08
Brazil	0.32	0.23	0.10	0.02	0.04	0.00	0.12	0.01	0.01	0.06	0.00	0.02	0.08
Singapore	0.32	0.22	0.07	0.04	0.02	0.00	0.22	0.00	0.03	0.04	0.00	0.01	0.03
South Africa	0.32	0.28	0.09	0.00	0.01	0.00	0.17	0.00	0.03	0.05	0.00	0.03	0.03

Source: Author's own calculations based on Land Matrix database (2017)

Table A3.43: List of the most numerous food crops grouped by broad target region

Broad region	Most numerous food crop	Number of deals	Number of all food crops	Number of all crops	Share in food crops	Share in all crop
Europe	Corn/Maize	21	153	238	13.73%	8.82%
Central America and the Caribbean	Oil Palm	16	73	77	21.92%	20.78%
South America	Corn/Maize	175	1163	1238	15.05%	14.14%
Africa	Oil Palm	149	872	1077	17.09%	13.83%
Asia	Corn/Maize	101	635	731	15.91%	13.82%
Oceania and Polynesia	Oil Palm	21	33	45	63.64%	46.67%

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.44: List of the most numerous non-food crops grouped by broad target region

Broad region	Most numerous non-food crop	Numb er of deals	Number of non-food crops	Number of all crops	Share in all non-food crop	Share in all crops
Europe	Rubber	52	85	238	0.61	0.22
Central America and the Caribbean	Cotton / Jatropha	2	4	77	0.50	0.03
South America	Cotton	27	75	1238	0.36	0.02
Africa	Jatropha	79	205	1077	0.39	0.07
Asia	Jatropha	38	96	731	0.40	0.05
Oceania and Polynesia	Jatropha	11	12	45	0.92	0.24

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.45: List of the most numerous food crops grouped by detailed target region

Detailed region	Most numerous food crop	Number of deals	Number of all food crops	Number of all crops	Share in food crops	Share in all crop
Europe						
Eastern Europe	Corn (Maize)	18	113	178	15.93%	10.11%
Norther Europe	Rice / Soya Bean	1	2	4	50.00%	25.00%
Southern Europe	Vegetables	3	8	8	37.50%	37.50%
Russian Federation	Sugar cane	10	30	48	33.33%	20.83%
Central America and the Caribbean	Oil Palm	16	73	77	21.92%	20.78%
South America	Corn (Maize)	175	1163	1238	15.05%	14.14%
Oceania and Polynesia	Oil Palm	21	33	45	63.64%	46.67%
Africa						
Eastern Africa	Oil Palm	57	357	455	15.97%	12.53%
Middle Africa	Corn (Maize)	51	216	241	23.61%	21.16%
Northern Africa	Soya Bean / Sugar cane	8	52	67	15.38%	11.94%
Southern Africa	Sugar cane	9	25	26	36.00%	34.62%
Western Africa	Oil Palm	73	222	288	32.88%	25.35%
Asia						
Western Asia	Oil Palm	1	3	3	33.33%	33.33%
Southeast Asia	Corn (Maize)	91	501	589	18.16%	15.45%
South Asia	Cassava	24	94	97	25.53%	24.74%
East Asia and Japan	Corn (Maize)	6	34	39	17.65%	15.38%
Central Asia	Corn (Maize) / Sugar cane / Sugar	1	3	3	33.33%	33.33%

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A3.46: List of the most numerous food non-crops grouped by detailed target region

Detailed region	Most numerous non-food crop	Number of deals	Number of non-food crops	Number of all crops	Share in all non-food crop	Share in all crops
Europe						
Eastern Europe	Rubber	39	65	178	60.00%	21.91%
Norther Europe	Jatropha	2	2	4	100.00%	50.00%
Russian Federation	Rubber	13	18	48	72.22%	27.08%
Central America and the Caribbean	Cotton / Jatropha	2	4	77	50,00%	2.60%
South America	Cotton	27	75	1238	36.00%	2.18%
Oceania and Polynesia	Jatropha	11	12	45	91.67%	24.44%
Africa						
Eastern Africa	Jatropha	41	98	455	41.84%	9.01%
Middle Africa	Jatropha	13	25	241	52.00%	5.39%
Northern Africa	Rubber	8	15	67	53.33%	11.94%
Southern Africa	Cotton	1	1	26	100.00%	3.85%
Western Africa	Rubber	32	66	288	48.48%	11.11%
Asia						
Southeast Asia	Jatropha	38	88	589	43.18%	6.45%
South Asia	Rubber	2	3	97	66.67%	2.06%
East Asia and Japan	Cotton / Fodder plants	2	5	39	40.00%	5.13%

Source: Author's own calculations based on Land Matrix database and United Nations' Statistical Division methodology (United Nations, 2017)

Table A4.1: List of developing countries used in my thesis

Belize	Kiribati
Benin	Korea, Rep.
Botswana	Lesotho
Burkina Faso	Libya
Cabo Verde	Madagascar
Cameroon	Malawi
Central African Republic	Malaysia
Chad	Mali
China	Mauritania
Colombia	Mauritius
Comoros	Morocco
Congo, Rep.	Nepal
Costa Rica	Niger
Cote d'Ivoire (Ivory Coast)	Nigeria
Dominica	Pakistan
Dominican Republic	Papua New Guinea
Ecuador	Paraguay
Egypt	Philippines
El Salvador	Portugal
Equatorial Guinea	Romania
Fiji	Senegal
Gabon	Sierra Leone
Gambia	Sri Lanka
Ghana	Swaziland[91]
Guatemala	Syrian Arab Republic
Guinea	Tanzania (Un. Rep. of)
Guinea-Bissau	Thailand
Guyana	Togo
Haiti	Tunisia
Honduras	Turkey
India	Zambia
Kenya	Zimbabwe

Source: United Nations' Statistical Division methodology (United Nations, 2017)

[91] Since April 18, 2018 Swaziland has been renamed into "the Kingdom of eSwatini"

Table A4.2: Variables and data sources

Dependent variable – Growth rate volatility		
AVGrVol	Average standard deviation of detrended annual GDP per capita growth rate	UNCTADSTAT
GrVol	Standard deviation of detrended annual GDP per capita growth rate	UNCTADSTAT
Independent variables		
Control variables		
Lag_1GrVol	First lagged value of dependent variable	UNCTADSTAT
Lag_2GrVol	Second lagged value of dependent variable	UNCTADSTAT
lnGDPPC	Log GDP per capita constant 2005 USD	UNCTADSTAT
Schooling	Gross primary school enrolment	UNESCO
Democracy	Polity2 score	Polity IV project – Centre for systemic peace[92]
Openness	Openness to trade (Import + Export)/GDP	World Bank WDI
WAR	Armed conflict	UCD/PRIO Armed conflict dataset
Explanatory variables – quick analysis		
Basic data	Gross production value of agricultural crops (constant 2004 – 2006, 1000 International US$)	FAOSTAT
AVShAgGDP(p)	Average share of agricultural production value in GDP	Author's own calculations
AVShCrGDP(p)	Average share of crops production value in GDP	Author's own calculations
AVShPLANT(p)	Average share of plantation crops in GDP	Author's own calculations
AVShNONPLANT(p)	Average share of non-plantation crops in GDP	Author's own calculations
AVRATIOPLANT(p)	Average ratio between non-plantation and plantation crops production values	
AVShPERISH(p)	Average share of perishable crops in GDP	Author's own calculations
AVShNONPERISH(p)	Average share of non-perishable crops in GDP	Author's own calculations
AVRATIOPERISH(p)	Average ratio between non-perishable and perishable crops production values	Author's own calculations
AVInvHHProduct(p)	Average value of inverted Herfindahl-Hirschman Index for all products	Author's own calculations
AVInvHHGroup(p)	Average value of inverted Herfindahl-Hirschman Index for product groups	Author's own calculations
AVInvHHFood(p)	Average value of inverted Herfindahl-Hirschman Index between food and non-food crops	Author's own calculations

[92] Information on political system comes from PolityIV dataset (The Center for Systemic Peace, 2016). In cases that information for the early years of this research is missing, we draw information from Papaioannou and Siourounis (2008) who provide information on year of democratisation.

Table A4.2: Continued

Explanatory variables – detailed analysis		
Basic data	Production value of agricultural crops (constant 2004 – 2006, 1000 International US$)	FAOSTAT
ShAgGDP	Share of agricultural production value in GDP	Author's own calculations
ShCrGDP	Share of crops production value in GDP	Author's own calculations
ShPLANT(p)	Share of plantation crops in GDP	Author's own calculations
ShNONPLANT(p)	Share of non-plantation crops in GDP	Author's own calculations
RATIOPLANT(p)	Ratio between non-plantation and plantation crops production values	Author's own calculations
FOOD(p)	Share of food crops in GDP	Author's own calculations
NONFOOD(p)	Share of non-food crops in GDP	Author's own calculations
RATIOFOOD(p)	Ratio between food and non-food crops production values	Author's own calculations
ShPERISH(p)	Share of perishable crops in GDP	Author's own calculations
ShNONPERISH(p)	Share of non-perishable crops in GDP	Author's own calculations
RATIOPERISH(p)	Ratio between non-perishable and perishable crops production values	Author's own calculations
InvHHProduct(p)	Inverted value of Herfindahl-Hirschman Index for all products	Author's own calculations
InvHHGroup(p)	Inverted value of Herfindahl-Hirschman Index for product groups	Author's own calculations
InvHHFood(p)	Inverted value of Herfindahl-Hirschman Index between food and non-food crops	Author's own calculations
Cereals(p)	Share of cereals in GDP	Author's own calculations
Vegetables(p)	Share of vegetables in GDP	Author's own calculations
Fruits(p)	Share of fruits in GDP	Author's own calculations
Nuts(p)	Share of nuts in GDP	Author's own calculations
Coffee, cocoa, tea(p)	Share of coffee, cocoa, and tea in GDP	Author's own calculations
Spices(p)	Share of spices in GDP	Author's own calculations
Oil(p)	Share of oil crops in GDP	Author's own calculations
Other food(p)	Share of other food crops in GDP	Author's own calculations
Fibres(p)	Share of fibre crops in GDP	Author's own calculations
Rubber(p)	Share of rubber in GDP	Author's own calculations
Tobacco(p)	Share of tobacco in GDP	Author's own calculations
Other non-food(p)	Share of other non-food crops in GDP	Author's own calculations
Interaction terms	Multiplication of centred values of Openness and corresponding explanatory variable	Author's own calculations

Table A4.3: Summary statistics – quick analysis

Variable	Mean	Min	Max	St. dev.	IQR
AVGrVol	2.611	0.937	8.047	1.303	1.397
AVShAgGDP	23.749	4.171	50.124	11.284	15.166
AVShCrGDP	18.565	1.501	59.848	13.245	18.581
AVShPLANT(p)	9.383	0.084	37.951	7.498	9.018
AVShNONPLANT(p)	9.183	0.306	27.763	8.114	14.836
AVRATIOPLANT(p)	2.169	0.045	21.070	3.689	1.846
AVShPERISH(p)	9.306	0.803	50.037	8.010	8.277
AVShNONPERISH(p)	0.388	0.000	5.019	0.888	0.366
AVRATIOPERISH(p)	0.053	0.000	0.610	0.102	0.068
AVInvHHProduct(p)	-0.178	-0.762	-0.062	0.123	0.096
AVInvHHGroup(p)	-0.339	-0.898	-0.188	0.116	0.153
AVInvHHFood(p)	-0.918	-1.000	-0.579	0.093	0.108

Source: Author’s own calculations based on relevant data sources

Table A4.4: Summary statistics – detailed analysis

Variable	Mean	Min	Max	Standard deviation	IQR	Within S.D.	Between S.D.
Dependent variable:							
GrVol	2.603	0.002	55.468	3.356	2.657	3.146	1.278
Independent variables							
Control variables							
lnGDPPC	7.021	5.034	10.029	1.010	1.524	0.320	0.967
Democracy	0.439	0.000	1.000	0.496	1.000	0.330	0.377
Openness	3.809	1.620	5.588	0.581	0.754	0.317	0.493
Schooling	91.754	11.726	207.230	27.398	35.461	14.859	23.315
INFL	11.799	-31.566	227.310	18.013	10.533	16.065	8.593
ShAgGDP	24.801	1.157	77.587	13.227	18.821	7.241	11.213
ShCrGDP	17.845	0.273	68.511	12.959	16.992	4.748	12.174
WAR	0.210	0.000	2.000	0.487	0.000	0.379	0.314
Explanatory variables							
ShPLANT(p)	8.825	0.008	35.611	7.145	9.305	2.859	6.614
ShNONPLANT(p)	9.020	0.151	50.424	8.388	12.916	2.962	7.658
RATIOPLANT(p)	2.243	0.021	71.433	4.645	1.732	2.875	3.704
FOOD(p)	16.225	0.267	363.79	13.408	15.400	7.713	11.119
NON-FOOD(p)	0.964	0.000	9.403	1.520	1.148	0.762	1.331
RATIOFOOD(p)	0.058	0.000	1.400	0.106	0.063	0.058	0.090
ShPERISH(p)	8.564	0.209	31.376	6.538	9.041	2.340	6.163
ShNONPERISH(p)	0.326	0.000	15.554	0.921	0.274	0.533	0.761
RATIOPERISH(p)	0.052	0.000	1.365	0.117	0.057	0.059	0.102

Table A4.4: Continued

Variable	Mean	Min	Max	Standard deviation	IQR	Within S.D.	Between S.D.
InvHHProduct(p)	-0.178	-0.847	-0.049	0.129	0.101	0.043	0.123
InvHHGroup(p)	-0.339	-0.935	-0.151	0.123	0.147	0.043	0.116
InvHHFood(p)	-0.918	-1.000	-0.500	0.102	0.109	0.044	0.093
Cereals(p)	4.524	0.000	163.840	6.587	4.768	3.443	5.684
Vegetables(p)	5.475	0.089	122.960	5.394	5.670	2.984	4.553
Fruits(p)	3.054	0.016	45.930	2.907	3.395	1.300	2.628
Nuts(p)	0.227	0.000	15.032	1.039	0.163	0.677	0.802
Coffee, cocoa, tea(p)	0.706	0.000	12.128	1.329	1.035	0.508	1.241
Spices(p)	0.116	0.000	16.293	0.420	0.067	0.325	0.273
Oil(p)	2.123	0.000	31.729	3.052	2.407	1.453	2.715
Other food(p)	0.000	0.000	0.012	0.001	0.000	0.000	0.000
Fibres(p)	0.616	0.000	8.251	1.144	0.612	0.613	0.978
Rubber(p)	0.129	0.000	9.364	0.611	0.015	0.367	0.495
Tobacco(p)	0.217	0.000	8.063	0.768	0.126	0.234	0.738
Other non-food(p)	0.003	0.000	0.255	0.015	0.000	0.009	0.012
Interaction variables							
Openness x ShPLANT(p)	-0.227	-29.974	10.991	1.578	0.321	1.179	1.073
Openness x ShNONPLANT(p)	-0.174	-23.747	14.571	1.350	0.281	1.076	0.839
Openness x RATIPLANT(p)	-0.060	-34.168	12.213	1.009	0.041	0.941	0.396
Openness x FOOD(p)	-0.316	-50.817	108.24	3.316	0.560	2.894	1.695
Openness x NONFOOD(p)	-0.045	-3.140	1.232	0.289	0.035	0.237	0.171
Openness x RATIOFOOD(p)	-0.001	-0.377	0.134	0.022	0.002	0.016	0.015

Table A4.4: Continued

Variable	Mean	Min	Max	Standard deviation	IQR	Within S.D.	Between S.D.
Openness x ShPERISH(p)	-0.150	-14.307	8.489	0.959	0.308	0.794	0.556
Openness x ShNONPERISH(p)	0.003	-2.160	3.475	0.177	0.004	0.144	0.107
Openness x RATIOPERISH(p)	0.002	-0.109	0.399	0.015	0.001	0.014	0.006
Openness x InvHHProduct(p)	-0.000	-0.155	0.102	0.014	0.005	0.011	0.009
Openness x InvHHGroup(p)	-0.000	-0.177	0.107	0.015	0.006	0.012	0.009
Openness x InvHHFood(p)	-0.001	-0.126	0.169	0.016	0.003	0.012	0.011
Openness x Cereals(p)	-0.209	-30.881	46.107	1.718	0.139	1.405	1.022
Openness x Vegetables(p)	-0.070	-16.062	38.229	1.169	0.183	1.044	0.556
Openness x Fruits(p)	-0.055	-4.357	14.197	0.455	0.114	0.394	0.238
Openness x Nuts(p)	0.036	-1.073	6.012	0.351	0.003	0.231	0.269
Openness x Coffee, cocoa, tea(p)	-0.112	-2.867	8.907	0.251	0.013	0.248	0.057
Openness x Spices(p)	0.004	-0.386	5.249	0.111	0.002	0.106	0.038
Openness x Oil(p)	-0.010	-4.913	7.116	0.444	0.066	0.361	0.267
Openness x Other food(p)	0.000	-0.003	0.002	0.000	0.000	0.000	0.000
Openness x Fibres(p)	-0.019	-2.365	1.222	0.215	0.018	0.194	0.100
Openness x Rubber(p)	-0.015	-3.118	0.230	0.155	0.000	0.107	0.115
Openness x Tobacco(p)	-0.012	-1.018	0.767	0.074	0.005	0.065	0.037
Openness x Other non-food(p)	-0.000	-0.044	0.015	0.002	0.000	0.002	0.001

Source: Author’s own calculations based on relevant data sources

Table A4.5: List of plantation crops

The list is compiled from different sources as there is no definite and recognised list of plantation crops. The sources are: Tiffen and Mortimore (1990), Burger (1994), Henderson and Osborne (2000), Singh, *et al.* (2013).

Areca nut
Banana
Cardamom
Cashew nut
Citrus fruits
Cocoa
Coconut
Coffee
Cotton
Hemp
Jute
Manioc (Tapioca, Cassava)
Olive
Oil palm
Pepper (piper spp.)
Pineapple
Potatoes
Rice
Rubber
Sisal
Strawberry
Sugar cane
Tea`
Tobacco
Tomatoes

Table A4.6: Crop groups – production

	Plantation crops	Non-plantation crops	Perishable crops	Non-perishable crops	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, tea, cocoa, spices	Spices	Other food crops	Fibres	Oil	Rubber	Tobacco	Other non-food crops
Agave fibres nes		x		x		x								x				
Almonds, with shell		x		x	x					x								
Anise, badian, fennel, coriander	x			x	x							x						
Apples				x	x				x									
Apricots		x	x		x				x									
Areca nuts		x		x	x					x								
Artichokes		x	x		x			x										
Asparagus		x	x		x			x										
Avocados		x	x		x				x									
Bambara beans	x		x		x			x										
Bananas	x		x		x				x									
Barley	x			x	x		x											
Bastfibres, other		x		x		x								x				
Beans, dry	x		x		x			x										
Beans, green	x		x		x			x										
Berries nes		x	x		x				x									
Blueberries		x	x		x				x									
Brazil nuts, with shell		x		x	x					x								
Broad beans, horse beans, dry	x		x		x			x										
Buckwheat	x			x	x		x											
Cabbages and other brassicas		x	x		x			x										
Canary seed	x			x	x		x						x					
Carobs		x	x		x			x										
Carrots and turnips		x	x		x			x										
Cashew nuts, with shell	x			x	x					x								
Cashewapple	x			x	x					x								
Cassava	x		x		x			x										
Castor oil seed	x			x		x									x			
Cauliflowers and broccoli		x	x		x			x										
Cereals, nes	x			x	x		x											
Cherries		x	x		x				x									
Cherries, sour		x	x		x				x									
Chestnut		x		x	x					x								
Chick peas	x		x		x			x										
Chicory roots		x	x		x			x										

Table A4.6: Continued

	Plantation crops	Non-plantation crops	Perishable crops	Non-perishable crops	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, tea, cocoa, spices	Spices	Other food crops	Fibres	Oil	Rubber	Tobacco	Other non-food crops
Chillies and peppers, dry		x	x		x			x										
Chillies and peppers, green		x	x		x			x										
Cinnamon (canella)	x			x	x							x						
Cloves	x			x	x							x						
Cocoa, beans	x			x	x						x							
Coconuts	x			x	x					x								
Coffee, green	x			x							x							
Cotton lint	x			x		x								x				
Cottonseed	x			x	x								x					
Cow peas, dry	x		x		x			x										
Cranberries		x	x		x				x									
Cucumbers and gherkins		x	x		x			x										
Currants		x	x		x				x									
Dates		x	x		x				x									
Eggplants (aubergines)		x	x		x			x										
Fibre crops nes	x			x		x								x				
Figs		x	x		x				x									
Flax fibre and tow	x			x		x								x				
Fonio		x		x	x		x											
Fruit, citrus nes	x		x		x				x									
Fruit, fresh nes	x		x		x				x									
Fruit, pome nes	x		x		x				x									
Fruit, stone nes	x		x		x				x									
Fruit, tropical fresh nes	x		x		x				x									
Garlic		x	x		x			x										
Ginger		x		x	x								x					
Gooseberries		x	x		x				x									
Grain, mixed	x			x	x		x											
Grapefruit (incl. pomelos)	x		x		x				x									
Grapes	x		x		x				x									
Groundnuts, with shell	x			x	x					x								

Table A4.6: Continued

	Plantation crops	Non-plantation crops	Perishable crops	Non-perishable crops	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, tea, cocoa, spices	Spices	Other food crops	Fibres	Oil	Rubber	Tobacco	Other non-food crops
Gums, natural	x			x		x										x		
Hazelnuts, with shell		x		x	x					x								
Hemp tow waste		x		x		x								x				
Hempseed		x		x		x								x				
Hops	x			x	x								x					
Jute		x		x		x								x				
Kapok fibre	x			x		x								x				
Kapokseed in shell	x			x	x	x												
Karite nuts (sheanuts)		x		x	x	x												
Kiwi fruit		x	x		x				x									
Kola nuts		x		x	x					x								
Leeks, other alliaceous vegetables		x	x		x			x										
Lemons and limes	x		x		x				x									
Lentils		x	x		x			x										
Lettuce and chicory		x	x		x			x										
Linseed	x			x									x					
Lupins		x	x		x			x										
Maize	x			x	x		x											
Maize, green	x			x	x		x											
Mangoes, mangosteens, guavas	x		x		x				x									
Manila fibre (abaca)		x		x		x								x				
Maté		x		x	x						x							
Melons, other (incl. cantaloupes)	x		x		x				x									
Melon seed	x		x		x				x									
Millet	x			x	x		x											
Mushrooms and truffles		x		x	x								x					
Mustard seed	x			x	x								x					
Nutmeg, mace and cardamoms	x			x	x							x						
Nuts, nes		x		x	x					x								
Oats	x			x	x		x											
Oil, palm	x			x		x									x			

Table A4.6: Continued

	Plantation crops	Non-plantation crops	Perishable crops	Non-perishable crops	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, tea, cocoa, spices	Spices	Other food crops	Fibres	Oil	Rubber	Tobacco	Other non-food crops
Oil, stillingia	x			x		x									x			
Oilseeds nes	x			x	x	x									x			
Okra		x	x		x			x										
Olives	x		x		x			x										
Onions, dry	x		x		x			x										
Onions, shallots, green	x		x		x			x										
Oranges	x		x		x				x									
Palm kernels	x			x		x									x			
Papayas	x		x		x				x									
Peaches and nectarines		x	x		x				x									
Pears		x	x		x				x									
Peas, dry	x		x		x			x										
Peas, green	x		x		x			x										
Pepper (piper spp.)	x		x		x			x										
Peppermint	x			x	x							x						
Persimmons		x	x		x			x										
Pigeon peas	x		x		x			x										
Pineapples	x		x		x				x									
Pistachios		x		x	x					x								
Plantains	x		x		x				x									
Plums and sloes		x	x		x				x									
Poppy seed	x			x	x								x					
Potatoes	x			x	x			x										
Pulses, nes	x		x		x			x										
Pumpkins, squash and gourds		x	x		x			x										
Pyrethrum, dried		x		x		x												x
Quinces		x	x		x				x									
Quinoa		x		x	x		x											
Ramie		x		x		x								x				
Rapeseed	x			x	x								x					
Raspberries		x	x		x				x									
Rice, paddy	x			x	x		x											
Roots and tubers, nes		x	x		x			x										
Rubber, natural	x			x		x										x		
Rye	x			x	x		x											

Table A4.6: Continued

	Plantation crops	Non-plantation crops	Perishable crops	Non-perishable crops	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, tea, cocoa, spices	Spices	Other food crops	Fibres	Oil	Rubber	Tobacco	Other non-food crops
Safflower seed	x			x	x								x					
Sesame seed	x			x	x								x					
Sisal		x		x		x								x				
Sorghum	x			x	x		x											
Soybeans	x		x		x			x										
Spices, nes	x			x	x							x						
Spinach		x	x		x			x										
Strawberries		x	x		x				x									
String beans	x		x		x			x										
Sugar beet	x		x		x			x										
Sugar cane	x		x		x			x										
Sugar crops, nes	x		x		x			x										
Sunflower seed	x			x	x								x					
Sweet potatoes	x		x		x			x										
Tangerines, mandarins, clementines, satsumas	x		x		x				x									
Taro (cocoyam)	x		x		x			x										
Tea	x			x	x						x							
Tea nes	x			x	x						x							
Tobacco, unmanufactured	x			x		x											x	
Tomatoes	x		x		x			x										
Triticale		x		x	x		x											
Tung nuts		x		x		x												x
Vanilla	x			x	x							x						
Vegetable tallow		x		x		x												x
Vegetables, fresh nes		x	x		x			x										
Vegetables, leguminous nes		x	x		x			x										
Vetches		x		x		x												x
Walnuts, with shell		x		x	x					x								
Watermelons	x		x		x				x									
Wheat	x			x	x		x											
Yams	x		x		x			x										
Yautia (cocoyam)	x		x		x			x										

Table A4.7: Unit root test results

	AR	Model with		ADF		ADF-GLS	LLC
		Constant	Constant and trend	IPS t-score	Inv. Normal z-score	Inv. Normal z-score	LLH z-score
Dependent variable:							
GrVol	1			-4.854***	-26.915***	-21.860***	-15.873***
Independent variables							
Control variables							
lnGDPPC	0	x		-5.234***	-28.323***	-34.514***	-1.603*
Democracy	1	x					-1.499*
Openness	1	x		-2.114***	-5.067***	-12.446***	-6.965***
Schooling	2	x		-1.801**	-1.849**	-10.121***	-0.451
INFL	0	x		-4.481***	-23.725***	-31.188***	-23.630***
ShAgGDP	1	x		-4.048***	-4.074***	-5.453***	-5.285***
ShCrGDP	1	x		-4.763***	-4.640***	-5.024***	-3.362***
WAR	0	x					-20.939***
Explanatory variables							
ShPLANT(p)	0	x		-2.367***	-6.947***	-8.057***	-8.514***
ShNONPLANT(p)	0	x		-2.341***	-7.120***	-5.613***	-8.044***
RATIOPLANT(p)	0	x		-2.277***	-6.375***	-6.752***	-12.496***
FOOD(p)	0	x		-2.222***	-6.147***	-7.530***	1.564
NON-FOOD(p)	0						-12.002***
RATIOFOOD(p)	0	x					-3.912***
ShPERISH(p)	0	x		-1.921***	-3.320***	-4.638***	-7.379***
ShNONPERISH(p)	0	x					-3.582***
RATIOPERISH(p)	0	x					-4.266***

Table A4.7: Continued

	AR	Model with		ADF		ADF-GLS	LLC
		Constant	Constant and trend	IPS t-score	Inv. Normal z-score	Inv. Normal z-score	LLH z-score
Independent variables							
Explanatory variables							
InvHHProduct(p)	0	x		-2.484***	-8.178***	-8.961***	-7.462***
InvHHGroup(p)	0	x		-2.365***	-6.793***	-9.420***	-6.575***
InvHHFood(p)	0						-6.760***
Cereals(p)	0	x					-2.890***
Vegetables(p)	0	x		-1.839***	-2.665***	-5.247***	3.384
Fruits(p)	0	x		-1.950***	-3.615***	-5.374***	-4.056***
Nuts(p)	0		x				-4.326***
Coffee, cocoa, tea(p)	0	x					-13.157***
Spices(p)	0						-30.018***
Oil(p)	0	x					-13.267***
Other food(p)	0	x					-7.770***
Fibres(p)	0	x					-9.829***
Rubber(p)	0	x					-24.050***
Tobacco(p)	0	x					-5.678***
Other non-food(p)	0	x					-5.891***
Interaction variables							
Openness x ShPLANT(p)	0	x		-3.678***	-16.992***	-19.731***	-15.980***
Openness x ShNONPLANT(p)	0	x		-4.234***	-19.803***	-23.415***	-24.898***
Openness x RATIPLANT(p)	0	x		-3.929***	-18.676***	-20.394***	-38.324***

Table A4.7: Continued

	AR	Model with		ADF		ADF-GLS	LLC
		Constant	Constant and trend	IPS t-score	Inv. Normal z-score	Inv. Normal z-score	LLH z-score
Independent variables							
Interaction variables							
Openness x FOOD(p)	0	x		-4.135***	-19.010***	-22.793***	-8.560***
Openness x NONFOOD(p)	0	x					-8.168***
Openness x RATIOFOOD(p)	0	x					-4.508***
Openness x ShPERISH(p)	0	x		-3.678***	-16.992***	-19.731***	-15.980***
Openness x ShNONPERISH(p)	0	x					-6.654***
Openness x RATIOPERISH(p)	0	x					-16.820***
Openness x InvHHProduct(p)	0	x		-3.888***	-18.254***	-20.044***	-18.214***
Openness x InvHHGroup(p)	0	x		-3.951***	-16.769***	-22.065***	-20.270***
Openness x InvHHFood(p)	0						-11.694***
Openness x Cereals(p)	0	x					-10.202***
Openness x Vegetables(p)	0	x		-3.708***	-16.461***	-17.768***	-1.666**
Openness x Fruits(p)	0	x		-3.390***	-14.628***	-17.647***	-3.723***
Openness x Nuts(p)	0	x					-2.320**
Openness x Coffee, cocoa, tea(p)	0	x					-24.531***
Openness x Spices(p)	0						-13.753***
Openness x Oil(p)	0	x					-27.995***
Openness x Other food(p)	0	x					-11.844***
Openness x Fibres(p)	0	x					-3.690***
Openness x Rubber(p)	0	x					-13.493***
Openness x Tobacco(p)	0	x					-29.957***
Openness x Other non-food(p)	0	x					-8.835***

Source: Author’s own calculations

Table A4.8: Correlation matrix

	GrVol	lnGDP	Democracy	Openness	Schooling	INFL	ShAgGDP	ShCrGDP	WAR	ShPLANT(p)	ShNONPLANT(p)	RATIOPLANT(p)
GrVol	1.000	0.068	-0.111	0.063	-0.019	0.041	0.053	-0.070	-0.043	-0.095	-0.027	0.127
lnGDP		1.000	0.210	0.236	0.363	-0.025	-0.469	-0.509	-0.068	-0.387	-0.457	-0.055
Democracy			1.000	0.214	0.279	0.017	-0.219	-0.148	0.117	-0.008	-0.221	-0.052
Openness				1.000	0.304	-0.112	-0.370	-0.385	-0.168	-0.189	-0.433	0.073
Schooling					1.000	-0.036	-0.439	-0.393	-0.045	-0.108	-0.515	-0.234
INFL						1.000	0.047	0.004	0.031	0.010	-0.003	0.004
ShAgGDP							1.000	0.574	-0.047	0.408	0.539	0.043
ShCrGDP								1.000	-0.026	0.803	0.861	-0.064
WAR									1.000	-0.003	-0.043	-0.066
ShPLANT(p)										1.000	0.388	-0.325
ShNONPLANT(p)											1.000	0.178
RATIOPLANT(p)												1.000

