Economic Implications of the Doha Development Agenda for China

Haiyan Wang

Department of Economics

University of Dublin

Trinity College

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Declaration

I declare that this thesis, submitted to Trinity College for the degree of Doctor in Philosophy (Ph.D.), has not been submitted as an exercise for a degree at this or any other university. All research herein is entirely my own. All the sources are fully acknowledged and are cited in the reference sections.

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Summary

The aim of my PhD thesis is to assess the consequences of possible Doha Round outcomes for China. The thesis is introduced in Chapter 1, which discusses the motivation for the thesis and outlines its structure.

Chapter 2 provides a detailed description of the computable general equilibrium (CGE) model used in the thesis - the GTAP model and database (Version 6). The discussion of the model structure includes detailed explanation of the functioning of the model economy and the behaviour of the economic agents. The source and construction of different components of the database are also described. The second half of the chapter gives an account of a review of literature on the analysis of trade liberalisation with CGE models.

The core of the analysis begins with a conventional GTAP model analysis to examine the welfare effects of the Doha Round trade liberalisation in the third chapter. The results suggest that China benefits from the Doha Round, particularly from manufacturing trade liberalisation. Labour-intensive sectors, such as textiles and apparel, leather products, rice and fruit and vegetables, are expected to expand in both production and exports. On the other hand, capital-intensive sectors, such as automobiles and parts and electronic machinery, are likely to be adversely affected. A broad examination on changes in prices and wages suggests that poverty and income inequality are likely to be reduced following the simulated Doha scenario.

One of the disadvantages of the analysis in Chapter 3 is the perfect labour mobility assumption used in the standard GTAP model, which does not reflect restrictions on labour movement in China. To model this feature of China's labour market in GTAP, Chapter 4 of the thesis derives the labour mobility elasticity between urban and rural areas in China following the approach by Jacoby (1993) and Sicular and Zhao (2002).

The empirical analysis shows that labour allocation choices between agricultural production and market wage employment are not responsive to changes in market wages, but are rather sensitive to changes in shadow wages in agricultural production. This indicates that labour is not pulled out of agriculture by higher market wages, but is pushed away by low agricultural returns. The elasticity of transformation of labour between farm and non-farm sectors is estimated to be 3.716%, which is incorporated in the GTAP model in the next chapter.

Chapter 5 re-examines the impact of the Doha Development Agenda on China, by including unemployment and imperfect labour mobility into the GTAP model. The analysis shows that labour movement is an important issue in determining the allocation of production factors between sectors, output responses and changes in prices and wages. The higher the degree of unskilled labour mobility between farm and non-farm sectors, the bigger the output responses and the narrower the gaps between agricultural and non-agricultural wages. When unemployment in the agricultural sector is also modelled, the simulated Doha Round is expected to increase the level of rural employment in China. The expansion of agricultural production does not have to rely on drawing labour from manufacturing sectors, as is predicted under full or fixed employment assumption. As a result of this more realistic assumption, China benefits more from the Doha Round.

Chapter 6 takes a closer look at the poverty and income distribution effects of the Doha Development Agenda on rural China at the household level. Changes in prices are taken from the GTAP analysis and then passed to a first-order welfare approximation function to estimate welfare changes for each household. The study suggests that in aggregate the Doha Round has a modest but positive welfare impact on rural households in China, but that the gains are not equally distributed, i.e., there are winners and losers among rural households. Household characteristics partly explain the differences in the level of gains and losses across households.

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Chapter 1 Introduction

This thesis is a collection of studies examining the economic implications of the Doha Development Agenda for China. More specifically, the aims of the thesis are:

- To quantify the impact of possible outcomes of the current Doha Round of the World Trade Organisation (WTO) on the Chinese economy, in a Computable General Equilibrium (CGE) setting.
- To more accurately model trade policy reforms within a CGE framework, and to apply more credible modelling to the Chinese economy, through the incorporation of labour market imperfections into the standard CGE model.
- To measure the effects of the conclusion of Doha Round negotiations on the poor in rural China at the household level.

1.1 Background and Motivation

The Doha Round of trade negotiations to further liberalise world trade was launched in November 2001. An important element of the Round is to rebalance trade rules in favour of developing countries and provide additional market access for their exports. Because of this focus, the new Round is also known as the Doha Development Agenda (DDA). It aims to lower trade barriers in a wide range of areas, including agriculture, manufacturing and services, and in addition to strengthening the rules governing international trade.

Seven years have passed and the Doha marathon is yet to reach an end. Meetings in Geneva in July 2008 were intended to bring Doha to a conclusion. However, despite making significant progress on a wide range of outstanding issues, members failed to bridge their differences on the special safeguard mechanism on agricultural products in developing countries, which would allow developing countries to raise tariffs temporarily in order to deal with import surges and price falls. At time of writing (summer 2009) the Doha Round is at risk of collapse.

As the world's most populous developing country having recently joined the WTO, how important is it to China to conclude the Doha Agenda successfully? What are the consequences for China if the failure at Geneva in July 2008 were to persist? How significant might the overall income and welfare effects of a successful outcome be? In which areas of the Doha Agenda would China be expected to gain - in which areas would it lose out - and by how much? What are the implications of Doha for poverty alleviation and income distribution in China?

Many studies have touched on these issues[1] and most have predicted a positive impact on China and the world economy (for instance, Polaski 2006, Anderson, Martin and van der Mensbrugge 2006). This thesis will contribute to the body of work in the following respects. First, this research examines the effects of the Doha Round on China in particular, in terms of economic welfare changes, sectoral

[1] See the literature review section in Chapter 2.

performance, price and wage changes, and the effect on poverty and income distribution. Second, this study uses the most recent trade reform proposals for the Doha Round to calibrate applied tariff cuts for countries so that a more accurate and realistic simulation is conducted using the CGE model. Third, this thesis divides unskilled labour in China into two broad sectors: agricultural unskilled labour and non-agricultural unskilled labour, and the mobility of unskilled labour between these two sectors is assumed to be imperfect. Fourthly, a large surplus of cheap rural labour[2] has long been a feature of the Chinese economy, and has served as one of the main forces behind China's rapid economic growth. The standard CGE model is therefore modified to allow for rural unemployment of unskilled workers in China. Lastly, when examining the poverty and income distribution effects of the Doha Round, data for "real households" based on a recent household survey are used instead of a representative household to take into consideration heterogeneity across households. These modifications help to provide a more accurate measurement of the impact of the Doha Round on China.

1.2 Structure of the Thesis

After the brief introduction presented in Chapter 1, which discusses the motivation for the thesis, Chapter 2 begins with a detailed discussion of the standard GTAP model and database. GTAP is a comparative static, multi-regional, computable general equilibrium model of the world economy, with 87 regions and 57 sectors

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[2] Cai (2007) suggests that underemployed rural workers in 2005 were about 105 million, which is equivalent to 22 per cent of total rural labour in China that year.

separately distinguished. It has now become one of the most popular CGE modelling tools. Significant modifications to the model are made in later chapters to ensure greater realism and to capture specific features of the Chinese economy not included in the standard model. Chapter 2 also gives an account of major studies applying CGE models to trade liberalisation analysis. Building on this literature, the analytical core of the thesis aims to project the potential outcomes of the Doha Round for the Chinese economy.

Chapter 3 provides a standard CGE analysis on the impacts of the Doha Round on China at the national level. The base data are updated to reflect changes in world trade since 2001. The analysis takes special care to accurately model trade barrier reductions by translating the latest WTO proposals, outlined in December 2008 at the WTO, into applied tariff cuts using the TASTE programme[3]. "Sensitive products" are also designated for China where smaller tariff cuts are applied. Both a plausible Doha scenario and a full global trade liberalisation scenario are simulated to quantify the changes in prices and quantities, national welfare, poverty and income distribution, etc..

The next contribution modifies the perfect labour mobility assumption adopted in the Chapter 3 analysis. Chapter 4 examines labour supply allocations in rural China using a household survey dataset[4]. A two-step approach following Jacoby (1993),

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[3] The Tariff Analytical and Simulation Tool for Economists. See details on TASTE in Chapter 3.
[4] Rozelle et.al (2000)

Skoufias (1994) and Sicular and Zhao (2004) is adopted to estimate the labour transformation elasticity between rural and urban sectors. First, shadow wages are imputed by estimating the household agricultural production function. Second, labour supply allocations are modelled as functions of shadow wages, observed market employment wages, and other relevant variables. The coefficients of the estimation are used to calculate the unskilled labour mobility elasticity between agriculture and non-agriculture.

Chapter 5 then applies this estimate to the GTAP model to investigate the implications of labour market imperfections for the impacts of the Doha Development Agenda examined in Chapter 3. The key assumption is that unskilled labour is perfectly mobile within agriculture (and within non-agriculture), but imperfectly mobile between agriculture and non-agriculture. The mobility is modelled using a Constant Elasticity of Transformation (CET) function. Further, unemployment in the agricultural sector is also incorporated into the model.

Another disadvantage of the Chapter 3 analysis is that it does not allow for heterogeneity of households in terms of endowment, skill sets, and consumption preferences, etc. This is because in the standard GTAP model there is only one representative household. To overcome this problem, Chapter 6 passes the simulation results on price changes from the CGE analysis on to a static, one-period first-order welfare approximation model to impute welfare gains and losses using household survey data. The poverty and inequality effects of trade liberalisation on China are therefore examined for "real households". This will allow for an in-depth household level analysis on poverty and income distribution and an identification of winners and losers among different households.

It is hoped that the results of the analysis may offer interesting insights into the consequences of a successful Doha Round for the Chinese economy, at both the macro and micro level. Chapter 7 concludes the thesis by offering a summary of the findings and sets out suggestions and directions for future research.

Chapter 2 Methodology and Literature Review

When examining the impact of trade policy changes, economists can choose among various methodologies. The partial equilibrium methodology usually focuses on one market of the economy, assuming that relevant economic variables such as prices and quantities in all the other markets are constant. The advantage of a partial equilibrium model is that it allows analysts to model the chosen market in greater depth without worrying about other markets. General equilibrium analysis, on the other hand, intends to capture the entire economy. It produces not only the first round effects of a policy shock on the relevant market, but also the impact on other markets and the feedback effects from these to the original market.

Cross-country econometric regression is also a common approach to examining the link between trade openness, economic performance, and poverty and inequality. This approach compares changes over time in poverty and inequality between countries with various degrees of openness in order to examine whether trade liberalisation is "pro-poor". In comparison with general equilibrium analysis, cross-country regression relies more on historical changes over time, but general equilibrium analysis is more suitable for an *ex ante* estimation of the impacts of trade liberalisation.

The computable general equilibrium model used in this thesis is the so-called Global Trade Analysis Project (GTAP, based in Purdue University). This strand of models creates a simulation of the workings of actual economies as they engage in trade, represented through an extensive series of equations that establish the relationships between economic variables (Polaski, 2006).

GTAP was established in 1992, with the objective of lowering the cost of entry for those seeking to conduct quantitative analyses of international economic issues in an economy-wide framework. Tom Hertel, the founder of GTAP, describes it as a comparative static, multi-regional CGE model of the world economy (Hertel, 1997). GTAP describes the vertical and horizontal linkages between all product markets within individual regions (i.e., countries or groups of countries) as well as between regions via international trade flows. GTAP shares many basic features with other current CGE models.

Version 6.1 of the GTAP database was used for this thesis. This chapter begins with a detailed description of the GTAP model and database. It then reviews the relevant literature applying CGE models to trade liberalisation analysis. This includes CGE analyses of the Doha Development Agenda in general, with a focus on findings on the Chinese economy, and on the impact on the poor.

2.1 The GTAP Model - Methodology and the Database

2.1.1 Overview of GTAP

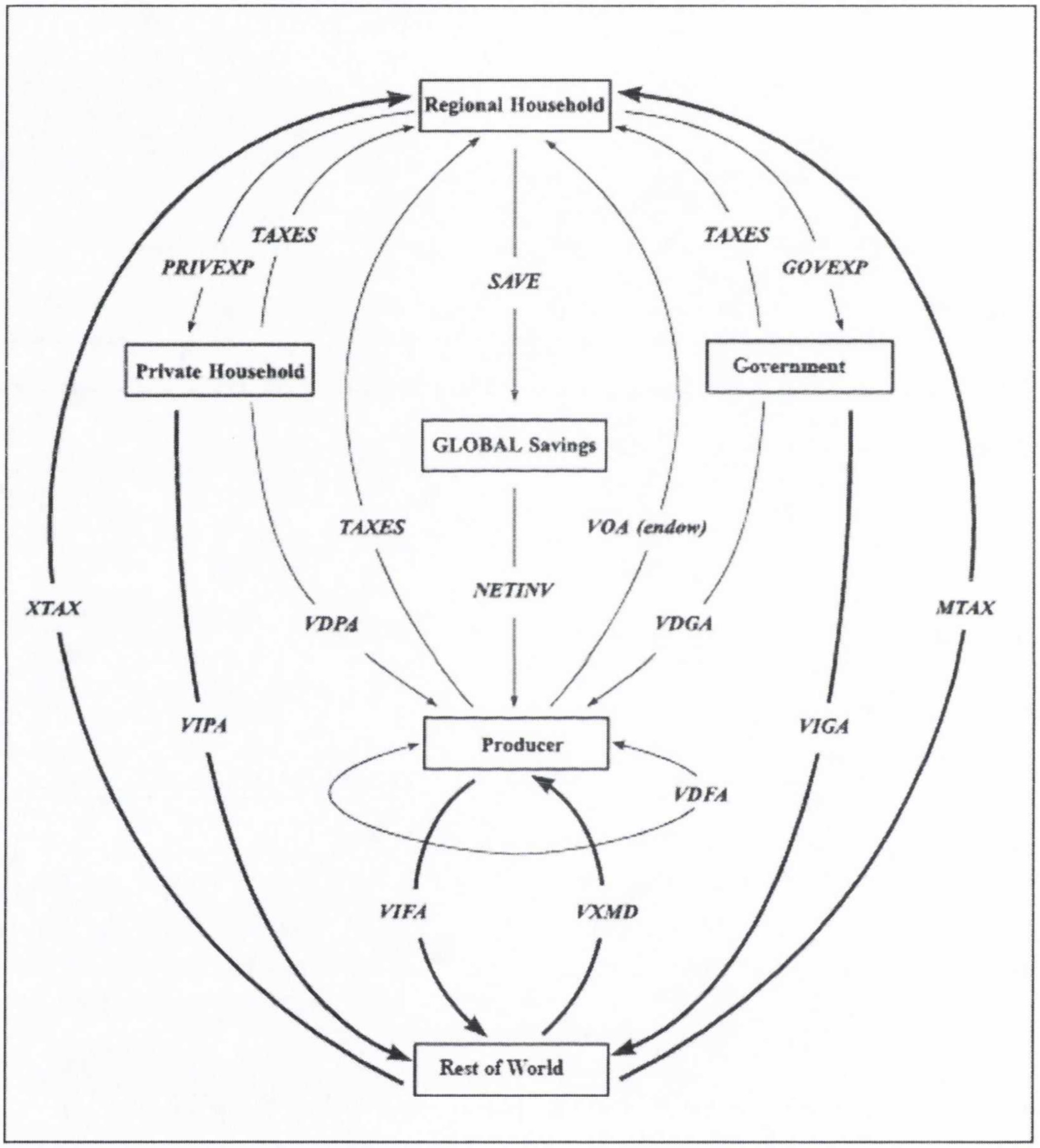
In the standard GTAP model the activities of economic agents — private households, firms and governments — are modeled under neoclassical assumptions. Consumers are assumed to maximise utility and producers to maximise profits. Markets are perfectly competitive and zero-profit conditions are satisfied at equilibrium. Prices and quantities are endogenously determined by households and firms' optimising behaviour, subject to resource limitations of the economy. Regions and economies are linked through international trade. A typical region in GTAP could be a single country, such as China, or it could be a few countries aggregated together, such as the European Union.

Figure 2.1 offers an overview of economic activity in an open economy. At the top of the figure is the representative regional household. Expenditures by this household are governed by an aggregate utility function that allocates expenditures across three broad categories: private, government, and savings expenditures. Savings expenditures go to producers via investment. Private households and the government spend their available income on domestic consumption or imports, and pay taxes to the regional household.

Firms combine their resource endowments with intermediate goods (domestic or imported) to produce goods for final demand. This involves sales to private households, government and for exports or sales of investment goods. There are taxes or subsidies on intermediate inputs, factors of production and consumption.

As shown in Figure 2.1, Rest of the World (ROW) is at the bottom of the figure. This makes the figure a representation of a multi-region open economy. The ROW is the source of imports into the regional economy as part of consumption (VIPA and VIGA) and intermediate inputs (VIFA). It is also the destination for exports, where the producers get additional revenues for selling commodities (denoted as VXMD) to the ROW. Furthermore, tariffs (MTAX and XTAX) are applied to the exchanges between ROW and the domestic economy.

Figure 2.1: Structure of Multi-region Open Economy in GTAP



Source: Brockmeier, 2001

2.1.2 Model Structure[1]

This section discusses the behaviour of the three agents in the GTAP model and the underlying behavioural equations.

Firm Behaviour

Producers' behaviour in the GTAP model is usually represented by an inverted production tree (See Figure 2.2). The key assumptions behind the technology tree are separability and constant returns to scale. A production function is separable when the marginal rate of technical substitution (MRTS) between two inputs is independent of other inputs. This means that firms' choice of the optimal mix of primary factors is invariant to the prices of intermediate inputs, and *vice versa*; the elasticity of substitution between any primary factor and intermediate inputs is zero, due to the Leontief assumption; and furthermore, the mix of imported intermediates are separable from domestic intermediates. The constant returns-to-scale assumption implies that perfect competition is assumed, and firms earn zero profit at equilibrium. The zero profits condition serves to determine the price of output in each sector.

At the top of the tree is total output (all the quantities are in percentage change form), assuming Leontief production technology. The standard GTAP model rules out the substitution between intermediate and primary inputs. Any price increase in intermediate inputs would not be followed by substitution towards more primary inputs and vice versa. Within the value-added nest, pair-wise constant elasticities of substitution (CES) are assumed.