Table A4.8: Continued

	InvHHFood (p)	InvHHGroup(p)	InvHHProduct(p)	RATIOPERISH (p)	ShNONPERISH(p)	ShPERISH(p)
GrVol	-0.013	-0.030	-0.040	-0.066	-0.049	-0.086
lnGDPPC05	-0.184	-0.102	-0.034	0.105	-0.110	-0.418
Democracy	-0.065	-0.245	-0.243	0.082	0.028	-0.092
Openness	-0.113	-0.353	-0.374	0.058	-0.176	-0.243
Schooling	-0.183	-0.141	-0.108	0.197	0.157	-0.252
INFL	-0.054	0.082	-0.078	0.079	0.059	0.022
ShAgGDP	0.094	0.134	0.092	-0.110	0.141	0.409
ShCrGDP	0.175	0.136	0.116	-0.058	0.351	0.816
WAR	0.190	-0.250	0.155	0.017	0.015	-0.116
ShPLANT(p)	0.110	0.057	-0.064	-0.078	0.308	0.672
ShNONPLANT(p)	0.176	0.162	0.233	-0.024	0.279	0.388
RATIOPLANT(p)	-0.107	-0.140	-0.012	0.001	-0.049	-0.129
ShPERISH(p)	-0.013	0.039	0.136	-0.159	0.195	1.000
ShNONPERISH(p)	0.082	0.075	0.125	0.532	1.000	
RATIOPERISH(p)	-0.066	0.062	0.128	1.000		
InvHHProduct(p)	0.218	0.849	1.000			
InvHHGroup(p)	0.378	1.000				
InvHHFood (p)	1.000					

Source: Author’s own calculations

Table A4.9: Variance Inflation Factors (VIF) of explanatory variables

lnGDPPC05	3.170
Openness	1.445
Democracy	1.261
INFL	1.136
Schooling	1.719
ShAgGDP	2.105
WAR	1.171
Cereals(p)	2.643
Vegetables(p)	1.956
Fruits(p)	1.389
Nuts(p)	1.069
Coffee, cocoa, tea(p)	1.297
Spices(p)	1.845
Oil(p)	1.247
Food Other(p)	1.153
Fibre(p)	1.349
Rubber(p)	1.099
Tobacco(p)	1.148
Non-food Other(p)	1.053

Minimum possible value = 1.0
Guidelines for VIF values:
VIF = 1 – no correlation, 1 < V <5 – moderately correlated, VIF > 5 collinearity problem
Source: Author’s own calculations

Table A4.10: Variance Inflation Factors (VIF) of explanatory variables and interaction variables

lnGDPPC05	3.654	Rubber(p)	2.308
Openness	1.537	Tobacco(p)	1.184
Democracy	1.285	Non-food Other(p)	1.214
INFL	1.194	Openness x Cereals(p)	4.471
Schooling	1.894	Openness x Vegetables(p)	5.068
ShAgGDP	2.168	Openness x Fruit(p)	2.172
WAR	1.187	Openness x Nuts(p)	2.431
Cereals(p)	3.458	Openness x Coffee, cocoa, tea(p)	1.097
Vegetables(p)	2.09	Openness x Spices(p)	4.441
Fruits(p)	1.447	Openness x Oil(p)	1.394
Nuts(p)	2.347	Openness x Food other(p)	1.168
Coffee, cocoa, tea(p)	1.348	Openness x Fibre(p)	1.326
Spices(p)	2.785	Openness x Rubber(p)	2.237
Oil(p)	1.333	Openness x Tobacco(p)	1.428
FoodOther(p)	1.189	Openness x Non-food other(p)	1.165
Fibre(p)	1.391		

Minimum possible value = 1.0
Guidelines for VIF values:
VIF = 1 – no correlation, 1 < V <5 – moderately correlated, VIF > 5 collinearity problem
Source: Author's own calculations

Table A4.11: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of explanatory variables

lambda	cond	const	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
8.492	1.000	0.000	0.000	0.000	0.003	0.003	0.001	0.001	0.002	0.002	0.002	0.003	0.001	0.002	0.001	0.003	0.000	0.002	0.001	0.001	0.000
1.472	2.402	0.000	0.000	0.000	0.027	0.012	0.001	0.000	0.019	0.034	0.016	0.006	0.005	0.000	0.078	0.001	0.008	0.020	0.038	0.016	0.000
1.186	2.676	0.000	0.000	0.000	0.009	0.058	0.000	0.000	0.063	0.001	0.000	0.000	0.014	0.001	0.035	0.001	0.218	0.004	0.195	0.016	0.033
1.097	2.782	0.000	0.000	0.000	0.008	0.023	0.000	0.001	0.023	0.012	0.000	0.001	0.043	0.059	0.039	0.001	0.236	0.004	0.010	0.000	0.220
1.073	2.813	0.000	0.000	0.000	0.000	0.011	0.000	0.001	0.002	0.001	0.000	0.009	0.016	0.048	0.065	0.081	0.027	0.109	0.008	0.037	0.200
0.998	2.918	0.000	0.000	0.000	0.001	0.004	0.000	0.000	0.003	0.001	0.003	0.000	0.524	0.023	0.009	0.006	0.004	0.001	0.003	0.248	0.000
0.901	3.070	0.000	0.000	0.000	0.036	0.001	0.001	0.000	0.105	0.003	0.000	0.008	0.013	0.005	0.012	0.001	0.079	0.043	0.286	0.073	0.129
0.868	3.128	0.000	0.000	0.000	0.002	0.013	0.000	0.000	0.044	0.002	0.000	0.004	0.182	0.100	0.001	0.016	0.001	0.073	0.050	0.172	0.218
0.777	3.306	0.000	0.000	0.000	0.012	0.003	0.000	0.001	0.285	0.000	0.001	0.000	0.071	0.063	0.004	0.061	0.052	0.025	0.150	0.180	0.029
0.728	3.416	0.000	0.000	0.000	0.040	0.051	0.001	0.001	0.222	0.000	0.001	0.001	0.013	0.204	0.009	0.024	0.003	0.032	0.102	0.115	0.108
0.537	3.976	0.000	0.000	0.000	0.000	0.524	0.003	0.000	0.000	0.000	0.001	0.001	0.034	0.005	0.002	0.273	0.145	0.069	0.001	0.002	0.021
0.497	4.135	0.000	0.000	0.000	0.003	0.248	0.000	0.000	0.091	0.000	0.003	0.003	0.001	0.097	0.000	0.334	0.157	0.195	0.107	0.004	0.001
0.388	4.680	0.000	0.001	0.002	0.595	0.009	0.003	0.010	0.004	0.029	0.003	0.000	0.043	0.099	0.030	0.001	0.012	0.196	0.004	0.001	0.012
0.328	5.085	0.000	0.000	0.001	0.034	0.001	0.005	0.000	0.001	0.033	0.007	0.555	0.001	0.091	0.348	0.017	0.000	0.012	0.017	0.023	0.000
0.276	5.548	0.000	0.000	0.000	0.127	0.002	0.001	0.014	0.007	0.248	0.100	0.363	0.001	0.015	0.202	0.037	0.012	0.102	0.002	0.035	0.001
0.208	6.388	0.000	0.000	0.000	0.035	0.001	0.001	0.026	0.040	0.219	0.821	0.001	0.003	0.074	0.002	0.017	0.003	0.040	0.010	0.021	0.003
0.125	8.232	0.000	0.001	0.001	0.017	0.012	0.017	0.596	0.005	0.290	0.003	0.001	0.018	0.104	0.090	0.057	0.024	0.027	0.001	0.001	0.000
0.035	15.678	0.007	0.012	0.084	0.008	0.006	0.904	0.063	0.000	0.008	0.010	0.009	0.015	0.000	0.037	0.023	0.011	0.018	0.007	0.036	0.002
0.011	27.482	0.024	0.207	0.765	0.001	0.014	0.059	0.001	0.029	0.000	0.003	0.004	0.001	0.009	0.001	0.000	0.003	0.005	0.007	0.001	0.005
0.003	58.114	0.969	0.779	0.146	0.041	0.003	0.003	0.284	0.054	0.118	0.027	0.031	0.000	0.000	0.035	0.047	0.003	0.024	0.002	0.017	0.018

1 - lnGDPPC05, 2 – Openness, 3 – Democracy, 4 – INFL, 5 – Schooling, 6 – ShAgGDP, 7 – WAR, 8 – Cereals(p), 9 – Vegetables(p), 10 – Fruits(p), 11 – Nuts(p), 12 - Coffee, cocoa, tea(p), 13 – Spices(p), 14 – Oil(p), 15 - Food other(p), 16 – Fibre(p), 17 – Rubber(p), 18 – Tobacco(p), 19 - Non-food other(p)
Lambda=eigenvalues of X'X, largest to smallest, cond = condition index, note: variance proportions columns sum to 1.0
Source: Author's own calculations

Table A4.12: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of explanatory and interaction variables

Lambda	cond	const	1	2	3	4	5	6	7	8	9	10
8.607	1.000	0.000	0.000	0.000	0.003	0.003	0.000	0.001	0.002	0.001	0.002	0.003
3.637	1.538	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000
1.893	2.132	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.004	0.005	0.002	0.000
1.771	2.205	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.004	0.002	0.000
1.649	2.285	0.000	0.000	0.000	0.001	0.010	0.000	0.000	0.007	0.005	0.000	0.001
1.354	2.521	0.000	0.000	0.000	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000
1.256	2.617	0.000	0.000	0.000	0.008	0.059	0.000	0.001	0.003	0.000	0.003	0.001
1.135	2.754	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.001	0.000	0.000
1.060	2.850	0.000	0.000	0.000	0.010	0.011	0.000	0.000	0.017	0.000	0.001	0.000
1.007	2.924	0.000	0.000	0.000	0.017	0.015	0.001	0.000	0.048	0.001	0.003	0.001
0.890	3.110	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.025	0.000	0.003	0.021
0.839	3.203	0.000	0.000	0.000	0.026	0.000	0.002	0.001	0.106	0.003	0.000	0.001
0.823	3.234	0.000	0.000	0.000	0.019	0.001	0.000	0.001	0.162	0.001	0.002	0.008
0.770	3.343	0.000	0.000	0.000	0.012	0.040	0.000	0.000	0.355	0.000	0.000	0.001
0.729	3.437	0.000	0.000	0.000	0.008	0.031	0.000	0.000	0.022	0.000	0.000	0.000
0.604	3.774	0.000	0.000	0.000	0.009	0.003	0.000	0.001	0.001	0.001	0.000	0.002
0.529	4.032	0.000	0.000	0.000	0.005	0.076	0.000	0.000	0.008	0.009	0.003	0.041
0.515	4.087	0.000	0.000	0.000	0.008	0.592	0.000	0.000	0.036	0.005	0.001	0.001
0.490	4.190	0.000	0.000	0.000	0.003	0.011	0.002	0.000	0.003	0.017	0.001	0.037
0.379	4.768	0.000	0.000	0.001	0.344	0.056	0.001	0.010	0.020	0.025	0.002	0.000
0.372	4.809	0.000	0.000	0.001	0.344	0.000	0.003	0.000	0.000	0.013	0.007	0.002
0.303	5.332	0.000	0.000	0.000	0.001	0.001	0.003	0.001	0.009	0.011	0.014	0.386
0.259	5.764	0.000	0.000	0.000	0.018	0.001	0.000	0.000	0.033	0.062	0.039	0.182
0.248	5.887	0.000	0.000	0.000	0.009	0.002	0.000	0.013	0.004	0.032	0.091	0.226
0.227	6.156	0.000	0.000	0.000	0.002	0.040	0.000	0.002	0.016	0.003	0.121	0.027
0.198	6.587	0.000	0.000	0.000	0.037	0.002	0.002	0.039	0.025	0.226	0.615	0.005
0.184	6.847	0.000	0.000	0.000	0.005	0.002	0.001	0.033	0.001	0.006	0.012	0.013
0.118	8.557	0.000	0.000	0.000	0.014	0.013	0.001	0.003	0.004	0.086	0.005	0.005
0.109	8.890	0.000	0.000	0.001	0.022	0.004	0.012	0.580	0.001	0.315	0.000	0.000
0.031	16.603	0.007	0.011	0.079	0.011	0.001	0.917	0.054	0.001	0.031	0.011	0.007
0.011	28.039	0.022	0.180	0.754	0.001	0.017	0.042	0.002	0.028	0.003	0.004	0.005
0.002	63.271	0.971	0.807	0.162	0.043	0.006	0.011	0.256	0.044	0.134	0.055	0.026

1 - lnGDPPC05, 2 – Openness, 3 – Democracy, 4 – INFL, 5 – Schooling, 6 – ShAgGDP, 7 – WAR, 8 – Cereals(p), 9 – Vegetables(p), 10 – Fruits(p), 11 – Nuts(p), 12 - Coffee,, cocoa, tea(p), 13 – Spices(p), 14 – Oil(p), 15 - Food other(p), 16 – Fibre(p), 17 – Rubber(p), 18 – Tobacco(p), 19 - Non-food other(p), 20 – Openness x Cereals(p), 21 – Openness x Vegetables(p), 22 – Openness x Fruit(p), 23 – Openness x Nuts(p), 24 – Openness x Coffee, cocoa, tea(p), 25 – Openness x Spices(p), 26 – Openness x Oil(p), 27 – Openness x Food Other(p), 28 – Openness x Fibre(p), 29 – Openness x Rubber(p), 30 – Openness x Tobacco(p), 31 – Openness x Non-food Other(p)

Lambda=eigenvalues of X'X, largest to smallest, cond = condition index, note: variance proportions columns sum to 1.0

Source: Author's own calculations

Table A4.12: Continued

Lambda	cond	11	12	13	14	15	16	17	18	19	20	21
8.607	1.000	0.000	0.002	0.001	0.003	0.000	0.002	0.000	0.001	0.000	0.000	0.000
3.637	1.538	0.000	0.000	0.010	0.000	0.001	0.000	0.000	0.000	0.000	0.010	0.012
1.893	2.132	0.014	0.001	0.001	0.000	0.004	0.006	0.047	0.003	0.000	0.005	0.002
1.771	2.205	0.070	0.001	0.006	0.000	0.003	0.002	0.000	0.004	0.001	0.003	0.001
1.649	2.285	0.014	0.007	0.008	0.002	0.000	0.000	0.051	0.001	0.018	0.003	0.000
1.354	2.521	0.000	0.003	0.002	0.007	0.003	0.007	0.005	0.005	0.240	0.001	0.000
1.256	2.617	0.000	0.018	0.003	0.009	0.217	0.034	0.001	0.024	0.009	0.000	0.000
1.135	2.754	0.009	0.003	0.001	0.021	0.001	0.005	0.000	0.017	0.004	0.002	0.000
1.060	2.850	0.000	0.053	0.003	0.006	0.097	0.000	0.010	0.024	0.000	0.004	0.000
1.007	2.924	0.000	0.018	0.004	0.012	0.112	0.044	0.002	0.186	0.005	0.000	0.000
0.890	3.110	0.002	0.158	0.005	0.032	0.047	0.059	0.002	0.081	0.000	0.000	0.000
0.839	3.203	0.002	0.003	0.001	0.007	0.012	0.140	0.001	0.034	0.014	0.000	0.000
0.823	3.234	0.001	0.041	0.003	0.000	0.025	0.003	0.001	0.388	0.007	0.000	0.002
0.770	3.343	0.005	0.020	0.000	0.061	0.018	0.000	0.000	0.001	0.018	0.001	0.000
0.729	3.437	0.001	0.021	0.001	0.032	0.019	0.000	0.000	0.045	0.001	0.011	0.000
0.604	3.774	0.000	0.050	0.000	0.001	0.001	0.000	0.001	0.009	0.606	0.000	0.000
0.529	4.032	0.009	0.095	0.062	0.228	0.016	0.031	0.000	0.003	0.008	0.001	0.005
0.515	4.087	0.003	0.091	0.001	0.037	0.377	0.000	0.000	0.003	0.001	0.005	0.004
0.490	4.190	0.004	0.029	0.040	0.265	0.001	0.226	0.003	0.005	0.021	0.000	0.001
0.379	4.768	0.002	0.031	0.005	0.004	0.003	0.210	0.003	0.001	0.005	0.026	0.012
0.372	4.809	0.005	0.053	0.001	0.007	0.002	0.000	0.000	0.008	0.002	0.072	0.029
0.303	5.332	0.056	0.086	0.369	0.031	0.001	0.003	0.001	0.028	0.000	0.003	0.030
0.259	5.764	0.008	0.006	0.063	0.011	0.004	0.012	0.412	0.009	0.004	0.000	0.017
0.248	5.887	0.213	0.017	0.000	0.029	0.000	0.038	0.287	0.018	0.000	0.002	0.001
0.227	6.156	0.528	0.001	0.085	0.000	0.003	0.075	0.072	0.018	0.005	0.005	0.040
0.198	6.587	0.014	0.073	0.019	0.038	0.000	0.015	0.031	0.006	0.003	0.000	0.029
0.184	6.847	0.010	0.024	0.121	0.014	0.009	0.010	0.049	0.001	0.000	0.087	0.026
0.118	8.557	0.025	0.000	0.085	0.012	0.001	0.016	0.001	0.020	0.001	0.738	0.739
0.109	8.890	0.001	0.086	0.008	0.047	0.012	0.018	0.015	0.005	0.000	0.000	0.047
0.031	16.603	0.001	0.000	0.088	0.024	0.005	0.018	0.005	0.034	0.001	0.018	0.000
0.011	28.039	0.000	0.006	0.002	0.000	0.003	0.006	0.002	0.001	0.004	0.001	0.001
0.002	63.271	0.002	0.000	0.003	0.060	0.005	0.017	0.000	0.020	0.023	0.000	0.001

1 - lnGDPPC05, 2 – Openness, 3 – Democracy, 4 – INFL, 5 – Schooling, 6 – ShAgGDP, 7 – WAR, 8 – Cereals(p), 9 – Vegetables(p), 10 – Fruits(p), 11 – Nuts(p), 12 - Coffee,, cocoa, tea(p), 13 – Spices(p), 14 – Oil(p), 15 - Food other(p), 16 – Fibre(p), 17 – Rubber(p), 18 – Tobacco(p), 19 - Non-food other(p), 20 – Openness x Cereals(p), 21 – Openness x Vegetables(p), 22 – Openness x Fruit(p), 23 – Openness x Nuts(p), 24 – Openness x Coffee, cocoa, tea(p), 25 – Openness x Spices(p), 26 – Openness x Oil(p), 27 – Openness x Food Other(p), 28 – Openness x Fibre(p), 29 – Openness x Rubber(p), 30 – Openness x Tobacco(p), 31 – Openness x Non-food Other(p)

Lambda=eigenvalues of X'X, largest to smallest, cond = condition index, note: variance proportions columns sum to 1.0

Source: Author's own calculations

Table A4.12: Continued

Lambda	cond	22	23	24	25	26	27	28	29	30	31
8.607	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.637	1.538	0.019	0.000	0.001	0.012	0.005	0.001	0.005	0.000	0.005	0.000
1.893	2.132	0.003	0.014	0.000	0.002	0.018	0.017	0.015	0.052	0.009	0.000
1.771	2.205	0.000	0.077	0.000	0.004	0.008	0.012	0.031	0.000	0.025	0.000
1.649	2.285	0.003	0.016	0.004	0.004	0.005	0.023	0.020	0.056	0.016	0.013
1.354	2.521	0.003	0.000	0.000	0.001	0.005	0.003	0.006	0.005	0.000	0.277
1.256	2.617	0.005	0.000	0.007	0.003	0.009	0.111	0.014	0.000	0.010	0.001
1.135	2.754	0.009	0.006	0.051	0.000	0.262	0.033	0.025	0.000	0.137	0.007
1.060	2.850	0.007	0.000	0.463	0.000	0.001	0.006	0.004	0.006	0.002	0.011
1.007	2.924	0.001	0.000	0.143	0.001	0.017	0.009	0.018	0.015	0.006	0.003
0.890	3.110	0.014	0.001	0.043	0.000	0.000	0.123	0.060	0.000	0.011	0.022
0.839	3.203	0.000	0.003	0.015	0.000	0.060	0.352	0.003	0.000	0.000	0.001
0.823	3.234	0.003	0.003	0.063	0.000	0.000	0.020	0.062	0.002	0.004	0.057
0.770	3.343	0.012	0.001	0.020	0.000	0.082	0.083	0.082	0.007	0.028	0.020
0.729	3.437	0.007	0.000	0.003	0.000	0.026	0.030	0.370	0.001	0.284	0.000
0.604	3.774	0.004	0.000	0.003	0.000	0.000	0.001	0.031	0.001	0.006	0.568
0.529	4.032	0.121	0.000	0.044	0.003	0.044	0.018	0.000	0.001	0.128	0.005
0.515	4.087	0.003	0.008	0.012	0.000	0.001	0.006	0.000	0.013	0.002	0.003
0.490	4.190	0.141	0.000	0.066	0.001	0.021	0.000	0.073	0.000	0.000	0.000
0.379	4.768	0.084	0.000	0.004	0.004	0.159	0.070	0.014	0.005	0.060	0.003
0.372	4.809	0.163	0.001	0.019	0.005	0.189	0.038	0.036	0.007	0.070	0.001
0.303	5.332	0.015	0.029	0.002	0.001	0.013	0.000	0.026	0.005	0.023	0.000
0.259	5.764	0.143	0.011	0.001	0.027	0.001	0.002	0.001	0.396	0.003	0.000
0.248	5.887	0.033	0.221	0.000	0.006	0.004	0.003	0.002	0.249	0.000	0.000
0.227	6.156	0.023	0.521	0.000	0.004	0.010	0.005	0.000	0.079	0.001	0.001
0.198	6.587	0.020	0.023	0.005	0.001	0.000	0.000	0.006	0.013	0.003	0.002
0.184	6.847	0.122	0.024	0.000	0.668	0.011	0.007	0.073	0.068	0.140	0.001
0.118	8.557	0.036	0.029	0.016	0.025	0.037	0.003	0.014	0.004	0.027	0.000
0.109	8.890	0.004	0.002	0.000	0.164	0.001	0.007	0.000	0.009	0.000	0.000
0.031	16.603	0.000	0.006	0.003	0.001	0.006	0.016	0.009	0.000	0.000	0.003
0.011	28.039	0.002	0.002	0.011	0.005	0.000	0.001	0.000	0.000	0.000	0.000
0.002	63.271	0.000	0.002	0.001	0.058	0.006	0.000	0.001	0.004	0.000	0.002

1 - lnGDPPC05, 2 – Openness, 3 – Democracy, 4 – INFL, 5 – Schooling, 6 – ShAgGDP, 7 – WAR, 8 – Cereals(p), 9 – Vegetables(p), 10 – Fruits(p), 11 – Nuts(p), 12 - Coffee,, cocoa, tea(p), 13 – Spices(p), 14 – Oil(p), 15 - Food other(p), 16 – Fibre(p), 17 – Rubber(p), 18 – Tobacco(p), 19 - Non-food other(p), 20 – Openness x Cereals(p), 21 – Openness x Vegetables(p), 22 – Openness x Fruit(p), 23 – Openness x Nuts(p), 24 – Openness x Coffee, cocoa, tea(p), 25 – Openness x Spices(p), 26 – Openness x Oil(p), 27 – Openness x Food Other(p), 28 – Openness x Fibre(p), 29 – Openness x Rubber(p), 30 – Openness x Tobacco(p), 31 – Openness x Non-food Other(p)

Lambda=eigenvalues of X'X, largest to smallest, cond = condition index, note: variance proportions columns sum to 1.0

Source: Author's own calculations

Table A4.13: GMM estimates for shares of agriculture in GDP and share of crops in GDP and lag of dependent variable as explanatory variables on growth rate volatility without constant term

	(1)	(2)
Constant		
Lag_1GrVol	-0.115	-0.070
	(-1.134)	(-0.711)
ShAgGDP	0.096***	
	(8.913)	
ShCrGDP		0.095***
		(6.671)
Sum of sq. res.	34595.86	38393.56
S.E. of regression	3.623	3.690
No. of countries	64	64
No. of observations	2496	2496
No. of instruments	77	77
Arellano-Bond test AR(1)	-2.629	-2.730
AR(1) p-value	0.009	0.006
Arellano-Bond test AR(2)	-0.154	0.498
AR(2) p-value	0.877	0.619
Sargan test df	75	75
Sargan test Chi-sq.(df)	63.441	63.021
Sargan test Chi-sq p-value	0.827	0.837
Wald (joint) test df	2	2
Wald (joint) test Chi-sq.(df)	188.647***	60.607***

Signif. codes: 0.01 ‘***’, 0.05 ‘**’, 0.1 ‘*’
Dependent variable: growth rate volatility (GrVol)

Table A4.14: GMM estimates for lag of dependent variable and control variables on growth rate volatility

	1	2	3	4	5	6
Constant	2.962***	1.850	3.378***	1.160	3.117***	2.265***
	(11.570)	(1.157)	(11.970)	(0.717)	(4.221)	(6.174)
Lag_1GrVol	-0.150	-0.153	-0.150	-0.155*	-0.149	-0.153
	(-1.561)	(-1.617)	(-1.611)	(-1.704)	(-1.557)	(-1.496)
lnGDP		0.160				
		(0.704)				
Democracy			-0.943**			
			(-2.574)			
Openness				0.468		
				(1.148)		
Schooling					-0.002	
					(-0.242)	
INFL						0.056**
						(2.031)
Sum of sq. res.	32201.63	32239.75	31740.87	32221.60	32180.55	34138.30
S.E. of regression	3.561	3.557	3.563	3.557	3.562	3.652
No. of countries	64	64	64	64	64	64
No. of observations	2496	2496	2496	2496	2496	2496
No. of instruments	77	78	78	78	78	78
Arellano-Bond test AR(1)	-2.568**	-2.572**	-2.603***	-2.607***	-2.567**	-2.622***
AR(1) p-value	0.010	0.010	0.009	0.009	0.010	0.009
Arellano-Bond test AR(2)	-0.080	-0.105	-0.077	-0.136	-0.076	-0.205
AR(2) p-value	0.937	0.916	0.939	0.892	0.939	0.838
Sargan test df	75	75	75	75	75	75
Sargan test Chi-sq.(df)	62.182	62.194	62.388	61.278	61.858	60.922
Sargan test Chi-sq p-value	0.855	0.855	0.851	0.873	0.862	0.880
Wald (joint) test df	1	2	2	2	2	2
Wald (joint) test Chi-sq.(df)	2.438	3.575	16.793***	8.960**	2.447	5.705*

Signif. codes: 0.01 ‘***’, 0.05 ‘**’, 0.1 ‘*’;Dependent variable: growth rate volatility (GrVol)

Table A4.14: Continued

	7	8	9	10	11
Constant	2.458***	3.017***	-7.539*	3.373***	-6.984
	(6.090)	(11.900)	(-1.829)	(9.067)	(-1.288)
Lag_1GrVol	-0.147	-0.153	-0.176*	-0.156*	-0.177*
	(-1.521)	(-1.587)	(-1.929)	(-1.668)	(-1.935)
lnGDP			0.650*		0.593
			(1.699)		(1.132)
Democracy			-1.350***		-1.331***
			(-3.366)		(-3.256)
Openness			1.171**		1.143**)
			(2.454)		(2.370)
Schooling			-0.003		-0.002
			(-0.388)		(-0.316)
INFL			0.068**		0.067**
			(2.320)		(2.225)
ShAgGDP	0.020		0.059**		0.065***
	(1.444)		(2.309)		(2.767)
WAR		-0.311	-0.100		-0.081
		(-1.376)	(-0.413)		(-0.329)
ShCrGDP				-0.022	-0.013
				(-1.631)	(-0.515)
Sum of sq. res.	32006.84	32225.34	34461.04	32223.26	34345.86
S.E. of regression	3.566	3.561	3.709	3.552	3.702
No. of countries	64	64	64	64	64
No. of observations	2496	2496	2496	2496	2496
No. of instruments	78	78	84	78	85
Arellano-Bond test AR(1)	-2.574**	-2.561**	-2.763***	-2.575***	-2.747***
AR(1) p-value	0.010	0.010	0.006	0.010	0.006
Arellano-Bond test AR(2)	-0.062	-0.087	-0.446	-0.137	-0.458
AR(2) p-value	0.951	0.931	0.656	0.891	0.647
Sargan test df	75	75	75	75	75
Sargan test Chi-sq.(df)	61.902	61.669	56.709	62.168	56.448
Sargan test Chi-sq p-value	0.861	0.866	0.943	0.855	0.946
Wald (joint) test df	2	2	8	2	9
Wald (joint) test Chi-sq.(df)	3.112	5.019*	42.521***	7.761**	48.912***

Signif. codes: 0.01 ‘***’, 0.05 ‘**’, 0.1 ‘*’;Dependent variable: growth rate volatility (GrVol)

Table A4.15: GMM estimates for lag of dependent variable, all control variables, and share of plantation and non-plantation crops in GDP as well as ratio between non-plantation and plantation crops as exploratory variables as well as their individual interaction with openness on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	-8.251*	-11.838	-7.679*	-13.989*
	(-1.816)	(-1.627)	(-1.953)	(-1.672)
Lag_1GrVol	-0.186**	-0.182**	-0.185*	-0.202**
	(-2.065)	(-2.013)	(-1.943)	(-2.192)
lnGDP	0.642	1.017	0.709*	1.253
	(1.442)	(1.533)	(1.754)	(1.556)
Democracy	-1.171***	-1.345***	-1.407***	-1.366***
	(-2.929)	(-3.386)	(-3.395)	(-3.289)
Openness	1.307***	1.414**	0.953*	1.321**
	(2.726)	(2.566)	(1.875)	(2.150)
Schooling	-0.002	-0.003	0.002	0.002
	(-0.295)	(-0.377)	(0.321)	(0.342)
INFL	0.073**	0.070**	0.062**	0.055
	(2.259)	(2.358)	(2.052)	(1.594)
ShAgGDP	0.082***	0.073**	0.061**	0.091***
	(3.082)	(2.337)	(2.293)	(2.754)
WAR	-0.022	-0.013	-0.028	0.142
	(-0.093)	(-0.044)	(-0.103)	(0.456)
ShPLANT(p)	-0.060**			-0.030
	(-2.288)			(-0.697)
Openness * ShPLANT(p)	-0.220			-0.271
	(-1.405)			(-1.102)
ShNONPLANT(p)		0.039		0.065
		(0.745)		(0.980)
Openness * ShNONPLANT(p)		-0.243		0.056
		(-1.128)		(0.203)
RATIOPLANT(p)			0.086	0.047
			(1.312)	(0.457)
Openness * RATIOPLANT(p)			-0.989	-1.224
			(-1.476)	(-1.376)
Sum of sq. res.	34902.42	34877.49	34606.04	35087.74
S.E. of regression	3.723	3.715	3.730	3.715
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	86	86	86	90
Arellano-Bond test AR(1)	-2.768***	-2.743***	-2.691***	-2.624***
AR(1) p-value	0.006	0.006	0.007	0.009
Arellano-Bond test AR(2)	-0.543	-0.480	-0.570	-0.735
AR(2) p-value	0.587	0.631	0.569	0.462
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	55.078	54.997	57.882	52.126
Sargan test Chi-sq. p-value	0.959	0.960	0.929	0.980
Wald (joint) test df	10	10	10	14
Wald (joint) test Chi-sq.(df)	47.872***	48.248***	60.849***	68.422***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*';Dependent variable: growth rate volatility (GrVol)