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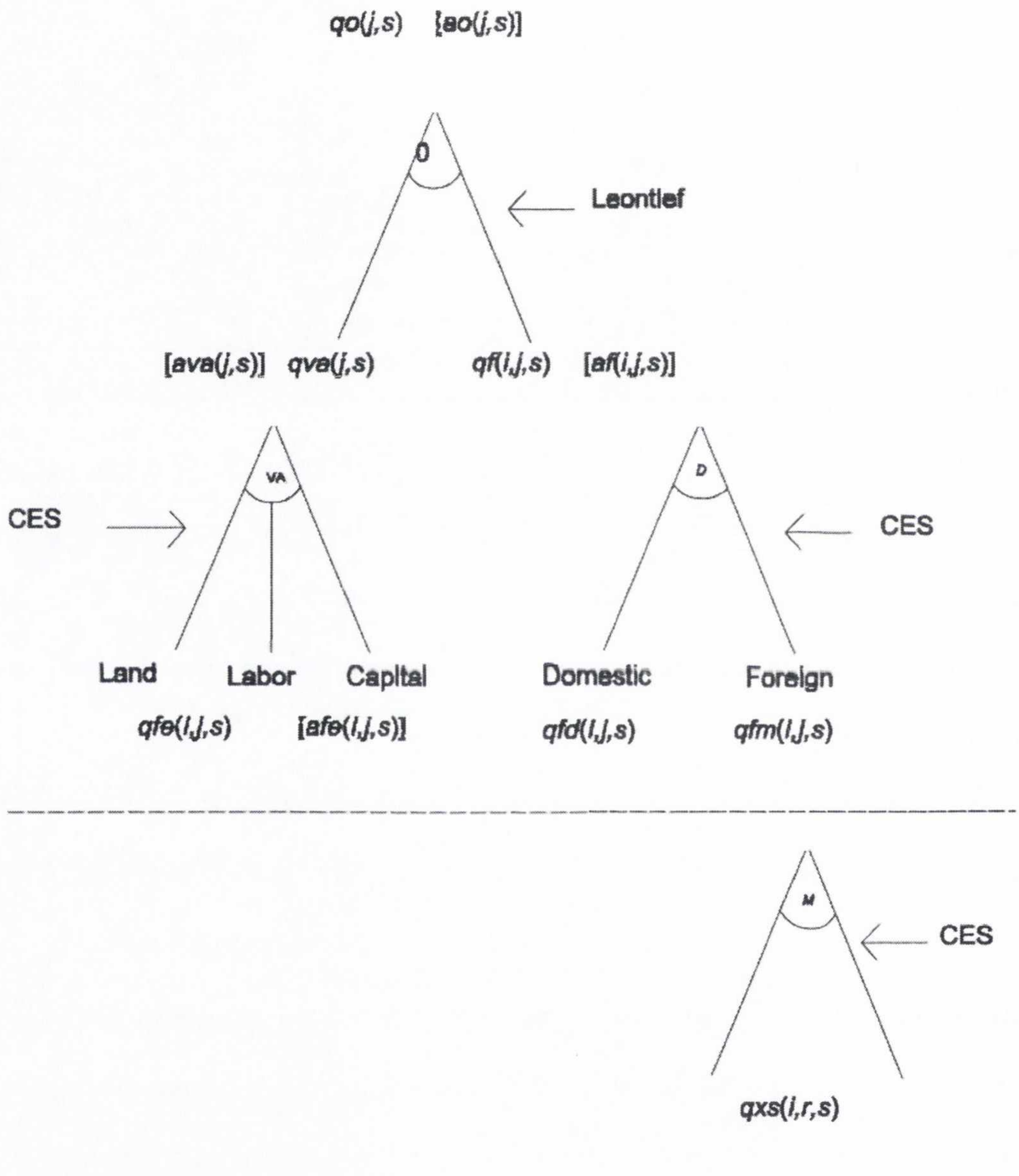
1 This part is drawn mainly from Hertel and Tsigas (1997).

Figure 2.2 Production Structure in GTAP



Source: Hertel and Tsigas "Structure of GTAP" (1997)

There are two nests on the intermediate input side. Firms first decide the composite source of their imports (the bottom of the tree), and then determine the optimal mix of imported and domestic inputs. As information on the composition of imports of intermediates by sector is not available, the dashed line is used between the firms' production tree and the constant elasticity of substitution nest combining bilateral imports. The CES assumption within each of the two nests is known as "Armington approach". The first tier assumes that domestic products are differentiated from imports, and the second tier assumes imports are differentiated by origin. Product differentiation and imperfect competition is now a preferred approach in CGE models, because traditional trade models with homogeneous goods, such as the Heckscher – Ohlin model, could not explain the problem of "cross-hauling" in international trade statistics, where a country usually exports and imports the same products simultaneously.

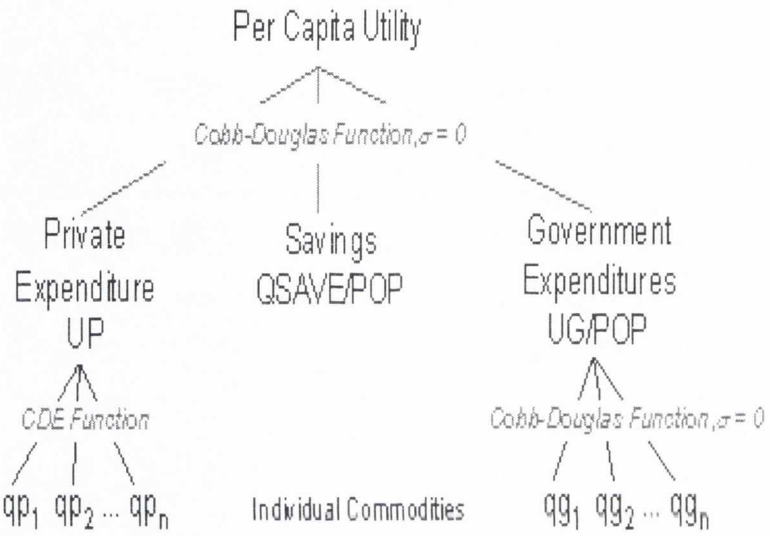
Household behaviour

Regional household. As shown in Figure 2.1 and further specified in Figure 2.3, the regional household receives all the income generated in a given economy and spends it on private, government and future consumption (savings) according to a Cobb-Douglas per capita utility function. Using a regional household gives some advantages: we can use regional income to compute regional equivalent variation as a measure of the welfare change resulting from a simulation; and we do not need detailed data on individual domestic taxes and subsidies. But there are some disadvantages as well. For example, there is no direct link between government expenditure and income, and there is no explicit government budget or constraint.

Government expenditure. The Cobb-Douglas assumption of constant budget shares on public goods is again applied to government consumption. Similar to the firm's demand in Figure

2.2, the Armington assumption is employed between imports and domestic public goods and between imports from different countries.

Figure 2.3 Household Behaviour in GTAP



Source: Hertel, GTAP annual short course, 2004

Private expenditure. Unlike savings and government demand, private consumption is not homothetic in real income. This requires the model to take into account the population growth rate when computing the utility of private household consumption. The percentage change in private utility, *up(r),* is therefore defined on a per capita basis. The constant difference of elasticities (CDE) functional form is used instead of a Cobb-Douglas function. The CDE function lies between the non-homothetic CES functional form and the fully flexible forms. It allows expenditure shares to change when income or relative prices change. For example, when a consumer's income increases, she would shift away from food and clothes and spend more on luxury goods.

Import Demand - Armington Elasticities

GTAP adopts the Armington approach to introduce product differentiation or imperfect competition between imports and domestic products, as well as among imports from different sources. There are two sets of Armington elasticities in the standard GTAP model: ESUBM and ESUBD. ESUBM describes the elasticity of substitution between regional allocation of imports, while ESUBD describes the elasticity of substitution between domestic goods and imports. They are the same for all regions but vary between sectors. As shown in Table 2.1, ESUBM elasticities approximately double the values of ESUBD, by the "rule of two". This rule was first proposed by Jomini *et al.* (1991). Liu, Arndt, and Hertel (2002) recently tested the rule, but failed to reject it, thereby lending additional support to this approach.

Closure

A **closure** in GTAP specifies exogenous and endogenous variables in the model. Endogenous variables are those whose values are determined in the model, while exogenous variables are those whose values come from outside of the model. Mathematically, a viable closure ensures that there are as many equations as endogenous variables, and thus ensures that the model provides a unique equilibrium solution. Economically, a closure is a meaningful representation of the economic system in the model. It specifies how the economy works.

Table 2.1: Armington Elasticities

ESBM	ESUBM	ESUBD
Rice	6.4	3.6
Wheat	8.9	4.5
Oilseeds	4.9	2.5
Sugar	5.4	2.7
Plant based fibre	5.0	2.5
Live animals and meat	6.9	3.0
Other Agricultural Products	5.0	2.6
Other Primary Products	13.0	4.9
Processed Food	4.6	2.3
Beverage and Tobacco	2.3	1.2
Textile	7.5	3.8
Apparel	7.4	3.7
Leather Products	8.1	4.1
Light Manufacturing	6.3	3.1
Chemical & Petroleum Products	6.1	2.9
Automobiles and Parts	5.6	2.8
Electronic Machinery	8.4	4.2
Metals	7.3	3.6
Other Manufacturing	7.5	3.5
Services	3.8	1.9

Source: GTAP 6 database

In the standard GTAP model closure, prices (including exchange rates), quantities of all non-endowment commodities, and regional incomes are endogenous variables, while policy variables (such as taxes, tariffs), technical change variables, population and total labour employment are exogenous. Perfect competition and full employment are assumed. Factors are mobile within regions but not between regions. Investment expenditure is determined by savings rates. This is also referred to as the "neo-classical" closure. Given the standard closure, we can design the simulations according to policy changes, i.e., "shock" one or more exogenous variables and then analyse how it would affect the economy.

In GTAP, all prices are in relative terms. A world average price of primary factors is treated as the numeraire. All the other prices are relative to this. It provides a point of reference against which the changes in all other prices are compared.

Factor mobility

In the GTAP model, primary factors that are perfectly mobile within a region are distinguished from those that are sluggish. In a standard model, the former includes both skilled and unskilled labour, and capital, and the latter refers to land and natural resources. The movement of a sluggish endowment commodity is governed by the elasticity of transformation, $\sigma_T < 0$. If σ_T is close to zero, then the allocation of factors across sectors is almost fixed and factor supply is very irresponsive to changes in relative returns. As σ_T becomes more negative, the supply of factors becomes more and more responsive. In the limit, as σ_T approaches negative infinity, the factor is perfectly mobile and returns to the factor converge across sectors.

2.1.3 GTAP Database[2]

The central ingredient in GTAP's success has been the global database (Hertel, 2002), which is used in most major CGE models (Polaski, 2006). The database consists of regional input-output data, bilateral trade, transport, and protection data. The Version 6 database based in 2001 used in the current work covers 87 regions and 57 sectors. The author is aware that Version 7 of the GTAP database has been made available since late 2008. However, most of the analysis in this thesis was already finished at the time. Future

[1] This part is mainly drawn from Dimaranan and McDougall (2002)

work will attempt to update the current analysis using the newly available database. This section gives a brief description of the data used in the thesis.

Bilateral trade data

One of the most important contributions of GTAP has been in the area of improved bilateral trade data for economic modelling (Hertel, 1997). The bilateral trade data has three dimensions: commodity, source and destination. The major source of the bilateral trade data is the United Nations COMTRADE database. The IMF balance of payments statistics are also used to obtain services data.

A special case is re-export services in Hong Kong. Hong Kong is one of China's major trading partners. A large part of Hong Kong's imports are re-exported to China at higher prices. This kind of re-exporting generates substantial revenues for Hong Kong exporters. In the data Re-exporting is treated as an export of trade services from Hong Kong to the destination countries. The value of the services is accounted for and referred as the "re-export markup" or "re-export margin". All Hong Kong's imports destined for other countries are re-routed such that the country of origin exports directly to the final destination rather than imported by Hong Kong and re-exported.

Protection data

The protection data in the GTAP Version 6 database come from the MAcMap dataset, a joint project by CEPII (the Centre d'Etudes Prospectives et d'Informations Internationales, Paris) and ITC (International Trade Centre, Geneva). MAcMap provides tariff rates at HS-6 digit level, including ad valorem tariff equivalents of specific and compound tariffs and key non-tariff barriers such as tariff-rate quotas (TRQs). It also incorporates all significant reciprocal and non-reciprocal preferences. MAcMap is the most comprehensive tariff database currently available. The Version 6 database has lower tariffs than the previous Version 5 database because of the inclusion for the first time of non-reciprocal trade preferences and because of major trade reform between 1997 and 2001 such as the continued implementation of the Uruguay Round agreements (Anderson, Martin and van der Mensbrugghe 2006).

In practice, many regions don't apply their bound tariffs. Their applied tariff rates may not only vary by sector but also by trading partner. There is usually a gap between bound and applied tariffs, which is called binding overhang. The binding overhang can determine significantly the impact of any negotiation outcome. To get rid of the "water" in bound tariffs, the GTAP database provides all the applied tariff rates, which are normally lower than the nominal or bound rates.

The average export tax equivalent rates of the ATC (Agreement on Textile and Clothing) quotas for the developing countries are reported in GTAP. They are based on the estimates of Joseph Francois and Dean Spinanger. The EU, US and Canada are the three countries that impose quotas on the developing countries in the model. The export tax equivalent rates are highest in South Asian countries. There are also large average export subsidies for textiles and wearing apparel in Uruguay, Rest of South America, and Rest of the Middle East. These large export subsidies are taken from the regional I-O tables. They more than offset the export tax equivalents of the ATC quotas in these countries.

Regional input-output data

In GTAP the regional input-output (I-O) tables provide information about the individual regional economies. They come from diverse sources and are harmonised to the same regional and sectoral aggregation and base year. Sectoral sales and cost data are derived heavily from I-O tables. In general, the input-output tables are adjusted to match the international trade data, instead of the other way around.

An I-O table summarises the employment of factor endowments and intermediates in production for each sector and each region. The I-O table contains the following matrices: an intermediate input matrix for domestic use of domestically produced commodities, an intermediate input matrix for domestic consumption of imports, final demand for domestic products, final demand for imports, taxes, etc.

2.1.4 The Structure of the Chinese Economy in the GTAP Database

Table 2.2 below presents the structure of the Chinese economy following the update of the GTAP 6 baseline to include China's WTO entry in 2001, EU enlargement and the removal of the Multi-Fibre Agreement (MFA) (see Chapter 3 also). As shown in the table, China is a large consumer and producer country. China produces and consumes 27% of world fruit and vegetables. Fruit and vegetables are labour intensive sectors. We would expect their output and exports to rise with further trade liberalisation as they could take advantage of Chinese abundant low-cost labour in rural areas. China also consumes 18% of world rice, 18% of world oilseeds, 17% of world cotton, 11% of live animals and meat and 10% of world wheat. The shares of China's output in these products are also significantly high. Food security has always been the top priority of China's agriculture policy and indeed China has been very successful in achieving a high grain self-sufficiency rate (wheat and rice for example), with very low grain trade flows with the rest of the world. The sufficiency rates for oilseeds and sugar are relatively low, at 56% and 81% respectively. Imports of these two commodities are large compared to domestic production. It is noticeable that China is a very small sugar consumer, consuming only 1% of total world sugar production. Currently imports of sugar are under the Tariff Rate Quotas (TRQs) system, with very low within-quota tariffs applied. The possible increase in quotas under the Doha Round is likely to see a big inflow of sugar into the Chinese market, given that the utilisation rate of the quota for sugar is relatively high compared to grain products[3].

China has a comparative advantage in most manufacturing sectors, especially apparel, leather products and light manufacturing. China's exports in apparel and leather products amount to more than 23% and nearly 36% of total world trade, respectively. On the other hand, its competitive position in the automobile sector and chemical & petroleum products is less favourable.

The last two columns of the table show the levels of trade protection applied to Chinese imports and exports. On average China's exports face a much higher tariff (20.7%) than imports into China (8.2%). The applied tariff rates faced by agricultural imports into China are extremely low. This is due to the application of TRQs, given that TRQ quotas are not binding for most of the products. For instance, the tariffs on rice and wheat are only 0.3%

[3] In 2006 the utilisation rate for sugar is about 70 per cent, while the utilisation rates for wheat, corn and rice are 6.3, 1 and 13.7 per cent respectively.

and 0.4%, but tariffs imposed on China's exports of rice and wheat are as high as 142% and 15%. These high tariffs can be explained by high protection levels in WTO members like Japan, the EU and Korea. Given the current tariff structure, China is expected to see a smaller impact from its own agricultural liberalisation but a bigger impact from other countries' tariff cuts.

China's protection on manufacturing products is slightly higher than that on the agricultural sector, but the average applied tariff rate is still only 10%. This is again lower than the world average. Due to measurement difficulties, trade protection on the services sector in GTAP is set to be zero or very close to zero for all countries. Given the very low tariff rates imposed by China before the Doha round, we expect to see a small cut in China's protection level, and hence a possible small impact on the Chinese economy from China's own trade liberalisation.

Table 2.2: Structure of the Chinese Economy in 2001 (2001 US$ Millions)

Sector	Value of Output	Value of Exports	Value of Imports	Self Sufficiency	World Output	Total World Trade	China's Consumption Share	China's Output Share	China's Export Share in World Trade	China's Applied Tariff Rates	Applied Tariff Rates imposed on China
Rice	42,049	640	101	101%	225,869	7,674	18%	19%	8%	0.3	129.9
Wheat	9,280	53	200	98%	95,096	16,205	10%	10%	0%	0.4	14.7
Oilseeds	7,552	475	5,980	56%	74,066	18,403	18%	10%	3%	5.6	34.1
Sugar	1,464	33	282	81%	164,951	8,509	1%	1%	0%	14.9	36.8
Plant based fibre	6,814	97	220	98%	39,878	8,334	17%	17%	1%	2.4	1.5
Live animals and meat	109,448	3,018	2,649	100%	1,009,901	75,048	11%	11%	4%	10.1	11.2
Fruits and vegetables	116,505	2,085	612	101%	429,132	46,994	27%	27%	4%	12.5	34.2
Other Agricultural Products	24,580	2,553	2,859	96%	638,211	73,050	4%	4%	3%	13.6	22.9
Other Primary Products	116,770	5,421	12,722	93%	1,167,969	366,503	11%	10%	1%	1.4	3.3
Processed Food	67,933	5,846	2,723	104%	1,462,148	164,346	4%	5%	4%	12.3	14.6
Beverage and Tobacco	46,397	966	529	101%	647,076	52,605	7%	7%	2%	19.1	33.1
Textile	153,489	24,023	18,420	102%	774,995	199,045	19%	20%	12%	10.1	13.8
Apparel	66,721	36,989	2,610	203%	510,812	160,351	6%	13%	23%	15.7	18.5
Leather Products	55,127	31,904	2,293	214%	210,918	89,747	12%	26%	36%	8.6	15.5
Light Manufacturing	91,421	15,721	8,644	107%	1,834,819	272,172	5%	5%	6%	3.0	8.2
Chemical & Petroleum Products	273,405	27,561	39,157	94%	3,450,907	808,916	8%	8%	3%	8.2	7.1
Automobiles and parts	45,374	2,650	6,528	90%	1,677,805	529,564	3%	3%	1%	13.7	9.2
Electronic machinery	388,801	125,655	101,509	105%	4,316,185	1,841,976	8%	9%	7%	5.4	6.4
Metals	210,393	18,561	19,843	98%	2,319,840	430,951	9%	9%	4%	4.5	8.7
Other Manufacturing	258,522	57,075	11,808	120%	1,914,371	503,128	11%	14%	11%	9.8	10.8
Services	930,151	22,462	37,345	99%	35,569,576	1,245,934	3%	3%	2%	0.0	0.0

Source: GTAP Database and own calculations, see text.