Table A4.16: GMM estimates for all my control variables and food crops, non-food crops, and ratio between non-food and food crops on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	-6.767	-8.660*	-9.132**	-8.043
	(-1.243)	(-1.866)	(-2.090)	(-1.389)
Lag_1GrVol	-0.181*	-0.176*	-0.175*	-0.182**
	(-1.954)	(-1.931)	(-1.906)	(-1.985)
lnGDP	0.567	0.729*	0.764*	0.631
	(1.028)	(1.731)	(1.944)	(1.119)
Democracy	-1.324***	-1.380***	-1.366***	-1.296***
	(-3.282)	(-3.248)	(-3.250)	(-2.919)
Openness	1.110**	1.242**	1.236**	1.159**
	(2.345)	(2.493)	(2.576)	(2.251)
Schooling	-0.001	-0.001	-0.001	0.002
	(-0.106)	(-0.204)	(-0.151)	(0.203)
INFL	0.068**	0.072**	0.071**	0.068**
	(2.252)	(2.355)	(2.298)	(2.223)
ShAgGDP	0.066***	0.059**	0.066**	0.071***
	(2.826)	(2.133)	(2.410)	(3.154)
WAR	-0.069	-0.098	-0.117	-0.129
	(-0.268)	(-0.373)	(-0.423)	(-0.505)
ShFood(p)	-0.020			-0.013
	(-0.641)			(-0.426)
ShNONFood(p)		0.173		-0.032
		(1.188)		(-0.075)
RATIOFOOD(p)			3.290	3.697
			(0.930)	(0.489)
Sum of sq. res.	34568.81	34706.72	34726.01	34621.10
S.E. of regression	3.706	3.728	3.722	3.700
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	85	85	85	87
Arellano-Bond test AR(1)	-2.729	-2.787	-2.782	-2.737
AR(1) p-value	0.006	0.005	0.005	0.006
Arellano-Bond test AR(2)	-0.487	-0.445	-0.443	-0.496
AR(2) p-value	0.626	0.657	0.658	0.620
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	56.772	57.421	56.536	54.440
Sargan test Chi-sq. p-value	0.942	0.935	0.945	0.965
Wald (joint) test df	9	9	9	11
Wald (joint) test Chi-sq.(df)	47.194***	44.621***	45.287***	49.911***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A4.17: GMM estimates for all my control variables, food crops, non-food crops, and ratio between non-food and food crops as well as interaction terms between explanatory variables and openness on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	-8.030	-9.305*	-8.689**	-9.502
	(-1.287)	(-1.853)	(-1.969)	(-1.164)
Lag_1GrVol	-0.191**	-0.178*	-0.174*	-0.189**
	(-2.109)	(-1.947)	(-1.886)	(-2.126)
lnGDP	0.626	0.821*	0.743*	0.782
	(1.008)	(1.884)	(1.894)	(1.101)
Democracy	-1.250***	-1.388***	-1.332***	-1.249**
	(-3.177)	(-3.131)	(-3.178)	(-2.381)
Openness	1.284***	1.221**	1.157**	1.288*
	(2.598)	(2.288)	(2.337)	(1.799)
Schooling	-0.003	-0.003	-0.000	-0.003
	(-0.356)	(-0.362)	(-0.061)	(-0.360)
INFL	0.075**	0.070**	0.066**	0.073*
	(2.392)	(2.153)	(2.031)	(1.934)
ShAgGDP	0.077***	0.065**	0.065**	0.081***
	(2.899)	(2.267)	(2.345)	(2.858)
WAR	-0.136	-0.093	-0.096	-0.170
	(-0.500)	(-0.336)	(-0.363)	(-0.561)
ShFOOD(p)	-0.024			-0.0180
	(-0.756)			(-0.411)
Openness * ShFOOD(p)	-0.198			0.002
	(-1.141)			(-0.006)
ShNONFOOD(p)		0.146		-0.009
		(0.973)		(-0.017)
Openness * ShNONFOOD(p)		-1.051		-3.338
		(-1.127)		(-0.653)
RATIOFOOD(p)			3.201	3.089
			(0.921)	(0.335)
Openness * RATIOFOOD(p)			5.483	35.968
			(0.277)	(0.548)
Sum of sq. res.	36336.90	34626.26	34195.38	35510.32
S.E. of regression	3.773	3.720	3.698	3.725
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	86	86	86	90
Arellano-Bond test AR(1)	-2.750	-2.785	-2.758	-2.755
AR(1) p-value	0.006	0.005	0.006	0.006
Arellano-Bond test AR(2)	-0.539	-0.456	-0.414	-0.551
AR(2) p-value	0.590	0.648	0.679	0.582
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	54.287	56.295	55.167	53.307
Sargan test Chi-sq. p-value	0.966	0.948	0.959	0.973
Wald (joint) test df	10	10	10	14
Wald (joint) test Chi-sq.(df)	52.846***	40.202***	45.601***	51.214***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A4.18: GMM estimates without intercept for all my control variables and food crops, non-food crops, and ratio between non-food and food crops on growth rate volatility

	(1)	(2)	(3)	(4)
Constant				
Lag_1GrVol	-0.176*	-0.165*	-0.163*	-0.176*
	(-1.875)	(-1.769)	(-1.745)	(-1.871)
lnGDP	-0.035	0.066	0.055	-0.069
	(-0.165)	(0.353)	(0.301)	(-0.317)
Democracy	-1.120***	-1.132***	-1.115***	-1.046**
	(-2.794)	(-2.688)	(-2.612)	(-2.541)
Openness	0.727**	0.600*	0.582*	0.703**
	(2.022)	(1.817)	(1.838)	(1.982)
Schooling	-0.000	-0.003	-0.002	0.001
	(-0.051)	(-0.461)	(-0.357)	(0.173)
INFL	0.066**	0.057**	0.060**	0.067**
	(2.235)	(2.223)	(2.248)	(2.225)
ShAgGDP	0.042**	0.013	0.012	0.043**
	(2.346)	(0.800)	(0.756)	(2.253)
WAR	-0.223	-0.263	-0.317	-0.270
	(-0.905)	(-1.104)	(-1.239)	(-1.135)
ShFood(p)	-0.052***			-0.052**
	(-2.877)			(-2.227)
ShNONFood(p)		0.011		0.007
		(0.091)		(0.018)
RATIOFOOD(p)			1.493	1.864
			(0.539)	(0.263)
Sum of sq. res.	34444.76	33472.91	33605.22	34543.04
S.E. of regression	3.704	3.662	3.672	3.710
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	84	84	84	86
Arellano-Bond test AR(1)	-2.706	-2.699	-2.718	-2.708
AR(1) p-value	0.007	0.007	0.007	0.007
Arellano-Bond test AR(2)	-0.434	-0.304	-0.294	-0.432
AR(2) p-value	0.664	0.761	0.769	0.665
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	57.789	57.911	57.459	56.157
Sargan test Chi-sq. p-value	0.930	0.928	0.934	0.949
Wald (joint) test df	9	9	9	11
Wald (joint) test Chi-sq.(df)	215.451***	214.000***	215.927***	224.844***

Signif. codes: 0.01 ‘***’, 0.05 ‘**’, 0.1 ‘*’, Dependent variable: growth rate volatility (GrVol)

Table A4.19: GMM estimates without intercept for all my control variables, food crops, non-food crops, and ratio between non-food and food crops as well as interaction terms between explanatory variables and openness on growth rate volatility

	(1)	(2)	(3)	(4)
Constant				
Lag_1GrVol	-0.182**	-0.164*	-0.160*	-0.183**
	(-1.978)	(-1.771)	(-1.708)	(-2.012)
lnGDP	-0.086	0.100	0.077	-0.028
	(-0.386)	(0.532)	(0.407)	(-0.116)
Democracy	-1.034***	-1.109***	-1.059**	-0.975**
	(-2.673)	(-2.612)	(-2.466)	(-2.283)
Openness	0.829**	0.571*	0.519	0.740*
	(2.278)	(1.701)	(1.514)	(1.756)
Schooling	-0.002	-0.005	-0.002	-0.004
	(-0.278)	(-0.780)	(-0.319)	(-0.443)
INFL	0.072**	0.059**	0.055**	0.068**
	(2.367)	(2.092)	(1.968)	(2.052)
ShAgGDP	0.048***	0.015	0.012**	0.049***
	(2.652)	(0.865)	(0.746)	(2.663)
WAR	-0.322	-0.303	-0.307	-0.344
	(-1.307)	(-1.259)	(-1.306)	(-1.344)
ShFOOD	-0.062***			-0.066**
	(-3.374)			(-2.299)
Openness * ShFOOD(p)	-0.188			0.009
	(-1.113)			(-0.061)
ShNONFOOD(p)		-0.027		-0.041
		(0.229)		(-0.079)
Openness * ShNONFOOD(p)		-1.162		-3.343
		(-1.221)		(-0.717)
RATIOFOOD(p)			2.069	0.751
			(0.625)	(0.082)
Openness * RATIOFOOD(p)			3.493	29.564
			(0.175)	(0.479)
Sum of sq. res.	36541.92	33566.41	33246.41	35231.10
S.E. of regression	3.803	3.669	3.657	3.729
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	85	85	85	89
Arellano-Bond test AR(1)	-2.746	-2.737	-2.730	-2.715
AR(1) p-value	0.006	0.006	0.006	0.007
Arellano-Bond test AR(2)	-0.446	-0.303	-0.254	-0.476
AR(2) p-value	0.656	0.762	0.800	0.634
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	55.934	56.786	55.235	54.654
Sargan test Chi-sq. p-value	0.951	0.942	0.958	0.963
Wald (joint) test df	10	10	10	14
Wald (joint) test Chi-sq.(df)	194.976***	188.800***	206.720***	216.844***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A4.20: Group classification of crops products

	Our grouping	FAO classification
Food	Cereals	Cereals and cereal products
	Vegetables	Roots and tubers and derived products
		Sugar crops and sweeteners and derived products*
		Pulses and derived products
		Vegetables and derived products (excl. Watermelons and melons)
		Hops from "Tobacco and rubber and other crops"
		Fresh and dry vegetable products from "Tobacco and rubber and other crops"
		Olive, tomatoes, artichokes, cucumbers from "Fruits"
	Nuts	Nuts and derived products
		Coconuts and groundnuts from "Oil bearing crops and derived products"
	Oil crops	Oil bearing crops and derived products (Excl. coconuts and groundnuts)
	Fruits	Fruits and derived products (Excl. Olive, tomatoes, artichokes, cucumbers)
		Watermelons and melons from "Vegetables and derived products"
	Fibre crops	Fibres of vegetal or animal origin (Excl. fibres of animal origin)
	Spices	Spices
	Coffee, cocoa, tea	Stimulant crops and derived products
Non-food	Tobacco	Tobacco from "Tobacco and rubber and other crops"
	Rubber	Rubber from "Tobacco and rubber and other crops"
	Others	Chicory roots from "Tobacco and rubber and other crops"
		Carobs roots from "Tobacco and rubber and other crops"
		Pyrethrum roots from "Tobacco and rubber and other crops"
		Beeswax*

*Although honey is classified under "sugar crops and sweeteners and derived products" I excluded honey from my agricultural products list. The same applies to beeswax.

Table A4.21: GMM estimates for all my control variables, and different crop groups on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	-6.906	-5.215	-6.218	-7.948*
	(-1.241)	(-1.163)	(-1.516)	(-1.956)
Lag_1GrVol	-0.175*	-0.182**	-0.182**	-0.177*
	(-1.928)	(-1.966)	(-1.972)	(-1.935)
lnGDP	0.584	0.390	0.545	0.678*
	(1.111)	(0.858)	(1.345)	(1.772)
Democracy	-1.350***	-1.300***	-1.226***	-1.402***
	(-3.206)	(-3.392)	(-3.053)	(-3.429)
Openness	1.135**	1.063**	1.090**	1.192**
	(2.153)	(2.348)	(2.370)	(2.491)
Schooling	-0.002	0.000	-0.002	-0.002
	(-0.306)	(0.064)	(-0.347)	(-0.292)
INFL	0.067**	0.071**	0.067**	0.071**
	(2.266)	(2.299)	(2.200)	(2.323)
ShAgGDP	0.059**	0.059**	0.057**	0.063**
	(2.225)	(2.305)	(2.331)	(2.389)
WAR	-0.104	-0.160	-0.110	-0.089
	(-0.425)	(-0.612)	(-0.472)	(-0.350)
Cereals(p)	-0.015			
	(-0.290)			
Vegetables(p)		-0.079*		
		(-1.744)		
Fruits(p)			-0.089	
			(-1.540)	
Nuts(p)				-0.155***
				(-2.876)
Sum of sq. res.	34327.67	34780.03	34263.17	34687.38
S.E. of regression	3.704	3.720	3.694	3.723
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	85	85	85	85
Arellano-Bond test AR(1)	-2.763	-2.753	-2.713	-2.779
AR(1) p-value	0.006	0.006	0.007	0.006
Arellano-Bond test AR(2)	-0.440	-0.489	-0.483	-0.462
AR(2) p-value	0.660	0.625	0.629	0.644
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	56.579	55.224	55.889	57.036
Sargan test Chi-sq. p-value	0.944	0.958	0.952	0.939
Wald (joint) test df	9	9	9	9
Wald (joint) test Chi-sq.(df)	42.757***	42.116***	41.620***	43.395***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*'; Dependent variable: growth rate volatility (GrVol)

Table A4.21: Continued

	(1)	(2)	(3)	(4)
Constant	-8.316**	-6.277	-8.967**	-7.846*
	(-2.081)	(-1.463)	(-1.974)	(-1.841)
Lag_1GrVol	-0.185**	-0.177*	-0.181*	-0.177*
	(-2.065)	(-1.921)	(-1.940)	(-1.907)
lnGDP	0.712*	0.474	0.756*	0.683*
	(1.826)	(1.118)	(1.763)	(1.735)
Democracy	-1.374***	-1.300***	-1.578***	-1.390***
	(-3.268)	(-2.991)	(-3.483)	(-3.582)
Openness	1.256***	1.106**	1.202**	1.166**
	(2.680)	(2.251)	(2.521)	(2.395)
Schooling	-0.003	0.002	0.002	-0.002
	(-0.454)	(0.198)	(0.219)	(-0.245)
INFL	0.069**	0.069**	0.073**	0.080***
	(2.366)	(2.331)	(2.336)	(2.656)
ShAgGDP	0.070***	0.055**	0.053*	0.058**
	(2.945)	(2.239)	(1.930)	(2.161)
WAR	-0.082	-0.105	-0.091	-0.136
	(-0.345)	(-0.386)	(-0.341)	(-0.471)
Coffee, cocoa, tea(p)	-0.287**			
	(-2.192)			
Spices(p)		-0.818		
		(-1.524)		
Oil crops(p)			0.197**	
			(2.392)	
Other food crops(p)				-749.876
				(-1.153)
Sum of sq. res.	34414.96	34654.76	34664.56	35258.66
S.E. of regression	3.705	3.718	3.732	3.769
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	85	85	85	85
Arellano-Bond test AR(1)	-2.730	-2.755	-2.753	-2.829
AR(1) p-value	0.006	0.006	0.006	0.005
Arellano-Bond test AR(2)	-0.540	-0.460	-0.484	-0.485
AR(2) p-value	0.589	0.645	0.628	0.627
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	55.566	57.678	57.046	56.858
Sargan test Chi-sq. p-value	0.955	0.931	0.939	0.941
Wald (joint) test df	9	9	9	9
Wald (joint) test Chi-sq.(df)	44.723***	45.261***	33.330***	45.566***

Signif. codes: 0.01 ‘***’, 0.05 ‘**’, 0.1 ‘*’;Dependent variable: growth rate volatility (GrVol)

Table A4.21: Continued

	(1)	(2)	(3)	(4)
Constant	-8.488*	-8.040*	-8.359**	-7.347*
	(-1.807)	(-1.936)	(-1.997)	(-1.749)
Lag_1GrVol	-0.175*	-0.19*	-0.178*	-0.175*
	(-1.914)	(-1.952)	(-1.958)	(-1.904)
lnGDP	0.682	0.693*	0.741*	0.620*
	(1.630)	(1.791)	(1.901)	(1.653)
Democracy	-1.351***	-1.302***	-1.380***	-1.365***
	(-3.232)	(-3.293)	(-3.302)	(-2.761)
Openness	1.263**	1.204**	1.231**	1.184**
	(2.460)	(2.516)	(2.535)	(2.330)
Schooling	-0.000	-0.003	-0.004	-0.002
	(-0.024)	(-0.387)	(-0.616)	(-0.307)
INFL	0.073**	0.066**	0.067**	0.066**
	(2.359)	(2.257)	(2.266)	(2.232)
ShAgGDP	0.057**	0.063**	0.061**	0.058**
	(2.091)	(2.360)	(2.426)	(2.239)
WAR	-0.099	-0.025	-0.081	-0.106
	(-0.370)	(-0.098)	(-0.323)	(-0.400)
Fibres(p)	0.238			
	(1.273)			
Rubber(p)		-0.309*		
		(-1.726)		
Tobacco(p)			0.282	
			(1.194)	
Other non – food crops(p)				7.796
				(0.125)
Sum of sq. res.	34726.99	34294.27	34377.47	34333.56
S.E. of regression	3.734	3.697	3.706	3.701
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	85	85	85	85
Arellano-Bond test AR(1)	-2.792	-2.731	-2.769	-2.759
AR(1) p-value	0.005	0.006	0.006	0.006
Arellano-Bond test AR(2)	-0.437	-0.467	-0.458	-0.428
AR(2) p-value	0.662	0.641	0.647	0.669
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	57.581	56.230	56.938	56.492
Sargan test Chi-sq. p-value	0.933	0.948	0.940	0.945
Wald (joint) test df	9	9	9	9
Wald (joint) test Chi-sq.(df)	41.229***	45.894***	51.499***	44.507***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*'; Dependent variable: growth rate volatility (GrVol)

Table A4.22: GMM estimates for all my control variables, and different crop groups as well as their corresponding interaction terms on growth rate volatility

	(1)	(2)	(3)
Constant	-7.439	-6.196	-6.657
	(-1.198)	(-1.334)	(-1.626)
Lag_1GrVol	-0.179**	-0.180*	-0.187**
	(-1.965)	(-1.951)	(-2.019)
lnGDP	0.601	0.498	0.564
	(1.001)	(1.076)	(1.368)
Democracy	-1.325***	-1.320***	-1.161***
	(-3.089)	(-3.423)	(-2.911)
Openness	1.222**	1.078**	1.075**
	(2.317)	(2.382)	(2.399)
Schooling	-0.003	0.000	-0.001
	(-0.456)	(0.023)	(-0.188)
INFL	0.071**	0.069**	0.069**
	(2.328)	(2.231)	(2.244)
ShAgGDP	0.065**	0.063**	0.066***
	(2.191)	(2.299)	(2.578)
WAR	-0.104	-0.090	-0.128
	(-0.398)	(-0.329)	(-0.530)
Cereals(p)	-0.031		
	(-0.470)		
Openness x Cereals(p)	-0.218		
	(-0.799)		
Vegetables(p)		-0.057	
		(-1.123)	
Openness x Vegetables(p)		0.022	
		(0.122)	
Fruits(p)			-0.098*
			(-1.723)
Openness x Fruits(p)			-0.697
			(-1.544)
Sum of sq. res.	35007.00	34553.62	34749.64
S.E. of regression	3.731	3.712	3.727
No. of countries	64	64	64
No. of observations	2496	2496	2496
No. of instruments	86	85	85
Arellano-Bond test AR(1)	-2.768	-2.739	-2.793
AR(1) p-value	0.006	0.006	0.005
Arellano-Bond test AR(2)	-0.471	-0.479	-0.441
AR(2) p-value	0.638	0.632	0.659
Sargan test df	75	75	75
Sargan test Chi-sq.(df)	55.636	55.106	57.108
Sargan test Chi-sq. p-value	0.954	0.959	0.938
Wald (joint) test df	10	10	9
Wald (joint) test Chi-sq.(df)	46.253***	40.482***	46.872***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*'; Dependent variable: growth rate volatility (GrVol)

Table A4.22: Continued

	(1)	(2)	(3)
Constant	-8.291*	-9.312**	-7.072
	(-1.910)	(-2.117)	(-1.562)
Lag_1GrVol	-0.178*	-0.210***	-0.181*
	(-1.947)	(-2.899)	(-1.953)
lnGDP	0.709*	0.760*	0.545
	(1.745)	(1.711)	(1.237)
Democracy	-1.401***	-1.416***	-1.315***
	(-3.345)	(-3.445)	(-3.101)
Openness	1.205**	1.414***	1.150**
	(2.520)	(2.738)	(2.392)
Schooling	-0.002	-0.004	0.001
	(-0.249)	(-0.558)	(0.161)
INFL	0.070**	0.072**	0.067**
	(2.302)	(2.380)	(2.260)
ShAgGDP	0.066**	0.077***	0.062**
	(2.194)	(2.810)	(2.195)
WAR	-0.064	-0.063	-0.095
	(-0.239)	(-0.263)	(-0.361)
Nuts(p)	-0.251		
	(-0.784)		
Openness x Nuts(p)	0.369		
	(0.292)		
Coffee, cocoa, tea(p)		-0.319**	
		(-2.210)	
Openness x Coffee, cocoa, tea(p)		-4.119***	
		(-2.928)	
Spices(p)			-0.490
			(-0.749)
Openness x Spices(p)			-2.110
			(-0.217)
Sum of sq. res.	34651.78	34935.08	34778.57
S.E. of regression	3.723	3.728	3.716
No. of countries	64	64	64
No. of observations	2496	2496	2496
No. of instruments	86	86	86
Arellano-Bond test AR(1)	-2.768	-2.930	-2.724
AR(1) p-value	0.006	0.003	0.006
Arellano-Bond test AR(2)	-0.486	-0.775	-0.477
AR(2) p-value	0.627	0.438	0.633
Sargan test df	75	75	75
Sargan test Chi-sq.(df)	57.100	55.958	56.822
Sargan test Chi-sq. p-value	0.938	0.951	0.942
Wald (joint) test df	10	10	10
Wald (joint) test Chi-sq.(df)	44.266***	54.996***	44.715***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*'; Dependent variable: growth rate volatility (GrVol)

Table A4.22: Continued[93]

	(1)	(2)	(3)
Constant	-9.113**	-9.216**	-8.073*
	(-2.054)	(-1.996)	(-1.950)
Lag_1GrVol	-0.181*	-0.179*	-0.178*
	(-1.953)	(-1.936)	(-1.946)
lnGDP	0.785*	0.786*	0.698*
	(1.812)	(1.835)	(1.799)
Democracy	-1.507***	-1.296***	-1.321***
	(-3.398)	(-3.106)	(-3.372)
Openness	1.167**	1.229**	1.208**
	(2.548)	(2.513)	(2.562)
Schooling	0.001	-0.001	-0.003
	(0.177)	(-0.174)	(-0.377)
INFL	0.073**	0.069**	0.066**
	(2.310)	(2.153)	(2.259)
ShAgGDP	0.055**	0.065**	0.063**
	(2.022)	(2.270)	(2.343)
WAR	-0.081	-0.057	-0.009
	(-0.316)	(-0.222)	(-0.034)
Oil(p)	0.200**		
	(2.414)		
Openness x Oil(p)	-0.243		
	(-0.187)		
Fibres(p)		0.250	
		(1.384)	
Openness x Fibres(p)		-1.316	
		(-1.061)	
Rubber(p)			-0.581
			(-0.938)
Openness x Rubber(p)			-1.782
			(-0.497)
Sum of sq. res.	34572.78	34935.08	34263.78
S.E. of regression	3.731	3.728	3.698
No. of countries	64	64	64
No. of observations	2496	2496	2496
No. of instruments	86	86	86
Arellano-Bond test AR(1)	-2.740	-2.930	-2.738
AR(1) p-value	0.006	0.003	0.006
Arellano-Bond test AR(2)	-0.462	-0.775	-0.463
AR(2) p-value	0.644	0.438	0.644
Sargan test df	75	75	75
Sargan test Chi-sq.(df)	56.077	55.958	56.263
Sargan test Chi-sq. p-value	0.950	0.951	0.948
Wald (joint) test df	10	10	10
Wald (joint) test Chi-sq.(df)	35.895***	54.996***	46.097***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*'; Dependent variable: growth rate volatility (GrVol)

[93] Due to perfect or near perfect collinearity it was not possible to perform regression with other food crops and its interaction term.)

Table A4.22: Continued

	(1)	(2)
Constant	-11.302***	-7.992**
	(-3.020)	(-2.006)
Lag_1GrVol	-0.219**	-0.179**
	(-2.373)	(-1.962)
lnGDP	1.009***	0.679*
	(2.689)	(1.890)
Democracy	-1.370***	-1.398***
	(-3.147)	(-2.866)
Openness	1.423***	1.198**
	(3.226)	(2.449)
Schooling	-0.010	-0.002
	(-1.382)	(-0.185)
INFL	0.082**	0.069**
	(2.359)	(2.265)
ShAgGDP	0.082***	0.062**
	(3.481)	(2.501)
WAR	-0.080	-0.097
	(-0.306)	(-0.368)
Tobacco(p)	0.278	
	(1.055)	
Openness x Tobacco(p)	-25.814***	
	(-3.293)	
Other non-food crops(p)		3.853
		(0.060)
Openness x Other non-food crops(p)		119.975
		(0.409)
Sum of sq. res.	43146.14	34667.13
S.E. of regression	4.020	3.717
No. of countries	64	64
No. of observations	2496	2496
No. of instruments	86	86
Arellano-Bond test AR(1)	-2.925	-2.757
AR(1) p-value	0.003	0.006
Arellano-Bond test AR(2)	-0.698	-0.474
AR(2) p-value	0.485	0.636
Sargan test df	75	75
Sargan test Chi-sq.(df)	54.986	56.531
Sargan test Chi-sq. p-value	0.960	0.945
Wald (joint) test df	10	10
Wald (joint) test Chi-sq.(df)	58.449***	46.968***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*'; Dependent variable: growth rate volatility (GrVol)

Table A4.23: GMM estimates for lag of dependent variable, all control variables, and inverted diversification indices for products, groups and food/non-food on growth rate volatility.

	(1)	(2)	(3)	(4)
Constant	-7.149*	-7.670*	-6.070	-5.968
	(-1.800)	(-1.88)	(-1.172)	(-1.072)
Lag_1GrVol	-0.175*	-0.174*	-0.175*	-0.173*
	(-1.906)	(-1.915)	(-1.918)	(-1.881)
lnGDP	0.640*	0.643*	0.680*	0.766*
	(1.727)	(1.705)	(1.860)	(1.804)
Democracy	-1.431***	-1.424***	-1.354***	-1.435***
	(-3.497)	(-3.476)	(-3.231)	(-3.396)
Openness	1.028**	1.089**	1.194**	1.080**
	(1.974)	(2.096)	(2.458)	(2.018)
Schooling	-0.003	-0.003	-0.001	-0.002
	(-0.377)	(-0.378)	(0.207)	(-0.225)
INFL	0.069**	0.069**	0.072**	0.070**
	(2.334)	(2.341)	(2.363)	(2.314)
ShAgGDP	0.056**	0.057**	0.059**	0.064**
	(2.314)	(2.327)	(2.427)	(2.058)
WAR	-0.063	-0.043	-0.153	0.003
	(-0.275)	(-0.171)	(-0.558)	(0.008)
InvHHProduct(p)	-1.822			2.205
	(-0.747)			(0.271)
InvHHGroup(p)		-1.604		-5.109
		(-0.669)		(-0.571)
InvHHFood(p)			2.076	3.907
			(0.633)	(0.957)
Sum of sq. res.	34399.87	34347.38	34749.64	34524.63
S.E. of regression	3.711	3.712	3.727	3.717
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	85	85	85	87
Arellano-Bond test AR(1)	-2.764***	-2.782***	-2.793***	-2.771***
AR(1) p-value	0.006	0.005	0.005	0.006
Arellano-Bond test AR(2)	-0.434	-0.427	-0.441	-0.423
AR(2) p-value	0.664	0.669	0.659	0.672
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	56.908	56.924	57.108	56.786
Sargan test Chi-sq. p-value	0.941	0.941	0.938	0.942
Wald (joint) test df	9	9	9	11
Wald (joint) test Chi-sq.(df)	40.170***	41.322***	46.872***	42.234***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*'; Dependent variable: growth rate volatility (GrVol)

Table A4.24: GMM estimates for all my control variables, inverted diversification indices for products, groups and food/non-food as well as the interaction variables between openness and each of the explanatory variables on growth rate volatility.

	(1)	(2)	(3)	(4)
Constant	-7.954*	-8.243**	-5.880	-5.896
	(-1.927)	(-2.016)	(-1.135)	(-1.045)
Lag_1GrVol	-0.177**	-0.179**	-0.176*	-0.185**
	(-2.001)	(-2.035)	(-1.918)	(-2.217)
lnGDP	0.696*	0.755*	0.695*	0.927**
	(1.863)	(1.857)	(1.948)	(2.216)
Democracy	-1.380***	-1.343***	-1.338***	-1.426***
	(-3.382)	(-3.514)	(-3.176)	(-3.531)
Openness	1.089*	1.047**	-1.144**	1.053
	(1.891)	(2.050)	(-2.283)	(1.761)
Schooling	-0.003	-0.004	-0.001	-0.005
	(-0.419)	(-0.619)	(-0.114)	(-0.612)
INFL	0.070**	0.065**	0.067**	0.066*
	(2.252)	(2.106)	(2.134)	(1.947)
ShAgGDP	0.062**	0.059**	0.061**	0.061*
	(2.515)	(2.316)	(2.529)	(1.871)
WAR	-0.037	0.014	-0.122	0.036
	(-0.158)	(0.053)	(-0.468)	(0.103)
InvHHProduct(p)	-1.715			0.666
	(-0.660)			(0.076)
Openness * InvHHProduct(p)	17.315			-4.806
	(0.332)			(-0.076)
InvHHGroup(p)		-1.807		-3.604
		(-0.663)		(-0.076)
Openness * InvHHGroup(p)		42.699		75.286
		(0.836)		(0.725)
InvHHFOOD(p)			2.288	4.381
			(0.689)	(0.924)
Openness * InvHHFood(p)			0.539	-30.304
			(0.020)	(-0.667)
Sum of sq. res.	34647.54	34881.94	34400.64	35649.78
S.E. of regression	3.713	3.709	3.706	3.738
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	86	86	86	90
Arellano-Bond test AR(1)	-2.814***	-2.792***	-2.761***	-2.841***
AR(1) p-value	0.005	0.005	0.006	0.005
Arellano-Bond test AR(2)	-0.461	-0.506	-0.436	-0.584
AR(2) p-value	0.645	0.613	0.663	0.560
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	54.810	56.709	55.449	55.896
Sargan test Chi-sq. p-value	0.962	0.943	0.956	0.952
Wald (joint) test df	10	10	10	14
Wald (joint) test Chi-sq.(df)	39.921***	46.117***	47.599***	49.996***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A4.25: GMM estimates without constant term for lag of dependent variable, all control variables, and inverted diversification indices for products, groups and food/non-food on growth rate volatility.

	(1)	(2)	(3)	(4)
Constant				
Lag_1GrVol	-0.164*	-0.162*	-0.169*	-0.173*
	(-1.740)	(-1.752)	(-1.819)	(-1.881)
lnGDP	0.095	0.053	0.327	0.766*
	(0.514)	(0.299)	(1.464)	(1.804)
Democracy	-1.287***	-1.199***	-1.162***	-1.435***
	(-3.275)	(-3.072)	(-2.648)	(-3.396)
Openness	0.414	0.468	0.817**	1.080**
	(1.018)	(1.116)	(2.115)	(2.018)
Schooling	-0.002	-0.003	-0.000	-0.002
	(-0.353)	(-0.420)	(0.036)	(-0.225)
INFL	0.061**	0.059**	0.070**	0.070**
	(2.222)	(2.206)	(2.354)	(2.314)
ShAgGDP	0.013	0.012	0.030*	0.064**
	(0.753)	(0.781)	(1.938)	(2.058)
WAR	-0.202	-0.213	-0.292	0.003
	(-0.934)	(-0.920)	(-1.120)	(0.008)
InvHHProduct(p)	-2.720			2.205
	(-1.082)			(0.271)
InvHHGroup(p)		-1.769		-5.109
		(-0.789)		(-0.571)
InvHHFood(p)			3.794*	3.907
			(1.704)	(0.957)
Sum of sq. res.	33623.41	33467.25	34527.84	34524.63
S.E. of regression	3.671	3.666	3.714	3.717
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	84	84	84	87
Arellano-Bond test AR(1)	-2.702	-2.712	-2.754	-2.771***
AR(1) p-value	0.007	0.007	0.006	0.006
Arellano-Bond test AR(2)	-0.300	-0.286	-0.371	-0.423
AR(2) p-value	0.764	0.775	0.711	0.672
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	57.727	56.899	57.838	56.786
Sargan test Chi-sq. p-value	0.931	0.941	0.929	0.942
Wald (joint) test df	9	9	9	11
Wald (joint) test Chi-sq.(df)	214.870***	209.650***	210.661***	42.234***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*'; Dependent variable: growth rate volatility (GrVol)

Table A4.26: GMM estimates without constant term for all my control variables, inverted diversification indices for products, groups and food/non-food as well as the interaction variables between openness and each of the explanatory variables on growth rate volatility.