2.2 Application of General Equilibrium Analysis - Literature Review

2.2.1 Economic implications of the Doha Development Agenda

The Doha Development Agenda is seen as the vehicle through which trade liberalisation can bring economic development and reduce poverty to the developing world. The World Development Report (2002) by the World Bank states that "Open trade in agriculture and labor intensive manufactures would raise incomes among the world's poor". IMF also states in their 1997 World Economic Outlook that "Policies toward foreign trade are among the more important factors promoting economic growth and convergence in developing countries".

The findings from empirical analyses are less straightforward. Ever since the Doha Development Agenda was launched, there has been a growing literature looking at its potential impacts on the world economy and the distribution of gains and losses among countries. China is usually separately distinguished in the models and thus, the effects on China are explicitly estimated. The current literature covers a recent generation of CGE models, including the World Bank's recursive dynamic LINKAGE model (Van der Mensbrugghe 2004b) used by Anderson, Martin and Van der Mensbrugge (2002 and 2006), GTAP-AGR (Global Trade Analysis Project- Agriculture) model used by Hertel and Keeney (2005) and Anderson and Valenzuela (2006), MIRAGE model used by Bouet (2006), Diao, Diaz, Bonnila, Robinson and Orden's (2005) CGE model, and the Carnegie model used by Polaski (2006). These studies are summarized in table 2.2 below.

Most studies have predicted an overall welfare gain for the world and for China from further trade liberalisation. Early CGE projections published by the World Bank in the World Development Report 2002 are overly positive. Using GTAP 5 database, they project a gain of 539 billion dollars for developing countries from full trade liberalisation, which is equivalent to 4.75% of their GDP. They also predict that about 2.75 million people will be out of poverty using 1 dollar per day standard and 165 million using 2 dollars per day measurement. The report was published before the Cancun Ministerial Meeting and became hugely influential and contentious.

A similar study examining the impact of global full liberalisation by Anderson et al. in 2006, however, forecasts a 128 billion US dollars gain for developing countries, which is only about one fourth of the original figure. Accordingly, the reduction of poverty headcount is rather limited. The big gap between the two studies stems mainly from the newly available GTAP 6 database being used in the later study, which is based in 2001. GTAP 5 data, however, is based in 1997. Moreover, GTAP 6 takes into account for the first time the tariff preferences that provide more favourable market access for goods exported by developing countries to developed countries. Models including GTAP 5 and earlier models that do not include these preference arrangements count these existing market access advantages as gains to be achieved from the Doha Round, thus overestimating the impacts of the Doha Round. In addition to database differences, Anderson et al.'s 2006 study also incorporates trade policy changes such as China's WTO entry, EU enlargement and the elimination of the Multi-Fibre Agreement, which were not included in the previous study.

Anderson, Martin and Van der Mensbrugge (2006) also designed more modest scenarios to model the possible outcomes of the Doha Round. They find a harmonizing formula for agricultural tariffs and a linear cut in non-agricultural tariffs would yield a global gain of about 96 billion dollars. Most of the gains go to high income countries. Developing countries only see a very modest gain ($16 billion) from the Doha deal. Moreover, most of the benefits for developing countries would not go to the poorest countries in Africa, but to a small number of emerging economies - Argentina, Brazil, China, India, Mexico, Thailand, Turkey, and Vietnam. China's national income increase is very small, amounting to about 1.7 billion US dollars.

Polaski (2006) finds the Doha round generates positive but quite modest income gains at the global level, ranging from $40 to $60 billion, depending on the level of the ambition in the scenario. China comes out as the biggest beneficiary from the simulated Doha scenario, with large gains from manufacturing trade liberalisation and losses from agricultural liberalisation. Overall China's income will increase by 10.3 billion US dollars. Hertel and Keeney (2006), on the other hand, predict a 22 billion US dollar welfare gain for the world and 5 billion US dollar gain for China from full trade liberalisation.

Table 2.3 Comparisons cross different studies of CGE trade liberalisation analysis

	Anderson et. al (2006)	Polaski (2006)	Hertel and Keeney (2005)	Anderson and Valenzuela (2006)	Bouet (2006)	Diao et. al (2005)
Model	LINKAGE	Carnegie	GTAP-AGR	GTAP-AGR	MIRAGE	MIRAGE
Dynamic?	Recursive dynamic	Static	Static	Static	Recursive dynamic	Some dynamic productivity effect
Database	GTAP 6.05	GTAP 6.05	GTAP 6	GTAP 6	GTAP 6	GTAP 5
Unskilled labour mobility	Free	Imperfect	Imperfect	Imperfect	Imperfect	Free
Employment	Fixed	Unemployment	Fixed	Fixed	Fixed	Unemployment for developing countries
Plausible Doha Scenarios						
Agricultural products						
Developed countries	45, 70 and 75% cut with inflexion points 15 & 90	36% linear cut	Full liberalisation	Full liberalisation	Full liberalisation	Full liberalisation
Developing	35, 40, 50 and 60% cut	24% linear cut	Full liberalisation	Full liberalisation	Full liberalisation	Full liberalisation

countries						
Manufacturing products						
Developed countries	50% cut on bound rates	50% cut on applied rates	Full liberalisation	Full liberalisation	Full liberalisation	Full liberalisation
Developing countries	33% cut on bound rates	33% cut on applied rates	Full liberalisation	Full liberalisation	Full liberalisation	Full liberalisation
Export subsidies	Eliminated for all countries	Eliminated for all countries	Full liberalisation	Full liberalisation	Full liberalisation	Full liberalisation
Domestic support	10 to 28% cut in 4 developed countries	1/3 cut for developed and developing	Full liberalisation	Full liberalisation	Full liberalisation	Full liberalisation
LDCs special treatment	No reductions	No reductions	Full liberalisation	Full liberalisation	Full liberalisation	Full liberalisation
Global welfare	$96 billion	$59 billion	$22 billion for developing countries	n.a.	$99.6 billion	$10 to 20 billion for developing countries
China's welfare	$1.7 billion	$14 billion	$5 billion	n.a	0.6%	0.2-0.3%

There is also variation in findings from studies on agricultural trade reform. In the Polaski (2006) simulation, China loses 0.3 billion dollars from agricultural liberalisation. Bouet (2005) also finds China's agriculture sector is adversely affected, with a decrease of 0.2% in production. On the other hand, Anderson and Valenzuela (2006) find that China benefits from both agricultural and non-agricultural global trade reforms. Agricultural value added increases by 11% while non-agricultural value added increases by 4.3%. Hertel and Keeney (2005) also show that China benefits from removing all agricultural tariffs and subsidies. The gains are mainly due to the removal of tariffs rather than the removal of export subsidies and domestic support.

Why do results vary from one study to another? There are many explanations. One important reason is the different data used by different modelers. Diao, Diaz, Bonnila, Robinson and Orden (2005) used the GTAP 5 database with base year in 1997, while other studies used the more recent GTAP 6 database with the base year in 2001. As pointed out by Polaski (2006), models that use earlier versions of GTAP tend to overestimate the gains that can be achieved from further trade liberalisation in the Doha Round. Even though many modelers use the same GTAP 6, the update of the database could differ across studies. Some provide a baseline projection of the world economy (Anderson, Martin and Van der Mensbrugge, 2006), and some include "Everything but Arms" agreement (Bouet, 2006s). Baselines that include such pre-simulation shocks are very different from those that do not.

The second reason could be the use of different estimates of the likely final tariff cut at the end of the negotiations. Since there aren't any final agreements, modelers have their own estimates of the final agreement for tariff and non-tariff reduction. Anderson, Martin and Van der Mensbrugghe (2006) in one of their scenarios use CEPII's Doha scenarios to cut the applied agricultural protection rates based on the Harbinson proposal (but slightly higher than the Harbinson proposal). They also take into account special and sensitive products. Polaski (2006), among a number of scenarios, also designs a plausible Doha scenario, which, however, is significantly different from Anderson, Martin and Van der Mensbrugghe's (2006) simulation (as can be seen in Table 2.2). These two studies simulate both more modest and realistic Doha scenarios, and full trade liberalisation scenarios. Others examine full trade liberalisation only, in which all the trade distortions including agricultural tariffs and subsidies and non-agricultural tariffs are removed. Such studies include Hetel and Keeney (2005), Bouet (2006) and Anderson and Valenzuela (2006). It should be noted that full liberalisation simulations provide an upper limit for the potential gains we can expect from the Doha round and are therefore expected to produce bigger results than a more realistic Doha scenario.

The third reason is different models used by different modellers. Although most models share basic common elements, some key elements of the models could be very different from each other. Some models are static, such as standard GTAP and GTAP-AGR. Static models do not take into account of capital accumulation and productivity growth. Some models are recursive dynamic models, such as LINKAGE and MIRAGE. The dynamics are driven by exogenous population and labour supply growth, savings-driven capital accumulation, and labour-augmenting technological progress. There are also significant differences within the static and dynamic models themselves. For example, the GTAP-AGR model is a modification to the standard GTAP model. The former incorporates a region-specific elasticity of land transformation amongst agriculture uses, region-specific labour and capital supply elasticities between agricultural and on-agricultural sectors, and substitution among farm-owned and purchased inputs.

Also, modelers tend to use different closures. In CGE models, closure is used to define endogenous and exogenous variables and other characteristics. Anderson and Valenzuela (2006) use the standard GTAP closure, in which regional balance of trade is determined by the relationship of regional investment and savings. In the World Bank LINKAGE model used by Anderson, Martin and Van der Mensbrugghe (2006), the current account balance and government fiscal balance is fixed. Additional imports are financed by increasing export revenues, which is typically achieved by real exchange rate depreciation. The assumption about employment may vary too. Some models assume full/fixed employment while others incorporate unemployment into the model.

Lastly, the Armington elasticities play a very important role in determining the results. Those used in the standard GTAP model are quite conservative compared with those in, for example, the World Bank's LINKAGE model. For this reason, the key results using the GTAP model can be considered lower-bound estimates (Anderson and Valenzuela, 2006). Further, the Armington assumption itself implies that there is one variety of the product for each region, so the aggregation of regions could potentially change the results.

2.2.2 WTO trade reforms and the poor

The poverty impact of trade liberalisation is still an ongoing debate. The Doha negotiations are now emphasizing the need to better understand the linkages between trade policies – particularly in rich countries – and poverty in the developing world. (Hertel and Winters, 2004). The relationship between trade and poverty reduction can be modeled through the impact of the former on economic growth, changes in consumer prices and factor prices, availability of goods, technology spill-over, etc (Winters, 2000). But the relationship between trade liberalisation and economic growth itself is an unresolved one. Whether consumer price changes, especially those of agri-food products, can generate net welfare gains for the rural poor depends on the magnitude of the substitution and income effects.

The literature on poverty and inequality effects of Doha round falls into two broad categories: studies which use representative household models and studies with "real" households. The former group of studies includes primarily multi-region CGE analyses with a broad brush of the impact on poverty. For instance, Anderson et al. (2006) estimate the unskilled wage changes and then link them to poverty reduction using an estimated income-to-poverty elasticity of 2 to calibrate the poverty alleviation headcount from full trade liberalisation. They find that the number of people living in extreme poverty (those earning $1 per day or less) in developing countries would drop by 32 million in 2015, compared to a baseline level of 622 million. Under their plausible Doha scenario, the poverty impacts are far more modest. The headcount is estimated to fall only by 2.5 million.

Polaski (2006) only examines the poverty impacts qualitatively. She finds that poverty might deepen or become more widespread in the countryside given that many developing countries experience negative effects from agricultural liberalisation. However, growing manufacturing exports could absorb some of these displaced farmers. As regards China, which reaps the largest gains, a Doha pact that lowers barriers to exports of low-skilled manufactured products could present a boost to income, if more jobs are created in that sector than lost in agriculture.

An overall study of developing countries is not able to take the special characteristics of different countries. Research on poverty impacts of trade reform is new and almost the only consensus it has reached is that countries differ (Hertel and Winters, 2006). It is therefore desirable to carry out country-specific analyses. A few studies on China are reviewed here. Recent work by Anderson, Huang and Ianchovichina (2004) focuses on the impacts of China's WTO accession on farmers' income and rural poverty. They employ GTAP version 5 model and database in 1997 and project it forward using World Bank projections of population, income, and endowments of productive factors. China's labour market limitations are accounted for in the model. Their results suggest that WTO accession may increase farm-nonfarm income inequality due to a bigger fall in relative producer prices of farm products than labour-intensive nonfarm products. At the same time farm unskilled wages decrease, while nonfarm unskilled wages and skilled wages both increase. Rural households' income might increase or decrease depending on the proportion of the income earned off-farm. Income inequality between unskilled and skilled nonfarm labour may improve slightly, as the real unskilled nonfarm wages increase more than skilled wages.

Huang, Li and Rozelle (2003) use a partial equilibrium model called China Agricultural Policy Simulation (CAPSIM) to measure the effect of WTO entry on poverty in China. They divide the farmers into 33 groups, depending on their income level and their region. They find that most of the farming sector is likely to benefit but the benefits are not distributed equally among farmers. Richer farmers in coastal areas will gain more than the poor ones inland because the former group enjoy better land quality and higher international production competitiveness. They recommend that relevant government policies are needed to make WTO trade reforms friendlier to equity and poverty reduction.

The problem of the representative household method applied in the above studies reviewed is that it fails to capture income distribution between real households. Even with more than one representative household, the "within-group" inequality is not differentiated. We need a more rigorous framework to combine "real" households with general equilibrium analysis. Cogneau and Robilliard (2000) pioneered this in a study on poverty in Madagascar. They embed over 4,000 households into a national CGE model to take into account of the heterogeneity of skills, labour preferences and consumption preferences of different households. They carry out a set of simulations and show that this kind of approach overcomes the difficulties of partial or general equilibrium analysis using representative households. The paper also stands out from previous studies in that the household behaviour is econometrically estimated and modelled.

Hertel and Zhai (2004) conducted a poverty study on China using a disaggregated household national CGE model. Based on the 1997 survey data, they group the households into 100 representative households, with 20 income levels for 2 rural and 3 urban strata. They find that multilateral trade reforms benefit most households in China. Overall the poverty headcount falls using 2 dollar per day poverty line. The biggest poverty reductions occur in the rural areas, largely as a result of higher agricultural prices. In the urban areas, households reliant on transfer payments might lose out. Their study also modelled labour market reforms in China. They show in their earlier work (2004) that when labour market reforms are included, the rural-urban income inequality will be reduced further.

Fully embedding individual households into the CGE model is a very demanding task. A more efficient way of linking CGE models with micro data is the so-called macro-micro sequential analysis, which has become increasingly popular. It combines the strengths of both macro-CGE models and micro-level simulations. Chen and Ravallion (2004) apply this method to examine the impact of WTO accession on China. They take the estimates of changes of prices and wages from Ianchovichina and Martin's (2002) GTAP analysis and apply them to 84,000 sample households in China. Their first-order welfare approximation gives a very detailed picture of the poverty impacts at the household level. Overall China's WTO accession has a very small impact on mean household income, inequality and poverty. However, there is variance across households of different characteristics. Rural families are predicted to lose slightly. Their mean income per capita decreases by 18 Yuan. This is caused by the drop in the wholesale prices of most farm products, plus higher prices for education and health care. Urban households gain 29 Yuan on average. They will enjoy lower prices for most farm products and higher wages. Impacts also differ across provinces. Farmers in the northeast region are hit by lower prices of feed grain after the WTO accession. The limitations of this study, though, are that households don't respond to the price changes and it does not explicitly model the labour market.

Kuiper and Tongeren (2004) overcome these problems by building a village level CGE model based on a household survey in a village in South China. They first produce macro-level GTAP simulation results from Doha round reforms, such as changes in prices for agricultural inputs and outputs and changes labour demand. They then feed these changes into the village model. The village model incorporates farm-household models, allowing for nonseparability of household production and consumption. As in Huang et al. (2003) they use a price transmission coefficient of 0.75 to link macro national level price changes to village level price changes, considering the imperfect integration of domestic markets. As for labour demand increase, they assume percentages changes in aggregate labour demand to be completely transmitted to the village. Their analysis show that all households benefit from Doha reforms, however, those households involved in outside province migration gain most.

This kind of village level analysis could be very data-demanding, and it might not be representative across China. Recent development has focused on labour market and migration in the micro-simulation. Herault (2006) uses the multinomial logit model to predict the occupational/sectoral decision by the workers. Each individual chooses the sector with the highest associated utility. He uses a regression model to predict individual earnings, which are used to calculate and update household real net incomes after trade reforms. Bussolo, Lay and van der Mensbrugghe (2006) also focus specifically on modelling the decision between farm and non-farm labour migration.

2.3 Conclusions

This chapter describes the Global Trade Analysis Project (GTAP) used for CGE analysis in the thesis. This standard model is modified in the following chapters to reflect a more realistic representation of the Chinese economy. Details of the modification can be found later where relevant.

The chapter also surveys the current literature on the implications of further trade liberalisation. There is a consensus on the overall economic benefit for China and the world. When focused on the poverty impacts of the trade liberalisation, China is also predicted to see a reduction in poverty headcount by most researchers. The findings on income distribution seem to be mixed. All studies have their advantages and disadvantages. These will be borne in mind as the analysis in later chapters builds upon this existing literature to carry out a special case study for China.

Chapter 3 A CGE Analysis of the Consequences of the Doha Development Agenda on China

3.1 Introduction

A successful Doha Round could have significant implications for all countries involved. This chapter examines the economic consequences of Doha Round trade liberalisation on the Chinese economy.