	(1)	(2)	(3)	(4)
Constant				
Lag_1GrVol	-0.161*	-0.166*	-0.169*	-0.176**
	(-1.742)	(-1.865)	(-1.829)	(-2.078)
lnGDP	0.090	0.098	0.356	0.555**
	(0.506)	(0.546)	(1.497)	(2.230)
Democracy	-1.239***	-1.143***	-1.162***	-1.306***
	(-3.166)	(-2.962)	(-2.650)	(-3.206)
Openness	0.426	0.449	0.792*	0.680
	(1.060)	(1.103)	(1.950)	(1.373)
Schooling	-0.003	-0.004	-0.000	-0.003
	(-0.445)	(-0.628)	(-0.039)	(-0.454)
INFL	0.060**	0.004**	0.067**	0.066**
	(2.227)	(1.999)	(2.214)	(2.052)
ShAgGDP	0.013	0.010	0.032**	0.033
	(0.781)	(0.625)	(1.985)	(1.580)
WAR	-0.212	-0.185	-0.281	-0.121
	(-0.995)	(-0.742)	(-1.133)	(-0.409)
InvHHProduct(p)	-2.530			0.326
	(-0.991)			(0.046)
Openness * InvHHProduct(p)	2.880			-13.654
	(0.057)			(-0.227)
InvHHGroup(p)		-1.625		-3.887
		(-0.703)		(-0.484)
Openness * InvHHGroup(p)		29.510		73.468
		(0.510)		(0.813)
InvHHFOOD(p)			3.954*	5.999*
			(1.754)	(1.959)
Openness * InvHHFood(p)			-2.592	-27.403
			(-0.088)	(-0.640)
Sum of sq. res.	33542.22	33866.25	34339.91	35262.19
S.E. of regression	3.674	3.665	3.704	3.728
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	85	85	85	89
Arellano-Bond test AR(1)	-2.758	-2.752	-2.752	-2.824
AR(1) p-value	0.006	0.006	0.006	0.005
Arellano-Bond test AR(2)	-0.282	-0.351	-0.366	-0.492
AR(2) p-value	0.777	0.725	0.715	0.622
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	55.967	57.165	56.712	56.399
Sargan test Chi-sq. p-value	0.951	0.938	0.943	0.956
Wald (joint) test df	10	10	10	14
Wald (joint) test Chi-sq.(df)	224.858***	199.238***	219.172***	229.044***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A5.1: List of countries

1	Belize	33	Kenya
2	Benin	34	Korea, Rep.
3	Botswana	35	Lao, PDR
4	Burkina Faso	36	Lesotho
5	Burundi	37	Madagascar
6	Cabo Verde	38	Malawi
7	Cameroon	39	Malaysia
8	Central African Republic	40	Mali
9	Chad	41	Mauritania
10	China	42	Morocco
11	Colombia	43	Nepal
12	Comoros	44	Niger
13	Congo, Rep.	45	Nigeria
14	Costa Rica	46	Pakistan
15	Cote d'Ivoire (Ivory Coast)	47	Papua New Guinea
16	Dominica	48	Paraguay
17	Dominican Republic	49	Philippines
18	Ecuador	50	Portugal
19	Egypt	51	Romania
20	El Salvador	52	Rwanda
21	Equatorial Guinea	53	Senegal
22	Fiji	54	Sierra Leone
23	Gabon	55	Sri Lanka
24	Gambia	56	Swaziland
25	Ghana	57	Syrian Arab Republic
26	Guatemala	58	Tanzania (Un. Rep. of)
27	Guinea	59	Thailand
28	Guinea-Bissau	60	Togo
29	Guyana	61	Tunisia
30	Haiti	62	Turkey
31	Honduras	63	Zambia
32	India	64	Zimbabwe

Table A5.2: Variables and data sources

Dependent variable – Growth rate volatility		
AVGrVol	Average standard deviation of annual GDP per capita growth rate	UNCTADSTAT
GrVol	Standard deviation of annual GDP per capita growth rate	UNCTADSTAT
Independent variables		
Control variables		
Lag_1GrVol	First lagged value of dependent variable	UNCTADSTAT
Lag_2GrVol	Second lagged value of dependent variable	UNCTADSTAT
lnGDPPC	Log GDP per capita constant 2005 USD	UNCTADSTAT
Democracy	Polity2 score	Polity IV project – Centre for systemic peace[94]
Openness	Openness to trade (Import + Export)/GDP	World Bank WDI
Schooling	Gross primary school enrolment	UNESCO
INFL	Inflation	World Bank WDI
ShAgGDP	Share of agricultural production in GDP	FAOSTAT
WAR	Armed conflict	UCD/PRIO Armed conflict dataset
SDExchRate	Standard deviation of exchange rate	Penn World Table, v. 9.0[95]
Explanatory variables – quick analysis		
Basic data	Export value of agricultural exports (constant 2004 – 2006 1000 International US$)	FAOSTAT
AVAgShGDP	Average share of agriculture in GDP	Author's own calculations
AVCrShGDP	Average share of crops production value in GDP	Author's own calculations
AVAgExShGDP	Average share of agricultural exports in GDP	Author's own calculations
AVCrExShGDP	Average share of crops exports in GDP	Author's own calculations
AVShPLANT(e)	Average share of plantation crops exports in GDP	Author's own calculations
AVShProcPLANT(e)	Average share of processed plantation crops exports in GDP	Author's own calculations
AVShUnprocPLANT(e)	Average share of unprocessed plantation crops exports in GDP	Author's own calculations
AVShNONPLANT(e)	Average share of non-plantation crops exports in GDP	Author's own calculations
AVShProcNONPLANT(e)	Average share of processed non-plantation crops exports in GDP	Author's own calculations
AVShUnprocNONPLANT(e)	Average share of unprocessed non-plantation crops exports in GDP	Author's own calculations

94 Information on political system comes from PolityIV dataset (The Center for Systemic Peace, 2016). In cases that information for the early years of this research is missing, we draw information from Papaioannou and Siourounis (2008) who provide information on year of democratisation.

95 Feenstra, et al. (2015)

Table A5.2: Continued

Independent variables		
Explanatory variables – quick analysis		
AVShPERISH(e)	Average share of perishable crops exports in GDP	Author's own calculations
AVShProcPERISH(e)	Average share of processed perishable crops exports in GDP	Author's own calculations
AVShUnprocPERISH(e)	Average share of unprocessed perishable crops exports in GDP	Author's own calculations
AVShNONPERISH(e)	Average share of non-perishable crops exports in GDP	Author's own calculations
AVShProcNONPERISH(e)	Average share of processed non-perishable crops exports in GDP	Author's own calculations
AVShUnprocNONPERISH(e)	Average share of unprocessed non-perishable crops exports in GDP	Author's own calculations
AVShPROC(e)	Average share of processed crops exports in GDP	Author's own calculations
AVShUNPROC(e)	Average share of unprocessed crops exports in GDP	Author's own calculations
AVInvHHProduct(e)	Average value of Inverted Herfindahl-Hirschman Index for all exported products	Author's own calculations
AVInvHHGroup(e)	Average value of inverted Herfindahl-Hirschman Index for export product groups	Author's own calculations
AVInvHHPlant(e)	Average value of inverted Herfindahl-Hirschman Index between exported plantation/non-plantation crops	Author's own calculations
AVInvHHPerish(e)	Average value of inverted Herfindahl-Hirschman Index between exported perishable/non-perishable crops	Author's own calculations
AVInvHHProc(e)	Average value of inverted Herfindahl-Hirschman Index between exported processed/unprocessed crops	Author's own calculations
AVInvHHFood(e)	Average value of inverted Herfindahl-Hirschman Index between exported food/non-food crops	Author's own calculations
Explanatory variables – detailed analysis		
Basic data	Export value of agricultural crops (constant 2004 – 2006, 1000 International US$)	FAOSTAT
AgExShGDP	Share of agricultural exports in GDP	Author's own calculations
CrExShGDP	Share of crops exports in GDP	Author's own calculations
ShPLANT(e)	Share of plantation crops exports in GDP	Author's own calculations
ShProcPLANT(e)	Share of processed plantation crops exports in GDP	Author's own calculations
ShUnprocPLANT(e)	Share of unprocessed plantation crops exports in GDP	Author's own calculations
ShNONPLANT(e)	Share of non-plantation crops exports in GDP	Author's own calculations
ShProcNONPLANT(e)	Share of processed non-plantation crops exports in GDP	Author's own calculations

Table A5.2: Continued

Independent variables		
Explanatory variables – detailed analysis		
ShUnprocNONPLANT(e)	Share of unprocessed non-plantation crops exports in GDP	Author's own calculations
ShPERISH(e)	Share of perishable crops exports in GDP	Author's own calculations
ShProcPERISH(e)	Share of processed perishable crops exports in GDP	Author's own calculations
ShUnprocPERISH(e)	Share of unprocessed perishable crops exports in GDP	Author's own calculations
ShNONPERISH(e)	Share of non-perishable crops exports in GDP	Author's own calculations
ShProcNONPERISH(e)	Share of processed non-perishable crops exports in GDP	Author's own calculations
ShUnprocNONPERISH(e)	Share of unprocessed non-perishable crops exports in GDP	Author's own calculations
ShPROC(e)	Share of processed crops exports in GDP	Author's own calculations
ShUNPROC(e)	Share of unprocessed crops exports in GDP	Author's own calculations
InvHHProduct(e)	Value of inverted Herfindahl-Hirschman Index for all exported products	Author's own calculations
InvHHGroup(e)	Value of inverted Herfindahl-Hirschman Index for exported product groups	Author's own calculations
InvHHPlant(e)	Value of inverted Herfindahl-Hirschman Index between exported plantation/non-plantation crops	Author's own calculations
InvHHPerish(e)	Value of inverted Herfindahl-Hirschman Index between exported perishable/non-perishable crops	Author's own calculations
InvHHProc(e)	Value of inverted Herfindahl-Hirschman Index between exported processed/unprocessed crops	Author's own calculations
InvHHFood(e)	Value of inverted Herfindahl-Hirschman Index between exported food/non-food crops	Author's own calculations
FoodExShGDP(e)	Share of food crops exports in GDP	Author's own calculations
NonfoodExShGDP(e)	Share of non-food crops exports in GDP	Author's own calculations
Cereals(e)	Share of cereals exports in GDP	Author's own calculations
Vegetables(e)	Share of vegetables exports in GDP	Author's own calculations
Fruits(e)	Share of fruits exports in GDP	Author's own calculations
Nuts(e)	Share of nuts exports in GDP	Author's own calculations
Coffee, cocoa, tea(e)	Share of exports of coffee, cocoa, and tea in GDP	Author's own calculations

Table A5.2: Continued

Independent variables		
Explanatory variables – detailed analysis		
Spices(e)	Share of spices exports in GDP	Author’s own calculations
Oil(e)	Share of food oil crops exports in GDP	Author’s own calculations
Other food crops(e)	Share of other food crops exports in GDP	Author’s own calculations
Fibres(e)	Share of fibre crops exports in GDP	Author’s own calculations
Rubber(e)	Share of rubber exports in GDP	Author’s own calculations
Tobacco(e)	Share of tobacco exports in GDP	Author’s own calculations
Other non-food crops(e)	Share of other non-food crops exports in GDP	Author’s own calculations

Table A5.3: Summary statistics – quick analysis

Variable	Min	Max	Mean	Standard deviation	IQR
AVGrVol	0.930	7.296	2.468	1.111	1.246
AVAgGDP	6.515	51.372	25.886	11.780	19.655
AVCrShGDP	1.506	86.802	20.631	15.939	19.385
AVAgExShGDP	0.152	14.738	4.777	3.834	4.770
AVCrExShGDP	0.155	21.834	6.062	5.434	6.795
AVShPLANT(e)	0.001	18.472	3.149	3.604	3.847
AVShProcPLANT(e)	0.0004	6.803	0.855	1.268	0.982
AVShUnprocPLANT(e)	0.0006	18.177	2.279	3.164	2.992
AVShNONPLANT(e)	0.015	18.114	2.913	3.817	2.742
AVShProcNONPLANT(e)	0.015	14.398	2.253	3.039	1.898
AVShUnprocNONPLANT(e)	0.000	9.508	0.672	1.386	0.523
AVShPERISH(e)	0.000	6.270	0.481	1.157	0.226
AVShProcPERISH(e)	0.000	12.328	1.329	2.617	1.118
AVShUnprocPERISH(e)	0.000	6.011	0.474	1.133	0.225
AVShNONPERISH(e)	0.049	21.779	5.581	5.223	6.629
AVShProcNONPERISH(e)	0.031	8.278	1.788	2.125	2.106
AVShUnprocNONPERISH(e)	0.015	19.007	2.460	3.240	3.104
AVShPROC(e)	0.034	14.428	3.119	3.614	4.291
AVShUNPROC(e)	0.011	19.025	2.943	3.451	3.561
AVInvHHProducts(e)	-0.848	-0.048	-0.307	0.184	0.221
AVInvHHGroup(e)	-0.971	-0.171	-0.493	0.190	0.268
AVInvHHPlant(e)	-0.999	-0.500	-0.690	0.141	0.216
AVInvHHPerish(e)	-1.000	-0.509	-0.904	0.126	0.151
AVInvHHProc(e)	-0.994	-0.502	-0.685	0.132	0.200
AVInvHHFood(e)					

Source: Author's own calculations based on relevant data sources

Table A5.4: Summary statistics – detailed analysis

Variable	Min	Max	Mean	Standard deviation	Within S.D.	Between S.D.	IQR
GrVol	0.0005	53.581	2.468	3.236	3.211	0.652	2.509
lnGDPPC05	4.965	10.029	6.919	1.028	1.022	0.197	1.578
Democracy	0.000	1.000	0.423	0.494	0.475	0.157	1.000
Openness	1.620	5.588	3.776	0.590	0.575	0.160	0.777
Schooling	11.726	207.23	91.103	27.408	26.242	8.986	36.111
INFL	-31.566	227.31	12.249	18.843	18.477	4.735	10.942
APGDP	1.157	77.587	25.886	13.703	13.304	3.921	19.311
WAR	0	2	0.222	0.501	0.502	0.072	0.000
SDExchRate	0.000	7590.2	205.920	628.360	626.240	111.810	138.090
AgExShGDP	0.0001	1.188	0.064	0.073	0.071	0.021	0.071
CrExShGDP	0.000	1.191	0.078	0.086	0.084	0.022	0.093
ShPLANT(e)	0.000	1.186	0.042	0.064	0.063	0.014	0.051
ShProcPLANT(e)	0.000	0.190	0.011	0.019	0.019	0.002	0.012
ShUnprocPLANT(e)	0.000	1.159	0.031	0.059	0.058	0.012	0.037
ShNONPLANT(e)	0.000	0.461	0.037	0.055	0.055	0.010	0.036
ShProcNONPLANT(e)	0.000	0.460	0.029	0.048	0.048	0.009	0.028
ShUnprocNONPLANT(e)	0.000	0.218	0.007	0.016	0.016	0.002	0.006

Table A5.4: Continued

Variable	Min	Max	Mean	Standard deviation	Within S.D.	Between S.D.	IQR
ShPERISH(e)	0.000	0.447	0.025	0.049	0.049	0.006	0.020
ShProcPERISH(e)	0.000	0.447	0.018	0.043	0.044	0.005	0.012
ShUnprocPERISH(e)	0.000	0.233	0.006	0.020	0.020	0.002	0.003
ShNONPERISH(e)	0.000	1.180	0.054	0.069	0.068	0.017	0.062
ShProcNONPERISH(e)	0.000	0.230	0.022	0.031	0.031	0.006	0.023
ShUnprocNONPERISH(e)	0.000	1.148	0.032	0.057	0.057	0.013	0.038
ShPROC(e)	0.000	0.461	0.040	0.056	0.056	0.010	0.043
ShUNPROC(e)	0.000	1.159	0.038	0.061	0.060	0.013	0.045
InvHHProduct(e)	-1.000	-0.027	-0.306	0.219	0.216	0.048	0.246
InvHHGroup(e)	-1.000	-0.127	-0.492	0.228	0.226	0.049	0.322
InvHHPlant(e)	-1.000	-0.500	-0.690	0.168	0.169	0.024	0.306
InvHHPerish(e)	-1.000	-0.500	-0.763	0.176	0.175	0.036	0.342
InvHHProc(e)	-1.000	-0.500	-0.685	0.161	0.161	0.026	0.286
InvHHFood(e)	-1.000	-0.500	-0.786	0.173	0.099	0.144	0.330

Table A5.4: Continued

Variable	Min	Max	Mean	Standard deviation	Within S.D.	Between S.D.	IQR
FoodExShGDP	0.000	1.188	0.059	0.078	0.051	0.059	0.068
NonfoodExShGDP	0.000	0.272	0.019	0.036	0.019	0.031	0.018
Cereals(e)	0.000	0.254	0.007	0.022	0.011	0.019	0.004
Vegetables(e)	0.000	0.459	0.014	0.039	0.021	0.033	0.006
Fruits(e)	0.000	0.233	0.007	0.021	0.010	0.019	0.004
Nuts(e)	0.000	0.146	0.001	0.008	0.006	0.005	0.000
Coffee, cocoa, tea(e)	0.000	1.148	0.018	0.051	0.039	0.033	0.018
Spices(e)	0.000	0.079	0.001	0.006	0.003	0.005	0.000
Oil(e)	0.000	0.262	0.010	0.024	0.015	0.019	0.006
Other food crops(e)	0.000	0.164	0.001	0.009	0.008	0.005	0.001
Fibres(e)	0.000	0.195	0.010	0.023	0.013	0.019	0.007
Rubber(e)	0.000	0.269	0.003	0.016	0.011	0.012	0.010
Tobacco(e)	0.000	0.251	0.005	0.023	0.008	0.022	0.002
Other non-food crops(e)	0.000	0.065	0.001	0.004	0.003	0.003	0.001

Source: Author’s own calculations based on relevant data sources

Table A5.5: Crops - export

	Plantation	Non-plantation	Perishable	Non-perishable	Processed	Unprocessed	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, cocoa, tea	Spices	Oil	Other food crops	Fibres	Rubber	Tobacco	Other non-food
Alfalfa meal and pellets		x		x	x			x												x
Almonds shelled		x		x	x		x					x								
Anise, badian, fennel, coriander		x		x		x	x							x						
Apples		x		x		x	x				x									
Apricots		x	x			x	x				x									
Apricots, dry		x	x		x		x				x									
Artichokes		x	x			x	x			x										
Asparagus		x	x			x	x			x										
Avocados		x	x			x	x				x									
Bambara beans		x	x			x	x			x										
Bananas	x		x			x	x				x									
Barley		x		x		x	x		x											
Barley, pearled		x		x	x		x		x											
Beans, dry		x	x		x		x			x										
Beans, green		x	x			x	x			x										
Beer of barley		x		x	x		x		x											
Beer of sorghum		x		x	x		x		x											
Beet pulp		x	x		x			x												x
Beverages, distilled alc.		x		x	x		x		x											
Beverages, fermented rice	x			x	x		x		x											
Beverages, non-alc.		x	x		x		x				x									
Blueberries		x	x			x	x				x									
Bran, buckwheat		x		x	x		x		x											
Bran, fonio		x		x	x		x		x											
Bran, maize		x		x	x		x		x											
Bran, millet		x		x	x		x		x											
Bran, sorghum		x		x	x		x		x											
Bran, wheat		x		x	x		x		x											
Brazil nuts, shelled		x		x	x		x					x								
Bread		x		x	x		x		x											
Broad beans, horse beans, dry		x	x		x		x			x										
Buckwheat		x		x		x	x		x											
Bulgur		x		x	x		x		x											
Butter of karite nuts		x		x	x		x					x								
Cabbages and other brassicas		x	x			x	x			x										
Cake, copra	x			x	x			x												x
Cake, cottonseed	x			x	x			x												x
Cake, groundnuts		x		x	x			x												x

Table A5.5: Continued

	Plantation	Non-plantation	Perishable	Non-perishable	Processed	Unprocessed	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, cocoa, tea	Spices	Oil	Other food crops	Fibres	Rubber	Tobacco	Other non-food
Cake, hempseed	x			x	x			x												x
Cake, kapok		x		x	x			x												x
Cake, linseed		x		x	x			x												x
Cake, maize		x		x	x			x												x
Cake, mustard		x		x	x			x												x
Cake, palm kernel	x			x	x			x												x
Cake, rapeseed		x		x	x			x												x
Cake, rice bran	x			x	x			x												x
Cake, safflower		x		x	x			x												x
Cake, sesame seed		x		x	x			x												x
Cake, soybeans		x		x	x			x												x
Cake, sunflower		x		x	x			x												x
Canary seed		x		x		x	x		x											
Cane tops	x			x		x		x												x
Carrots and turnips		x	x			x	x			x										
Cashew nuts, shelled	x			x	x		x					x								
Cashew nuts, with shell	x			x		x	x					x								
Cashew apple	x		x			x	x				x									
Cassava	x		x			x	x			x										
Cassava dried	x		x		x		x			x										
Cauliflowers and broccoli		x	x			x	x			x										
Cereal preparations, nes		x		x	x		x		x											
Cereals		x		x		x	x		x											
Cereals and Preparations		x		x	x		x		x											
Cereals, breakfast		x		x	x		x		x											
Cherries		x	x			x	x				x									
Cherries, sour		x	x		x		x				x									
Chestnut		x		x		x	x					x								
Chick peas		x	x			x	x			x										
Chillies and peppers, dry		x	x		x		x			x										
Chillies and peppers, green		x	x			x	x			x										
Chocolate products nes	x			x	x		x						x							
Cider *etc.*		x		x	x		x				x									
Cigarettes	x			x	x			x											x	
Cigars, cheroots	x			x	x			x											x	
Cinnamon (canella)		x		x		x	x							x						

Table A5.5: Continued

	Plantation	Non-plantation	Perishable	Non-perishable	Processed	Unprocessed	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, cocoa, tea	Spices	Oil	Other food crops	Fibres	Rubber	Tobacco	Other non-food
Cloves		x		x		x	x							x						
Cocoa, beans	x			x		x	x						x							
Cocoa, butter	x			x	x		x						x							
Cocoa, paste	x			x	x		x						x							
Cocoa, powder & cake	x			x	x		x						x							
Coconuts	x			x		x	x													
Coconuts, desiccated	x			x	x		x													
Coffee, extracts	x			x	x		x						x							
Coffee, green	x			x		x	x						x							
Coffee, husks and skins	x			x	x		x						x							
Coffee, roasted	x			x	x		x						x							
Coffee, substitutes containing coffee	x			x	x		x						x							
Copra		x		x		x	x													
Cotton lint	x			x	x			x									x			
Cotton linter	x			x	x			x									x			
Cotton waste	x			x	x			x									x			
Cotton, carded, combed	x			x	x			x									x			
Cottonseed	x			x		x	x													
Cranberries		x	x			x	x				x									
Cucumbers and gherkins		x	x			x	x			x										
Currants		x	x			x	x				x									
Dates		x	x			x	x				x									
Dregs from brewing, distillation		x		x	x		x		x											
Eggplants (aubergines)		x	x			x	x			x										
Feed and meal, gluten		x		x	x			x												x
Feed minerals		x		x	x			x												x
Feed supplements		x		x	x			x												x
Feed, compound, nes		x		x	x			x												x
Feed, pulp of fruit		x		x	x			x												x
Feed, vegetable products nes		x		x	x			x												x
Figs		x	x			x	x				x									
Figs dried		x	x		x		x				x									
Fixed Vegetable Oils		x	x		x		x													
Flax fibre and tow		x		x	x			x									x			
Flax fibre raw		x		x		x		x									x			
Flax tow waste		x		x	x			x									x			
Flour, cereals		x		x	x		x		x											

Table A5.5: Continued

	Plantation	Non-plantation	Perishable	Non-perishable	Processed	Unprocessed	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, cocoa, tea	Spices	Oil	Other food crops	Fibres	Rubber	Tobacco	Other non-food
Flour, fonio		x		x	x		x		x											
Flour, maize		x		x	x		x		x											
Flour, mixed grain		x		x	x		x		x											
Flour, mustard		x		x	x		x		x											
Flour, potatoes	x			x	x		x		x											
Flour, pulses		x	x		x		x			x										
Flour, roots and tubers nes		x	x		x		x			x										
Flour, wheat		x		x	x		x		x											
Fodder & Feeding stuff		x		x	x			x												x
Fonio		x		x		x	x		x											
Food prep nes		x	x		x		x								x	x				
Food wastes		x	x		x		x								x	x				
Forage and silage, clover		x		x	x			x												x
Forage and silage, grasses nes		x		x	x			x												x
Forage and silage, legumes		x		x	x			x												x
Forage products		x		x	x			x												x
Fructose and syrup, other		x	x		x		x				x									
Fruit, cooked, homogenized preparations		x	x		x		x				x									
Fruit, dried nes		x	x		x		x				x									
Fruit, fresh nes		x	x			x	x				x									
Fruit, prepared nes		x	x		x		x				x									
Fruit, tropical fresh nes		x	x			x	x				x									
Garlic		x	x			x	x			x										
Germ, maize		x		x	x		x		x											
Ginger		x		x		x	x							x						
Glucose and dextrose		x		x	x		x		x											
Gooseberries		x	x			x	x				x									
Grain, mixed		x		x		x	x		x											
Grapefruit (incl. pomelos)	x		x			x	x				x									
Grapes		x	x			x	x				x									
Groundnuts Total Shelled		x		x	x		x													
Hay (clover, lucerne,etc)		x		x		x		x												x
Hay (unspecified)		x		x		x		x												x
Hazelnuts, shelled		x		x	x		x					x								
Hops		x		x		x	x								x	x				
Juice, citrus, conc.	x		x		x		x				x									

Table A5.5: Continued

	Plantation	Non-plantation	Perishable	Non-perishable	Processed	Unprocessed	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, cocoa, tea	Spices	Oil	Other food crops	Fibres	Rubber	Tobacco	Other non-food
Juice, citrus, single strength	x		x		x		x				x									
Juice, fruit nes		x	x		x		x				x									
Juice, grape		x	x		x		x				x									
Juice, grapefruit	x		x		x		x				x									
Juice, grapefruit, conc.	x		x		x		x				x									
Juice, lemon, conc.	x		x		x		x				x									
Juice, orange, conc.	x		x		x		x				x									
Juice, orange, single strength	x		x		x		x				x									
Juice, pineapple	x		x		x		x				x									
Juice, pineapple, conc.	x		x		x		x				x									
Juice, plum, conc.		x	x		x		x				x									
Juice, plum, single strength		x	x		x		x				x									
Juice, tomato	x		x		x		x			x										
Jute	x			x		x		x									x			
Kapok fibre		x		x		x		x									x			
Kapok seed in shell		x		x		x	x													
Kapok seed shelled		x		x	x		x													
Kiwi fruit		x	x			x	x				x									
Kola nuts		x		x		x	x					x								
Leeks, other alliaceous vegetables		x	x			x	x			x										
Lemons and limes	x		x			x	x				x									
Lentils		x	x			x	x			x										
Lettuce and chicory		x	x			x	x			x										
Linseed		x		x		x	x													
Macaroni		x		x	x		x		x											
Maize		x		x		x	x		x											
Maize, green		x		x		x	x		x											
Malt		x		x	x		x		x											
Mangoes, mangosteens, guavas		x	x			x	x				x									
Manila fibre (abaca)		x		x		x		x									x			
Maple sugar and syrups		x		x	x		x								x	x				
Margarine, liquid		x	x		x		x			x										
Margarine, short		x	x		x		x			x										
Maté		x		x		x	x						x							
Melons, other (incl. cantaloupes)		x	x			x	x				x									
Millet		x		x		x	x		x											

Table A5.5: Continued

	Plantation	Non-plantation	Perishable	Non-perishable	Processed	Unprocessed	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, cocoa, tea	Spices	Oil	Other food crops	Fibres	Rubber	Tobacco	Other non-food
Miscellaneous Food		x	x		x		x								x	x				
Mixes and doughs		x		x	x		x		x											
Molasses		x		x	x		x			x										
Mushrooms and truffles		x	x			x	x			x										
Mushrooms, canned		x	x		x		x			x										
Mustard seed		x		x		x	x													
Natural Rubber	x			x		x		x										x		
Nutmeg, mace and cardamoms		x		x		x	x							x						
Nuts, nes		x		x		x	x					x								
Nuts, prepared (exc. groundnuts)		x		x	x		x					x								
Oats		x		x		x	x		x											
Oats rolled		x		x	x		x		x											
Oil, boiled *etc.*		x		x	x		x													
Oil, castor beans		x		x	x		x													
Oil, citronella		x		x	x		x													
Oil, coconut (copra)	x			x	x		x													
Oil, cottonseed	x			x	x		x													
Oil, essential nes		x		x	x		x													
Oil, groundnut		x		x	x		x													
Oil, kapok		x		x	x		x													
Oil, linseed		x		x	x		x													
Oil, maize		x		x	x		x													
Oil, olive residues	x			x	x		x													
Oil, olive, virgin	x			x	x		x													
Oil, palm	x			x	x		x													
Oil, palm kernel	x			x	x		x													
Oil, poppy		x		x	x		x													
Oil, rapeseed		x		x	x		x													
Oil, rice bran	x			x	x		x													
Oil, safflower		x		x	x		x													
Oil, sesame		x		x	x		x													
Oil, soybean		x		x	x		x													
Oil, sunflower		x		x	x		x													
Oil, vegetable origin nes		x		x	x		x													
Oilseed Cake Meal		x		x	x		x													
Oilseed Cake nes		x		x	x		x													
Oilseeds		x		x		x	x													
Oilseeds nes		x		x		x	x													
Olives	x			x		x	x													

Table A5.5: Continued

	Plantation	Non-plantation	Perishable	Non-perishable	Processed	Unprocessed	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, cocoa, tea	Spices	Oil	Other food crops	Fibres	Rubber	Tobacco	Other non-food
Olives preserved	x			x	x		x													
Onions, dry		x	x		x		x			x										
Onions, shallots, green		x	x			x	x			x										
Oranges	x		x			x	x				x									
Other Citrus Fruit	x		x			x	x				x									
Papayas		x	x			x	x				x									
Pastry		x		x	x		x		x											
Peaches and nectarines		x	x			x	x				x									
Peanut butter		x		x	x		x					x								
Pears		x	x			x	x				x									
Peas, dry		x	x		x		x			x										
Peas, green		x	x			x	x			x										
Pepper (piper spp.)	x			x		x	x							x						
Peppermint		x		x		x	x							x						
Persimmons		x	x			x	x				x									
Pineapples	x		x			x	x				x									
Pineapples canned	x		x		x		x				x									
Pistachios		x		x		x	x					x								
Plantains		x	x			x	x				x									
Plums and sloes		x	x			x	x				x									
Plums dried (prunes)		x	x		x		x				x									
Poppy seed		x		x		x	x													
Potato offals	x			x	x		x			x										
Potatoes	x			x		x	x			x										
Potatoes, frozen	x			x	x		x			x										
Pumpkins, squash and gourds		x	x			x	x			x										
Pyrethrum, dried		x		x	x			x												x
Pyrethrum, extraction		x		x	x			x												x
Quinces		x	x			x	x				x									
Raisins		x	x		x		x				x									
Raspberries		x		x		x	x													
Rapeseed		x	x			x	x				x									
Rice - total (Rice milled equivalent)	x			x		x	x		x											
Roots and tubers, nes		x	x			x	x			x										
Rubber natural dry	x			x	x			x										x		
Rubber, natural	x			x		x		x										x		
Rye		x		x		x	x		x											
Sesame seed		x		x		x	x													