Since joining the WTO in 2001, China has become a more active and prominent figure in the world economy. China's exports have been growing at an accelerated rate of 29.6% per annum between 2002 and 2006, compared to 12.4% per annum during the five years preceding accession.[1] The current Doha Round of trade liberalisation is expected to create more export opportunities for China. Domestically, however, China faces many challenges, such as the relative decline of farm incomes, the widening gap between urban and rural incomes, and the maintenance of an effective food security policy.

The impact of Doha would be felt differently by different sectors, depending on the relative strength of each sector. Firstly, China has comparative advantages in the manufacturing sector, especially in labour-intensive commodities. Manufacturing has

[1] Calculation from Ministry of Commerce, the People's Republic of China (MOFCOM).

been the main driving force behind China's industrialization and rapid economic growth in recent years. In 2006, manufacturing accounted for 92.4% of China's merchandise exports (WTO Trade Policy Review: China, 2008). By developing-country standards, tariffs on manufactured goods in China are low, with a simple average applied MFN tariff of 9.7% in 2007, reflecting great openness and relative competitive advantage in this sector. Further global trade liberalisation under the Doha Round is likely to benefit China's manufacturing sector, particularly through improved market access for China's exports.

China's services sector, on the other hand, is underdeveloped and inefficient. Although the services sector has been growing over the past decades and its contribution to GDP has increased from just below 24 per cent in 1978 to around 40 per cent in 2008, it is still below the average level of some 52 percent for other developing countries (National Bureau of Statistics China and WTO). China made radical services commitments upon joining the WTO. However, the pace of liberalisation has been slower than that for manufacturing, and most services are still subject to a high degree of state control and a lack of competition. Services liberalisation is a particularly important but sensitive issue in the Doha Round. Protection levels on the services sector are difficult to measure, and the GTAP database includes no trade barriers (tariff equivalents to the qualitative barriers) for service sectors. Modelling services sector liberalisation is not included in this analysis.

China made substantial agricultural offers upon accession. Since then, China has seen significant increases in agricultural imports. China's agriculture sector is composed of numerous small and inadequately equipped farmers endowed with small plots of land. Many are worried that they are not likely to be able to compete with large farmers equipped with modern equipment and technology in developed countries. The nature of endowments in China means that further trade liberalisation is expected to shift agriculture production in China away from the land-intensive sector and stimulate the output and exports of labour-intensive crops (Huang, Li & Rozelle 2003, Lin 2001).

Further trade liberalisation also raises a challenge for China's grain self-sufficiency policy. Food security has remained a top priority for China's policy makers for decades. Although China has been successful in remaining self-sufficient in the past (see Table 3.1), the anticipated increase in imports of land-and-capital intensive products will be a concern for policy makers in China.

Table 3.1 Food self-sufficiency in China in the baseline[2]

Product	Baseline
Rice	101%
Wheat	98%
Oilseeds	56%
Sugar	81%
Plant-based fibre	98%
Live animals and meat	100%
Fruits and vegetables	101%
Other Agricultural Products	96%

Source: GTAP model baseline simulation results

[2] See Section 4.3.3 and Box 1 for detail.

Another concern is the impact of trade liberalisation on poverty and income distribution in China. While China lifted some 270 million rural poor out of poverty during the period 1980 to 2000, farmers have experienced much slower income growth in recent years. Moreover, the 'efficiency-driven-but-equity-ignoring' development experience has led to growing income inequality between rural and urban sectors, and across regions (Wan, 2008; Luo and Zhu, 2008). In 2004, the urban-rural income ratio was 3.2, which is among the highest in the world (Luo and Zhu, 2008). Globalisation, as represented by trade and foreign direct investment (FDI), is one of the most influential factors causing the dramatic increase in inequality in China (Wan 2008). Therefore, an analysis of the impact of the Doha Round on China would not be complete without looking at the impact on poverty and income inequality.

According to Heckscher-Ohlin theory, it is possible for countries to increase their incomes through specialisation and international trade. If international trade leads to a country to specialise in labour-intensive products, such a specialisation increases wages and benefits the workers, but decreases the income of the capital owners. Relative factor prices would move in the direction of equality between trading countries which share the same technology. The theory would therefore predict a gain for unskilled workers in China given China's factor endowments. However, restrictions on labour mobility in China might complicate the simple predictions from standard trade models. If labour is not allowed to move freely to labour-intensive sectors, the income distribution effect of trade is unlikely to be realised.

The objective of this chapter is to quantify how the Doha Development Agenda will impact on China, and also examine broadly the implications for poverty reduction and rural-urban income inequality. Particular attention is paid to more accurate modelling of trade liberalisation scenarios using the WTO December 2008 Draft Modalities, which provides the most recent update on Doha proposals upon which future negotiations will be based. Facilitated by the newly available TASTE programme (Horridge and Laborde 2008), I translate the nominal tariff cuts in the draft proposals into applied cuts that are readily applicable in GTAP. This is contrasted with a deeper trade liberalisation simulation which involves removing all tariff barriers completely across the world. The impact of China's own trade liberalisation is separately examined from the impact of the rest of the world's reforms in each simulation.

The structure of the chapter is as follows. The next section outlines the progress made towards reaching a conclusion of the Doha Round. Section 3.3 describes the methodology and the experimental design. Section 3.4 presents the results and the final section offers some conclusions and limitations of the study.

3.2 The Doha Round Negotiations – What's on the Table?

The December 2008 Draft Modalities[3]

The Doha Agenda is a comprehensive one. It covers agriculture, manufactures, services and WTO rules. Progress has been made despite the stalemate since the collapse of trade talks in Geneva in July 2008. The December 2008 draft modalities on agriculture and non-agriculture reflect the latest progress in the Doha negotiations, and they will be a focus of crucial talks in the future. The width and depth of the reforms proposed are significant in determining the impacts for all countries involved. This section outlines some of the main issues in the proposal and a more detailed description of the December 2008 proposals are provided in Appendix 3.1.

The Draft Modalities for Agriculture

Agricultural liberalisation has been a central and highly sensitive issue in the current round of negotiations. The Uruguay Round Agreement on Agriculture specified for the first time a framework for disciplines on agricultural support and production, but the extent of actual liberalisation agreed in the Uruguay Round was relatively limited. Specific targets for the cuts will be agreed in the current Round under "three pillars": market access, domestic support, and export subsidies and related issues. It has been already agreed in the 2005 Hong Kong Ministerial Meeting that export subsidies will

[3] This section is based on the Chairperson's Texts in December 2008 on Agriculture and NAMA respectively (Falconer and Wasescha, 2008). Available at www.wto.org.

be eliminated by 2013.[4]

For market access[5], the December 2008 text proposes that bound tariffs shall be reduced on a tiered basis in equal annual installments over a five-year period for developed country members and a ten-year period for developing members. The tiered formula ensures that those members with higher tariff levels will implement the largest cuts. The tariff bands and the targets of cuts are specified in the December Text. Smaller cuts are applied for developing countries and the bands themselves are also wider. Least developed countries (LDCs) are exempt from all commitments. There are also special treatments envisaged for Recently Acceded Members (RAMs) and Small Vulnerable Economies (SVEs). It should also be noted that some products are allowed smaller cuts depending on whether they are "sensitive products" (available to all countries) or "special products" (available only to developing countries).

Domestic support[6] is divided into three types: Amber Box, Blue Box, and Green Box. The Amber Box is directly linked to prices and production, and it is the most trade-distorting type of support. Countries providing large amounts of support would cut the Amber Box the most. A small or "de minimis" amount of Amber Box support are allowed, limited to 2.5 per cent of the value of production for developed countries and 6.7 per cent for developing countries. The less distorting Blue Box, i.e.,

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[4] See Hong Kong Ministerial Conference Declaration, 2005.
[5] See Appendix 3.1 for more detailed discussion on market access. Pp. 73-75.
[6] See Appendix 3.1 for more detailed discussion on domestic support. Pp 75-76.

direct payments to farmers based on the number of animals they have or the size of area planted, would be limited to 2.5 per cent of production for developed countries and 5 per cent for developing countries with caps per product. For supports under the "Green Box", i.e., supports for development, infrastructure, research, agricultural extension, structural adjustment, etc., revisions will be made to ensure that they are really "decoupled".

Modelling domestic support changes has not been included in the scenarios used in this study. However, there have been some interesting changes in China's domestic support policy in recent years. The Chinese government has switched from taxing farmers and agriculture to providing direct subsidies to grain production and purchased inputs. Yu and Jensen (2008) find that the impact of recent policy changes depends on which type of support China provides. If Blue Box and de minimis support are used, China will see increased grain production, increased rural employment, and significantly higher income. If decoupled payments are provided, these variables will remain unchanged. The Doha Round disciplines would not have a significant effect on China given China's low support base, but they could be important in constraining Chinese agricultural policy in the future.

The December 2008 NAMA Modalities

The December text on non-agricultural market access (NAMA) provided details of options for further trade liberalisation. A simple Swiss formula[7] is applied for tariff reductions for industrial products. A higher coefficient in the formula equals a lower tariff cut, and *vice versa.* The coefficient also defines the maximum tariff rate at the end of the period. No matter how high the original tariff is, a Swiss formula always produces a narrow range of final tariff rates.

In the December text, the coefficient for developed country members was 8 per cent, and the cut is implemented in 5 years. Developing country members can choose from 20, 22 or 25 per cent, depending on further options. The implementation period for developing countries is 11 years. Consistent with other aspects of WTO agricultural trade liberalisation, least developed countries are exempt from tariff reductions. As a net exporter in manufacturing products, China is expected to benefit from the reduction in non-agricultural tariffs.

3.3 The Methodology

The GTAP Model

The Global Trade Analysis Project (GTAP) model and database, a computable general equilibrium (CGE) model, is used to quantify the economic implications of Doha. GTAP is well suited for modeling the impact of changes in the world trading

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[7] The formula was proposed by Switzerland in the 1973–79 Tokyo Round negotiations. It is a special case of a harmonizing formula tariff cut, which greatly narrows the gap between high and low tariffs. The key feature of a Swiss formula is a number, or coefficient, which is negotiated and inserted into the formula. The formula proposed in the December 2008 text is $t_1 = \{[a \text{ or } (x \text{ or } y \text{ or } z)]*t_0\}/\{[a \text{ or } (x \text{ or } y \text{ or } z)]+t_0\}$, where t_1 is the final bound rate, t_0 is the base rate, a is the coefficient for developed members and x and y and z are coefficients for developing countries.

system. It returns the welfare impact of trade reforms for each country, calculated as the equivalent variation in income, as well as changes in prices and quantities for each commodity and factor of production.

The standard assumptions of GTAP are applied here: all prices, including real exchange rates, are endogenous. Quantities and regional incomes are also endogenous variables. Markets are assumed to be perfectly competitive. Prices of goods and factors adjust until all markets are clear. Conversely, tax rates, technology variables and population levels are all exogenous. Labour and capital are perfectly mobile between sectors within a region while land and natural resources are imperfectly mobile. Different regions and economies are linked through trade. The Armington assumption is used to differentiate between imported goods and domestic goods and between imports from different countries. A detailed description of the model can be found in Chapter 2.

The GTAP 6 database used in this analysis covers trade and production data for 87 regions and 57 sectors. To keep the sizes of the tables of results manageable, I aggregated the database to 20 regions and 21 sectors. This regional aggregation clearly distinguishes major players in the world market and China's main trading partners. The sectors cover 10 agricultural and food sectors, 1 primary sector, 9 manufacturing sectors and 1 services sector. Table 3.2 lists all the regions and sectors.

Table 3.2: Regional and Sectoral Aggregation

Regions	Sectors
EU	Rice
USA	Wheat
Japan	Oilseeds
China	Sugar
Hongkong	Plant based fibre
ASEAN	Live animals and meat
XASIA (Rest of Asia)	Fruits and vegetables
Taiwan	Other Agricultural Products
Brazil	Other Primary Products
Korea	Processed Food
AU and NZ	Beverage and Tobacco
New EU	Textiles
EU Candidate	Apparel
Russia	Leather Products
India	Light Manufacturing
SSA	Chemical & Petroleum Products
Canada	Automobiles and parts
MERCOSUR	Electronic machinery
Mexico	Metals
ROW	Other Manufacturing
	Services

Source: GTAP 6 database

"Water" in Tariffs

The Doha negotiations deal with legally bound rates, whereas tariffs actually charged can be much lower (applied rates). The gap between the two is the so-called "water" in tariffs. "Water" in tariffs creates one of the challenges of evaluating any trade proposals using GTAP or similar applied general equilibrium models where all tariff rates are applied rates. This is because reductions in bound tariffs do not always translate into corresponding reductions in applied tariffs. Take for example a developing country that has a bound tariff of 50 per cent but only charges 10 per cent. If the proposed cut in the bound tariff is 38 per cent, i.e., cut to 31 per cent, then there need be no change at all in the applied rate actually charged. Therefore, we can not simply reduce the applied tariff in GTAP by 38 per cent.

To compute the applied tariff cuts in GTAP, we need more detailed data on trade flows and on bound and applied tariffs to translate the proposed bound tariff reductions. Fortunately relevant data are available from CEPII[8] and the computation is made much easier using the Tariff Analytical and Simulation Tool for Economists (TASTE) programme. TASTE was created by Horridge of Monash University and Laborde of IFPRI[9] (Horridge and Laborde 2008). It compresses the impressively large CEPII trade tariffs dataset and allows the user to rapidly process the whole dataset. The user can specify different sets of tariff cut rules, for instance a tiered or Swiss formula. The programme then produces new applied tariff rates that can be used as shocks in GTAP.

In this study, the December 2008 Proposals were modelled directly in TASTE to take account of "water" in agricultural and non-agricultural tariffs. Specifically, for NAMA a simple Swiss formula is used. The coefficients for developing and developed countries are 8 and 25 percent respectively. For agriculture, the bound rates are cut by 50, 57, 64 and 70 percent for developed countries using a tiered formula with inflexion points at 0, 20, 50 and 75 per cent. For developing countries,

[8] The Centre d'Etudes Prospectives et d'Informations Internationales, Paris.
[9] International Food Policy Research Institute.

the inflexion points are 0, 30, 80 and 130 and the cut is two thirds of the equivalent cut for developed countries.

Sensitive products are considered when calculating China's applied tariff cuts. Laborde, Martin and Van der Mensbrugghe (2008) find that once sensitive and special products are included in the Doha scenario the worldwide cut in tariffs is more than halved. It is therefore necessary to consider sensitive products if one wishes to get a clearer picture of the implications of the Doha Round. Therefore, sensitive products are simulated in the model for China. Leaving out sensitive products for the rest of world is likely to overestimate the results for China, as the tariff reduction level is likely to be smaller when sensitive products are considered. However, because agricultural trade liberalisation has a modest effect on the Chinese economy, as will be shown later in this chapter, the impact is likely to be very small.

Two options for designating 'sensitive products' are outlined in the December text. Either they have to be products that already had tariff quotas before the Doha Round, or members can choose any product to be sensitive. To select "sensitive products" for China, I assumed the first option. Products that are currently governed by the Tariff Rate Quota (TRQ) system, including wheat, rice, corn, cotton, wool, sugar, and vegetable oils[10], are all chosen to be "sensitive" (see Appendix 3.3 for details of the TRQ implementation in China). The importance of the commodity, the height of the existing tariff, and the gap between the tariff binding and the

[10] Note that TRQs for oil were removed in 2006.

applied rate are loosely taken into account in determining other "sensitive products" for China. Given that soybeans, rapeseeds, and some milk products are imported to China in relatively large volumes compared to other agricultural products, they are included in the sensitive products as well. Overall, six percent of tariff lines at HS6 level are classified as sensitive (see Appendix 3.2 for a complete list of sensitive products for China). Reductions on bound tariffs for sensitive products are assumed to be only half of the cuts specified for developing countries in each tier. Further, in-quota tariffs remain uncut given that China is a recently acceded member and the original in-quota tariffs are under 15 per cent. As a result, the applied tariff rates for most sensitive products in China would stay the same except dairy products.

Experimental design

The base year of the GTAP 6 data is 2001. Since then, substantial trade reforms have occurred, including China's accession to the WTO in November 2001, EU enlargement to 25 members in 2004, and the phasing out of the Multi-Fibre Agreement (MFA) in 2005. These reforms are incorporated into the model to create a baseline, against which two further simulations are implemented. The tariff shocks for China's WTO accession were taken from CEPII's baseline scenario estimated by Jean, Laborde and Martin (2005). The EU enlargement implies the elimination of all remaining trade barriers between the new and old members. Import tariffs and export subsidies between the two regions, and between the new members themselves, are set to zero. The new members implement the EU's common external tariff toward third countries. The phasing out of the MFA involves removing all the MFA quotas for textile and apparel exports by developing countries, measured as export taxes in GTAP.

Two simulations are designed to model the impacts of trade liberalisation on the Chinese economy. One is the Doha simulation based on the recent December drafts, including both agricultural and manufacturing trade liberalisation. The shocks to the applied tariff rates are generated in the TASTE model as mentioned above. The second simulation is full global merchandise trade liberalisation, where all tariffs are shocked to zero. Results from the two simulations are compared and contrasted. The simulations are summarised in Box 1.

On 1 January 2006, TRQs in China on soybean oil, palm oil, and rapeseed oil (10 items) were eliminated and the in-quota tariff rates are now applied to all imports of vegetable oils. China grants the right to trade such oils to all individuals and enterprises, subject to automatic import licences. For other products under the TRQ system, such as wheat, rice, corn and sugar, the fill rates are noticeably low. All the imports come into the Chinese market at very low in-quota tariff rates. Modelling TRQs thus becomes a minor concern for China.

Box 1: Summary of the Trade Liberalisation Scenarios

Simulation 0: Baseline

China's accession into the WTO, EU enlargement and the elimination of the MFA

Simulation 1: The December 2008 Modalities

Agricultural liberalisation:

Cut the applied agricultural protection rates corresponding to 50, 57, 64 and 70 per cent bound rate cuts for developed countries using a tiered formula and 47, 43, 38 and 30 per cent cuts for developing countries;

The tariff cut for sensitive products in each tier in China is half the cut specified for developing countries;

All developed and developing country members provide duty-free and quota-free market access to least developing countries; and

Eliminate export subsidies.

NAMA: applied import tariffs are reduced using a simple Swiss formula, where the coefficients are set at 8 and 25 per cent for developed and developing countries respectively;

All developed and developing country members provide duty-free and quota-free market access to least developing countries.

Simulation 2: Full trade liberalisation.

All tariff rates set to zero and all export subsidies eliminated.

The impact of Doha on the Chinese economy does not only depend on the level of the tariff cut, but also on the initial tariff levels imposed by China and other countries. The pace of tariff reform in China has been rapid in the past 20 years. The progressive reductions in tariffs between 1992 and 2001 lowered average tariffs by two thirds (Ianchovichina and Martin, 2004). This, coupled with substantial WTO commitments in 2001, ensures that China's tariff reductions required in further trade liberalisation are relatively small. As shown in Table 3.3, the average import protection on grain products is extremely low in the baseline; hence, no cut is required under the current Doha Round proposals. Although tariff rates on other agriculture commodities are relatively high, the cuts required are still relatively low. As a result, China is expected to benefit modestly from liberalization of its own agricultural sector.

China's import protection on manufacturing products is also relatively low, but a slightly higher cut is applied across manufacturing sectors. China's own NAMA liberalisation will possibly have a bigger impact than agriculture reforms.

However, tariffs imposed on China's exports were very high (also see Table 3.3) before Doha. Under the Doha agriculture proposal, these tariffs are to be cut substantially. For instance, the applied tariff rate or ad valorem equivalent on China's rice exports is to be reduced from 130 per cent to 36 per cent. The biggest contributors are Japan and Korea, whose protection on rice is cut from 1,000 per cent respectively to 233 per cent and 300 per cent (see Table 3.4). China's rice production and exports could easily shoot up after the Doha reform.

Table 3.3 China's applied tariffs and protection against China before and after Doha

	China's Import Protection		Protection Against China	
	Baseline: Pre-Doha	After Doha	Baseline: Pre-Doha	After Doha
Rice	0.34	0.34	129.89	36.12
Wheat	0.38	0.38	14.67	10.64
Oilseeds	5.63	5.63	34.10	12.37
Sugar	14.90	14.90	36.83	5.46
Plant Based Fibre	2.36	2.28	1.52	1.48
Live Animals and Meat	10.09	7.37	11.17	5.12
Fruit & Vegetables	12.48	9.13	34.18	22.01
Other Agricultural Prods	13.63	11.45	22.93	13.48
Processed Food	12.29	9.08	14.56	9.29
Beverage &Tobacco	19.06	12.54	33.13	19.95
Primary Products	1.45	1.27	3.30	2.50
Textile	10.13	6.44	13.82	9.68
Apparel	15.66	9.70	18.48	11.46
Leather Products	8.55	5.03	15.53	9.89
Light Manufacturing	3.03	2.24	8.22	6.85
Chemical & Petroleum Products	8.21	5.74	7.07	6.04
Automobiles and Parts	13.66	6.68	9.19	6.44
Electronic Machinery	5.36	3.41	6.42	5.63
Metals	4.47	3.56	8.69	7.44
Other Manufacturing	9.81	6.37	10.78	8.23
Services	0.00	0.00	0.00	0.00

Source: GTAP database and TASTE estimation

Other tariffs facing Chinese exports will also fall significantly, particularly for competitive sectors including fruit and vegetables, and textiles and apparel. Overall, protection against China would be cut much more than protection by China; hence, China is predicted to benefit more from other countries' liberalisation than from its own. In the next section, results from the estimation of the model are described in detail.

Table 3.4: Example: cuts on the rice tariffs facing China

	Before Doha	After Doha
EU	149	58
Japan	1000	233
Korea	1000	300
USA	9	5
ASEAN	11	10
Australia and New Zealand	0	0
India	66	30

Source: GTAP database and TASTE calculation

3.4 Results Analysis

Output, employment, exports and imports

Trade negotiators often think more in terms of the boost to the value of trade than to the increase in economic welfare (Anderson, Martin, Van der Mensbrugghe, 2006). Does global trade liberalisation boost China's exports? The simulation suggests that this is the case for China's textiles and apparel sectors (Table 3.5). China has a competitive advantage in these sectors, which together account for a quarter of Chinese exports in the baseline. Output in these sectors rises by 4 and 5 billion US dollars respectively. Corresponding to this, exports and employment also surge. This in turn stimulates the production of plant-based fibres (mostly cotton), which increases by 172 million US dollars. Imports of textiles also increase sharply (approximately 2.7 billion US dollars), mainly from Japan, Taiwan, Korea and the EU.

Table 3.5[11] Sectoral Effects for China from the Doha Round
(Changes shown as 2001 US$ million)

Sector	Output	Exports	Imports	Empl-Unskilled	Empl-Skilled	Producer Prices %	Consumer Prices %
Rice	2,454	1,765	-5	500	18	1.83	1.83
Wheat	52	-3	6	18	0	1.49	1.48
Oilseeds	12	-37	113	11	0	1.90	1.71
Sugar	50	41	3	16	0	1.82	1.82
Plant-based Fibre	172	2	12	46	0	1.49	1.45
Live Animals & Meat	567	-110	284	260	5	1.86	1.79
Fruit & Vegetables	284	309	37	209	2	1.96	1.95
Other Agri-Prods	1,068	911	203	272	5	2.09	1.38
Processed Food	26	125	218	-9	1	1.47	1.35
Beverage &Tobacco	137	182	42	2	2	1.26	1.16
Primary Products	-717	334	70	-222	-12	0.32	0.32
Textile	4,035	2,453	2,701	317	60	0.64	0.01
Apparel	5,154	5,686	585	842	122	0.64	0.02
Leather Products	4,528	3,991	562	449	74	0.86	0.34
Light Manufacturing	-1250	-441	279	-183	-23	0.80	0.69
Chemical & Petroleum Products	-4,701	-152	2,222	-372	-61	0.50	0.33
Automobiles and Parts	-2,149	-108	1,040	-164	-27	-0.04	-1.17
Electronic Machinery	-9,427	-1,614	4,442	-954	-168	0.36	0.03
Metals	-3,882	15	675	-364	-53	0.63	0.55
Other Manufacturing	-1,455	529	1,074	-248	-21	0.74	0.59
Services	-392	-796	429	-425	75	0.86	0.79

Source: GTAP model simulation results

The biggest response in agriculture takes place for rice. Production of rice increases by over 2 billion US dollars, which is met by increased unskilled labour demand in this sector. Employment opportunities are created. The increase in production is mostly driven by exports to Japan, Korea and the EU. Imports of rice remain largely unchanged.

11 The results presented here are measured against the baseline.

Output and employment for other agricultural products (including cereal grain, raw milk, wool, silk worm and vegetable oils) also increase by large amounts. There is a moderate increase in sugar, fruits and vegetable, oilseeds and processed food production. Exports of live animals and meat decreases while production and imports increase, indicating a likely shift in consumption from grain to meat when income rises.

Overall, the magnitude of changes in the manufacturing sectors is greater than in the agricultural sectors, and the changes are mostly negative. Although labour-intensive sectors such as clothing and leather products are boosted, other sectors such as electronic machinery, the automobile industry, chemical and petroleum products, metals, etc. will contract. Workers in these declining sectors will be drawn into the expanding sectors.

Electronic machinery represents approximately one third of total Chinese export value in the baseline. After the simulated trade liberalization, domestic output decreases by over nine billion US dollars. On the one hand, demand in the US, Japan, Hong Kong and Canada falls; but on the other hand, Chinese producers substitute towards imported intermediate goods because of lower prices through the tariff reduction. Over half of the increase in imports of electronic machinery is from the EU, followed by Japan, the US and ASEAN countries.

In all the sectors in which output expands, the additional output is to supply increased demand for Chinese exports mainly from developed countries, including the EU, Japan and USA, indicating China's trade flow pattern and a substantial tariff cut in these countries. On the other hand, the reductions in output have to be made up with imports. The change in flows of imports into China shows a similar picture with large increases from developed countries dwarfing those of developing countries.

Table 3.6 provides self-sufficiency rates in agriculture in China after the simulated Doha trade liberalisation. There are only minor changes compared to the baseline rates, except for rice. China remains self-sufficient in most agricultural products, but will continue to rely on imports to meet the excess demand of oilseeds and sugar.

Table 3.6 Food self-sufficiency in China after Simulation 1 (The Doha Simulation)

Product	Baseline- Pre-Doha	Post-Doha
Rice	101%	105%
Wheat	98%	98%
Oilseeds	56%	55%
Sugar	81%	84%
Plant based fibre	98%	98%
Live animals and meat	100%	100%
Fruits and vegetables	101%	101%
Other Agricultural Products	96%	99%

Source: GTAP model Simulation results

National Economic Welfare

In GTAP, welfare changes are measured using Equivalent Variation (EV), which is equal to the difference between the expenditure required to obtain the new (post-shock) level of utility at initial prices and that available initially (Huff and Hertel, 2001). The welfare changes reported in GTAP arise principally from the reallocation of resources within an economy, which is called the allocative efficiency effect. When import tariffs are reduced or eliminated, the market can move closer to its competitive equilibrium and reduce the efficiency losses associated with any tax or subsidy. Welfare changes may also result from terms of trade or other effects.

Welfare Changes from overall Doha trade liberalisation

The global welfare distribution across regions from the overall Doha trade liberalisation is presented in Table 3.7. There is a welfare gain of over 36 billion US dollars to the world economy, which is equivalent to 0.12 per cent of total world GDP. China's welfare also increases as a result of Doha trade liberalisation, by 0.24 per cent of total GDP. Most countries, except the US, Taiwan, Russia, new EU member states and Mexico, gain from the Doha liberalisation scenarios as proposed in the December 2008 draft.

The US is the biggest loser from the simulated Doha trade liberalisation. The welfare loss mainly results from changes in the Terms of Trade (TOT) effects. After Doha trade liberalisation simulated in this study, there is an increase in imports to the US. As a result, US exports have to rise to maintain the trade balance. The US increases exports by becoming more competitive, reducing costs and prices via lower factor prices. This reduction in export prices generates a TOT loss for the US.

Table 3.7 Total Welfare Effects of Doha Trade Liberalisation
(Measured as Equivalent Variation in 2001 US$ million)

Welfare	Total Welfare Change	% of GDP
EU	7,347	0.09%
USA	-2,255	-0.02%
Japan	16,065	0.38%
China	2,560	0.24%
Hongkong	512	0.32%
ASEAN	2,253	0.42%
XASIA	686	0.33%
Taiwan	-189	-0.07%
Brazil	2,191	0.43%
Korea	3,093	0.72%
AUandNZ	1,451	0.36%
NewEU	-88	-0.03%
EU Candidates	442	0.20%
Russia	-764	-0.25%
India	1,784	0.37%
SSA	476	0.15%
Canada	406	0.06%
MERCOSUR	332	0.09%
Mexico	-96	-0.02%
ROW	236	0.01%
Total	36,482	0.12%

Source: GTAP simulation results

Japan is the biggest winner (more than US $16 billion) in absolute terms. The welfare decomposition is shown in Table 3.8. The allocative efficiency change (US$16.4 billion) dominates the results. Japan has highly protected agricultural sectors before the simulation. After a deep tariff cut in these sectors (especially in rice), resources are allocated into more efficient sectors and hence the allocative efficiency improves. Korea is the biggest winner in terms of relative gain, which is 0.73 per cent of its

GDP. Similar to Japan, the gain is also due to a substantial cut in agricultural protection. The EU is the second biggest winner in absolute terms; its allocative efficiency gains are mainly captured among sectors such as sugar and livestock products. The elimination of export subsidies is a big contributor to the EU's allocative efficiency gains.

Table 3.8 Welfare Decomposition for Selected Countries from Trade Liberalisation (Measured as Equivalent Variation in 2001 US$ million)

WELFARE	Allocative Efficiency Effect	Terms of Trade Effect	Investment-Saving Price Effect	Total Welfare
EU	8,457	-1,479	368	7,347
USA	1,017	-2,468	-804	-2,255
Japan	16,172	-239	132	16,065
ASEAN	995	1,170	88	2,253
Brazil	432	1,650	109	2,191
Korea	2,665	532	-104	3,093
AU& New Zealand	260	1,205	-14	1,451
New EU	235	-291	-31	-88
India	2,030	-272	26	1,784
Sub-Sahara Africa	193	278	6	476
MERCOSUR	121	222	-10	332
World Total	36,538	-58	1	36,482

Source: GTAP model simulation results

Emerging economies such as Brazil, India and ASEAN countries are among the big winners from the Doha round. Brazil and India gain mostly from agricultural liberalisation as big agri-food producers and exporters, while ASEAN countries benefit more from non-agriculture trade liberalisation. Sub-Sahara African countries gain a moderate 476 million US dollars, mostly accrued from agricultural trade liberalisation. As a non-WTO-member country, Russia is not subject to any Doha modalities and hence loses out from Doha trade liberalisation.

The decomposition of the welfare changes for China is presented in Table 3.9. Allocative efficiency effects and terms of trade effects drive the positive welfare result. The former is predominantly due to tariff reductions across manufacturing sectors. The welfare change from agricultural liberalisation is negligible, as predicted, since China's baseline agricultural tariff rates are extremely low and the cuts are also very small in the simulation. The share of agriculture in China's total exports is very small as well. The TOT effect results from sectors such as electronics and machinery, textiles, apparel and leather products. The prices of exports of these products from China increase compared to the prices of imports. The investment and savings price effect is a terms of trade effect for the capital account.

Table 3.9: Welfare Effects of Doha Trade Liberalisaiton for China
(Measured as Equivalent Variation in 2001 US$ Millions)

Welfare Change	*US$ Million*
Total	2,560
Allocative Efficiency Effect	587
Terms of Trade Effect	2,487
Investment-Saving Price Effect	-474
Agriculture	182
Own liberalisation	4
Other countries liberalisation	178
Manufacturing	2434
Own liberalisation	-509
Other countries liberalisation	2943

Source: GTAP Model simulation results.

In both agricultural and industrial scenarios, other countries' trade liberalisation has a much bigger impact on China than China's own trade reforms. China only gains 4 million US dollars from its own agricultural liberalisation. As regards to China's own manufacturing liberalisation, the loss from the terms of trade effect (about -$1350 million) outweighs the gain from allocative efficiency effect (about $520 million). On balance China loses about 500 million US dollars from its own manufacturing liberalisation.

Welfare Changes from Agricultural Trade Liberalisation

Table 3.10 gives the figures on welfare change from agricultural trade liberalisation. The world has a total welfare gain of some 28 billion US dollars. Most countries benefit from agricultural trade liberalisation.

Once again Japan is the biggest winner, followed by the EU and Brazil. Their welfare gains are dominated by the allocative efficiency effect attributed to the sharp tariff cut in agricultural products. The tariff shock causes the resources to be redistributed from relatively less productive but highly protected sectors to more competitive sectors. As expected, there is a terms of trade loss for all the three countries, as tariff cuts lead to more imports, and in order to pay for the imports, Japan and the EU have to export more. This drives their export prices down and worsens their terms of trade. As one of the biggest winners from agricultural trade liberalisation, Brazil's welfare increase mainly comes from the terms of trade effect, attributed to the export price (fob price) increase after simulation. The impact on the US is fairly modest.

Table 3.10: Welfare gains from tariff reductions in agricultural goods

WELFARE	Allocative Efficiency Effect	Terms of Trade effect	Investment and saving price effect	Total
EU	7,454	-982	-1	6,471
USA	-124	393	13	282
Japan	15,648	-2,279	209	13,578
China	-121	395	-92	182
Hongkong	0	-47	-4	-52
ASEAN	274	784	-67	991
XASIA	-20	205	0	185
Taiwan	-502	-286	32	-756
Brazil	261	1,771	112	2,144
Korea	2,109	-307	11	1,813
AUandNZ	53	1,198	-49	1,202
NewEU	182	-115	-21	46
EUcandidate	398	-8	-2	388
Russia	-183	-250	11	-423
India	1,513	-364	-6	1,143
SSA	105	376	-11	470
Canada	219	328	-49	499
MERCOSUR	123	372	-61	435
Mexico	8	-113	-7	-113
ROW	725	-1,117	-18	-410
Total	28,123	-47	0	28,076

Source: GTAP model simulation results

China gains very little in this simulation. Since China's tariff cuts are very small or even zero in such major commodities as rice and wheat, there is not a big allocative efficiency or terms of trade welfare change. China suffers a loss of investment and saving price effect. As a net supplier of savings to global banks, the fall in the price of savings relative to investment goods leads to negative welfare effects.

Welfare Changes from Manufacturing Liberalisation

Table 3.11 shows the welfare changes from manufacturing liberalisation. The world in total gains 8.5 billion US dollars, which is much smaller than the gain from agricultural tariff cuts. This signals the greater importance of agricultural liberalisation elements in the current Doha Round negotiations. The USA, the new EU members and Russia are losers in this experiment. The USA suffers big terms of trade effect losses. The US is a big player in the world market and it can use optimal import tariffs to maximise welfare. Manufacturing liberalisation is then welfare-reducing for the US.

China benefits from this scenario, from both the allocative efficiency effect and the terms of trade effect. Japan, ASEAN, Korea, Taiwan and India also gain from manufacturing liberalisation. They are traditionally exporters in the world market and have comparative advantages in manufacturing sectors. The EU gains overall from manufacturing trade reforms but incurs a modest loss due to the terms of trade effect.

Table 3.11 Welfare Effects from Manufacturing Trade Liberalisation (Measured as Equivalent Variation in 2001 US$ Millions)

WELFARE	Allocative Efficiency Effect	Terms of Trade Effect	Investment-Saving Price Effect	Total Welfare Change
EU	960	-497	369	831
USA	1,158	-2,871	-811	-2,523
Japan	560	2,028	-75	2,514
China	713	2,109	-389	2,434
Hongkong	-1	495	69	563
ASEAN	723	387	152	1,262
XASIA	216	271	19	506
Taiwan	381	152	48	581
Brazil	203	-131	-1	71
Korea	578	844	-117	1,305
AUandNZ	220	5	33	259
NewEU	52	-178	-11	-138
EUcandidate	69	-12	2	59
Russia	-30	-530	218	-343
India	513	95	32	641
SSA	90	-107	16	0
Canada	128	-340	117	-94
MERCOSUR	2	-156	51	-103
Mexico	395	-496	122	20
Rest of the world	1,600	-1,096	155	660
Total	8,530	-28	2	8,503

Source: GTAP model simulation results

Poverty effects - Wages and Prices

In the standard GTAP model, a world average price of primary factors is treated as the numeraire. All the other price changes are relative to this. Changes in prices and wages are very useful in examining in a broad way the impact of trade liberalisation on poverty and on rural-urban income inequality. Generally speaking, if prices of agricultural products increase, farmers are likely to benefit from trade liberalisation. Given that farmers in China have a lower income than average and are more likely to be poor, this will have a positive poverty effect. The same is true for unskilled labour wages. As the majority of the labour employed in agriculture is unskilled, a relative increase in unskilled labour wages means farmers are getting paid relatively more. Lastly, GTAP also produces ratios of returns of primary factors (such as labour, land and capital) to help examine the well-being of farmers after trade simulations.