Table A5.5: Continued

	Plantation	Non-plantation	Perishable	Non-perishable	Processed	Unprocessed	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, cocoa, tea	Spices	Oil	Other food crops	Fibres	Rubber	Tobacco	Other non-food
Sorghum		x		x		x	x		x											
Soya curd		x	x		x		x			x										
Soya paste		x	x		x		x			x										
Soya sauce		x	x		x		x			x										
Soybeans		x	x			x	x			x										
Spices, nes		x		x		x	x							x						
Spinach		x	x			x	x			x										
Starch, cassava	x		x		x		x			x										
Straw husks		x		x		x		x												x
Strawberries	x		x			x	x				x									
Sugar beet		x	x			x	x			x										
Sugar confectionery		x	x		x		x			x										
Sugar crops, nes		x	x			x	x			x										
Sugar non-centrifugal		x	x		x		x			x										
Sugar Raw Centrifugal		x	x		x		x			x										
Sugar refined		x	x		x		x			x										
Sugar, nes		x	x		x		x			x										
Sunflower seed		x		x		x	x													
Sweet corn frozen		x	x		x		x			x										
Sweet corn prep or preserved		x	x		x		x			x										
Sweet potatoes		x	x			x	x			x										
Tangerines, mandarins, clementines, satsumas	x		x			x	x				x									
Tea	x			x		x	x						x							
Tea, mate extracts	x			x	x		x						x							
Textile Fibres		x		x	x			x									x			
Tobacco	x			x		x		x											x	
Tobacco products nes	x			x	x			x											x	
Tobacco, unmanufactured	x			x		x		x											x	
Tomatoes	x		x			x	x			x										
Tomatoes, paste	x		x		x		x			x										
Tomatoes, peeled	x		x		x		x			x										
Triticale		x		x		x	x		x											
Turnips for fodder		x		x		x		x												x
Vanilla		x		x		x	x							x						
Vegetable tallow		x	x		x		x			x										
Vegetables in vinegar		x	x		x		x			x										
Vegetables, canned nes		x	x		x		x			x										
Vegetables, dehydrated		x	x		x		x			x										
Vegetables, dried nes		x	x		x		x			x										

Table A5.5: Continued

	Plantation	Non-plantation	Perishable	Non-perishable	Processed	Unprocessed	Food	Non-food	Cereals	Vegetables	Fruits	Nuts	Coffee, cocoa, tea	Spices	Oil	Other food crops	Fibres	Rubber	Tobacco	Other non-food
Vegetables, fresh nes		x	x			x	x			x										
Vegetables, fresh or dried products nes		x	x		x		x			x										
Vegetables, frozen		x	x		x		x			x										
Vegetables, homogenized preparations		x	x		x		x			x										
Vegetables, preserved nes		x	x		x		x			x										
Vegetables, preserved, frozen		x	x		x		x			x										
Vegetables, temporarily preserved		x	x		x		x			x										
Vermouths & similar		x	x		x		x				x									
Vetches		x	x			x	x			x										
Vitamins		x	x		x		x								x	x				
Wafers		x		x	x		x		x											
Walnuts, shelled		x		x	x		x					x								
Walnuts, with shell		x		x		x	x					x								
Watermelons		x	x			x	x				x									
Waxes, vegetable		x	x		x			x												x
Wheat		x		x		x	x		x											
Wine		x	x		x		x				x									

Table A5.6: Unit root test results

	AR	Model with	ADF		ADF-GLS	LLC
		Constant	IPS t-score	Inv. Normal z-score	Inv. Normal z-score	LLH z-score
Dependent variable:						
GrVol	1		-6.349***	-35.373***	-45.336***	-45.580***
Independent variables						
Control variables						
lnGDPPC	0	x	-5.977***	-33.855***	-42.545***	-44.373***
Democracy	0	x	-7.001***	-38.632***	-45.471***	-54.896***
Openness	0	x	-6.249***	-35.062***	-41.536***	-39.320***
Schooling	0	x	-5.578***	-31.564***	-39.685***	-37.115***
INFL	0	x	-6.279***	-35.161***	-46.025***	-42.786***
WAR	0	x	-6.477***	-36.049***	-45.886***	-46.546***
AgShGDP	0	x	-6.866***	-38.072***	-48.210***	-51.128***
CrShGDP	0	x	-6.861***	-37.977***	-48.857***	-53.504***
AgExShGDP	0	x	-5.352***	-30.280***	-36.367***	-37.840***
CrExShGDP	0	x	-5.094***	-28.754***	-33.900***	-35.388***
Explanatory variables						
ShPLANT(e)	0	x	-4.744***	-26.395***	-34.187***	-31.519***
ShProcPLANT(e)	0	x	-4.989***	-28.013***	-35.232***	-32.198***
ShUnprocPLANT(e)	0	x	-5.243***	-29.318***	-37.563***	-37.018***
ShNONPLANT(e)	0	x	-6.695***	-37.140***	-42.087***	-48.386***
ShProcNONPLANT(e)	0	x	-6.664***	-37.043***	-43.212***	-48.525***
ShUnprocNONPLANT(e)	0	x	-6.186***	-34.403***	-40.789***	-42.896***

Table A5.6: Continued

	AR	Model with	ADF		ADF-GLS	LLC
		Constant	IPS t-score	Inv. Normal z-score	Inv. Normal z-score	LLH z-score
Independent variables						
Explanatory variables						
ShPERISH(e)	0	x	-6.805***	-37.740***	-43.403***	-50.588***
ShProcPERISH	0	x	-7.083***	-38.687***	-47.821***	-51.010***
ShUnprocPERISH(e)	0	x	-5.916***	-32.845***	-38.320***	-41.314***
ShNONPERISH(e)	0	x	-5.660***	-31.777***	-38.391***	-39.973***
ShProcNONPERISH(e)	0	x	-5.855***	-32.812***	-37.815***	-41.320***
ShUnprocNONPERISH(e)	0	x	-5.935***	-33.542***	-42.083***	-43.290***
ShPROC(e)	0	x	-6.007***	-33.762***	-38.914***	-43.302***
ShUNPROC(e)	0	x	-5.208***	-29.190***	-36.213***	-36.544***
InvHHProduct(e)	0	x	-6.137***	-34.513***	-43.952***	-43.773***
InvHHGroup(e)	0	x	-6.265***	-35.267***	-42.575***	-42.762***
InvHHPlant(e)	0	x	-5.895***	-33.055***	-40.525***	-42.941***
InvHHPerish(e)	0	x	-6.765***	-37.514***	-47.460***	-49.798***
InvHHProc(e)	0	x	-5.790***	-32.647***	-39.393***	-39.153***
InvHHFood(e)	0	x	-2.639***	-9.767***	-11.415***	-8.508***
FoodExShGDP	0	x	-2.636***	-9.956***	-11.726***	-11.392***
NonfoodExShGDP	0	x	-2.783***	-8.785***	-12.115***	-9.160***
Cereals(e)	0	x				-5.011***
Vegetables(e)	0	x				-7.838***
Fruits(e)	0	x	-2.589***	-8.964***	--9.328***	-4.651***
Nuts(e)	0	x				-6.040***
Coffee, cocoa, tea(e)	0	x				-11.209***
Spices(e)	0	x				-14.534***
Oil(e)	0	x				-11.693***
Other food crops(e)	0	x				-5.763***
Fibres(e)	0	x				-5.114***
Rubber(e)	0	x				-5.959***
Tobacco(e)	0	x				-5.719***
Other non-food crops(e)	0	x				-11.110***

Source: Author's own calculations

Table A5.7: Correlation matrix

	GrVol	lnGDPPC	Democracy	Openness	Schooling	INFL	WAR	AgShGDP	CrShGDP	AgExShGDP
GrVol	1.000									
lnGDPPC	-0.023	1.000								
Democracy	-0.122	0.375	1.000							
Openness	0.029	0.442	0.242	1.000						
Schooling	-0.059	0.517	0.269	0.306	1.000					
INFL	0.061	-0.025	0.006	-0.104	-0.025	1.000				
WAR	-0.024	-0.067	0.096	-0.168	-0.047	0.026	1.000			
AgShGDP	0.086	-0.696	-0.286	-0.404	-0.437	0.058	-0.034	1.000		
CrShGDP	0.034	-0.555	-0.270	-0.285	-0.377	0.043	0.042	0.631	1.000	
AgExShGDP	0.009	0.057	0.070	0.367	-0.007	-0.039	-0.087	0.158	0.251	1.000

Table A5.7: Continued

	CrExShGDP	ShPLANT(e)	ShProcPLANT(e)	ShUnprocPLANT(e)	ShNONPLANT(e)	ShProcNONPLANT(e)	ShUnprocNONPLANT(e)
GrVol	-0.002	-0.011	0.004	-0.013	0.010	0.022	-0.031
lnGDPPC	0.026	-0.046	-0.006	-0.048	0.093	0.119	0.040
Democracy	0.071	-0.007	0.027	-0.016	0.118	0.118	0.047
Openness	0.338	0.181	0.179	0.140	0.313	0.343	0.044
Schooling	-0.024	-0.007	-0.178	0.049	-0.028	-0.028	-0.014
INFL	-0.051	-0.024	-0.118	0.012	-0.051	-0.051	-0.021
WAR	-0.072	-0.005	0.080	-0.030	-0.107	-0.102	-0.059
AgShGDP	0.146	0.241	0.076	0.238	-0.052	-0.075	0.047
CrShGDP	0.239	0.285	0.102	0.278	0.041	0.026	0.059
AgExShGDP	0.932	0.763	0.346	0.721	0.559	0.580	0.173
CrExShGDP	1.000	0.763	0.461	0.684	0.664	0.643	0.341
ShPLANT(e)		1.000	0.417	0.967	0.023	0.031	-0.013
ShProcPLANT(e)			1.000	0.135	0.230	0.251	0.034
ShUnprocPLANT(e)				1.000	-0.048	0.047	-0.025
ShNONPLANT(e)					1.000	0.959	0.542
ShProcNONPLANT(e)						1.000	0.281
ShUnprocNONPLANT(e)							1.000

Table A5.7: Continued

ShPERISH(e)	ShProcPERISH(e)	ShUnprocPERISH(e)	ShNONPERISH(e)	
-0.014	-0.005	-0.025	0.008	GrVol
0.287	0.225	0.218	-0.173	lnGDPPC
0.228	0.168	0.197	-0.075	Democracy
0.406	0.384	0.164	0.130	Openness
0.169	0.118	0.159	-0.150	Schooling
-0.044	-0.032	-0.038	-0.032	INFL
-0.124	-0.097	-0.095	-0.001	WAR
-0.190	-0.161	-0.117	0.318	AgPrShGDP
-0.026	-0.030	0.001	0.316	CrPrShGDP
0.626	0.569	0.305	0.712	AgExShGDP
0.595	0.552	0.263	0.819	CrExShGDP
0.139	0.031	0.276	0.849	ShPLANT(e)
0.161	0.165	0.038	0.457	ShProcPLANT(e)
0.100	-0.019	0.289	0.779	ShUnprocPLANT(e)
0.759	0.818	0.088	0.284	ShNONPLANT(e)
0.823	0.909	0.046	0.212	ShProcNONPLANT(e)
0.129	0.073	0.160	0.332	ShUnprocNONPLANT(e)
1.000	0.915	0.472	0.025	ShPERISH(e)
	1.000	0.076	0.032	ShProcPERISH(e)
		1.000	-0.010	ShUnprocPERISH(e)
			1.000	ShNONPERISH(e)

Table A5.7: Continued

ShProcNONPERISH(e)	ShUnprocNONPERISH(e)	ShPROC(e)	
0.043	-0.014	0.020	GrVol
-0.134	-0.136	0.101	lnGDPPC
-0.035	-0.071	0.111	Democracy
0.106	0.099	0.355	Openness
-0.319	-0.009	-0.083	Schooling
-0.108	0.020	-0.084	INFL
0.025	-0.015	-0.061	WAR
0.156	0.298	-0.040	AgPrShGDP
0.146	0.301	0.057	CrPrShGDP
0.321	0.682	0.616	AgExShGDP
0.514	0.707	0.708	CrExShGDP
0.259	0.881	0.166	ShPLANT(e)
0.772	0.134	0.551	ShProcPLANT(e)
0.035	0.917	0.005	ShUnprocPLANT(e)
0.495	0.075	0.904	ShNONPLANT(e)
0.443	0.016	0.946	ShProcNONPLANT(e)
0.359	0.205	0.253	ShUnprocNONPLANT(e)
0.101	-0.024	0.763	ShPERISH(e)
0.120	-0.025	0.839	ShProcPERISH(e)
-0.013	-0.005	0.052	ShUnprocPERISH(e)
0.567	0.897	0.336	ShNONPERISH(e)
1.000	0.143	0.641	ShProcNONPERISH(e)
	1.000	0.059	ShUnprocNONPERISH(e)
		1.000	ShPROC(e)

Table A5.7: Continued

ShUNPROC(e)	InvHHProduct(e)	InvHHGroup(e)	
-0.021	-0.191	-0.218	GrVol
-0.057	0.129	0.251	lnGDPPC
-0.003	0.108	0.179	Democracy
0.147	-0.073	-0.010	Openness
0.044	-0.018	0.177	Schooling
0.006	-0.059	-0.003	INFL
-0.045	0.055	0.048	WAR
0.243	-0.303	-0.399	AgPrShGDP
0.285	-0.218	-0.247	CrPrShGDP
0.746	-0.222	-0.209	AgExShGDP
0.756	-0.123	-0.171	CrExShGDP
0.924	-0.148	-0.174	ShPLANT(e)
0.140	0.099	-0.062	ShProcPLANT(e)
0.963	-0.193	-0.170	ShUnprocPLANT(e)
0.100	-0.019	-0.063	ShNONPLANT(e)
0.030	-0.079	-0.104	ShProcNONPLANT(e)
0.247	0.168	0.094	ShUnprocNONPLANT(e)
0.132	-0.137	-0.059	ShPERISH(e)
0.001	-0.137	-0.075	ShProcPERISH(e)
0.324	-0.039	0.019	ShUnprocPERISH(e)
0.845	-0.056	-0.171	ShNONPERISH(e)
0.131	0.129	-0.095	ShProcNONPERISH(e)
0.945	-0.137	-0.154	ShUnprocNONPERISH(e)
0.073	-0.035	-0.111	ShPROC(e)
1.000	-0.142	-0.139	ShUNPROC(e)
	1.000	0.848	InvHHProduct(e)
		1.000	InvHHGroup(e)

Table A5.7: Continued

InvHHPlant(e)	InvHHPerish(e)	InvHHProcess(e)	
-0.119	-0.124	-0.153	GrVol
-0.001	0.454	0.079	lnGDPPC
-0.035	0.249	0.040	Democracy
-0.134	0.209	-0.159	Openness
-0.124	0.285	0.016	Schooling
-0.097	-0.032	-0.002	INFL
0.127	-0.016	0.055	WAR
-0.135	-0.498	-0.197	AgPrShGDP
-0.046	-0.327	-0.137	CrPrShGDP
-0.160	-0.090	-0.180	AgExShGDP
-0.102	-0.055	-0.108	CrExShGDP
-0.075	-0.158	-0.084	ShPLANT(e)
0.301	-0.072	-0.002	ShProcPLANT(e)
-0.178	-0.149	-0.091	ShUnprocPLANT(e)
-0.071	0.099	-0.069	ShNONPLANT(e)
-0.067	0.085	-0.155	ShProcNONPLANT(e)
-0.043	0.080	0.225	ShUnprocNONPLANT(e)
-0.099	0.145	-0.146	ShPERISH(e)
-0.093	0.107	-0.164	ShProcPERISH(e)
-0.040	0.126	-0.003	ShUnprocPERISH(e)
-0.056	-0.172	-0.029	ShNONPERISH(e)
0.210	-0.060	-0.013	ShProcNONPERISH(e)
-0.180	-0.174	-0.028	ShUnprocNONPERISH(e)
0.043	0.050	-0.134	ShPROC(e)
-0.184	-0.123	-0.027	ShUNPROC(e)
0.563	0.534	0.706	InvHHProduct(e)
0.484	0.615	0.678	InvHHGroup(e)
1.000	0.235	0.453	InvHHPlant(e)
	1.000	0.334	InvHHPerish(e)
		1.000	InvHHProcess(e)

Table A5.7: Continued

InvHHFood(e)	FoodExShGDP	NonfoodExShGDP	
-0.079	-0.032	0.052	GrVol
-0.139	0.137	-0.232	lnGDPPC
-0.056	0.099	-0.044	Democracy
-0.115	0.380	-0.015	Openness
-0.162	0.059	-0.182	Schooling
0.019	-0.031	-0.054	INFL
0.082	-0.096	0.034	WAR
-0.032	0.071	0.194	AgPrShGDP
-0.005	0.195	0.146	CrPrShGDP
-0.171	0.920	0.232	AgExShGDP
-0.075	0.905	0.423	CrExShGDP
-0.017	0.646	0.418	ShPLANT(e)
0.188	0.218	0.618	ShProcPLANT(e)
-0.079	0.634	0.258	ShUnprocPLANT(e)
-0.096	0.653	0.171	ShNONPLANT(e)
-0.122	0.639	0.152	ShProcNONPLANT(e)
0.038	0.316	0.129	ShUnprocNONPLANT(e)
-0.274	0.684	-0.059	ShPERISH(e)
-0.224	0.628	-0.039	ShProcPERISH(e)
-0.186	0.319	-0.060	ShUnprocPERISH(e)
0.103	0.637	0.568	ShNONPERISH(e)
0.239	0.252	0.671	ShProcNONPERISH(e)
-0.005	0.630	0.322	ShUnprocNONPERISH(e)
-0.041	0.624	0.339	ShPROC(e)
-0.067	0.702	0.284	ShUNPROC(e)
0.516	-0.175	0.083	InvHHProduct(e)
0.531	-0.150	-0.083	InvHHGroup(e)
0.351	-0.205	0.198	InvHHPlant(e)
0.035	0.035	-0.202	InvHHPerish(e)
0.434	-0.092	-0.056	InvHHProcess(e)
1.000	-0.234	0.323	InvHHFood(e)
	1.000	-0.002	FoodExShGDP
		1.000	NonfoodExShGDP

Table A5.7: Continued

Cereals(e)	Vegetables(e)	Fruits(e)	Nuts(e)	
-0.041	0.004	-0.029	-0.004	GrVol
0.033	0.185	0.256	-0.075	lnGDPPC
0.034	0.147	0.215	-0.073	Democracy
0.131	0.322	0.214	-0.071	Openness
0.023	0.137	0.172	-0.017	Schooling
-0.019	-0.007	-0.055	0.039	INFL
-0.015	-0.105	-0.099	-0.017	WAR
-0.023	-0.127	-0.139	0.153	AgPrShGDP
0.026	-0.009	-0.008	0.024	CrPrShGDP
0.204	0.544	0.359	0.045	AgExShGDP
0.342	0.507	0.274	0.032	CrExShGDP
0.032	-0.022	0.284	0.088	ShPLANT(e)
-0.003	0.033	0.088	-0.020	ShProcPLANT(e)
0.036	-0.034	0.281	0.103	ShUnprocPLANT(e)
0.491	0.809	0.095	-0.053	ShNONPLANT(e)
0.389	0.867	0.123	-0.049	ShProcNONPLANT(e)
0.508	0.168	-0.042	-0.036	ShUnprocNONPLANT(e)
0.224	0.857	0.579	-0.050	ShPERISH(e)
0.265	0.940	0.233	-0.042	ShProcPERISH(e)
-0.026	0.064	0.922	-0.033	ShUnprocPERISH(e)
0.265	0.018	-0.073	0.075	ShNONPERISH(e)
0.236	0.057	-0.083	-0.030	ShProcNONPERISH(e)
0.192	-0.009	-0.043	0.106	ShUnprocNONPERISH(e)
0.337	0.758	0.132	-0.049	ShPROC(e)
0.173	0.014	0.262	0.090	ShUNPROC(e)
0.125	-0.093	-0.058	-0.180	InvHHProduct(e)
0.057	-0.098	-0.003	-0.105	InvHHGroup(e)
0.076	-0.130	-0.007	-0.085	InvHHPlant(e)
0.140	0.077	0.090	-0.106	InvHHPerish(e)
0.201	-0.146	-0.050	-0.081	InvHHProcess(e)
-0.027	-0.223	-0.254	-0.030	InvHHFood(e)
0.367	0.586	0.357	0.043	FoodExShGDP
0.023	-0.057	-0.115	-0.018	NonfoodExShGDP
1.000	0.318	-0.037	-0.031	Cereals(e)
	1.000	0.160	-0.037	Vegetables(e)
		1.000	-0.034	Fruits(e)
			1.000	Nuts(e)

Table A5.7: Continued

Coffee, cocoa, tea(e)	Spices(e)	Oil(e)	Other food crops(e)	
-0.012	-0.035	0.005	-0.047	GrVol
-0.055	-0.095	0.012	0.111	lnGDPPC
-0.110	-0.018	0.125	-0.009	Democracy
0.107	-0.034	0.143	0.159	Openness
-0.022	0.047	-0.174	0.040	Schooling
0.018	-0.017	-0.063	-0.011	INFL
-0.003	-0.034	-0.009	-0.028	WAR
0.250	0.107	0.019	-0.131	AgPrShGDP
0.283	0.039	0.035	-0.067	CrPrShGDP
0.631	0.002	0.167	0.178	AgExShGDP
0.524	0.003	0.347	0.202	CrExShGDP
0.797	-0.045	0.120	0.025	ShPLANT(e)
0.086	-0.058	0.391	0.044	ShProcPLANT(e)
0.842	-0.030	0.005	0.014	ShUnprocPLANT(e)
-0.112	0.056	0.398	0.283	ShNONPLANT(e)
-0.102	-0.045	0.312	0.330	ShProcNONPLANT(e)
-0.077	0.324	0.423	-0.019	ShUnprocNONPLANT(e)
-0.064	-0.059	0.133	0.373	ShPERISH(e)
-0.080	-0.046	0.109	0.382	ShProcPERISH(e)
0.016	-0.046	0.090	0.088	ShUnprocPERISH(e)
0.697	0.046	0.336	-0.015	ShNONPERISH(e)
0.005	-0.041	0.575	0.007	ShProcNONPERISH(e)
0.835	0.078	0.095	-0.022	ShUnprocNONPERISH(e)
-0.059	-0.058	0.402	0.298	ShPROC(e)
0.795	0.058	0.119	0.012	ShUNPROC(e)
-0.207	-0.026	0.163	0.062	InvHHProduct(e)
-0.176	-0.006	0.002	0.085	InvHHGroup(e)
-0.195	-0.109	-0.040	-0.020	InvHHPlant(e)
-0.164	-0.138	0.184	0.025	InvHHPerish(e)
-0.093	-0.008	0.045	-0.055	InvHHProcess(e)
-0.093	-0.117	0.109	-0.065	InvHHFood(e)
0.586	0.027	0.279	0.233	FoodExShGDP
-0.017	-0.050	0.221	-0.020	NonfoodExShGDP
-0.079	-0.041	-0.023	0.013	Cereals(e)
-0.081	-0.039	-0.024	0.172	Vegetables(e)
0.013	-0.047	-0.010	0.128	Fruits(e)
-0.022	-0.017	-0.030	-0.014	Nuts(e)
1.000	-0.012	-0.021	-0.007	Coffee, cocoa, tea(e)
	1.000	0.036	-0.022	Spices(e)
		1.000	0.006	Oil(e)
			1.000	Other food crops(e)

Table A5.7: Continued

Fibres(e)	Rubber(e)	Tobacco(e)	Other non-food crops(e)	
0.068	-0.036	0.031	0.033	GrVol
-0.255	0.070	-0.147	-0.048	lnGDPPC
-0.170	0.116	0.015	0.035	Democracy
-0.075	0.135	-0.045	0.027	Openness
-0.327	0.007	0.059	-0.140	Schooling
-0.076	-0.042	0.025	-0.041	INFL
0.016	0.138	-0.050	-0.027	WAR
0.247	-0.036	0.080	0.012	AgPrShGDP
0.171	0.008	0.044	0.053	CrPrShGDP
0.121	0.152	0.119	0.118	AgExShGDP
0.191	0.272	0.242	0.263	CrExShGDP
0.115	0.319	0.326	-0.020	ShPLANT(e)
0.553	0.620	-0.018	0.105	ShProcPLANT(e)
-0.051	0.149	0.361	-0.055	ShUnprocPLANT(e)
0.162	0.051	-0.003	0.429	ShNONPLANT(e)
0.159	0.054	-0.013	0.315	ShProcNONPLANT(e)
0.075	0.013	0.028	0.515	ShUnprocNONPLANT(e)
-0.107	0.051	-0.034	0.082	ShPERISH(e)
-0.099	0.075	-0.022	0.050	ShProcPERISH(e)
-0.048	-0.038	-0.037	0.094	ShUnprocPERISH(e)
0.314	0.302	0.325	0.268	ShNONPERISH(e)
0.728	0.358	-0.001	0.490	ShProcNONPERISH(e)
-0.015	0.170	0.391	0.058	ShUnprocNONPERISH(e)
0.324	0.254	-0.016	0.311	ShPROC(e)
-0.030	0.147	0.357	0.086	ShUNPROC(e)
-0.003	0.074	0.055	0.158	InvHHProduct(e)
-0.170	0.046	-0.004	0.071	InvHHGroup(e)
0.307	0.034	-0.000	-0.104	InvHHPlant(e)
-0.277	0.030	-0.081	0.115	InvHHPerish(e)
-0.146	0.098	-0.0152	0.033	InvHHProcess(e)
0.202	0.189	0.144	0.193	InvHHFood(e)
-0.085	0.119	-0.035	0.204	FoodExShGDP
0.631	0.385	0.643	0.183	NonfoodExShGDP
-0.038	0.060	0.025	0.049	Cereals(e)
-0.071	-0.030	-0.003	0.023	Vegetables(e)
-0.104	-0.027	-0.047	-0.062	Fruits(e)
-0.004	-0.013	-0.010	-0.024	Nuts(e)
-0.020	0.027	-0.018	-0.035	Coffee, cocoa, tea(e)
-0.063	0.035	-0.032	-0.042	Spices(e)
0.030	0.331	-0.031	0.711	Oil(e)
-0.018	0.012	-0.022	-0.003	Other food crops(e)
1.000	-0.055	0.014	0.098	Fibres(e)
	1.000	-0.022	0.033	Rubber(e)
		1.000	-0.009	Tobacco(e)
			1.000	Other non-food crops(e)

Table A5.8: Variance inflation factor (VIF) for different regression combinations

GrVol_lag1	1.038	1.042	1.042	1.038	1.038	1.043	1.043
lnGDPPC	2.527	2.481	2.489	2.463	2.467	2.482	2.492
Democracy	1.235	1.231	1.232	1.238	1.240	1.239	1.241
Openness	1.361	1.479	1.513	1.497	1.527	1.629	1.670
Schooling	1.432	1.425	1.529	1.445	1.452	1.448	1.540
INFL	1.031	1.030	1.045	1.030	1.031	1.030	1.046
War	1.076	1.078	1.091	1.075	1.075	1.081	1.098
SDExchRate	1.106	1.086	1.086	1.072	1.131	1.087	1.148
AgShGDP	2.509	2.395	2.395	2.099	2.099	2.403	2.404
CrShGDP	1.921						
AgExShGDP							
CrExShGDP							
ShPLANT(e)		1.214				1.217	
ShProcPLANT(e)			1.168				1.212
ShUnprocPLANT(e)			1.195				1.216
ShNONPLANT(e)				1.149		1.151	
ShProcNONPLANT(e)					1.289		1.351
ShUnprocNONPLANT(e)					1.164		1.164

Minimum possible value = 1.0
Guidelines for VIF values:
VIF = 1 – no correlation, 1 < V <5 – moderately correlated, VIF > 5 collinearity problem
Source: Author's own calculations based on relevant data sources

Table A5.8: Continued

GrVol_lag1	1.039	1.039	1.040	1.042	1.042	1.044
lnGDPPC	2.490	2.506	2.463	2.464	2.491	2.507
Democracy	1.247	1.257	1.232	1.235	1.248	1.261
Openness	1.504	1.517	1.491	1.499	1.636	1.652
Schooling	1.421	1.424	1.426	1.610	1.426	1.612
INFL	1.030	1.031	1.030	1.045	1.030	1.047
War	1.077	1.080	1.077	1.078	1.083	1.088
SDExchRate	1.072	1.078	1.074	1.076	1.075	1.085
AgShGDP	2.103	2.105	2.343	2.371	2.352	2.385
ShPERISH(e)	1.251				1.252	
ShProcPERISH(e)		1.198				1.216
ShUnprocPERISH(e)		1.092				1.092
ShNONPERISH(e)			1.234		1.234	
ShProcNONPERISH(e)				1.222		1.235
ShUnprocNONPERISH(e)				1.215		1.222

Minimum possible value = 1.0
Guidelines for VIF values:
VIF = 1 – no correlation, 1 < V <5 – moderately correlated, VIF > 5 collinearity problem
Source: Author's own calculations based on relevant data sources

Table A5.8: Continued

GrVol_lag1	1.038	1.042	1.043
lnGDPPC	2.470	2.470	2.478
Democracy	1.235	1.230	1.235
Openness	1.573	1.438	1.647
Schooling	1.481	1.443	1.504
INFL	1.032	1.030	1.033
War	1.071	1.072	1.072
SDExchRate	1.073	1.073	1.075
AgShGDP	2.112	2.356	2.372
ShPROC(e)	1.228		1.228
ShUNPROC(e)		1.178	1.179

Minimum possible value = 1.0
Guidelines for VIF values:
VIF = 1 – no correlation, 1 < V <5 – moderately correlated, VIF > 5 collinearity problem
Source: Author's own calculations based on relevant data sources

Table A5.8: Continued

GrVol_lag1	1.077	1.083	1.053	1.052	1.060	1.045	1.087
lnGDPPC	2.467	2.463	2.463	2.507	2.463	2.521	2.586
Democracy	1.235	1.238	1.232	1.238	1.230	1.231	1.259
Openness	1.412	1.413	1.392	1.361	1.444	1.362	1.473
Schooling	1.446	1.422	1.458	1.422	1.422	1.441	1.594
INFL	1.032	1.030	1.041	1.030	1.030	1.030	1.055
War	1.072	1.071	1.078	1.072	1.071	1.072	1.087
SDExchRate	1.080	1.071	1.072	1.076	1.075	1.077	1.104
AgShGDP	2.347	2.356	2.187	2.258	2.210	2.176	2.395
InvHHProduct(e)	1.257						4.998
InvHHGroup(e)		1.314					6.008
InvHHPlant(e)			1.138				1.572
InvHHPerish(e)				1.415			2.365
InvHHProc(e)					1.152		2.232
InvHHFood(e)						1.095	1.922

Minimum possible value = 1.0
Guidelines for VIF values:
VIF = 1 – no correlation, 1 < V <5 – moderately correlated, VIF > 5 collinearity problem
Source: Author's own calculations based on relevant data sources

Table A5.8: Continued

GrVol_lag1	1.046	1.040	1.048	1.040	1.038	1.039	1.038
lnGDPPC	2.529	2.512	2.576	2.463	2.465	2.506	2.467
Democracy	1.231	1.233	1.233	1.230	1.235	1.251	1.233
Openness	1.624	1.376	1.643	1.387	1.457	1.372	1.360
Schooling	1.422	1.429	1.429	1.421	1.422	1.423	1.425
INFL	1.030	1.033	1.033	1.030	1.031	1.031	1.030
War	1.071	1.072	1.072	1.071	1.075	1.078	1.071
SDExchRate	1.072	1.074	1.076	1.071	1.071	1.073	1.071
AgShGDP	2.310	2.103	2.320	2.096	2.099	2.106	2.138
FoodExShGDP	1.303		1.304				
NonfoodExShGDP		1.094	1.095				
Cereals(e)				1.024			
Vegetables(e)					1.132		
Fruits(e)						1.121	
Nuts(e)							1.034