Table 3.5 gave percentage changes in supply and consumption prices for the simulated December 2008 Modalities scenario. Producer prices of farm products experience increases, which should lead to poverty reduction in rural China. Supply prices of non-agriculture sectors also increase, but by smaller amounts than for the agriculture sectors, indicating a possible improvement in rural-urban income inequality. Changes in private consumption prices are smaller than supply prices across all sectors. Prices of textiles and apparel experience very little change after Doha liberalisation. Poorer households who spend most of their income on subsistence goods are therefore better off.

Farmers also benefit from a predicted increase in the demand for land, the rental price of which increases by 4.42 per cent (see Table 3.12). Meanwhile, the real wages of unskilled labour increase by 0.54 per cent, more than the increase in skilled labour wages. Overall, as most workers in agriculture sectors are unskilled, poverty and income distribution may improve slightly.

Table 3.12: Changes in China's Real Factor Prices and farm household income

	% change
Rental price of land	4.42
Unskilled wages	0.54
Skilled wages	0.23
Rental price of capital	0.21
Farm household income from agriculture	1.51

Source: GTAP Model simulation results.

According to the GTAP database, 57 percent of farm income from agriculture comes from unskilled labour, 26 percent from land, and 17 percent from capital (Anderson, Huang and Ianchovichina. 2004). If we assume that all households have the same expenditure pattern before and after Doha trade liberalisation, a typical farm household's income would increase by 1.51 per cent.

Doha vs Full Liberalisation of Global Merchandise Trade

The Doha Development Agenda is only a small step towards a free global trade scenario. If Doha is welfare-enhancing, a deeper cut would benefit the world even more. In the second simulation, I create an ideal world trade scenario where all tariff barriers are removed for merchandise goods (i.e., agricultural and manufacturing goods) Indeed, the overall welfare gain to the world as a whole more than doubles (see Table 3.13).

Japan, Korea and EU are once again among the biggest winners, and their gains are dominated by allocative efficiency effects originating from trade protection cuts.

China's national economic welfare also increases sharply as compared to the simulated Doha scenario. Again, China benefits from both terms of trade effects and allocative efficiency effects (see Table 3.14). In terms of sectoral distribution, the benefits for China mainly result from manufacturing trade liberalisation, which is just over 4 billion US dollars. China benefits very modestly from agricultural trade reforms. As a big player in the world market, China incurs a terms of trade effects loss from its own liberalisation, particularly in industrial sectors such as textiles, apparel, leather products and electronics and machinery products. However, China is made better off from other countries trade reforms.

Table 3.13: Welfare Changes- Doha vs. Full liberalisation

WELFARE	Doha	Full liberalisation
EU	7,347	7,047
USA	-2,255	-4,401
Japan	16,065	27,786
China	2,560	4,773
Hongkong	512	6,192
ASEAN	2,253	6,857
XASIA	686	1,095
Taiwan	-189	1,694
Brazil	2,191	5,584
Korea	3,093	10,833
AUandNZ	1,451	2,328
NewEU	-88	61
EU Candidates	442	1,190
Russia	-764	831
India	1,784	1,636
SSA	476	-56
Canada	406	149
MERCOSUR	332	1,177
Mexico	-96	-95
ROW	236	7,994
Total	36,482	82,675

Source: GTAP Model simulation results.

Table 3.14: Welfare Effects for China from full liberalisation
(Measured as Equivalent Variation in 2001 US$ Millions)

Welfare Change	*US$ Million*
Total	4,773
Allocative Efficiency Effect	1,535
Terms of Trade Effect	4,272
Investment-Saving Price Effect	-1,034
China's own liberalisation	-2,614
Other countries liberalisation	7,385
Agricultural liberalisation	470
Manufacturing liberalisation	4,303

Source: GTAP Model simulation results.

Complete free trade would also reduce poverty and narrow rural-urban income inequality in China. Agricultural households in China also benefit more from full global trade liberalisation as real returns to factors increase more than in Simulation 1 (see Table 3.15). The rental price of land increases by a significant 6.22 per cent, while the real wages of unskilled labour increase by 2.07 per cent. Using the same calculation as before, overall income from agriculture for farmers would increase by 3.08 per cent.

Table 3.15: Changes in China's Real Factor Prices and farm household income

	% change
Rental price of land	6.22
Unskilled wages	2.07
Skilled wages	1.70
Rental price of capital	1.65
Farm household income from agriculture	3.08

Source: GTAP Model simulation results.

3.5 Conclusions

This chapter provides a quantitative examination of the impacts of the Doha Development Agenda on China and the rest of the world using a static computable general equilibrium model. Special attention is given to more accurately model agricultural trade barrier reductions by taking account of water in tariffs and sensitive products for China. The implications for poverty and rural-urban income inequality in China are also examined. Three simulations have been designed: a baseline simulation to incorporate trade reforms before the Doha Round, a Doha simulation based on the December agriculture and NAMA proposals, and an alternative simulation of full liberalisation of global merchandise trade. The analysis suggests that the overall trade liberalisation brings welfare gains to China and the world; Japan is the biggest winner. The EU, ASEAN, Brazil and Korea are among the big winners also. But, some countries such as the USA and Russia will lose from further trade liberalisation.

After the global trade reforms simulated in this study, particularly with regard to the manufacturing sector, China is going to play a bigger role in the world market. Exports of textiles, apparel and leather products from China will increase sharply. On the import side, textiles, chemical and petroleum products, electronic machinery and metals are the three main sources of import expansion. Some agricultural imports, for instance rice, live animals and meat products, will increase too. The study finds a small impact of the agricultural tariff cut on China, suggesting that China could take a more liberal position in future Doha negotiations. In addition to the total welfare gain, poverty would be reduced and income more equally distributed from a successful conclusion of the Doha Round. Firstly, an increase in prices for farm products would increase incomes generated from agricultural production. Secondly, the return to unskilled labour would increase, slightly more than for skilled labour, which makes farm workers better off in absolute and relative terms. Thirdly, farmers would also benefit from higher rental prices for land.

Limitations and moving forward

There are limitations of this chapter which need to be acknowledged and addressed. Firstly, the results of the simulations are based on the Armington assumption of imperfect substitutability between goods from different origins. This assumption gives each country or region in the model market power regardless of their size and market share. This is especially so when all Armington elasticities are close to or below unity. Zhang (2006) reveals that the Armington structure changes the terms of trade effects in two ways. First, on the demand side, Armington differentiation increases the monopoly power of trading countries, for all elasticities of substitution. Second, it reduces the supply response in the tariff-imposing country.

Secondly, the standard GTAP model used in this study is a comparative static model. It does not capture some of the costs and benefits associated with the transition and reallocation of resources. For example, for the benefits of trade liberalisation for

China to be realised, resources have to be moved from uncompetitive sectors to more productive sectors. This transaction would induce costs to the Chinese economy, but such costs are not included in the standard GTAP model. As a result, the benefits from trade policy reforms are likely to be overstated.

Thirdly, the model assumes full, or at least constant, employment of land and labour. This is not plausible in most developing countries, including China. In the presence of unemployment, trade liberalisation may simply move the unemployed to expanding sectors instead of pulling workers from other sectors. Or it could result in workers in low productivity, protected sectors becoming unemployed. This issue will be addressed in Chapter 5.

Lastly, but most importantly, this study uses the standard GTAP closure, which assumes perfect labour movement across all sectors within an economy; hence the mobility parameter is set to infinity. This assumption is contrary to the fact that there are institutional barriers in place to prevent rural farmers from moving to urban areas in China. If a worker from a rural area wants to get a job in an urban area, she will need to obtain a "hukou", an urban residence permit, which is usually very difficult and costly to obtain. Although labour market reforms have taken off since the 1990s, barriers to internal migration still exist. Leaving this important factor out of the modelling leads to inaccurate simulation results. The chapters that follow will address this issue.

Appendix 3.1 The December 2008 Draft Modalities

The Draft Modalities for Agriculture

The negotiations aim to reform agricultural trade principally under "three pillars": market access, domestic support, and export subsidies and related issues. For domestic support and tariffs, "tiered" formulas would be used to ensure that higher tariffs are cut more steeply. Export subsidies would be eliminated by 2013, as agreed in the 2005 Hong Kong Ministerial Meeting. This appendix discusses the details of the "three pillars".

Market Access: Tariffs, Tariff Quotas and Safeguards

Agricultural liberalisation has been a central and highly sensitive issue in the current round of negotiations. Although the Uruguay Round Agreement on Agriculture specified an effective framework for disciplines on agricultural support and protection, the extent of actual liberalisation was relatively limited. The December text specifies that bound custom duties shall be reduced in equal annual installments over a five-year period for developed country members. A tiered formula is used such that those members with higher tariff levels will implement larger cuts: where the final bound tariff or ad valorem equivalent in a country's Schedule of Concessions in the Uruguay Round Agreement on Agriculture is less than or equal to 20 percent, the reduction shall be 50 percent; where the final bound tariff is greater than 20 percent and less than or equal to 50 percent, the reduction shall be 57 per cent; where the final bound tariff is greater than 50 percent and less than or equal to 75 percent, the reduction shall be 64 percent; and where the final bound tariff is greater than 75 percent, the reduction shall be 70 percent. The minimum overall average cut shall be at least 54 percent.

For developing country members, a smaller cut is applied, that is, 2/3 of the cut for developed country members in each tier, and the tiers themselves are wider. Also, the implementation period is longer. The inflexion points for the four tiers are 0, 30, 80 and 130 percent. It is widely agreed that the maximum overall average cut should not exceed 36 percent for developing countries, while the Least Developed Countries (LDCs) are exempt from all commitments. There are also special treatments envisaged for Recently Acceded Members (RAMs) and Small Vulnerable Economies (SVEs).

Some products are allowed smaller cuts depending on whether they are "sensitive products" (available to all countries) or "special products" (available to developing countries). Sensitive products are sensitive mainly for political reasons. Developed country members shall have the right to designate up to four percent of tariff lines as "Sensitive Products", while developing country members shall have the right to designate up to one-third more of tariff lines as "Sensitive Products". The tariff cut for "Sensitive Products" may be one-third, one-half or two thirds of the reduction that would otherwise have been required by the tired reduction formula. This is combined with different degrees of tariff rate quota expansion. Developing countries could avail of further flexibilities under "Special products" system. Twelve percent of tariff lines could be declared "special" guided by indicators for food and livelihood security or rural development. Up to 5 per cent of products could be exempt completely from cuts. In any case, the tariff cut on special products would have to average 11 per cent. RAMs have different conditions – 13 per cent of products can be special with a ten percent average cut.

Domestic Support

Domestic support is divided into three types: Amber Box, Blue Box and Green Box. The Amber Box is the most trade-distorting type of support. It is directly linked to prices and production. Examples include price guarantees or support that is based on how much is produced. It encourages farmers to produce more in the subsidising countries than elsewhere and depresses world prices and discourages production in poorer countries. In the past, it has even created wasteful surpluses which were a source of public concern as "wine lakes" and "beef mountains" grew. Countries providing large amounts of support would cut the Amber Box the most. The EU (higher tier, above $ 40bn) is to cut Amber Box support by 70 per cent; the US and Japan are to cut by 60 per cent and the rest by 45 per cent. Countries are still allowed a small or "de minimis" amount of Amber Box support, limited to 2.5 per cent of the value of production for developed countries and 6.7 per cent for developing countries. The amount of support a country can give to individual products would also be limited.

The Blue Box is less distorting. It is for direct payments to farmers based on the number of animals they have or the size of area planted, but there is a production limit or other conditions designed to reduce distortions so that over-production is curbed. The Blue Box would be limited to 2.5 per cent of production for developed countries and 5 per cent for developing countries with caps per product.

A wide range of support for agriculture as a whole would be allowed without limit under the "Green Box", i.e., supports for development, infrastructure, research, agricultural extension, structural adjustment, etc. Revisions will be made to prevent direct income supports from stimulating production, i.e. to ensure income supports are really "decoupled".

The December 2008 NAMA Modalities

The December text on non-agricultural market access (NAMA) provided details of options for further trade liberalisation. A simple Swiss formula is applied for tariff reductions for industrial products. A Swiss formula is a progressive tariff cut formula - it produces deeper cuts for higher tariffs. A higher coefficient in the formula equals a lower tariff cut and vice versa, so that developing countries have higher coefficients than developed countries. Table 3.2 and Figure 3.1 illustrate how a Swiss formula with a coefficient of 8 works over 5 years. The coefficient defines the maximum tariff rate at the end of the period. No matter how high the original tariff is (from

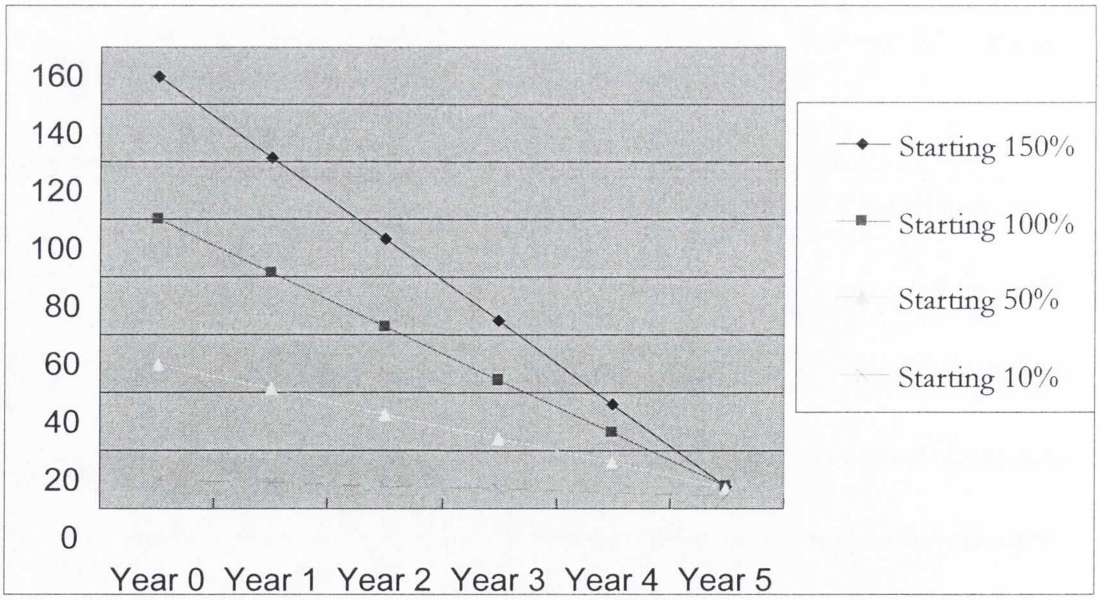
10% to 150 %), a Swiss formula produces a narrow range of final tariff rates (from 4.4 to 7.6%).

Table 3A.1 How a Swiss formula with a coefficient of 8 works over 5 years

	Starting tariff 150%	Starting tariff 100%	Starting tariff 50%	Starting tariff 10%
Year 0	150	100	50	10
Year 1	121.52	81.48	41.38	8.89
Year 2	93.04	62.96	32.76	7.78
Year 3	64.56	44.44	24.14	6.67
Year 4	36.08	25.93	15.52	5.56
Year 5	7.59	7.41	6.90	4.44
Annual step	28.48	18.52	8.62	1.11

Source: Own calculation

Figure 3A.2 How a Swiss formula with a coefficient of 8 works over 5 years



Source: Own calculation

In the December text the coefficient for developed country members was 8 per cent and the cut is implemented in 5 years. Developing country members can choose from 20, 22 or 25 per cent, depending on further options they choose to use. The implementation period for developing countries is 11 years. Consistent with agricultural trade liberalisation, least developed countries are exempt from tariff reductions. As a net exporter in manufacturing products, China will welcome the reduction in non-agricultural tariffs.