Minimum possible value = 1.0
Guidelines for VIF values:
VIF = 1 – no correlation, 1 < V <5 – moderately correlated, VIF > 5 collinearity problem
Source: Author's own calculations based on relevant data sources

Table A5.8: Continued

GrVol_lag1	1.043	1.040	1.038	1.041	1.040	1.039	1.039
lnGDPPC	2.507	2.475	2.468	2.464	2.466	2.467	2.567
Democracy	1.254	1.230	1.256	1.237	1.235	1.235	1.236
Openness	1.425	1.360	1.400	1.381	1.369	1.390	1.360
Schooling	1.425	1.448	1.509	1.423	1.498	1.425	1.461
INFL	1.031	1.030	1.034	1.030	1.038	1.030	1.031
War	1.079	1.072	1.071	1.071	1.072	1.098	1.076
SDExchRate	1.074	1.071	1.081	1.071	1.071	1.071	1.080
AgShGDP	2.373	2.108	2.097	2.102	2.114	2.102	2.096
Coffee, cocoa, tea(e)	1.179						
Spices(e)		1.038					
Oil(e)			1.116				
Other food crops(e)				1.042			
Fibres(e)					1.170		
Rubber(e)						1.060	
Tobacco(e)							1.072

Minimum possible value = 1.0
Guidelines for VIF values:
VIF = 1 – no correlation, 1 < V <5 – moderately correlated, VIF > 5 collinearity problem
Source: Author's own calculations based on relevant data sources

Table A5.8: Continued

GrVol_lag1	1.039
lnGDPPC	2.463
Democracy	1.239
Openness	1.363
Schooling	1.464
INFL	1.033
War	1.072
SDExchRate	1.112
AgShGDP	2.101
Other non-food crops(e)	1.074

Minimum possible value = 1.0
Guidelines for VIF values:
VIF = 1 – no correlation, 1 < V <5 – moderately correlated, VIF > 5 collinearity problem
Source: Author's own calculations based on relevant data sources

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables

lambda	cond	const	1	2	3	4	5	6	7	8	9	10
6.773	1.000	0.000	0.006	0.000	0.005	0.000	0.001	0.006	0.003	0.002	0.002	0.003
1.031	2.564	0.000	0.000	0.000	0.078	0.000	0.001	0.012	0.049	0.453	0.002	0.024
0.831	2.854	0.000	0.094	0.000	0.002	0.000	0.000	0.001	0.707	0.080	0.000	0.000
0.707	3.095	0.000	0.218	0.000	0.195	0.000	0.002	0.003	0.133	0.184	0.005	0.030
0.651	3.227	0.000	0.000	0.000	0.001	0.000	0.001	0.959	0.000	0.031	0.001	0.006
0.539	3.543	0.000	0.580	0.000	0.015	0.000	0.000	0.002	0.032	0.212	0.016	0.089
0.307	4.696	0.001	0.089	0.002	0.657	0.003	0.021	0.000	0.008	0.001	0.005	0.156
0.104	8.058	0.000	0.003	0.001	0.009	0.001	0.021	0.001	0.004	0.012	0.541	0.661
0.041	12.869	0.009	0.006	0.016	0.000	0.074	0.903	0.000	0.000	0.016	0.048	0.004
0.012	24.118	0.036	0.001	0.257	0.000	0.827	0.046	0.016	0.022	0.004	0.005	0.005
0.004	42.566	0.953	0.004	0.724	0.037	0.094	0.004	0.000	0.041	0.005	0.375	0.023

1 – GrVol_lag1, 2 - lnGDPPC05,3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 10 – CrPrShGDP
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of plantation crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	11
6.554	1.000	0.000	0.006	0.000	0.005	0.000	0.001	0.006	0.004	0.002	0.002	0.005
0.974	2.594	0.000	0.001	0.000	0.036	0.000	0.000	0.040	0.044	0.648	0.001	0.022
0.847	2.781	0.000	0.063	0.000	0.015	0.000	0.000	0.005	0.676	0.048	0.001	0.048
0.687	3.088	0.000	0.154	0.000	0.001	0.000	0.000	0.296	0.004	0.108	0.002	0.339
0.673	3.120	0.000	0.216	0.000	0.274	0.000	0.002	0.006	0.189	0.012	0.004	0.081
0.626	3.236	0.000	0.216	0.000	0.001	0.000	0.001	0.612	0.007	0.028	0.000	0.142
0.389	4.107	0.001	0.331	0.001	0.390	0.001	0.005	0.015	0.001	0.110	0.024	0.194
0.195	5.805	0.000	0.000	0.002	0.236	0.003	0.039	0.005	0.002	0.015	0.307	0.065
0.041	12.644	0.008	0.005	0.016	0.000	0.069	0.893	0.000	0.001	0.014	0.071	0.000
0.011	24.272	0.026	0.001	0.301	0.000	0.777	0.056	0.014	0.019	0.011	0.003	0.046
0.004	42.612	0.965	0.006	0.680	0.042	0.149	0.003	0.001	0.054	0.004	0.584	0.058

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 11 – ShPLANT(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and shares of processed and unprocessed plantation crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	12	13
6.745	1.000	0.000	0.006	0.000	0.005	0.000	0.001	0.005	0.003	0.002	0.002	0.004	0.004
1.017	2.576	0.000	0.002	0.000	0.015	0.000	0.000	0.067	0.027	0.499	0.001	0.097	0.034
0.870	2.784	0.000	0.028	0.000	0.033	0.000	0.000	0.004	0.563	0.004	0.002	0.008	0.160
0.792	2.919	0.000	0.045	0.000	0.038	0.000	0.001	0.077	0.070	0.273	0.001	0.260	0.070
0.693	3.121	0.000	0.085	0.000	0.007	0.000	0.000	0.255	0.073	0.017	0.000	0.094	0.384
0.675	3.162	0.000	0.413	0.000	0.216	0.000	0.002	0.031	0.121	0.035	0.002	0.007	0.005
0.566	3.452	0.000	0.051	0.000	0.000	0.000	0.001	0.522	0.065	0.014	0.001	0.385	0.104
0.396	4.126	0.001	0.357	0.001	0.404	0.001	0.004	0.017	0.000	0.113	0.028	0.022	0.105
0.195	5.881	0.000	0.000	0.002	0.241	0.003	0.036	0.006	0.002	0.014	0.308	0.012	0.041
0.037	13.444	0.010	0.005	0.018	0.000	0.072	0.906	0.003	0.000	0.014	0.072	0.080	0.021
0.011	24.653	0.024	0.001	0.298	0.000	0.771	0.044	0.012	0.020	0.011	0.002	0.014	0.030
0.004	43.283	0.964	0.006	0.680	0.041	0.152	0.005	0.000	0.056	0.004	0.582	0.016	0.040

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 12 – ShProcPLANT(e), 13 – ShUnprocPLANT(e)
Source: Author’s own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of non-plantation crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	14
6.531	1.000	0.000	0.006	0.000	0.005	0.000	0.001	0.006	0.004	0.002	0.002	0.005
0.965	2.602	0.000	0.001	0.000	0.050	0.000	0.000	0.040	0.043	0.651	0.002	0.008
0.882	2.721	0.000	0.016	0.000	0.000	0.000	0.000	0.021	0.634	0.016	0.000	0.142
0.741	2.969	0.000	0.302	0.000	0.078	0.000	0.000	0.120	0.020	0.157	0.002	0.165
0.641	3.191	0.000	0.204	0.000	0.062	0.000	0.000	0.625	0.081	0.029	0.002	0.004
0.549	3.450	0.000	0.023	0.000	0.102	0.000	0.005	0.161	0.156	0.010	0.000	0.567
0.433	3.884	0.001	0.436	0.000	0.390	0.001	0.001	0.009	0.000	0.098	0.043	0.001
0.204	5.656	0.000	0.001	0.003	0.273	0.003	0.043	0.003	0.002	0.005	0.309	0.001
0.039	12.926	0.011	0.005	0.020	0.000	0.064	0.911	0.001	0.003	0.015	0.082	0.046
0.011	24.220	0.029	0.001	0.278	0.000	0.812	0.030	0.013	0.013	0.004	0.000	0.049
0.004	41.585	0.958	0.005	0.699	0.037	0.120	0.009	0.001	0.044	0.011	0.557	0.013

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 14 – ShNONPLANT(e)
Source: Author’s own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and shares of processed and unprocessed non-plantation crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	15	16
6.697	1.000	0.000	0.006	0.000	0.005	0.000	0.001	0.006	0.003	0.002	0.002	0.004	0.004
1.073	2.499	0.000	0.006	0.000	0.011	0.000	0.000	0.002	0.112	0.248	0.000	0.032	0.264
0.976	2.619	0.000	0.001	0.000	0.026	0.000	0.000	0.074	0.058	0.317	0.002	0.179	0.036
0.827	2.846	0.000	0.160	0.000	0.039	0.000	0.000	0.031	0.511	0.008	0.002	0.002	0.082
0.645	3.222	0.000	0.325	0.000	0.110	0.000	0.000	0.389	0.121	0.000	0.002	0.000	0.015
0.606	3.324	0.000	0.051	0.000	0.086	0.000	0.004	0.472	0.107	0.112	0.000	0.063	0.098
0.487	3.707	0.000	0.023	0.000	0.036	0.000	0.000	0.000	0.025	0.162	0.000	0.579	0.485
0.432	3.936	0.001	0.416	0.000	0.374	0.001	0.001	0.008	0.001	0.124	0.044	0.009	0.008
0.203	5.740	0.000	0.001	0.003	0.273	0.003	0.043	0.003	0.001	0.002	0.310	0.005	0.005
0.039	13.142	0.012	0.005	0.020	0.000	0.061	0.913	0.001	0.003	0.010	0.085	0.051	0.001
0.011	24.642	0.028	0.001	0.282	0.000	0.806	0.027	0.014	0.013	0.008	0.000	0.056	0.001
0.004	42.264	0.960	0.004	0.694	0.038	0.128	0.010	0.001	0.044	0.007	0.553	0.020	0.002

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 15 – ShProcNONPLANT(e), 16 - ShUnprocNONPLANT(e)
Source: Author’s own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and shares of plantation and non-plantation crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	11	14
6.886	1.000	0.000	0.005	0.000	0.005	0.000	0.001	0.005	0.003	0.002	0.001	0.005	0.005
0.977	2.655	0.000	0.001	0.000	0.036	0.000	0.000	0.049	0.019	0.649	0.001	0.022	0.007
0.886	2.787	0.000	0.015	0.000	0.004	0.000	0.000	0.019	0.657	0.003	0.000	0.010	0.115
0.751	3.028	0.000	0.196	0.000	0.118	0.000	0.000	0.064	0.009	0.084	0.005	0.080	0.210
0.687	3.167	0.000	0.079	0.000	0.023	0.000	0.000	0.247	0.020	0.082	0.004	0.414	0.001
0.633	3.299	0.000	0.358	0.000	0.031	0.000	0.000	0.417	0.080	0.012	0.000	0.087	0.020
0.545	3.555	0.000	0.001	0.000	0.144	0.000	0.005	0.163	0.143	0.013	0.000	0.018	0.529
0.388	4.212	0.001	0.331	0.001	0.371	0.001	0.005	0.017	0.001	0.109	0.024	0.194	0.003
0.194	5.951	0.000	0.000	0.002	0.231	0.002	0.039	0.005	0.002	0.015	0.305	0.065	0.001
0.039	13.278	0.010	0.005	0.020	0.000	0.060	0.909	0.001	0.003	0.016	0.074	0.001	0.046
0.011	25.474	0.020	0.001	0.314	0.001	0.764	0.035	0.012	0.012	0.010	0.001	0.044	0.047
0.004	44.016	0.969	0.007	0.662	0.037	0.172	0.005	0.001	0.050	0.005	0.584	0.061	0.016

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 11 – ShPLANT(e), 14 – ShNONPLANT(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and shares of processed and unprocessed plantation and non-plantation crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	12	13	15	16
7.248	1.000	0.000	0.005	0.000	0.004	0.000	0.001	0.004	0.003	0.002	0.001	0.004	0.004	0.004	0.003
1.097	2.570	0.000	0.002	0.000	0.008	0.000	0.000	0.005	0.050	0.348	0.000	0.024	0.031	0.005	0.198
1.050	2.627	0.000	0.008	0.000	0.004	0.000	0.000	0.094	0.046	0.076	0.001	0.096	0.001	0.175	0.095
0.866	2.894	0.000	0.052	0.000	0.038	0.000	0.000	0.004	0.514	0.006	0.002	0.002	0.152	0.001	0.017
0.794	3.021	0.000	0.036	0.000	0.049	0.000	0.001	0.048	0.075	0.123	0.002	0.179	0.229	0.021	0.002
0.692	3.236	0.000	0.355	0.000	0.116	0.000	0.001	0.013	0.012	0.015	0.001	0.103	0.183	0.008	0.046
0.604	3.463	0.000	0.017	0.000	0.043	0.000	0.003	0.754	0.013	0.036	0.000	0.048	0.001	0.065	0.005
0.588	3.512	0.000	0.159	0.000	0.047	0.000	0.000	0.009	0.138	0.168	0.000	0.143	0.066	0.008	0.395
0.421	4.148	0.000	0.012	0.000	0.067	0.000	0.000	0.035	0.079	0.049	0.000	0.312	0.062	0.582	0.219
0.395	4.282	0.001	0.342	0.001	0.352	0.001	0.004	0.010	0.005	0.143	0.028	0.002	0.138	0.026	0.010
0.194	6.119	0.000	0.000	0.002	0.233	0.002	0.037	0.007	0.001	0.007	0.307	0.019	0.035	0.009	0.006
0.036	14.118	0.011	0.004	0.021	0.000	0.061	0.916	0.003	0.000	0.011	0.077	0.055	0.018	0.024	0.001
0.011	26.243	0.018	0.001	0.317	0.001	0.754	0.030	0.012	0.012	0.014	0.000	0.004	0.035	0.050	0.001
0.004	45.348	0.969	0.007	0.658	0.038	0.181	0.007	0.001	0.051	0.002	0.579	0.009	0.047	0.022	0.002

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 12 – ShProcPLANT(e), 13 – ShUnprocPLANT(e), 15 – ShProcNONPLANT(e), 16 - ShUnprocNONPLANT(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of perishable crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	17
6.431	1.000	0.000	0.006	0.000	0.006	0.000	0.001	0.006	0.004	0.002	0.002	0.004
1.050	2.475	0.000	0.003	0.000	0.045	0.000	0.000	0.041	0.015	0.370	0.003	0.187
0.900	2.673	0.000	0.004	0.000	0.007	0.000	0.000	0.000	0.608	0.139	0.000	0.087
0.767	2.896	0.000	0.308	0.000	0.060	0.000	0.000	0.012	0.075	0.305	0.003	0.100
0.640	3.169	0.000	0.075	0.000	0.007	0.000	0.000	0.881	0.013	0.052	0.002	0.001
0.534	3.471	0.000	0.256	0.000	0.093	0.000	0.003	0.039	0.224	0.029	0.004	0.423
0.424	3.894	0.000	0.334	0.000	0.530	0.001	0.001	0.002	0.009	0.071	0.034	0.063
0.199	5.678	0.000	0.001	0.003	0.220	0.003	0.048	0.002	0.000	0.004	0.317	0.031
0.041	12.596	0.010	0.006	0.017	0.000	0.065	0.895	0.000	0.002	0.013	0.087	0.011
0.011	23.996	0.026	0.001	0.288	0.001	0.783	0.046	0.014	0.011	0.008	0.000	0.043
0.004	42.034	0.963	0.005	0.691	0.030	0.147	0.006	0.001	0.039	0.008	0.548	0.049

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 17 – ShPERISH(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and shares of processed and unprocessed perishable crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	18	19
6.492	1.000	0.000	0.006	0.000	0.006	0.000	0.001	0.006	0.004	0.002	0.002	0.003	0.003
1.118	2.409	0.000	0.007	0.000	0.034	0.000	0.000	0.036	0.045	0.176	0.003	0.171	0.175
0.945	2.621	0.000	0.001	0.000	0.006	0.000	0.000	0.002	0.266	0.366	0.000	0.002	0.210
0.840	2.779	0.000	0.096	0.000	0.037	0.000	0.000	0.008	0.315	0.017	0.001	0.124	0.261
0.739	2.964	0.000	0.181	0.000	0.010	0.000	0.000	0.000	0.045	0.246	0.001	0.376	0.110
0.640	3.186	0.000	0.065	0.000	0.008	0.000	0.000	0.879	0.015	0.063	0.001	0.001	0.005
0.550	3.434	0.000	0.309	0.000	0.115	0.001	0.003	0.050	0.248	0.012	0.002	0.183	0.158
0.421	3.929	0.000	0.321	0.000	0.536	0.001	0.001	0.001	0.010	0.085	0.036	0.015	0.056
0.200	5.702	0.000	0.001	0.003	0.220	0.003	0.047	0.002	0.000	0.004	0.317	0.022	0.006
0.040	12.681	0.010	0.006	0.018	0.000	0.064	0.899	0.000	0.002	0.012	0.087	0.015	0.000
0.011	24.245	0.026	0.001	0.286	0.000	0.790	0.042	0.015	0.013	0.009	0.000	0.054	0.000
0.004	42.260	0.963	0.005	0.692	0.028	0.142	0.006	0.001	0.038	0.008	0.549	0.034	0.017

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 18 – ShProcPERISH(e), 19 – ShUnprocPERISH(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of non-perishable crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	20
6.626	1.000	0.000	0.006	0.000	0.005	0.000	0.001	0.006	0.004	0.002	0.002	0.005
0.962	2.624	0.000	0.001	0.000	0.051	0.000	0.000	0.029	0.085	0.632	0.001	0.000
0.840	2.809	0.000	0.081	0.000	0.009	0.000	0.000	0.010	0.621	0.125	0.001	0.023
0.696	3.085	0.000	0.037	0.000	0.164	0.000	0.001	0.170	0.154	0.000	0.006	0.227
0.673	3.138	0.000	0.229	0.000	0.087	0.000	0.001	0.444	0.050	0.080	0.000	0.028
0.596	3.335	0.000	0.391	0.000	0.003	0.000	0.001	0.299	0.013	0.055	0.002	0.226
0.367	4.248	0.001	0.242	0.001	0.452	0.002	0.008	0.019	0.000	0.064	0.015	0.261
0.185	5.986	0.000	0.000	0.002	0.186	0.003	0.033	0.008	0.001	0.013	0.347	0.138
0.041	12.768	0.010	0.006	0.017	0.000	0.065	0.907	0.000	0.001	0.012	0.059	0.009
0.011	24.507	0.028	0.001	0.294	0.000	0.798	0.040	0.013	0.020	0.008	0.005	0.057
0.004	42.134	0.961	0.005	0.685	0.043	0.132	0.007	0.001	0.052	0.008	0.561	0.025

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 20 – ShNONPERISH(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and shares of processed and unprocessed non-perishable crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	21	22
6.848	1.000	0.000	0.005	0.000	0.005	0.000	0.001	0.005	0.003	0.002	0.002	0.005	0.004
0.965	2.664	0.000	0.000	0.000	0.050	0.000	0.000	0.034	0.086	0.615	0.001	0.002	0.003
0.882	2.787	0.000	0.020	0.000	0.037	0.000	0.000	0.053	0.266	0.081	0.002	0.094	0.183
0.794	2.937	0.000	0.062	0.000	0.021	0.000	0.001	0.053	0.429	0.052	0.001	0.092	0.108
0.688	3.156	0.000	0.005	0.000	0.051	0.000	0.001	0.453	0.039	0.111	0.000	0.085	0.165
0.667	3.203	0.000	0.500	0.000	0.121	0.000	0.001	0.002	0.085	0.002	0.000	0.026	0.138
0.536	3.573	0.000	0.092	0.000	0.001	0.000	0.002	0.355	0.020	0.017	0.000	0.472	0.129
0.383	4.228	0.001	0.304	0.001	0.470	0.001	0.005	0.017	0.000	0.078	0.023	0.030	0.123
0.187	6.053	0.000	0.000	0.002	0.200	0.003	0.029	0.009	0.001	0.012	0.343	0.037	0.060
0.035	13.982	0.011	0.003	0.020	0.000	0.076	0.919	0.005	0.000	0.015	0.059	0.145	0.020
0.011	24.912	0.028	0.001	0.295	0.000	0.792	0.037	0.013	0.020	0.008	0.005	0.011	0.040
0.004	42.915	0.960	0.006	0.681	0.044	0.127	0.003	0.001	0.051	0.007	0.563	0.000	0.027

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 21 – ShProcNONPERISH(e), 22 – ShUnprocNONPERISH(e)
Source: Author’s own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and shares of perishable and non-perishable crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	17	20
6.857	1.000	0.000	0.005	0.000	0.005	0.000	0.001	0.005	0.003	0.002	0.002	0.004	0.005
1.051	2.555	0.000	0.003	0.000	0.048	0.000	0.000	0.038	0.013	0.361	0.003	0.190	0.001
0.900	2.760	0.000	0.005	0.000	0.009	0.000	0.000	0.000	0.613	0.128	0.000	0.085	0.001
0.787	2.951	0.000	0.197	0.000	0.079	0.000	0.000	0.003	0.056	0.296	0.005	0.092	0.071
0.684	3.166	0.000	0.049	0.000	0.005	0.000	0.000	0.572	0.020	0.056	0.003	0.004	0.195
0.596	3.393	0.000	0.418	0.000	0.001	0.000	0.001	0.281	0.020	0.055	0.002	0.001	0.218
0.527	3.607	0.000	0.086	0.000	0.167	0.000	0.004	0.067	0.216	0.009	0.000	0.472	0.034
0.364	4.338	0.001	0.222	0.001	0.520	0.001	0.007	0.014	0.003	0.054	0.013	0.017	0.245
0.179	6.191	0.000	0.000	0.002	0.135	0.002	0.038	0.006	0.000	0.010	0.355	0.041	0.149
0.040	13.051	0.010	0.006	0.018	0.000	0.057	0.905	0.001	0.002	0.012	0.066	0.009	0.007
0.011	25.424	0.020	0.001	0.315	0.001	0.759	0.037	0.012	0.012	0.010	0.001	0.036	0.050
0.004	43.945	0.969	0.006	0.663	0.031	0.179	0.007	0.001	0.043	0.006	0.552	0.050	0.025

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 17 – ShPERISH(e), 20 – ShNONPERISH(e)
Source: Author’s own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and shares of processed and unprocessed perishable and non-perishable crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	18	19	21	22
7.139	1.000	0.000	0.005	0.000	0.004	0.000	0.001	0.005	0.003	0.002	0.001	0.003	0.002	0.004	0.004
1.130	2.514	0.000	0.006	0.000	0.039	0.000	0.000	0.030	0.034	0.151	0.003	0.170	0.176	0.000	0.015
0.954	2.735	0.000	0.002	0.000	0.000	0.000	0.000	0.013	0.147	0.375	0.000	0.009	0.251	0.026	0.010
0.897	2.821	0.000	0.019	0.000	0.057	0.000	0.000	0.019	0.363	0.000	0.002	0.040	0.023	0.075	0.121
0.788	3.010	0.000	0.029	0.000	0.000	0.000	0.000	0.100	0.043	0.018	0.001	0.208	0.260	0.030	0.188
0.750	3.086	0.000	0.137	0.000	0.001	0.000	0.000	0.110	0.095	0.300	0.000	0.160	0.016	0.103	0.001
0.669	3.266	0.000	0.312	0.000	0.011	0.000	0.000	0.245	0.003	0.005	0.000	0.040	0.012	0.054	0.242
0.556	3.584	0.000	0.048	0.000	0.108	0.001	0.005	0.340	0.124	0.004	0.000	0.066	0.196	0.120	0.002
0.510	3.740	0.000	0.171	0.000	0.042	0.000	0.000	0.100	0.130	0.033	0.000	0.175	0.013	0.360	0.167
0.377	4.351	0.001	0.259	0.001	0.561	0.001	0.005	0.011	0.004	0.070	0.019	0.007	0.026	0.034	0.102
0.181	6.287	0.000	0.000	0.003	0.145	0.002	0.032	0.008	0.000	0.009	0.352	0.034	0.008	0.052	0.056
0.035	14.309	0.011	0.003	0.021	0.000	0.067	0.919	0.005	0.000	0.014	0.063	0.004	0.000	0.135	0.021
0.010	26.102	0.020	0.002	0.317	0.000	0.759	0.035	0.013	0.013	0.012	0.001	0.048	0.000	0.006	0.040
0.004	45.019	0.968	0.007	0.658	0.030	0.170	0.002	0.001	0.041	0.006	0.556	0.038	0.016	0.000	0.031

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 18 – ShProcPERISH(e), 19 – ShUnprocPERISH(e), 21 – ShProcNONPERISH(e), 22 – ShUnprocNONPERISH(e)

Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of processed crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	23
6.561	1.000	0.000	0.006	0.000	0.005	0.000	0.001	0.006	0.004	0.002	0.002	0.005
0.991	2.574	0.000	0.000	0.000	0.040	0.000	0.000	0.053	0.012	0.607	0.002	0.046
0.862	2.759	0.000	0.043	0.000	0.008	0.000	0.000	0.008	0.732	0.002	0.001	0.056
0.714	3.031	0.000	0.268	0.000	0.065	0.000	0.000	0.217	0.001	0.223	0.001	0.118
0.646	3.187	0.000	0.245	0.000	0.108	0.000	0.000	0.457	0.120	0.026	0.002	0.016
0.540	3.484	0.000	0.008	0.000	0.115	0.000	0.005	0.222	0.062	0.000	0.000	0.557
0.429	3.910	0.001	0.417	0.000	0.343	0.001	0.002	0.020	0.002	0.108	0.044	0.030
0.204	5.668	0.000	0.001	0.003	0.279	0.003	0.040	0.003	0.002	0.006	0.309	0.000
0.038	13.202	0.013	0.005	0.022	0.000	0.058	0.919	0.002	0.003	0.010	0.080	0.077
0.011	24.503	0.025	0.001	0.284	0.001	0.799	0.019	0.011	0.015	0.008	0.000	0.066
0.004	41.998	0.961	0.005	0.690	0.036	0.139	0.012	0.000	0.047	0.008	0.559	0.028

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 23 – ShPROC(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of processed crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	24
6.545	1.000	0.000	0.006	0.000	0.005	0.000	0.001	0.006	0.004	0.002	0.002	0.005
0.962	2.608	0.000	0.001	0.000	0.051	0.000	0.000	0.029	0.089	0.628	0.001	0.000
0.852	2.772	0.000	0.043	0.000	0.004	0.000	0.000	0.010	0.618	0.119	0.001	0.073
0.704	3.050	0.000	0.342	0.000	0.032	0.000	0.000	0.158	0.000	0.043	0.000	0.296
0.653	3.166	0.000	0.122	0.000	0.234	0.000	0.002	0.041	0.216	0.009	0.006	0.213
0.635	3.211	0.000	0.095	0.000	0.005	0.000	0.001	0.725	0.000	0.079	0.000	0.110
0.399	4.052	0.001	0.379	0.001	0.379	0.001	0.004	0.010	0.004	0.081	0.027	0.160
0.196	5.775	0.000	0.000	0.002	0.249	0.003	0.041	0.004	0.004	0.008	0.305	0.053
0.041	12.690	0.008	0.005	0.015	0.000	0.075	0.885	0.000	0.000	0.015	0.080	0.009
0.011	24.149	0.028	0.001	0.297	0.000	0.786	0.064	0.016	0.017	0.008	0.003	0.039
0.004	42.219	0.962	0.006	0.684	0.040	0.135	0.002	0.001	0.048	0.008	0.575	0.041

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 24 – ShUNPROC(e)
Source: Author’s own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and shares of processed and unprocessed crops

lambda	cond	const	1	2	3	4	5	6	7	8	9	23	24
6.911	1.000	0.000	0.005	0.000	0.005	0.000	0.001	0.005	0.003	0.002	0.001	0.005	0.005
0.991	2.641	0.000	0.001	0.000	0.038	0.000	0.000	0.055	0.010	0.608	0.001	0.047	0.000
0.881	2.800	0.000	0.019	0.000	0.014	0.000	0.000	0.014	0.675	0.001	0.001	0.045	0.055
0.721	3.097	0.000	0.332	0.000	0.039	0.000	0.000	0.198	0.006	0.176	0.000	0.069	0.069
0.666	3.220	0.000	0.007	0.000	0.065	0.000	0.001	0.011	0.057	0.062	0.004	0.067	0.579
0.646	3.271	0.000	0.248	0.000	0.103	0.000	0.000	0.459	0.116	0.028	0.002	0.017	0.001
0.540	3.576	0.000	0.005	0.000	0.106	0.000	0.004	0.224	0.060	0.000	0.000	0.569	0.001
0.397	4.173	0.001	0.371	0.001	0.347	0.001	0.004	0.016	0.006	0.087	0.028	0.012	0.152
0.196	5.934	0.000	0.000	0.002	0.248	0.002	0.039	0.004	0.004	0.008	0.303	0.000	0.053
0.037	13.655	0.011	0.004	0.021	0.000	0.060	0.915	0.002	0.002	0.011	0.084	0.084	0.015
0.011	25.548	0.019	0.001	0.313	0.001	0.764	0.029	0.011	0.013	0.010	0.001	0.057	0.030
0.004	43.966	0.968	0.007	0.662	0.035	0.171	0.006	0.001	0.048	0.006	0.575	0.027	0.040

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 23 – ShPROC(e), 24 – ShUNPROC(e)
Source: Author’s own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and inverted product HH index

lambda	cond	const	1	2	3	4	5	6	7	8	9	25
6.905	1.000	0.000	0.005	0.000	0.005	0.000	0.001	0.005	0.003	0.002	0.002	0.004
0.973	2.663	0.000	0.002	0.000	0.061	0.000	0.000	0.021	0.115	0.557	0.001	0.004
0.842	2.864	0.000	0.095	0.000	0.004	0.000	0.000	0.009	0.582	0.182	0.000	0.005
0.682	3.182	0.000	0.306	0.000	0.215	0.000	0.002	0.029	0.204	0.051	0.002	0.006
0.649	3.262	0.000	0.025	0.000	0.004	0.000	0.000	0.911	0.024	0.054	0.001	0.007
0.449	3.923	0.000	0.533	0.000	0.296	0.000	0.000	0.002	0.000	0.118	0.030	0.036
0.258	5.172	0.001	0.008	0.003	0.245	0.003	0.018	0.000	0.001	0.007	0.008	0.598
0.186	6.088	0.000	0.015	0.001	0.125	0.001	0.026	0.004	0.005	0.000	0.314	0.285
0.041	13.024	0.008	0.009	0.015	0.000	0.074	0.887	0.000	0.001	0.012	0.082	0.008
0.011	24.609	0.031	0.000	0.282	0.000	0.801	0.061	0.017	0.018	0.004	0.004	0.026
0.004	42.922	0.959	0.001	0.699	0.045	0.120	0.003	0.001	0.048	0.013	0.556	0.020