Appendix 3.2 The list of sensitive products for China at HS6 level

GTAP sector	Mod-HS4 code	Description
MIL	MIL0402	MILK AND CREAM IN SOLID FORMS OF A FAT
MIL	MIL0402	MILK AND CREAM IN SOLID FORMS OF A FAT
MIL	MIL0402	MILK AND CREAM IN SOLID FORMS OF A FAT
MIL	MIL0402	MILK AND CREAM CONCENTRATED BUT UNSWEET
MIL	MIL0402	MILK AND CREAM CONCENTRATED AND SWEETEN
MIL	MIL0405	BUTTER EXCL. DEHYDRATED BUTTER AND GHEE
MIL	MIL0405	DAIRY SPREADS OF A FAT CONTENT BY WEIGH
MIL	MIL0405	FATS AND OILS DERIVED FROM MILK AND DEH
WHT	WHT1001	DURUM WHEAT
WHT	WHT1001	WHEAT AND MESLIN EXCL. DURUM WHEAT
GRO	GRO1005	MAIZE SEED
GRO	GRO1005	MAIZE EXCL. SEED
PDR	PDR1006p	RICE IN THE HUSK `PADDY` OR ROUGH
PDR	PDR1006p	HUSKED OR BROWN RICE
PCR	PCR1006p	SEMI MILLED OR WHOLLY MILLED RICE
PCR	PCR1006p	BROKEN RICE
OSD	OSD1201	SOYA BEANS WHETHER OR NOT BROKEN
OSD	OSD1205	RAPE OR COLZA SEEDS WHETHER OR NOT BROK
VOL	VOL1507	CRUDE SOYA BEAN OIL WHETHER OR NOT DE G
VOL	VOL1507	SOYA BEAN OIL AND ITS FRACTIONS WHETHER
VOL	VOL1511	CRUDE PALM OIL
VOL	VOL1511	PALM OIL AND ITS FRACTIONS WHETHER OR N
VOL	VOL1512	CRUDE SUNFLOWER SEED OR SAFFLOWER OIL
VOL	VOL1512	SUNFLOWER SEED OR SAFFLOWER OIL AND THEI
VOL	VOL1512	CRUDE COTTON SEED OIL
VOL	VOL1512	COTTON SEED OIL AND ITS FRACTIONS WHETH
VOL	VOL1513	CRUDE COCONUT OIL
VOL	VOL1513	COCONUT OIL AND ITS FRACTIONS WHETHER O
VOL	VOL1513	CRUDE PALM KERNEL AND BABASSU OIL
VOL	VOL1513	PALM KERNEL AND BABASSU OIL AND THEIR FR
VOL	VOL1514	CRUDE RAPE COLZA OR MUSTARD OIL
VOL	VOL1514	RAPE COLZA OR MUSTARD OIL AND FRACTIONS
SGR	SGR1701	RAW CANE SUGAR EXCL. ADDED FLAVOURING O
SGR	SGR1701	RAW BEET SUGAR EXCL. ADDED FLAVOURING O
SGR	SGR1701	REFINED CANE OR BEET SUGAR CONTAINING A
SGR	SGR1701	CANE OR BEET SUGAR AND CHEMICALLY PURE S

SGR	SGR1702p	MAPLE SUGAR IN SOLID FORM AND MAPLE SY
SGR	SGR1703	CANE MOLASSES RESULTING FROM THE EXTRACT
SGR	SGR1703	BEET MOLASSES RESULTING FROM THE EXTRACT
WOL	WOL5101p	GREASY SHORN WOOL INCL. FLEECE WASHED W
WOL	WOL5101p	GREASY WOOL INCL. FLEECE WASHED WOOL N

Appendix 3.3 Tariff quota utilisation in China, 2004-06

		2004	2005	2006
Wheat	Quota level ('000 tonnes)	9,636.0	9,636.0	9,636.0
	Out-of-quota imports ('000 tonnes)	..	..	..
	In-quota imports ('000 tonnes)	7,260.0	354.0	610
	Utilization rate (%)	75.3	36.7	6.3
	State-trading share	90.0	90.0	90.0
	In-quota MFN tariff rate (%)	1-10	1-10	1-10
	Out-of-quota MFN tariff rate (%)	65	65	65
Corn	Quota level ('000 tonnes)	7,200.0	7,200.0	7,200.0
	Out-of-quota imports ('000 tonnes)	..	..	..
	In-quota imports ('000 tonnes)	<5	>5	7.0
	Utilization rate (%)	0.1	0.1	1.0
	State-trading share	60.0	60.0	60.0
	In-quota MFN tariff rate (%)	1-10	1-10	1-10
	Out-of-quota MFN tariff rate (%)	20-65	20-65	20-65
Rice	Quota level ('000 tonnes)	5,320.0	5,320.0	5,320
	Out-of-quota imports ('000 tonnes)	..	..	..
	In-quota imports ('000 tonnes)	770	520	729
	Utilization rate (%)	14.5	9.7	13.7
	State-trading share	50.0	50.0	50.0
	In-quota MFN tariff rate (%)	1-9	1-9	1-9
	Out-of-quota MFN tariff rate (%)	10-65	10-65	10-65
Soybean oil[a]	Quota level ('000 tonnes)	3,587.1	3,587.0	n.a.
	Out-of-quota imports ('000 tonnes)	..	..	n.a.
	In-quota imports ('000 tonnes)	2,520	1,690	n.a.
	Utilization rate (%)	80.8	47.1	n.a.
	State-trading share	18.0	10.0	n.a.
	In-quota MFN tariff rate (%)	9.0	9.0	n.a.
	Out-of-quota MFN tariff rate (%)	30.7	19.9	n.a.
Palm oil[a]	Quota level ('000 tonnes)	3,168.0	3,168	n.a.
	Out-of-quota imports ('000 tonnes)	..	..	n.a.
	In-quota imports ('000 tonnes)	2,390	2,840	n.a.
	Utilization rate (%)	88.5	89.6	n.a.
	State-trading share	..	..	n.a.
	In-quota MFN tariff rate (%)	9.0	9.0	n.a.
	Out-of-quota MFN tariff rate (%)	30.7	19.9	n.a.
Rape seed oil[a]	Quota level ('000 tonnes)	1,243.0	1,243.0	n.a.

		2004	2005	2006
	Out-of-quota imports ('000 tonnes)	..	..	n.a.
	In-quota imports ('000 tonnes)	350	18.0	n.a.
	Utilization rate (%)	31.1	14.5	n.a.
	State-trading share	18.0	10.0	n.a.
	In-quota MFN tariff rate (%)	9.0	9.0	n.a.
	Out-of-quota MFN tariff rate (%)	30.7	19.9	n.a.
Sugar	Quota level ('000 tonnes)	1,945.0	1,945.0	1,945
	Out-of-quota imports ('000 tonnes)	..	..	..
	In-quota imports ('000 tonnes)	1,210	1,390	1,370
	Utilization rate (%)	62.2	71.5	70.4
	State-trading share	70.0	70.0	70.0
	In-quota MFN tariff rate (%)	15.0	15.0	15
	Out-of-quota MFN tariff rate (%)	50.0	50.0	50
Wool[b]	Quota level ('000 tonnes)	287.0	287.0	287.0
	Out-of-quota imports ('000 tonnes)	..	..	..
	In-quota imports ('000 tonnes)	220	250	280
	Utilization rate (%)	76.7	87.1	97.6
	State-trading share	n.a.	n.a.	n.a.
	In-quota MFN tariff rate (%)	1.0	1.0	1.0
	Out-of-quota MFN tariff rate (%)	38.0	38.0	38.0
Cotton	Quota level ('000 tonnes)	1,894.0	894.0	894.0
	Out-of-quota imports ('000 tonnes)	..	..	..
	In-quota imports ('000 tonnes)	1,910	2,570	894
	Utilization rate (%)	213.6	287.5	100.0
	State-trading share	33.0	33.0	33.0
	In-quota MFN tariff rate (%)	1.0	1.0	1.0
	Out-of-quota MFN tariff rate (%)	40.0	40.0	40.0
Fertilizer				
- Urea	Quota level ('000 tonnes)	2,800.0	2,800.0	3,300.0
	Out-of-quota imports ('000 tonnes)	..	..	..
	In-quota imports ('000 tonnes)	..	..	..
	Utilization rate (%)	..	..	..
	State-trading share	90.0	90.0	90.0
	In-quota MFN tariff rate (%)	4.0	4.0	4.0
	Out-of-quota MFN tariff rate (%)	50.0	50.0	50.0
- NPK	Quota level ('000 tonnes)	3,290.0	3,290.0	3,450.0
	Out-of-quota imports ('000 tonnes)	..	..	..
	In-quota imports ('000 tonnes)	..	..	..

		2004	2005	2006
	Utilization rate (%)	..	..	..
	State-trading share	75.0	70.0	65.0
	In-quota MFN tariff rate (%)	4.0	4.0	4.0
	Out-of-quota MFN tariff rate (%)	50.0	50.0	50.0
- Diammonium phosphate	Quota level ('000 tonnes)	6,560.0	6,560.0	6,900.0
	Out-of-quota imports ('000 tonnes)	..	..	..
	In-quota imports ('000 tonnes)	..	..	..
	Utilization rate (%)	..	..	..
	State-trading share	75.0	70.0	65.0
	In-quota MFN tariff rate (%)	4.0	4.0	4.0
	Out-of-quota MFN tariff rate (%)	50.0	50.0	50.0

.. Not available.

n.a. Not applicable.

a TRQ for oil removed in 2006.

b Non-state-trading products.

Note: Utilization rate refers to in-quota imports divided by quota level. Quota levels for cotton were increased during 2003-05.

Source: WTO documents G/AG/N/CHN/11, 14 September 2007; G/AG/N/CHN/9, 25 October 2006; G/AG/N/CHN/7, 6 April 2005, and Corr.1, 20 April 2005; G/AG/N/CHN/3, 25 September 2003; G/AG/N/CHN/1, 24 September 2002; and the Chinese authorities.

Chapter 4 Shadow Wages, Labour Supply and Sectoral Mobility in Rural China

4.1. Restricting Migration in China

The analysis in the previous chapter is based on the assumption that labour is perfectly mobile within China, both within and between sectors. However, substantial restrictions on migration have been a feature of China's labour market for decades. The household registration (*hukou*) system was first introduced in the mid-1950s, whereby geographical and sectoral migration between rural and urban areas was initially prohibited. It was politically motivated to support the development of urban areas (though this came at the expense of rural areas). At the time, the government organised rural labour into collectives to intensify crop production and raise land productivity. All surplus agricultural products were then acquired at very low prices set by the government to meet the demand in urban areas.

Since the 1980s, the Chinese government has gradually relaxed restrictions on labour mobility. China has since witnessed an unprecedented surge in labour migration, both geographical between regions, and transformational between sectors. The former refers to migration particularly to the bigger coastal cities with more and better economic opportunities. The latter refers to movement between rural (agricultural) and urban (non-agricultural) sectors, which could be local or cross-regional. Although regional migration is a very important issue in examining China's labour markets, and it has significant implications for sectoral mobility, it is the latter that is of most interest in this thesis, as most trade models – including the GTAP model used in this analysis - require factor mobility between sectors.

The rapid growth of Township and Village Enterprises (TVEs) in the 1980s and early 1990s led to the transfer of rural labour to off-farm jobs. Rural workers are given the opportunity to find employment outside of agriculture without migrating to other areas. Throughout the 1990s, around 130 million workers, or just under 20% of the national workforce, were employed in TVEs each year (OECD, 2005).

Inter-region rural to urban migration has also surged. Between 1989 and 2000, rural emigrants accounted for 13% of the total rural population in China and 20-30% in some areas in Western China. In those fast-growing regions (e.g. Guangdong), most unskilled positions are filled by rural emigrants (Chinese Agricultural Policy Survey Report, 2004).

Based on the unprecedented movement of rural workers into cities for jobs, some authors (e.g. Rawski and Mead, 1998) argue that China's labour markets are now fairly open and competitive. However, others (e.g. Knight and Song, 1999) believe that institutional and administrative barriers persist. While rural labourers can go to urban areas, there are only a limited number of ways to acquire an urban residency, such as finding employment after college, confiscation of cultivated land by the government, and purchasing houses in cities on the commercial market in some cases. Without this urban residency, rural residents often find it difficult to obtain permanent employment. They receive lower wages, as well as working and living under inferior conditions. They are not entitled to most social welfare and other benefits which are provided only to urban residents, such as education, social health services and housing services. A recent survey found that the biggest concern of rural migrants to Beijing is their children's education (Cui and Pan 2002). They have to pay extra fees for their kids to go to local schools. They also face substantial institutional burdens introduced by urban local governments, such as a temporary residency fee, a family planning fee and an urban size expansion fee (Bai and Song, 2002: OECD, 2005).

The *hukou* system is complemented by the land tenure system in China in restricting movement between rural and urban areas. Land is obviously a key income-generating source for farmers. An entitlement to the use of land might act as insurance for rural workers who lose their jobs in the cities. Rural households who migrate face the risk of losing their entitlement to the use of land, which might deter them from moving, particularly if there are uncertainties and fluctuations in urban labour markets and off-farm incomes.

This Chapter aims to examine the imperfections of labour markets in China and to derive the elasticity of labour mobility. The elasticity refers to *the elasticity of transformation* of unskilled labour between agricultural and non-agricultural sectors in response to a change in relative wages. More specifically, it measures the responsiveness of unskilled labour allocation between agriculture and non-agriculture to a one per cent change in the agriculture: non-agriculture wage ratio.

Following Jacoby (1993), Meng (2000) and Sicular and Zhao (2004), I use a two-step approach to estimate the elasticity of labour mobility. First, since family agricultural production wages are not observable, I obtain agricultural shadow wages as marginal products of labour by estimating the agricultural household production function. Labour supply functions in family agricultural production and wage employment are then specified as functions of shadow wages, observed off-farm wages and other relevant variables such as household characteristics. Based on these labour supply equations, I calculate the unskilled labour transformation elasticity that can be modelled in GTAP in the next chapter. The household survey data used in this chapter are from a survey conducted by Rozelle et al. on 1,200 rural households across six provinces in China in 2000[1]. These data are described in detail in Section 4.3.

4.2 The Model

[1] Special thanks to Professor Scott Rozelle for making the data available to me.

China's agriculture sector is made up of numerous small self-employed farmers. The family farm is predominantly the unit of production. A large proportion of the work force is not primarily engaged in the labour market. The absence of widespread labour market participation makes it difficult to use market wages to explain and estimate labour supply behaviour and labour allocation decisions.

The empirical literature on agricultural household model relies on the assumption of separability between home consumption and farm household production to deal with time allocation of farm households (e.g. Kuroda and Yotopoulos 1978, Lau, Yotopoulos, Chou and Lin 1981, Singh, Squire, and Strauss 1986). Under this assumption, the problems of production decisions, consumption decisions and labour supply decisions may be analysed separately. First, it is assumed that the farm household decides how much labour to use on its farm so as to maximise profits from its production activities, subject to production constraints. Second, the resulting farm profits then form part of its full income constraint, subject to which the household is assumed to maximise its utility by choosing how much to consume and how much labour to supply to the market. Thus, under separability, the market wage provides an exogenous measure of the value of time of family labour, irrespective of whether the family works on or off-farm, while the production decisions of the household influence family labour supply only through the income effects of changes in farm profits.

This approach is justifiable under certain assumptions: rural labour markets are efficient, and household members are not constrained in their off-farm decisions; family and hired labour are perfect substitutes, and individuals are not constrained in their ability to hire or rent farm labour; and there are perfect food markets. Separability could break down if any of these conditions do not hold. For instance, labour markets might fail for various reasons. Poor infrastructure or long distances from the labour market could make the transaction costs prohibitively high so that they prevent farmers from supplying their labour to the market. Some agricultural good markets might be missing due to the gap between (low) selling and (high) buying prices if the transaction costs are very high. The optimal strategy for the household is then self-sufficiency. A rise in price, therefore, cannot lead to an increase in supply or changes in labour time allocation.

When a market fails, the price of the good is no longer determined by market forces. For self-employed farmers, the opportunity cost of time, or the "shadow wage", is determined within the household. The production and consumption decisions of farm households must be simultaneous, or nonseparable. According to Jacoby (1993), an agricultural production function may be used to obtain the budget constraint for the household to maximise utility. At the optimum, the shadow wage of each household equals the value of the marginal product of labour in household production. Details of the theoretical model can be derived as follows.

The household is assumed to maximise its utility derived from the consumption of goods (C) and leisure (C_l), where C is made up of the consumption of home-produced agricultural goods (C_a) and purchases of market goods (C_m). The utility function is given by $U(C, C_l: Z_h)$, where Z_h represents household characteristics influencing the marginal utility of consumption. The utility function is assumed to be well-behaved. The household faces a production technology for agricultural products (Q_a) with family labour (L_f), hired labour (L_h) and capital (K_f, e.g., land). The production technology is described by the function: $Q_a = f\ (L_f, L_h, K_f)$, assumed to be strictly concave. Leisure is "produced" simply by not allocating household time to production or to waged work. The household may also work off-farm (L_0), but total labour use cannot exceed the family time endowment (T).

This very basic household model can be described mathematically as:

$\text{Max } U(C, C_l: Z_h)$ Utility function (1)

subject to

$Q_a = f\ (L_f, L_h, K_f)$ Production function (2)

$L_f + L_0 + C_l = T$ Time constraint (3)

$p_a Q_a + w_m L_0 = p_a C_a + w_h L_h + p_m C_m$ Cash constraint (4)

$L_0 >= 0$ (5)

where p_a and p_m are the (shadow) prices of the composite agricultural commodity and purchased market goods, and w_m and w_h are the off-farm market wage rate and the wage rate for hired labour. If we normalise p and p_m to be equal to 1, the first-order conditions for this problem become:

$$MRS_{c,l} = w_m, \text{ if } L_0 > 0$$

$$MRS_{c,l} = w^*, \text{ if } L_0 = 0$$

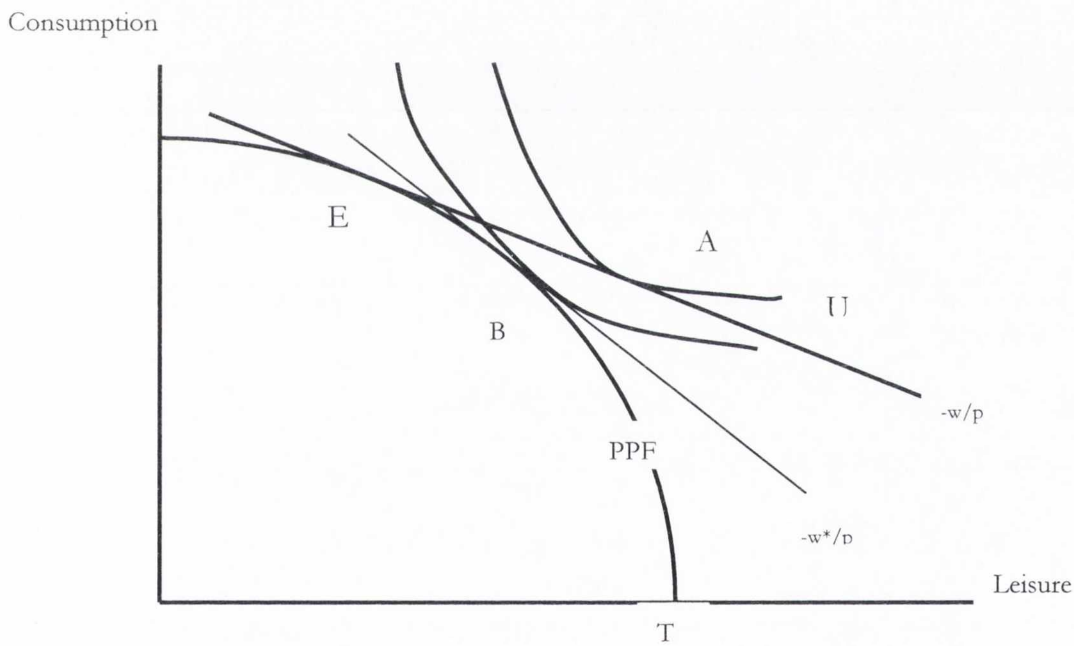
$$d\,Q_a / d\,L_f = w^*$$

$$d\,Q_a / d\,L_h = w_h$$

where w_m is the market wage rate and w^* is the shadow wage of the household's self-employment. If a household supplies labour off the farm, the marginal rate of substitution between household consumption and leisure is equal to the market wage, and the shadow wage equals the market wage. If the shadow wage is higher than the market wage due to high transaction costs or other constraints, the household withdraws from the labour market, and the marginal rate of substitution between consumption and leisure equals the shadow wage or the marginal product of labour. The optimum will occur at the point where family labour is utilised on the farm until the marginal product of labour is equal to the market wage.