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 25 – InvHHProduct(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and inverted product group HH index

lambda	cond	const	1	2	3	4	5	6	7	8	9	26
7.030	1.000	0.000	0.005	0.000	0.004	0.000	0.001	0.005	0.003	0.002	0.001	0.002
0.964	2.700	0.000	0.001	0.000	0.055	0.000	0.000	0.026	0.098	0.609	0.001	0.000
0.841	2.891	0.000	0.093	0.000	0.006	0.000	0.000	0.008	0.619	0.147	0.001	0.002
0.680	3.214	0.000	0.311	0.000	0.225	0.000	0.002	0.034	0.188	0.045	0.002	0.002
0.650	3.288	0.000	0.024	0.000	0.007	0.000	0.000	0.903	0.023	0.059	0.001	0.003
0.455	3.930	0.000	0.526	0.000	0.303	0.000	0.000	0.001	0.000	0.104	0.030	0.016
0.217	5.695	0.001	0.000	0.004	0.354	0.004	0.049	0.000	0.001	0.002	0.167	0.053
0.107	8.116	0.001	0.035	0.000	0.001	0.000	0.004	0.007	0.001	0.002	0.238	0.874
0.040	13.219	0.011	0.001	0.018	0.000	0.073	0.891	0.001	0.001	0.014	0.041	0.029
0.012	24.703	0.033	0.000	0.265	0.000	0.818	0.045	0.014	0.020	0.005	0.005	0.017
0.004	42.909	0.954	0.003	0.712	0.043	0.103	0.006	0.001	0.047	0.010	0.513	0.001

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 26 – InvHHGroup(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and inverted plantation crops' HH index

lambda	cond	const	1	2	3	4	5	6	7	8	9	27
7.136	1.000	0.000	0.005	0.000	0.004	0.000	0.001	0.005	0.003	0.002	0.002	0.001
0.962	2.724	0.000	0.001	0.000	0.050	0.000	0.000	0.030	0.084	0.636	0.001	0.000
0.837	2.919	0.000	0.081	0.000	0.004	0.000	0.000	0.005	0.676	0.118	0.000	0.000
0.677	3.246	0.000	0.324	0.000	0.182	0.000	0.002	0.163	0.114	0.067	0.001	0.000
0.641	3.337	0.000	0.128	0.000	0.033	0.000	0.000	0.765	0.044	0.042	0.002	0.000
0.444	4.011	0.000	0.441	0.000	0.410	0.001	0.001	0.005	0.000	0.100	0.034	0.002
0.204	5.908	0.000	0.001	0.003	0.275	0.003	0.040	0.003	0.002	0.006	0.304	0.000
0.044	12.742	0.000	0.013	0.000	0.000	0.009	0.551	0.005	0.002	0.004	0.141	0.532
0.039	13.563	0.014	0.000	0.027	0.000	0.078	0.345	0.002	0.007	0.011	0.001	0.455
0.012	24.734	0.034	0.000	0.259	0.000	0.818	0.052	0.017	0.019	0.005	0.002	0.004
0.004	43.300	0.951	0.005	0.710	0.043	0.091	0.008	0.000	0.049	0.010	0.511	0.005

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 27 – InvHHPlant(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and inverted perishable crops' HH index

lambda	cond	const	1	2	3	4	5	6	7	8	9	28
7.130	1.000	0.000	0.005	0.000	0.004	0.000	0.001	0.005	0.003	0.002	0.001	0.001
0.963	2.721	0.000	0.001	0.000	0.052	0.000	0.000	0.028	0.089	0.625	0.001	0.000
0.833	2.925	0.000	0.090	0.000	0.004	0.000	0.000	0.004	0.666	0.126	0.001	0.000
0.676	3.247	0.000	0.318	0.000	0.199	0.000	0.002	0.129	0.135	0.062	0.001	0.000
0.645	3.325	0.000	0.089	0.000	0.031	0.000	0.000	0.814	0.038	0.040	0.002	0.000
0.457	3.949	0.000	0.475	0.000	0.351	0.000	0.000	0.002	0.000	0.109	0.031	0.004
0.206	5.878	0.000	0.002	0.003	0.306	0.004	0.047	0.002	0.002	0.005	0.256	0.002
0.046	12.469	0.003	0.008	0.004	0.004	0.025	0.679	0.000	0.005	0.006	0.238	0.176
0.029	15.716	0.006	0.000	0.026	0.022	0.099	0.212	0.000	0.008	0.015	0.127	0.696
0.012	24.736	0.030	0.001	0.280	0.000	0.786	0.055	0.015	0.017	0.007	0.000	0.005
0.003	45.604	0.961	0.010	0.685	0.027	0.086	0.003	0.001	0.037	0.005	0.343	0.116

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 28 – InvHHPerish(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and inverted processed crops' HH index

lambda	cond	const	1	2	3	4	5	6	7	8	9	29
7.136	1.000	0.000	0.005	0.000	0.004	0.000	0.001	0.005	0.003	0.002	0.002	0.001
0.962	2.724	0.000	0.001	0.000	0.050	0.000	0.000	0.030	0.084	0.634	0.001	0.000
0.836	2.922	0.000	0.085	0.000	0.004	0.000	0.000	0.005	0.677	0.117	0.000	0.000
0.677	3.247	0.000	0.311	0.000	0.182	0.000	0.002	0.174	0.118	0.067	0.001	0.000
0.644	3.329	0.000	0.121	0.000	0.040	0.000	0.000	0.762	0.050	0.039	0.002	0.000
0.446	4.002	0.000	0.452	0.000	0.398	0.000	0.001	0.003	0.000	0.103	0.033	0.003
0.204	5.911	0.000	0.001	0.003	0.278	0.003	0.042	0.003	0.002	0.005	0.296	0.000
0.049	12.073	0.000	0.016	0.000	0.001	0.014	0.558	0.000	0.000	0.003	0.151	0.367
0.032	14.854	0.018	0.003	0.036	0.002	0.068	0.344	0.002	0.000	0.016	0.002	0.605
0.012	24.878	0.032	0.000	0.247	0.000	0.829	0.046	0.015	0.021	0.004	0.005	0.021
0.004	43.276	0.950	0.005	0.712	0.041	0.085	0.006	0.001	0.046	0.009	0.507	0.004

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 29 – InvHHProc(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and inverted food crops' HH index

lambda	cond	const	1	2	3	4	5	6	7	8	9	30
7.140	1.000	0.000	0.005	0.000	0.004	0.000	0.001	0.005	0.003	0.002	0.002	0.001
0.962	2.724	0.000	0.001	0.000	0.049	0.000	0.000	0.031	0.081	0.636	0.002	0.000
0.835	2.924	0.000	0.083	0.000	0.003	0.000	0.000	0.005	0.687	0.111	0.000	0.000
0.679	3.243	0.000	0.316	0.000	0.169	0.000	0.002	0.195	0.107	0.071	0.001	0.000
0.642	3.334	0.000	0.141	0.000	0.043	0.000	0.000	0.739	0.052	0.037	0.002	0.000
0.444	4.012	0.000	0.440	0.000	0.417	0.001	0.001	0.003	0.000	0.102	0.034	0.002
0.205	5.897	0.000	0.001	0.003	0.270	0.003	0.038	0.004	0.002	0.006	0.312	0.001
0.043	12.820	0.003	0.007	0.005	0.000	0.023	0.831	0.000	0.000	0.006	0.112	0.195
0.034	14.590	0.012	0.000	0.017	0.001	0.100	0.078	0.001	0.001	0.010	0.003	0.775
0.011	24.919	0.041	0.001	0.282	0.000	0.772	0.043	0.017	0.021	0.008	0.000	0.025
0.004	43.220	0.944	0.004	0.693	0.042	0.101	0.006	0.001	0.047	0.010	0.533	0.000

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 30 – InvHHFood(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and all inverted HH indices

lambda	cond	const	1	2	3	4	5	6	7	8	9	25	26	27	28	29	30
11.608	1.000	0.000	0.002	0.000	0.001	0.000	0.000	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
0.979	3.444	0.000	0.003	0.000	0.070	0.000	0.000	0.014	0.132	0.495	0.001	0.001	0.000	0.000	0.000	0.000	0.000
0.865	3.664	0.000	0.065	0.000	0.010	0.000	0.000	0.035	0.495	0.228	0.000	0.001	0.000	0.000	0.000	0.000	0.000
0.696	4.085	0.000	0.248	0.000	0.206	0.000	0.002	0.000	0.266	0.038	0.002	0.002	0.001	0.000	0.000	0.000	0.000
0.666	4.174	0.000	0.011	0.000	0.000	0.000	0.000	0.885	0.018	0.062	0.000	0.001	0.000	0.000	0.000	0.000	0.000
0.496	4.837	0.000	0.644	0.000	0.196	0.000	0.000	0.012	0.000	0.120	0.012	0.004	0.002	0.000	0.001	0.000	0.000
0.295	6.276	0.001	0.003	0.002	0.307	0.003	0.013	0.004	0.001	0.000	0.000	0.095	0.011	0.000	0.000	0.000	0.000
0.194	7.729	0.000	0.010	0.001	0.150	0.001	0.021	0.005	0.006	0.001	0.316	0.037	0.001	0.001	0.002	0.001	0.001
0.054	14.655	0.001	0.004	0.002	0.004	0.010	0.453	0.002	0.005	0.017	0.177	0.130	0.077	0.003	0.020	0.016	0.005
0.038	17.550	0.000	0.001	0.000	0.006	0.003	0.004	0.002	0.005	0.001	0.049	0.027	0.011	0.004	0.245	0.003	0.315
0.034	18.364	0.000	0.000	0.001	0.006	0.000	0.124	0.014	0.011	0.000	0.000	0.000	0.054	0.775	0.039	0.010	0.015
0.027	20.767	0.001	0.000	0.005	0.004	0.065	0.072	0.000	0.000	0.000	0.035	0.178	0.192	0.190	0.052	0.284	0.035
0.021	23.732	0.004	0.000	0.032	0.002	0.026	0.278	0.007	0.000	0.000	0.002	0.403	0.206	0.003	0.015	0.432	0.104
0.016	27.170	0.001	0.005	0.000	0.002	0.407	0.012	0.006	0.018	0.011	0.075	0.005	0.303	0.000	0.212	0.197	0.189
0.009	35.251	0.009	0.003	0.488	0.001	0.378	0.020	0.009	0.003	0.024	0.042	0.003	0.116	0.001	0.134	0.003	0.259
0.003	66.338	0.984	0.001	0.469	0.035	0.106	0.000	0.002	0.039	0.002	0.288	0.112	0.025	0.022	0.279	0.053	0.076

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 25 – InvHHProduct(e), 26 – InvHHGroup(e), 27 – InvHHPlant(e), 28 – InvHHPerish(e), 29 – InvHHProc(e), 30 - InvHHFood(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of food crops' export in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	31
6.618	1.000	0.000	0.006	0.000	0.005	0.000	0.001	0.006	0.003	0.002	0.002	0.005
0.971	2.611	0.000	0.001	0.000	0.046	0.000	0.000	0.042	0.029	0.657	0.001	0.013
0.866	2.764	0.000	0.025	0.000	0.004	0.000	0.000	0.008	0.729	0.020	0.000	0.058
0.717	3.039	0.000	0.396	0.000	0.095	0.000	0.000	0.114	0.004	0.137	0.001	0.087
0.640	3.216	0.000	0.141	0.000	0.032	0.000	0.000	0.763	0.044	0.043	0.002	0.000
0.522	3.559	0.000	0.018	0.000	0.281	0.000	0.002	0.028	0.110	0.012	0.006	0.456
0.407	4.030	0.001	0.396	0.001	0.221	0.001	0.005	0.021	0.021	0.095	0.034	0.190
0.204	5.698	0.000	0.001	0.003	0.281	0.003	0.041	0.004	0.003	0.006	0.287	0.003
0.041	12.766	0.009	0.006	0.017	0.000	0.059	0.900	0.000	0.002	0.012	0.070	0.008
0.011	24.732	0.018	0.002	0.312	0.001	0.737	0.045	0.014	0.011	0.009	0.000	0.064
0.003	44.122	0.972	0.009	0.668	0.034	0.200	0.006	0.001	0.044	0.006	0.597	0.115

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 31 – FoodExShGDP
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of non-food crops' export in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	32
6.437	1.000	0.000	0.006	0.000	0.005	0.000	0.001	0.006	0.004	0.003	0.002	0.005
0.965	2.583	0.000	0.000	0.000	0.039	0.000	0.000	0.039	0.072	0.643	0.001	0.014
0.850	2.751	0.000	0.086	0.000	0.037	0.000	0.000	0.026	0.383	0.039	0.003	0.251
0.801	2.834	0.000	0.007	0.000	0.033	0.000	0.002	0.031	0.341	0.068	0.001	0.376
0.671	3.096	0.000	0.223	0.000	0.128	0.000	0.002	0.373	0.080	0.091	0.000	0.014
0.606	3.258	0.000	0.327	0.000	0.023	0.000	0.000	0.483	0.054	0.023	0.000	0.168
0.418	3.925	0.001	0.338	0.001	0.447	0.001	0.003	0.020	0.000	0.094	0.036	0.070
0.194	5.755	0.000	0.001	0.003	0.244	0.003	0.038	0.007	0.001	0.009	0.346	0.064
0.041	12.593	0.009	0.005	0.017	0.000	0.072	0.906	0.001	0.001	0.013	0.069	0.010
0.012	23.637	0.037	0.001	0.257	0.000	0.834	0.043	0.014	0.022	0.006	0.003	0.015
0.004	41.278	0.952	0.005	0.723	0.043	0.088	0.005	0.001	0.044	0.011	0.539	0.012

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 32 – NonfoodExShGDP
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of food and non-food crops' export in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	31	32
6.855	1.000	0.000	0.005	0.000	0.005	0.000	0.001	0.005	0.003	0.002	0.002	0.005	0.004
0.973	2.655	0.000	0.001	0.000	0.039	0.000	0.000	0.048	0.027	0.659	0.001	0.011	0.008
0.867	2.811	0.000	0.033	0.000	0.010	0.000	0.000	0.013	0.703	0.017	0.001	0.047	0.017
0.830	2.873	0.000	0.034	0.000	0.060	0.000	0.001	0.025	0.033	0.000	0.003	0.031	0.580
0.705	3.118	0.000	0.280	0.000	0.041	0.000	0.000	0.306	0.000	0.155	0.000	0.071	0.054
0.607	3.360	0.000	0.300	0.000	0.012	0.000	0.001	0.535	0.036	0.027	0.000	0.002	0.163
0.519	3.634	0.000	0.002	0.000	0.273	0.000	0.002	0.014	0.130	0.007	0.004	0.482	0.017
0.396	4.162	0.001	0.328	0.001	0.278	0.001	0.007	0.031	0.011	0.094	0.029	0.158	0.054
0.194	5.947	0.000	0.001	0.002	0.247	0.003	0.036	0.008	0.001	0.010	0.319	0.004	0.065
0.040	13.060	0.009	0.006	0.018	0.000	0.057	0.911	0.001	0.001	0.011	0.060	0.009	0.011
0.011	25.416	0.019	0.001	0.304	0.001	0.755	0.037	0.012	0.013	0.010	0.001	0.068	0.019
0.003	45.084	0.971	0.009	0.675	0.035	0.183	0.005	0.001	0.042	0.007	0.581	0.112	0.008

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 31 – FoodExShGDP, 32 – NonfoodExShGDP
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of cereals' export in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	33
6.306	1.000	0.000	0.007	0.000	0.006	0.000	0.001	0.006	0.004	0.003	0.002	0.003
0.978	2.540	0.000	0.004	0.000	0.040	0.000	0.000	0.039	0.034	0.528	0.002	0.159
0.897	2.652	0.000	0.004	0.000	0.007	0.000	0.000	0.001	0.166	0.086	0.000	0.684
0.826	2.763	0.000	0.127	0.000	0.003	0.000	0.000	0.000	0.558	0.154	0.001	0.057
0.663	3.084	0.000	0.285	0.000	0.219	0.000	0.002	0.115	0.137	0.047	0.001	0.070
0.640	3.140	0.000	0.119	0.000	0.020	0.000	0.000	0.810	0.032	0.048	0.002	0.000
0.431	3.825	0.001	0.441	0.000	0.384	0.001	0.001	0.009	0.000	0.099	0.044	0.009
0.204	5.560	0.000	0.001	0.003	0.278	0.003	0.043	0.003	0.002	0.005	0.310	0.001
0.041	12.417	0.009	0.006	0.016	0.000	0.073	0.896	0.000	0.001	0.014	0.080	0.003
0.012	23.366	0.035	0.001	0.270	0.000	0.818	0.049	0.015	0.020	0.006	0.001	0.013
0.004	40.649	0.955	0.005	0.710	0.042	0.105	0.006	0.001	0.047	0.010	0.558	0.002

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 33 – Cereals(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of vegetables' export in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	34
6.329	1.000	0.000	0.007	0.000	0.006	0.000	0.001	0.006	0.004	0.003	0.002	0.003
1.024	2.487	0.000	0.001	0.000	0.035	0.000	0.000	0.028	0.027	0.331	0.002	0.317
0.928	2.612	0.000	0.003	0.000	0.016	0.000	0.000	0.005	0.426	0.242	0.000	0.151
0.775	2.858	0.000	0.252	0.000	0.039	0.000	0.000	0.002	0.200	0.235	0.003	0.169
0.643	3.136	0.000	0.009	0.000	0.003	0.000	0.001	0.924	0.002	0.060	0.001	0.020
0.613	3.212	0.000	0.309	0.000	0.167	0.000	0.002	0.007	0.283	0.005	0.000	0.244
0.430	3.837	0.000	0.408	0.000	0.444	0.001	0.001	0.007	0.001	0.091	0.040	0.015
0.202	5.600	0.000	0.001	0.003	0.253	0.003	0.045	0.003	0.000	0.005	0.315	0.015
0.041	12.443	0.009	0.006	0.017	0.000	0.068	0.895	0.000	0.001	0.014	0.082	0.003
0.011	23.763	0.030	0.001	0.286	0.000	0.801	0.050	0.016	0.013	0.007	0.000	0.041
0.004	41.127	0.960	0.004	0.694	0.037	0.126	0.005	0.001	0.043	0.009	0.554	0.022

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 34 – Vegetables(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of fruits' export in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	35
6.319	1.000	0.000	0.007	0.000	0.006	0.000	0.001	0.006	0.004	0.003	0.002	0.003
1.092	2.406	0.000	0.005	0.000	0.042	0.000	0.000	0.034	0.012	0.257	0.002	0.334
0.901	2.648	0.000	0.002	0.000	0.008	0.000	0.000	0.001	0.518	0.227	0.000	0.118
0.788	2.831	0.000	0.244	0.000	0.034	0.000	0.000	0.003	0.174	0.336	0.002	0.110
0.640	3.141	0.000	0.068	0.000	0.006	0.000	0.000	0.889	0.012	0.053	0.001	0.002
0.574	3.319	0.000	0.298	0.000	0.142	0.001	0.003	0.044	0.217	0.010	0.000	0.362
0.427	3.848	0.000	0.365	0.000	0.482	0.001	0.001	0.003	0.003	0.081	0.040	0.037
0.203	5.581	0.000	0.001	0.003	0.247	0.003	0.044	0.002	0.001	0.005	0.314	0.009
0.041	12.413	0.009	0.006	0.016	0.000	0.074	0.895	0.000	0.001	0.014	0.079	0.000
0.012	23.253	0.034	0.001	0.264	0.000	0.812	0.051	0.015	0.019	0.006	0.001	0.001
0.004	41.185	0.956	0.005	0.717	0.032	0.109	0.005	0.000	0.040	0.009	0.558	0.026

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 35 – Fruits(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of nuts' export in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	36
6.215	1.000	0.000	0.007	0.000	0.006	0.000	0.001	0.007	0.004	0.003	0.002	0.001
1.031	2.455	0.000	0.001	0.000	0.037	0.000	0.000	0.012	0.042	0.123	0.002	0.614
0.932	2.582	0.000	0.000	0.000	0.015	0.000	0.000	0.017	0.029	0.567	0.000	0.286
0.827	2.741	0.000	0.090	0.000	0.001	0.000	0.000	0.002	0.706	0.079	0.000	0.022
0.670	3.045	0.000	0.356	0.000	0.186	0.000	0.002	0.136	0.115	0.050	0.001	0.025
0.640	3.117	0.000	0.121	0.000	0.023	0.000	0.000	0.802	0.034	0.046	0.002	0.000
0.426	3.820	0.001	0.412	0.000	0.427	0.001	0.001	0.005	0.000	0.096	0.040	0.028
0.202	5.548	0.000	0.001	0.003	0.261	0.003	0.043	0.003	0.002	0.006	0.313	0.014
0.041	12.347	0.009	0.006	0.016	0.000	0.075	0.896	0.000	0.001	0.014	0.082	0.006
0.012	23.054	0.036	0.001	0.265	0.000	0.820	0.050	0.015	0.020	0.006	0.001	0.000
0.004	40.378	0.954	0.004	0.715	0.043	0.100	0.006	0.001	0.046	0.010	0.556	0.003

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 36 – Nuts(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of export coffee, cocoa, and tea in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	37
6.340	1.000	0.000	0.006	0.000	0.006	0.000	0.001	0.006	0.004	0.003	0.002	0.003
0.969	2.557	0.000	0.001	0.000	0.073	0.000	0.000	0.021	0.100	0.468	0.002	0.083
0.913	2.635	0.000	0.003	0.000	0.013	0.000	0.000	0.012	0.012	0.240	0.001	0.545
0.821	2.779	0.000	0.086	0.000	0.001	0.000	0.001	0.001	0.671	0.058	0.000	0.076
0.668	3.082	0.000	0.341	0.000	0.136	0.000	0.002	0.229	0.093	0.058	0.000	0.031
0.638	3.152	0.000	0.196	0.000	0.031	0.000	0.000	0.705	0.045	0.041	0.001	0.006
0.396	4.004	0.001	0.353	0.001	0.463	0.001	0.002	0.005	0.000	0.095	0.031	0.136
0.199	5.644	0.000	0.000	0.003	0.224	0.003	0.042	0.003	0.002	0.009	0.298	0.032
0.041	12.447	0.008	0.005	0.016	0.000	0.073	0.893	0.000	0.001	0.015	0.074	0.002
0.011	23.546	0.028	0.001	0.285	0.000	0.785	0.055	0.016	0.019	0.008	0.002	0.021
0.004	42.101	0.963	0.007	0.696	0.053	0.138	0.004	0.001	0.054	0.007	0.588	0.065

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 37 – Coffee, cocoa, tea(e)
Source: Author’s own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of spices' export in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	38
6.245	1.000	0.000	0.007	0.000	0.006	0.000	0.001	0.007	0.004	0.003	0.002	0.001
0.988	2.514	0.000	0.001	0.000	0.024	0.000	0.000	0.001	0.098	0.188	0.001	0.545
0.947	2.568	0.000	0.003	0.000	0.026	0.000	0.000	0.040	0.008	0.467	0.000	0.334
0.825	2.751	0.000	0.118	0.000	0.003	0.000	0.000	0.000	0.642	0.099	0.000	0.038
0.672	3.049	0.000	0.303	0.000	0.209	0.000	0.002	0.112	0.149	0.064	0.002	0.019
0.639	3.125	0.000	0.120	0.000	0.019	0.000	0.000	0.811	0.029	0.051	0.002	0.002
0.426	3.830	0.001	0.439	0.000	0.398	0.001	0.001	0.010	0.001	0.092	0.041	0.030
0.203	5.548	0.000	0.000	0.003	0.272	0.003	0.043	0.004	0.002	0.006	0.315	0.008
0.040	12.452	0.009	0.005	0.016	0.000	0.077	0.892	0.000	0.000	0.014	0.087	0.019
0.012	23.127	0.036	0.001	0.266	0.000	0.817	0.053	0.015	0.020	0.006	0.002	0.002
0.004	40.452	0.953	0.004	0.715	0.042	0.101	0.007	0.001	0.047	0.010	0.548	0.002

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 38 – Spices(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of oils' export in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	39
6.358	1.000	0.000	0.006	0.000	0.006	0.000	0.001	0.006	0.004	0.003	0.002	0.004
0.963	2.570	0.000	0.001	0.000	0.052	0.000	0.000	0.037	0.077	0.619	0.002	0.005
0.888	2.675	0.000	0.012	0.000	0.010	0.000	0.000	0.069	0.043	0.019	0.000	0.690
0.830	2.767	0.000	0.105	0.000	0.004	0.000	0.000	0.000	0.650	0.125	0.001	0.005
0.654	3.117	0.000	0.439	0.000	0.183	0.000	0.001	0.058	0.155	0.004	0.003	0.044
0.620	3.203	0.000	0.001	0.000	0.008	0.000	0.003	0.805	0.002	0.084	0.000	0.143
0.431	3.841	0.000	0.424	0.000	0.404	0.001	0.001	0.004	0.000	0.106	0.044	0.009
0.202	5.613	0.000	0.001	0.003	0.295	0.003	0.036	0.005	0.002	0.004	0.316	0.014
0.038	12.937	0.011	0.005	0.018	0.002	0.073	0.913	0.001	0.001	0.020	0.075	0.076
0.012	23.392	0.034	0.001	0.265	0.000	0.815	0.036	0.014	0.019	0.004	0.001	0.007
0.004	40.856	0.954	0.004	0.713	0.037	0.106	0.009	0.000	0.047	0.011	0.558	0.004

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 39 – Oil(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of exports of other food crops in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	40
6.224	1.000	0.000	0.007	0.000	0.006	0.000	0.001	0.007	0.004	0.003	0.002	0.001
1.016	2.475	0.000	0.003	0.000	0.012	0.000	0.000	0.015	0.000	0.223	0.002	0.601
0.938	2.576	0.000	0.000	0.000	0.038	0.000	0.000	0.015	0.154	0.390	0.000	0.278
0.825	2.747	0.000	0.117	0.000	0.002	0.000	0.000	0.002	0.596	0.148	0.001	0.040
0.671	3.045	0.000	0.278	0.000	0.201	0.000	0.002	0.174	0.133	0.058	0.001	0.021
0.639	3.121	0.000	0.142	0.000	0.034	0.000	0.000	0.760	0.043	0.043	0.002	0.003
0.432	3.798	0.001	0.438	0.000	0.383	0.001	0.001	0.008	0.000	0.102	0.045	0.006
0.199	5.595	0.000	0.002	0.003	0.282	0.003	0.046	0.003	0.001	0.004	0.311	0.033
0.041	12.375	0.010	0.006	0.017	0.000	0.073	0.895	0.000	0.001	0.013	0.085	0.009
0.012	23.140	0.035	0.001	0.267	0.000	0.817	0.048	0.016	0.019	0.006	0.001	0.006
0.004	40.395	0.955	0.005	0.712	0.043	0.105	0.007	0.001	0.047	0.010	0.550	0.002

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 40 – Other food crops(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of fibre crops' exports in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	41
6.359	1.000	0.000	0.007	0.000	0.006	0.000	0.001	0.006	0.004	0.003	0.002	0.003
0.987	2.539	0.000	0.014	0.000	0.096	0.000	0.001	0.000	0.066	0.269	0.004	0.230
0.930	2.615	0.000	0.021	0.000	0.002	0.000	0.000	0.072	0.010	0.420	0.000	0.298
0.823	2.779	0.000	0.056	0.000	0.001	0.000	0.001	0.001	0.742	0.072	0.000	0.032
0.665	3.091	0.000	0.141	0.000	0.089	0.000	0.002	0.555	0.045	0.091	0.000	0.012
0.588	3.287	0.000	0.501	0.000	0.035	0.000	0.000	0.311	0.065	0.031	0.000	0.157
0.401	3.980	0.001	0.250	0.001	0.534	0.001	0.004	0.028	0.001	0.078	0.033	0.126
0.192	5.757	0.000	0.001	0.003	0.198	0.003	0.033	0.009	0.001	0.009	0.362	0.079
0.039	12.804	0.010	0.004	0.017	0.001	0.077	0.912	0.002	0.000	0.012	0.053	0.058
0.012	23.331	0.035	0.001	0.264	0.000	0.821	0.043	0.015	0.020	0.006	0.001	0.001
0.004	40.843	0.954	0.005	0.715	0.040	0.097	0.004	0.001	0.046	0.010	0.544	0.003

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 41 – Fibres(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of rubber exports in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	42
6.236	1.000	0.000	0.007	0.000	0.006	0.000	0.001	0.007	0.004	0.003	0.002	0.001
1.098	2.383	0.000	0.011	0.000	0.024	0.000	0.000	0.022	0.105	0.146	0.001	0.444
0.895	2.639	0.000	0.031	0.000	0.014	0.000	0.000	0.009	0.048	0.631	0.000	0.166
0.770	2.846	0.000	0.035	0.000	0.002	0.000	0.000	0.015	0.652	0.004	0.000	0.308
0.670	3.051	0.000	0.401	0.000	0.221	0.000	0.002	0.071	0.069	0.037	0.002	0.036
0.637	3.129	0.000	0.076	0.000	0.010	0.000	0.000	0.851	0.045	0.048	0.001	0.017
0.433	3.797	0.001	0.428	0.000	0.406	0.001	0.001	0.007	0.001	0.098	0.043	0.002
0.204	5.526	0.000	0.001	0.003	0.280	0.003	0.042	0.003	0.002	0.005	0.310	0.000
0.041	12.365	0.009	0.006	0.016	0.000	0.072	0.899	0.000	0.000	0.013	0.080	0.006
0.012	23.216	0.034	0.001	0.271	0.000	0.812	0.047	0.014	0.023	0.006	0.001	0.011
0.004	40.587	0.956	0.005	0.708	0.039	0.111	0.007	0.001	0.052	0.010	0.559	0.010

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 42 – Rubber(e)
Source: Author's own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of tobacco exports in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	43
6.257	1.000	0.000	0.007	0.000	0.006	0.000	0.001	0.007	0.004	0.003	0.002	0.002
0.990	2.514	0.000	0.002	0.000	0.007	0.000	0.000	0.010	0.013	0.310	0.000	0.521
0.951	2.565	0.000	0.006	0.000	0.046	0.000	0.000	0.020	0.215	0.320	0.002	0.202
0.797	2.802	0.000	0.096	0.000	0.000	0.000	0.000	0.006	0.529	0.111	0.000	0.203
0.676	3.042	0.000	0.329	0.000	0.195	0.000	0.002	0.136	0.126	0.064	0.001	0.000
0.639	3.129	0.000	0.118	0.000	0.025	0.000	0.000	0.795	0.040	0.049	0.002	0.004
0.432	3.805	0.001	0.429	0.000	0.400	0.001	0.001	0.007	0.000	0.102	0.042	0.004
0.203	5.553	0.000	0.001	0.003	0.277	0.003	0.042	0.003	0.002	0.006	0.314	0.008
0.040	12.482	0.009	0.006	0.015	0.000	0.078	0.884	0.000	0.000	0.016	0.088	0.021
0.012	23.214	0.039	0.001	0.253	0.000	0.820	0.056	0.016	0.019	0.007	0.002	0.007
0.004	41.043	0.951	0.005	0.729	0.045	0.096	0.012	0.000	0.050	0.014	0.546	0.029

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 43 – Tobacco(e)
Source: Author’s own calculations

Table A5.9: Belsley-Kuh-Welsch collinearity diagnostics: Variance proportions of control variables and share of exports of other non-food crops in GDP

lambda	cond	const	1	2	3	4	5	6	7	8	9	44
6.305	1.000	0.000	0.007	0.000	0.006	0.000	0.001	0.006	0.004	0.003	0.002	0.003
1.058	2.442	0.000	0.000	0.000	0.019	0.000	0.000	0.000	0.046	0.373	0.000	0.309
0.842	2.737	0.000	0.058	0.000	0.047	0.000	0.000	0.081	0.365	0.026	0.003	0.289
0.824	2.766	0.000	0.040	0.000	0.010	0.000	0.000	0.083	0.347	0.257	0.000	0.182
0.666	3.078	0.000	0.439	0.000	0.192	0.000	0.002	0.000	0.167	0.042	0.002	0.031
0.617	3.196	0.000	0.013	0.000	0.002	0.000	0.001	0.805	0.001	0.139	0.002	0.130
0.430	3.828	0.000	0.432	0.000	0.399	0.001	0.001	0.004	0.000	0.119	0.042	0.013
0.204	5.562	0.000	0.001	0.003	0.282	0.003	0.040	0.004	0.002	0.004	0.312	0.003
0.039	12.636	0.009	0.004	0.017	0.000	0.078	0.901	0.001	0.001	0.024	0.078	0.039
0.012	23.217	0.036	0.001	0.266	0.000	0.818	0.048	0.015	0.020	0.005	0.001	0.000
0.004	40.651	0.954	0.005	0.713	0.043	0.100	0.005	0.001	0.047	0.008	0.559	0.002

1 – GrVol_lag1, 2 - lnGDPPC05, 3 – Democracy, 4 – Openness, 5 – Schooling, 6 – INFL, 7 – WAR, 8 – SDExchRate, 9 – AgPrShGDP, 44 – Other non-food crops(e)
Source: Author's own calculations

Table A5.10: GMM estimates for lag of dependent variable and control variables on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	2.873**	2.919***	1.786	3.091***
	(6.940)	(10.670)	(1.254)	(5.011)
Lag_1GrVol	-0.025	-0.032	-0.026	-0.024
	(-0.297)	(-0.383)	(-0.308)	(-0.277)
lnGDP	-0.052			
	(-0.281)			
Democracy		-0.959***		
		(-3.203)		
Openness			0.189	
			(0.511)	
Schooling				-0.006
				(-0.996)
Sum of sq. res.	28236.12	27954.54	28238.50	28116.29
S.E. of regression	3.620	3.613	3.621	3.622
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	78	78	78	78
Arellano-Bond test AR(1)	-3.107	-3.128	-3.128	-3.107
AR(1) p-value	0.002	0.002	0.002	0.002
Arellano-Bond test AR(2)	-0.147	-0.195	-0.165	-0.127
AR(2) p-value	0.883	0.846	0.869	0.899
Sargan test df	75	75	75	75
Sargan test Chi-sq. (df)	60.426	59.534	60.026	60.916
Sargan test Chi-sq. p-value	0.889	0.904	0.896	0.880
Wald (joint) test df	2	2	2	2
Wald (joint) test Chi-sq. (df)	0.157	11.169***	0.496	0.993

Signif. codes: 0.01 ‘***’, 0.05 ‘**’, 0.1 ‘*’, Dependent variable: growth rate volatility (GrVol)

Table A5.10: Continued

	(5)	(6)	(7)	(8)
Constant	1.483**	2.690***	1.853***	2.309***
	(2.508)	(9.690)	(5.094)	(8.927)
Lag_1GrVol	-0.048	-0.032	-0.027	-0.026
	(-0.536)	(-0.368)	(-0.312)	(-0.306)
INFL	0.083*			
	(1.902)			
WAR		-0.710		
		(-1.134)		
AgPrShGDP			0.026**	
			(2.317)	
CrPrShGDP				0.796
				(1.435)
Sum of sq. res.	33353.57	28538.12	28058.78	28173.76
S.E. of regression	3.841	3.621	3.621	3.619
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	78	78	78	78
Arellano-Bond test AR(1)	-3.139	-3.117	-3.116	-3.097
AR(1) p-value	0.002	0.002	0.002	0.002
Arellano-Bond test AR(2)	-0.506	-0.162	-0.162	-0.154
AR(2) p-value	0.613	0.871	0.871	0.878
Sargan test df	75	75	75	75
Sargan test Chi-sq. (df)	58.016	60.696	60.161	60.590
Sargan test Chi-sq. p-value	0.927	0.884	0.894	0.886
Wald (joint) test df	2	2	2	2
Wald (joint) test Chi-sq. (df)	5.256*	1.375	5.469*	2.063

Signif. codes: 0.01 ‘***’, 0.05 ‘**’, 0.1 ‘*’, Dependent variable: growth rate volatility (GrVol)

Table A5.10: Continued

	(9)
Constant	2.548***
	(12.170)
Lag_1GrVol	-0.027
	(-0.312)
SDExchRate	-0.217**
	(-2.406)
Sum of sq. res.	28254.61
S.E. of regression	3.618
No. of countries	64
No. of observations	2496
No. of instruments	78
Arellano-Bond test AR(1)	-3.097
AR(1) p-value	0.002
Arellano-Bond test AR(2)	-0.159
AR(2) p-value	0.874
Sargan test df	75
Sargan test Chi-sq. (df)	60.025
Sargan test Chi-sq. p-value	0.896
Wald (joint) test df	2
Wald (joint) test Chi-sq. (df)	6.359**

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A5.11: GMM estimates for lag of dependent variable, control variables, and shares of plantation and non-plantation crops as well as their processed and unprocessed parts on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	-7.467*	-6.485	-7.226*	-6.055
	(-1.712)	(-1.428)	(-1.673)	(-1.402)
Lag_1GrVol	-0.082	-0.072	-0.079	-0.072
	(-1.020)	(-0.899)	(-0.991)	(-0.907)
lnGDP	0.522	0.485	0.491	0.439
	(1.436)	(1.250)	(1.358)	(1.167)
Democracy	-1.237***	-1.268***	-1.237***	-1.265***
	(-2.821)	(-2.979)	(-2.844)	(-2.886)
Openness	1.209**	1.053**	1.180**	1.018*
	(2.214)	(2.095)	(2.263)	(1.951)
Schooling	-0.002	-0.002	-0.001	-0.002
	(-0.277)	(-0.309)	(-0.103)	(-0.270)
INFL	0.089**	0.086**	0.091**	0.092**
	(1.970)	(2.137)	(2.039)	(2.202)
WAR	0.017	0.026	-0.035	-0.077
	(0.036)	(0.050)	(-0.076)	(-0.148)
AgPrShGDP	0.066**	0.056**	0.064**	0.052*
	(2.274)	(2.044)	(2.133)	(1.931)
SDExchRate	-0.492***	-0.447***	-0.510**	-0.478***
	(-2.578)	(-2.691)	(-2.486)	(-2.855)
ShPLANT(e)	-4.269			
	(-0.579)			
ShProcPLANT(e)		-0.068		
		(-0.003)		
ShUnprocPLANT(e)			-5.179	
			(-0.543)	
ShNONPLANT(e)				1.047
				(0.132)
Sum of sq. res.	33619.16	33237.97	33843.14	34040.34
S.E. of regression	3.878	3.874	3.899	3.915
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	86	86	86	86
Arellano-Bond test AR(1)	-3.162	-3.195	-3.170	-3.219
AR(1) p-value	0.002	0.001	0.002	0.001
Arellano-Bond test AR(2)	-0.898	-0.807	-0.897	-0.820
AR(2) p-value	0.369	0.420	0.370	0.412
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	54.168	54.599	54.718	54.859
Sargan test Chi-sq p-value	0.967	0.963	0.962	0.961
Wald (joint) test df	10	10	10	10
Wald (joint) test Chi-sq.(df)	65.382***	61.144***	61.970***	57.474***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A5.11: Continued

	(5)	(6)	(7)	(8)
Constant	-6.042	-6.944	-7.732*	-7.833
	(-1.369)	(-1.575)	(-1.665)	(-1.601)
Lag_1GrVol	-0.073	-0.075	-0.082	-0.081
	(-0.908)	(-0.934)	(-1.020)	(-1.024)
lnGDP	0.439	0.495	0.533	0.494
	(1.155)	(1.290)	(1.432)	(1.317)
Democracy	-1.265***	-1.317***	-1.232***	-1.298***
	(-2.947)	(-2.960)	(-2.868)	(-2.862)
Openness	1.019*	1.121**	1.259*	1.281*
	(1.860)	(2.404)	(1.883)	(1.812)
Schooling	-0.002	-0.002	-0.002	0.001
	(-0.281)	(-0.338)	(-0.291)	(0.071)
INFL	0.092**	0.093**	0.090**	0.089**
	(2.226)	(2.217)	(2.039)	(2.161)
WAR	-0.083	0.015	-0.002	-0.008
	(-0.163)	(0.030)	(-0.004)	(-0.018)
AgPrShGDP	0.052*	0.057**	0.068**	0.070**
	(1.916)	(2.102)	(2.214)	(2.081)
SDExchRate	-0.470***	-0.509***	-0.509***	-0.585**
	(-2.689)	(-2.548)	(-2.789)	(-2.387)
ShPLANT(e)			-4.680	
			(-0.623)	
ShProcPLANT(e)				7.594
				(0.268)
ShUnprocPLANT(e)				-9.248
				(-0.743)
ShNONPLANT(e)			-0.673	
			(-0.081)	
ShProcNONPLANT(e)	1.335			-1.508
	(0.171)			(-0.163)
ShUnprocNONPLANT(e)		8.085		8.860
		(0.371)		(0.327)
Sum of sq. res.	34016.72	34255.22	33856.58	33746.13
S.E. of regression	3.913	3.920	3.891	3.892
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	86	86	87	89
Arellano-Bond test AR(1)	-3.216	-3.194	-3.194	-3.213
AR(1) p-value	0.001	0.001	0.001	0.001
Arellano-Bond test AR(2)	-0.819	-0.855	-0.893	-0.924
AR(2) p-value	0.413	0.392	0.372	0.356
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	54.728	54.355	54.389	53.822
Sargan test Chi-sq p-value	0.962	0.965	0.965	0.969
Wald (joint) test df	10	10	11	13
Wald (joint) test Chi-sq.(df)	56.957***	56.816***	65.126***	69.299***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A5.12: GMM estimates for lag of dependent variable, control variables, and shares of perishable and non-perishable crops as well as their processed and unprocessed parts on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	-6.470	-6.668	-6.728	-6.941
	(-1.449)	(-1.458)	(-1.605)	(-1.524)
Lag_1GrVol	-0.074	-0.074	-0.075	-0.077
	(-0.932)	(-0.939)	(-0.933)	(-0.970)
lnGDP	0.470	0.477	0.488	0.500
	(1.227)	(1.239)	(1.288)	(1.325)
Democracy	-1.254***	-1.250***	-1.320***	-1.239***
	(-3.035)	(-2.979)	(-3.021)	(-2.774)
Openness	1.071**	1.117**	1.085**	1.138**
	(2.084)	(2.055)	(2.480)	(2.049)
Schooling	-0.002	-0.002	-0.003	-0.003
	(-0.326)	(-0.357)	(-0.378)	(-0.401)
INFL	0.091**	0.092**	0.091**	0.088**
	(2.137)	(2.179)	(2.169)	(2.002)
WAR	-0.062	-0.070	0.013	0.026
	(-0.118)	(-0.139)	(0.027)	(0.052)
AgPrShGDP	0.055**	0.055**	0.058**	0.063*
	(2.001)	(2.005)	(2.136)	(1.936)
SDExchRate	-0.466**	-0.476**	-0.469***	-0.456**
	(-2.502)	(-2.559)	(-2.616)	(-2.311)
ShPERISH(e)	-0.287			
	(-0.037)			
ShProcPERISH(e)		-1.707		
		(-0.198)		
ShUnprocPERISH(e)			8.546	
			(0.406)	
ShNONPERISH(e)				-2.729
				(-0.402)
Sum of sq. res.	33884.56	34018.19	33945.66	33475.11
S.E. of regression	3.903	3.910	3.902	3.876
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	86	86	86	86
Arellano-Bond test AR(1)	-3.191	-3.201	-3.171	-3.174
AR(1) p-value	0.001	0.001	0.002	0.002
Arellano-Bond test AR(2)	-0.840	-0.851	-0.858	-0.856
AR(2) p-value	0.401	0.395	0.391	0.392
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	54.598	54.456	54.168	53.448
Sargan test Chi-sq p-value	0.963	0.965	0.967	0.972
Wald (joint) test df	10	10	10	10
Wald (joint) test Chi-sq.(df)	58.167***	57.937***	58.060***	63.165***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A5.12: Continued

	(5)	(6)	(7)	(8)
Constant	-5.912	-7.072	-7.196	-8.104
	(-1.440)	(-1.596)	(-1.449)	(-1.622)
Lag_1GrVol	-0.070	-0.078	-0.078	-0.077
	(-0.867)	(-0.979)	(-0.984)	(-0.968)
lnGDP	0.420	0.469	0.513	0.462
	(1.145)	(1.279)	(1.320)	(1.237)
Democracy	-1.256***	-1.255***	-1.228***	-1.264**
	(-2.861)	(-2.837)	(-2.915)	(-2.500)
Openness	0.949*	1.178**	1.182*	1.315*
	(1.827)	(2.283)	(1.794)	(1.836)
Schooling	0.001	-0.001	-0.003	0.004
	(0.060)	(-0.098)	(-0.411)	(0.378)
INFL	0.091**	0.090**	0.088**	0.094**
	(2.167)	(2.041)	(1.992)	(2.194)
WAR	-0.099	-0.022	0.014	-0.062
	(-0.201)	(-0.048)	(0.027)	(-0.124)
AgPrShGDP	0.049*	0.065**	0.064*	0.072**
	(1.911)	(2.065)	(1.935)	(2.060)
SDExchRate	-0.471***	-0.486**	-0.465**	-0.564***
	(-2.858)	(-2.383)	(-2.225)	(-2.875)
ShPERISH(e)			-1.030	
			(-0.134)	
ShProcPERISH(e)				-6.361
				(-0.543)
ShUnprocPERISH(e)				5.913
				(0.189)
ShNONPERISH(e)			-2.901	
			(-0.426)	
ShProcNONPERISH(e)	7.122			10.670
	(0.489)			(0.675)
ShUnprocNONPERISH(e)		-6.120		-11.517
		(-0.676)		(-0.980)
Sum of sq. res.	33585.95	33630.43	33521.32	34085.87
S.E. of regression	3.904	3.893	3.878	3.932
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	86	86	87	89
Arellano-Bond test AR(1)	-3.239	-3.165	-3.184	-3.225
AR(1) p-value	0.001	0.002	0.002	0.001
Arellano-Bond test AR(2)	-0.819	-0.893	-0.862	-0.967
AR(2) p-value	0.413	0.372	0.389	0.334
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	54.853	53.907	53.370	53.852
Sargan test Chi-sq p-value	0.961	0.969	0.972	0.969
Wald (joint) test df	10	10	11	13
Wald (joint) test Chi-sq.(df)	58.938***	60.580***	63.720***	62.665***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A5.13: GMM estimates for all my control variables and shares of processed and unprocessed crops exports in GDP on growth rate volatility

	(1)	(2)	(3)
Constant	-5.964	-6.970	-6.822
	(-1.377)	(-1.605)	(-1.436)
Lag_1GrVol	-0.072	-0.079	-0.077
	(-0.902)	(-0.991)	(-0.971)
lnGDP	0.433	0.479	0.467
	(1.156)	(1.308)	(1.238)
Democracy	-1.258***	-1.215***	-1.225***
	(-2.944)	(-2.854)	(-2.904)
Openness	1.007*	1.165**	1.139*
	(1.764)	(2.305)	(1.672)
Schooling	-0.002	-0.001	-0.001
	(-0.237)	(-0.188)	(-1.122)
INFL	0.091**	0.090**	0.090**
	(2.205)	(2.045)	(2.109)
WAR	-0.085	-0.056	-0.072
	(-0.172)	(-0.125)	(-0.163)
AgPrShGDP	0.052*	0.062**	0.061*
	(1.952)	(2.004)	(1.875)
SDExchRate	-0.464***	-0.457**	-0.472**
	(-2.684)	(-2.165)	(-2.203)
ShPROC(e)	1.197		1.016
	(0.164)		(0.135)
ShUNPROC(e)		-4.359	-4.915
		(-0.563)	(-0.600)
Sum of sq. res.	33759.72	33732.21	33672.89
S.E. of regression	3.901	3.893	3.896
No. of countries	64	64	64
No. of observations	2496	2496	2496
No. of instruments	86	86	87
Arellano-Bond test AR(1)	-3.223	-3.160	-3.210
AR(1) p-value	0.001	0.002	0.001
Arellano-Bond test AR(2)	-0.810	-0.896	-0.865
AR(2) p-value	0.418	0.370	0.387
Sargan test df	75	75	75
Sargan test Chi-sq.(df)	54.596	53.939	54.192
Sargan test Chi-sq p-value	0.963	0.968	0.967
Wald (joint) test df	10	10	11
Wald (joint) test Chi-sq.(df)	57.204***	61.153***	61.544***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A5.14: GMM estimates for all my control variables and shares of food and non-food crops exports in GDP on growth rate volatility

	(1)	(2)	(3)
Constant	-6.684	-6.341	-6.797
	(-1.125)	(-1.540)	(-1.12)
Lag_1GrVol	-0.081	-0.074	-0.081
	(-1.029)	(-0.913)	(-1.024)
lnGDP	0.471	0.478	0.499
	(1.011)	(1.315)	(1.073)
Democracy	-1.177***	-1.271***	-1.188***
	(-2.922)	(-2.876)	(-2.831)
Openness	1.155	1.000**	1.100
	(1.519)	(2.174)	(1.379)
Schooling	-0.002	-0.001	-0.001
	(-0.286)	(-0.190)	(-0.183)
INFL	0.088*	0.091**	0.088*
	(1.960)	(2.137)	(1.937)
WAR	-0.086	-0.102	-0.118
	(-0.187)	(-0.211)	(-0.256)
AgPrShGDP	0.057	0.050**	0.055
	(1.489)	(2.009)	(1.393)
SDExchRate	-0.451**	-0.450***	-0.439**
	(-2.064)	(-2.693)	(-2.147)
FoodExShGDP(e)	-2.837		-2.534
	(-0.345)		(-0.277)
NonfoodExShGDP(e)		6.816	6.255
		(0.723)	(0.657)
Sum of sq. res.	33379.86	33750.07	33312.82
S.E. of regression	3.870	3.904	3.875
No. of countries	64	64	64
No. of observations	2496	2496	2496
No. of instruments	86	86	87
Arellano-Bond test AR(1)	-3.174	-3.186	-3.156
AR(1) p-value	0.002	0.001	0.002
Arellano-Bond test AR(2)	-0.914	-0.868	-0.952
AR(2) p-value	0.361	0.386	0.341
Sargan test df	75	75	75
Sargan test Chi-sq.(df)	53.896	54.651	53.994
Sargan test Chi-sq p-value	0.969	0.963	0.968
Wald (joint) test df	10	10	11
Wald (joint) test Chi-sq.(df)	59.247***	59.654***	61.383***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A5.15: GMM estimates for all my control variables and shares of different agricultural product groups' exports in GDP on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	-6.543	-6.438	-6.465	-7.294*
	(-1.454)	(-1.403)	(-1.519)	(-1.805)
Lag_1GrVol	-0.074	-0.073	-0.075	-0.078
	(-0.928)	(-0.923)	(-0.937)	(-0.972)
lnGDP	0.475	0.464	0.474	0.545
	(1.208)	(1.204)	(1.251)	(1.423)
Democracy	-1.269***	-1.253***	-1.285***	-1.301***
	(-2.982)	(-2.961)	(-3.033)	(-3.003)
Openness	1.091**	1.081**	1.054**	1.084**
	(2.318)	(2.053)	(2.358)	(2.512)
Schooling	-0.002	-0.002	-0.002	-0.001
	(-0.353)	(-0.351)	(-0.361)	(-0.206)
INFL	0.090**	0.092**	0.089**	0.090**
	(2.161)	(2.206)	(2.110)	(2.066)
WAR	-0.052	-0.079	-0.031	-0.025
	(-0.101)	(-0.155)	(-0.062)	(-0.054)
AgPrShGDP	0.056**	0.054*	0.056**	0.064**
	(2.006)	(1.960)	(2.104)	(2.400)
SDExchRate	-0.464**	-0.473***	-0.447***	-0.461**
	(-2.439)	(-2.673)	(-2.374)	(-2.365)
Cereals(e)	-4.511			
	(-0.138)			
Vegetables(e)		-0.955		
		(-0.102)		
Fruits(e)			5.455	
			(0.277)	
Nuts(e)				-38.892
				(-0.973)
Sum of sq. res.	33753.17	34067.08	33761.29	33969.50
S.E. of regression	3.899	3.914	3.891	3.893
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	86	86	86	86
Arellano-Bond test AR(1)	-3.192	-3.201	-3.152	-3.171
AR(1) p-value	0.001	0.001	0.002	0.002
Arellano-Bond test AR(2)	-0.839	-0.840	-0.853	-0.850
AR(2) p-value	0.402	0.401	0.394	0.395
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	54.617	54.515	54.402	53.969
Sargan test Chi-sq p-value	0.963	0.964	0.965	0.968
Wald (joint) test df	10	10	10	10
Wald (joint) test Chi-sq.(df)	59.096***	58.181***	57.543***	61.631***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A5.15: Continued

	(5)	(6)	(7)	(8)
Constant	-7.195*	-6.773	-6.051	-7.089
	(-1.689)	(-1.557)	(-1.459)	(1.596)
Lag_1GrVol	-0.081	-0.075	-0.074	-0.075
	(-0.997)	(0.938)	(-0.916)	(-0.935)
lnGDP	0.510	0.505	0.444	0.531
	(1.412)	(1.294)	(1.165)	(1.300)
Democracy	-1.314***	-1.291***	-1.253**	-1.236***
	(-2.805)	(-2.969)	(-2.261)	(-2.729)
Openness	1.151**	1.105**	1.009**	1.061**
	(2.297)	(2.418)	(2.249)	(2.347)
Schooling	-0.001	-0.003	-0.002	-0.002
	(-0.198)	(-0.445)	(-0.188)	(-0.236)
INFL	0.089**	0.092**	0.093**	0.090**
	(1.978)	(2.253)	(2.078)	(2.107)
WAR	-0.017	-0.009	-0.111	-0.002
	(-0.036)	(-0.018)	(-0.217)	(-0.004)
AgPrShGDP	0.065**	0.054**	0.052**	0.061*
	(2.490)	(2.014)	(1.990)	(1.655)
SDExchRate	-0.495***	-0.456**	-0.491**	-0.458**
	(-2.749)	(-2.456)	(-2.488)	(-2.390)
Coffee, cocoa, tea(e)	-7.356			
	(-0.691)			
Spices(e)		42.681		
		(0.299)		
Oil crops(e)			3.155	
			(0.105)	
Other food crops(e)				11.506
				(0.100)
Sum of sq. res.	33461.36	34294.49	34126.12	34002.47
S.E. of regression	3.882	3.910	3.917	3.897
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	86	85	86	85
Arellano-Bond test AR(1)	-3.137	-3.197	-3.146	-3.130
AR(1) p-value	0.002	0.001	0.002	0.002
Arellano-Bond test AR(2)	-0.915	-0.845	-0.841	-0.859
AR(2) p-value	0.360	0.398	0.400	0.391
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	54.252	54.289	54.843	54.384
Sargan test Chi-sq p-value	0.966	0.966	0.961	0.965
Wald (joint) test df	10	10	10	10
Wald (joint) test Chi-sq.(df)	60.480***	58.168***	55.815***	55.542***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol);

Table A5.15: Continued

	(9)	(10)	(11)	(12)
Constant	-5.962	-6.696	-6.659	-6.889*
	(-1.393)	(-1.480)	(-1.513)	(-1.694)
Lag_1GrVol	-0.070	-0.073	-0.074	-0.078
	(-0.869)	(-0.909)	(-0.928)	(-0.954)
lnGDP	0.420	0.486	0.511	0.483
	(1.135)	(1.235)	(1.299)	(1.276)
Democracy	-1.192***	-1.261***	-1.291***	-1.316***
	(-2.596)	(-2.941)	(-2.968)	(-2.871)
Openness	0.977**	1.093**	1.065**	1.054**
	(2.036)	(2.342)	(2.338)	(2.418)
Schooling	-0.001	-0.002	-0.003	-0.000
	(-0.078)	(-0.358)	(-0.449)	(-0.021)
INFL	0.089**	0.092**	0.090**	0.096**
	(2.205)	(2.133)	(2.175)	(2.218)
WAR	-0.137	0.014	0.012	-0.002
	(-0.282)	(0.026)	(0.025)	(-0.004)
AgPrShGDP	0.048*	0.056**	0.055**	0.057**
	(1.831)	(2.043)	(2.091)	(2.164)
SDExchRate	-0.459***	-0.458**	-0.441**	-0.579**
	(-2.792)	(-2.595)	(-2.433)	(-2.315)
Fibre crops(e)	11.719			
	(0.766)			
Rubber(e)		-4.784		
		(-0.106)		
Tobacco(e)			5.706	
			(0.338)	
Other non-food crops(e)				88.181
				(0.662)
Sum of sq. res.	33297.53	33932.67	33676.67	34493.48
S.E. of regression	3.892	3.907	3.893	3.937
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	86	86	86	85
Arellano-Bond test AR(1)	-3.188	-3.174	-3.183	-3.224
AR(1) p-value	0.001	0.002	0.002	0.001
Arellano-Bond test AR(2)	-0.840	-0.834	-0.841	-0.871
AR(2) p-value	0.401	0.404	0.401	0.384
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	54.590	54.657	54.559	55.258
Sargan test Chi-sq p-value	0.963	0.963	0.964	0.958
Wald (joint) test df	10	10	10	10
Wald (joint) test Chi-sq.(df)	60.122***	60.617***	60.586***	52.360***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol);

Table A5.16: GMM estimates for all my control variables and different diversification indices on growth rate volatility

	(1)	(2)	(3)	(4)
Constant	-3.982	-4.226	-7.704	-6.940
	(-0.789)	(-0.910)	(-1.596)	(-1.437)
Lag_1GrVol	-0.092	-0.099	-0.087	-0.079
	(-1.250)	(-1.328)	(-1.120)	(-1.030)
lnGDP	0.370	0.283	0.529	0.434
	(0.817)	(0.622)	(1.247)	(1.116)
Democracy	-1.065***	-1.042***	-1.341***	-1.185***
	(-2.744)	(-2.715)	(-3.190)	(-3.157)
Openness	0.655	0.605	0.954**	0.947**
	(1.366)	(1.307)	(2.261)	(2.157)
Schooling	-0.006	-0.001	-0.006	-0.001
	(-0.783)	(-0.166)	(-0.838)	(-0.120)
INFL	0.082*	0.086**	0.076*	0.093**
	(1.936)	(1.985)	(1.861)	(2.102)
WAR	-0.241	-0.222	0.194	-0.102
	(-0.409)	(-0.414)	(0.378)	(-0.209)
AgPrShGDP	0.025	0.007	0.048*	0.037
	(0.672)	(0.198)	(1.625)	(1.527)
SDExchRate	-0.647***	-0.545**	-0.443**	-0.534***
	(-2.623)	(-2.097)	(-2.437)	(-2.636)
InvHHProduct(e)	-3.604**			
	(-1.971)			
InvHHGroup(e)		-4.401***		
		(-2.903)		
InvHHPlant(e)			-2.906	
			(-1.508)	
InvHHPerish(e)				-1.988
				(-0.921)
Sum of sq. res.	32471.40	32514.65	32265.49	33833.86
S.E. of regression	3.821	3.849	3.796	3.909
No. of countries	64	64	64	64
No. of observations	2496	2496	2496	2496
No. of instruments	86	86	86	86
Arellano-Bond test AR(1)	-3.232	-3.225	-3.171	-3.220
AR(1) p-value	0.001	0.001	0.002	0.001
Arellano-Bond test AR(2)	-0.920	-1.062	-0.854	-0.889
AR(2) p-value	0.357	0.288	0.393	0.374
Sargan test df	75	75	75	75
Sargan test Chi-sq.(df)	56.217	58.112	55.034	55.396
Sargan test Chi-sq p-value	0.948	0.926	0.960	0.956
Wald (joint) test df	10	10	10	10
Wald (joint) test Chi-sq.(df)	53.767***	49.520***	65.518***	55.889***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A5.16: Continued

	(5)	(6)
Constant	-6.264	-6.181
	(-1.197)	(-1.453)
Lag_1GrVol	-0.086	-0.081
	(-1.085)	(-1.020)
lnGDP	0.344	0.297
	(0.716)	(0.809)
Democracy	-1.184***	-1.343***
	(-2.736)	(-2.967)
Openness	0.663	0.997**
	(1.558)	(2.197)
Schooling	-0.003	-0.004
	(-0.416)	(-0.613)
INFL	0.090**	0.088**
	(2.054)	(2.109)
WAR	-0.152	-0.106
	(-0.297)	(-0.221)
AgPrShGDP	0.033	0.040
	(0.990)	(1.566)
SDExchRate	-0.617***	-0.532**
	(-2.887)	(-2.271)
InvHHProcess(e)	-4.269**	
	(-2.495)	
InvHHFood(e)		-2.415*
		(-1.685)
Sum of sq. res.	33437.04	33467.01
S.E. of regression	3.885	3.878
No. of countries	64	64
No. of observations	2496	2496
No. of instruments	86	86
Arellano-Bond test AR(1)	-3.161	-3.193
AR(1) p-value	0.002	0.001
Arellano-Bond test AR(2)	-0.927	-0.863
AR(2) p-value	0.354	0.388
Sargan test df	75	75
Sargan test Chi-sq.(df)	54.995	55.634
Sargan test Chi-sq p-value	0.960	0.954
Wald (joint) test df	10	10
Wald (joint) test Chi-sq.(df)	58.333***	47.695***

Signif. codes: 0.01 '***', 0.05 '**', 0.1 '*', Dependent variable: growth rate volatility (GrVol)

Table A6.1: Summary of results for crops' production variables and their interaction terms with openness

Exploratory variables and interaction terms	Hypothesised effect	Calculated effect	
		Individually	Combined
Plantation/non-plantation crops			
ShPLANT(p)	-	-**	-
Openness x ShPLANT(p)	-	-	-
ShNONPLANT(p)	+	+	+
Openness x ShNONPLANT(p)	+	-	+
RATIOPLANT(p)	+	+	+
Openness x RATIOPLANT(p)	+	-	-
Food/non-food crops			
ShFOOD(p)	-	- (-***)	- (-**)
Openness x ShFOOD(p)	+	- (-)	+ (+)
ShNONFOOD(p)	-	+ (-)	- (-)
Openness x ShNONFOOD(p)	-	- (-)	- (-)
RATIOFOOD(p)	+	+ (+)	+ (+)
Openness x RATIOFOOD(p)	+	+ (+)	+ (+)
Perishable/non-perishable crops			
ShPERISH(p)	-	-	-
Openness x ShPERISH(p)	-	-*	-
ShNONPERISH(p)	-	-	+
Openness x ShNONPERISH(p)	-	-	-
RATIOPERISH(p)	-	-*	-
Openness x RATIOPERISH(p)	-	+*	+
Diversification			
InvHHProduct(p)	-	- (-)	+ (+)
Openness x InvHHProduct(p)	-	+ (+)	- (-)
InvHHGroup(p)	-	- (-)	- (-)
Openness x InvHHGroup(p)	-	+ (+)	+ (+)
InvHHFood(p)	+	+ (+*)	+ (*)
Openness x InvHHFood(p)	-	+ (-)	- (-)
Crop groups			
Cereals(p)	-	-	
Openness x Cereals(p)	+	-	
Vegetables(p)	-	-	
Openness x Vegetables(p)	+	+	
Fruits(p)	-	-*	
Openness x Fruits(p)	-	-	
Nuts(p)	+	-	
Openness x Nuts(p)	-	+	
Coffee, cocoa, tea(p)	-	-**	
Openness x Coffee, cocoa, tea(p)	+	-***	
Spices(p)	+	-	
Openness x Spices(p)	-	-	

Table A6.1: Continued

Exploratory variables and interaction terms	Hypothesised effect	Calculated effect	
		Individually	Combined
Oil(p)	+	+**	
Openness x Oil(p)	+	-	
Other food(p)	+		
Openness x Other food(p)	+		
Fibres(p)	-	+	
Openness x Fibres(p)	-	-	
Rubber(p)	-	-	
Openness x Rubber(p)	-	-	
Tobacco(p)	+	+	
Openness x Tobacco(p)	-	-***	
Other non-food(p)	+	+	
Openness x Other non-food(p)	+	+	

Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'; negative (-) effects means with its increased value, variable decreases growth rate volatility whereas positive (+) effect indicates increased growth rate volatility with variable's increased value; results in parenthesis are for analyses without the intercept term; shaded variable indicates confirmed hypothesis