The graphical solution of the problem allows a direct view of household time allocation decisions (see Figure 4.1). The household faces a trade-off between producing consumption and leisure, depicted by the production possibility frontier (PPF). If the household supplies labour both on and off the farm, the optimal production level is at point E where the slope of the PPF equals the price-ratio between labour and consumption. The optimal consumption is at point A where the marginal rate of substitution equals the price ratio. When labour markets are missing, the household allocates its members' time only between leisure and farm work. In terms of Figure 4.1, this implies finding the point (B) where the indifference curve touches the PPF. At this point, the marginal rate of substitution is equal to the ratio between the shadow wage and the price of consumption goods.

Figure 4.1: A household's production and consumption decisions



The empirical work carried out in this chapter consists of four steps. First, a household agricultural production function is estimated using a Cobb-Douglas function. Second, the corresponding shadow wages or marginal products of labour are imputed based on the estimates of the agricultural production function, as are shadow incomes. Third, labour supply decisions in own agricultural production and market employment are modelled as functions of the shadow wages, observed market wage rates, as well as other relevant variables. Lastly, the estimates of the coefficients in labour supply equations are used to calculate the elasticity of transformation of unskilled labour.

4.3 Data and description of variables

The data used in this study come from a sampling household survey, the China National Rural Survey (CNRS) carried out in November and December 2000. I specially thank Professor Scott Rozelle of the University of California at Davis for kindly providing the survey data for this research. The survey team also included Loren Brandt of the University of Toronto and Linxiu Zhang of the Center for Chinese Agricultural Policy at the Chinese Academy of Sciences.

The CNRS survey term selected six provinces across China: Hebei, Liaoning, Shaanxi, Zhejiang, Hubei and Sichuan. As can be seen from Figure 4.2, Zhejiang, Liaoning and Hebei are situated in the fast-growing coastal area of China. Rural income per capita in these regions were above the national average in 2006 (NBSC, 2007). In particular, Zhejiang is one of the most affluent provinces in China, with an income per capita more than double the national level. In contrast, the other three provinces are located in the middle and western part of China, with Shannxi being one of the poorest regions and Hubei very close to the national per capita income.

Figure 4.2: Map of China by Province

To ensure broad coverage within each province, one county was selected randomly from within each income quintile for the province, as measured by the gross value of industrial output. Two villages were selected randomly within each county. The survey team used village rosters and their own counts to choose randomly 20 households, both those with their residency permits (hukou) in the village and those without. A total of 1,199 households were surveyed.

The data are very useful to this study as they provide detailed information on households' demographic characteristics, wealth, agricultural production, non-farm activities, as well as expenditure patterns and net income transfers. Several parts of the survey were designed to gather information on household's on-farm and off-farm labour markets participation. Information on the market employment was collected for roughly half of the households surveyed (610 out of 1,199), and individuals who lived in the house for over 3 months and those who lived outside the house for over 9 months in 2000 were both included. This information allows the author to investigate mobility between household agricultural production and wage employment, both within and between regions. Geographical mobility between rural and urban areas was not examined.

For estimation reasons, some observations with missing variables are left out of the regressions. Thus, the number of observations varies from regression to regression. For instance, to estimate the agricultural production function, those households that do not engage in farming activities are not included in the model. The number of observations is therefore smaller than the sample size.

Table 4.1 summarises the key characteristics of the households. The value of total agricultural production is used instead of the output level since there are multiple outputs for most of the households. It is calculated as the aggregate value of all crops, fruits and vegetables, forestry products, animals and livestock. The value of each product is calculated using the selling price if there is market activity, or the village-level price otherwise.

Land is measured as the land area used in production, including own land and rented land. Aggregate family labour hours are used on the strong assumption that male and female members of the household have the same productivity. Time spent in rearing small amounts of livestock (e.g. one pig or a small flock of fowl) was counted as time spent doing housework rather than as time spent on farming. Child labour hours (those who are under 16 years of age) are not recorded in the survey. The majority of the surveyed households (88%) do not hire any workers, so hours worked by hired labourers are not included in the model. For fertiliser, pesticide and seeds, expenditure level data are used given the variation in quality and price. The value of equipment, mainly tractors, harvesters, cows, horses and threshers, is a proxy for capital input.

Education might increase management and productivity of the household. The education status of the household head is used as an indicator of the potential productivity of the household. The average years of schooling of household heads in the sample is about 6.5 years. Age of head of household is a measure of experience. It is expected to have a positive effect on output initially and possibly a negative impact after a certain age. Provincial dummies are also included as explanatory variables to account for different natural endowments and environments.

Table 4.1 also contains comparison of the CNRS survey data with the 2000 National Bureau Statistics of China (NBSC) data, where available. Household size and the number of working age adults are very close to the NBSC data. Land area calculated from the NBSC data is also similar to the CNRS survey data.

Table 4.1: Variables used in the estimation of the household production function (RMB Yuan in 2000 prices for monetary variables)

Variable	Description	NBS Mean	CHNS Survey Mean	CHNS Survey Std. Dev.
Household size	Number of household members	4.2	4.1	1.3
Value of output	Value of all crops and livestock		3963.8	4687.2
Land	Land area in mu, owned or rented	8.3[a]	8.5	10.4
Labour hours	Hours of family farm work		2862.2	2517.4
Equipment	Value of farm equipment		1018.1	1986.5
Fertilizer	Expenditures on fertilizer		493.9	455.8
Pesticide	Expenditures on pesticide		124.9	224.2
Seeds	Expenditures on seeds		124.4	194.3
Head's age	Age of household head		45.2	11.0
Head's education	Years of schooling of household head		6.5	3.4
Phone	Dummy: 1 if phone present in village		0.9	0.3
Enterprise	Dummy: 1 if town and village enterprise present in village		0.8	0.4
Geographic	Dummy: 1 if flat		0.4	0.5
Hebei	Dummy: 1 if live in Hebei Province		0.2	0.4
Shanxi	Dummy: 1 if live in Shanxi Province		0.2	0.4
Liaoning	Dummy: 1 if live in Liaoning Province		0.2	0.4
Zhejiang	Dummy: 1 if live in Zhejiang Province		0.2	0.4
Sichuan	Dummy: 1 if live in Sichuan Province		0.2	0.4
Hubei	Dummy: 1 if live in Hubei Provine		0.2	0.4
No. of adults	Number of working age adults	2.76	2.78	1.19
No. of children	Number of children		0.90	0.87
No. of elderly	Number of elderly members		0.35	0.63

Source: Survey data by Rozelle et.al (2000)

a. Average land area per household is calculated using land area per person multiplied by household size

4.4 Estimation of the production function

The Cobb-Douglas functional form is applied to estimate the farm household production function. This form is used because preliminary analysis with more flexible functional forms such as the translog yielded inconclusive results. Specifically, most of the coefficients of the interaction terms were not statistically significant, while some of the coefficients turned out to be negative, contrary to *a priori* expectations. The advantage of the Cobb-Douglas form is its ease of estimation and interpretation: the coefficient of an input in the function represents the production elasticity of that input. The production function is specified as follows:

$$\ln Y_i = \sum_{i=1}^{n} \alpha_i \ln M_i + \sum_{i=1}^{n} \beta_i Z_i + \varepsilon_i \qquad i = \text{each household}$$

where Y_i is the total value of output produced by the household, including crops, vegetables, fruits, hogs and animals. M_i is a vector of production inputs, including total family labour hours, land area, value of equipment, and expenditure on fertiliser, seeds and pesticide. Z_i is a vector of control variables, affecting tastes towards work. This vector includes household characteristics, such as years of schooling of household head, age and age-squared of head, and provincial dummies. The coefficients α_i provide estimates of own-price elasticities of inputs.

In econometric modeling, the problem of endogeneity occurs when one or more of the independent variables are correlated with the error term. This violates one of the most important OLS assumptions. In the presence of endogeneity, OLS regression can produce biased and inconsistent parameter estimates. Hypotheses tests can therefore be misleading. The best way to deal with endogeneity problems is through instrumental variable (IV) techniques. The instruments have to be genuinely exogenous but strongly correlated with the potentially endogenous explanatory variable. The most common IV estimator is Two Stage Least Squares (2SLS). In the first stage, each endogenous variable in the original equation is regressed on all of the exogenous variables in the model, including both exogenous variables in the original equation and the instruments. The predicted values from these regressions are obtained. In the second stage, the equation is estimated using an OLS regression, except that each endogenous variable is replaced with the predicted values from the first stage. These predicted values are exogenous to the original dependent variable by construction, so that the OLS assumptions are not violated.

In the above farm household production model, family labour input is potentially endogenous. The error term ε_i in the production function might contain unobservable variables such as managerial ability or anticipation of shocks which are correlated with family labour input. This is dealt with using the following groups of instrumental variables. The first group includes household composition variables, such as the number of working age adults, the number of elderly members, the number of children and their quadratic terms. The second group of instrumental variables are community-level variables, such as village size dummy, average distance to land, average village income, and main crop price at the village level.

Table 4.2 presents the OLS and IV estimations of the Cobb-Douglas production function. The OLS results indicate that all the input variables used in the analysis are statistically significant. As a variable input, fertiliser contributes most to output, which is consistent with previous studies (Sicular and Zhao 2004, Meng 2000). Land input is the second biggest contributor. Family labour hours have an elasticity of 0.156. The coefficients of seeds, pesticides and equipment are significant too. The education of household head has a statistically positive impact on output, while the age of the head of household is not significant.

Whether a telephone is present in a village is a proxy of technology and the economic development level of the village. It is expected to be positively related to farm income, and this is confirmed by the regression analysis. The geographic features of an area capture partially the land quality. If the landscape of the village is flat, it helps to boost output. Province dummies are also significant. Compared to Hebei (dropped in the regression), province dummies such as Liaoning, Zhejiang, Sichuan and Hubei all have a positive impact on output.

The instrumental variable estimates are very similar to the OLS estimates. The Durbin-Wu-Hausman test (Hausman 1978[2]) indicates that the OLS estimates are consistent. Therefore in the next section the OLS results are used to calculate and predict shadow wages.

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[2] The test was first proposed by Durbin (1954) and separately by Wu (1973) and Hausman (1978).

Table 4.2: Estimation of Household Agricultural Production Function

Dependent variable: log value of agricultural output	OLS	IV
Log labour hours	0.156	0.177
	(3.22)**	(1.45)
Log land area	0.196	0.191
	(4.44)**	(3.50)**
Log value of equipment	0.039	0.037
	(4.18)**	(3.93)**
Log expenditure on fertilizer	0.247	0.246
	(6.04)**	(5.32)**
Log expenditure on pesticide	0.067	0.064
	(4.11)**	(3.20)**
Log expenditure on seeds	0.133	0.135
	(6.55)**	(6.62)**
Head age	0.031	0.028
	(1.71)	(1.37)
Head age squared	0	0
	(1.56)	(1.23)
Head education level	0.026	0.027
	(3.31)**	(3.18)**
Phone present in village	0.173	0.172
	(2.07)*	(2.11)*
Geographic dummy (1 if plain, 0 otherwise)	0.243	0.255
	(4.58)**	(4.34)**
Shanxi	0.177	0.171
	(1.92)	(1.71)
Liaoning	0.376	0.364
	(3.74)**	(3.14)**
Zhejiang	0.342	0.366
	(3.08)**	(2.66)**
Sichuan	0.44	0.438
	(4.77)**	(4.18)**
Hubei	0.181	0.178
	(2.11)*	(1.86)
Constant	2.73	2.639
	(5.67)**	(4.04)**
No. of observations	989	970
R-squared	0.52	0.51

Absolute value of t statistics in parentheses
* significant at 5%; ** significant at 1%

4.5 Estimation of the shadow wages

After estimating the farm household production function, the shadow wage rates of family labour hours can be easily calculated as:

$$\hat{W}_i = \frac{\hat{\alpha}_i \hat{Y}}{F_i}$$

where $\hat{Y}$ is the predicted value of output derived from the estimated coefficient $\hat{\alpha}_i$, and F_i is the total hours of family labour.

Households make their labour supply decisions between on-farm and off-farm sectors based on their expected wage differentials. When the decision is made, we can only observe wages in the sectors that are selected. A "missing variable" problem arises if one wishes to estimate the labour supply decision as a function of market and shadow wage rates, as market wages are not reported for households not participating in the labour market, and shadow wages are not reported for households not participating in family agricultural production. The solution is to estimate the wage functions on a sub-sample of households/individuals working in the selected on-farm or off-farm sectors to predict missing wages.

Estimation of shadow wage equation

The shadow wage equation is described as,

$$\log W_{Ai} = \alpha_i \log N_i + \beta_i \log Z_i + \varepsilon_i \quad \text{i = individual households}$$

where W_{Ai} is the shadow wage for each household *i*, N_i is a vector of fixed production input variables, including land area and value of equipment, and Z_i is a set of variables including household characteristics and village dummies. Household characteristics variables include household structure variables, years of schooling of household head, age and age-squared of head.

The OLS estimates of the shadow wage equation for agricultural household production are presented in Table 4.3. The OLS regression method is chosen because all the explanatory variables in the equation are believed to be exogenous. Overall the regression function has a good explanatory power. The results indicate that the fixed agricultural production inputs, i.e., land and equipment, have a significant and positive impact on agricultural marginal productivity. A 1% increase in land area will increase the shadow wage by 0.088%, and a 1% increase in the value of farming equipment will increase the shadow wage by 0.031%. Education level, as measured by years of schooling of household head, also helps to improve agricultural productivity. Town and village enterprises present in the local area are an indicator of local economic performance, and are positively related to the agricultural shadow wage.

The number of working age adults has a negative effect on the shadow wage initially, indicating a diminishing marginal productivity given the limited farming resources. Other household structural variables, such as the number of children, the number of adults and their quadratic forms, are not statistically significant. Age of household head is also not significant.

Table 4.3: Shadow wage equations in household agricultural production

(OLS estimation)

Dependent variable: log shadow wage hourly	Coefficient	t-statistic
Log land area	0.088	(2.13)*
Log value of equipment	0.031	(3.09)**
Number of adults	-0.318	(3.43)**
Number of adults squared	0.038	(2.80)**
Number of children	-0.115	(1.49)
Number of children squared	0.035	(1.22)
Number of elderly	0.174	(1.43)
Number of elderly squared	-0.146	(2.10)*
Head age	0.011	(0.53)
Head age squared	0.000	(0.73)
Head years of schooling	0.047	(5.23)**
Enterprise present in village	0.505	(1.66)*
A set of village dummies		
Constant	-1.848	(4.03)**
No. of observations	989	
R-squared	0.48	

Absolute value of t-statistics in parentheses
* significant at 5%; ** significant at 1%

The provincial dummies in the previous regression are replaced by village dummies. There are 60 villages in total in the sample data and three village dummies are dropped in the regression. Some village dummies are statistically significant while others are not. Explaining the significance of each village dummy is beyond the scope of this chapter, so the coefficients of the village dummy variables are not reported here.

Estimation of market wage equation

The market wage is estimated for individual family members, rather than at the household level. It is specified as a function of individual characteristics well as other variables.

$$\log W_{Mj} = \alpha X_j + \beta V_j + \varepsilon_j \qquad \text{j= individual family members}$$

where X_j is a vector of variables representing individual family worker's characteristics, such as gender, marital status, *hukou* permit, age and education variables. V_j is a set of village level variables, including village size (i.e., number of households in the village), whether enterprise and phone are present in the village, distance from the village to town, and a set of village dummies.

Table 4.4 reports the OLS estimates of the market wage equation. Female labour has lower wage rates, indicating a gender gap in market wages. As expected, age and education are both significant and have a positive effect on wage rates. The number of dependents, marriage status and *hukou* status do not have a significant impact on market wage rates. Village level variables are not statistically significant either.

After the regression, market wage rates for all individual workers are projected, which are then used to impute the average market wage at the household level. The weights used to calculate the average market wage are based on each individual's hours of work, where data are available. For households where hours worked for individual members are not available, the simple average of the market is used instead.

R-squared is low in both the shadow wage and market wage equation estimations. This is usually the case for cross-sectional regressions because of the diversity of the cross-sectional units. What is important is that the model is correctly specified, that the regressors have the theoretically expected signs, and that the regression coefficients are statistically significant. While low R-squared in itself is not a problem as it does not bear on the unbiasedness of the estimates, it interacts with the sample size to determine the precision of the estimates.

Table 4.4: Market employment wage equation (OLS estimation)

Dependent variable: log hourly market wage rate	Coefficient	t-statistic
Female	-0.164	(3.21)**
Number of dependents	0.017	(0.40)
Marriage	-0.003	(0.13)
Urban hukou	-0.018	(0.22)
Age	0.057	(3.20)**
Age squared	-0.001	(3.14)**
Education	0.046	(5.60)**
Village size	-0.008	(0.03)
Enterprise present in village	0.234	(0.80)
Phone	0.426	(1.17)
Distance to town	-0.063	(0.52)
A set of village dummies		
Constant	-0.827	(1.93)
Observations	986	
R-squared	0.19	

Absolute value of t statistics in parentheses
* significant at 5%; ** significant at 1%

After estimating the wage equations, the shadow wage and market wage rates are estimated for all households in the sample. Table 4.5 shows the comparison between observed market wage rates per hour and the estimated shadow wages for agricultural production and all the predicted wages. There is a gap between the returns to labour in the agricultural and non-agricultural sectors, in terms of both observed and predicated wage rates. Due to the extreme values in observed market wage rates and estimated agricultural wages (as shown by the differences in the maximum values for these distributions in Table 4.5), on average the means of the predicted values are lower than those observed.

Table 4.5: Shadow wage and market wage rates

Unit: Yuan/hour in 2000 prices

Variable	No. of obs	Mean	Std. Dev.	Min.	Max.
Agricultural shadow wage, estimated	989	0.883	6.987	0.029	159.036
Agricultural shadow wage for all household, predicted	1030	0.365	0.265	0.043	1.589
Agricultural shadow wage for those in agri-production, predicted	44	0.389	0.236	0.100	0.945
Agricultural Shadow wage for those not in agri-production, predicted	986	0.364	0.266	0.043	1.589
Non-agri market wage rate, observed	986	3.032	2.534	0.002	25.833
Non-agri market wage rate, predicted	3442	2.303	0.799	0.552	5.625
Non-agri market wage rate for those employed, predicted	986	2.508	0.784	1.004	5.625
Non-agri market wage rate for those not employed, predicted	2456	2.221	0.790	0.552	5.433

4.6 Estimation of the labour supply equations

The labour supply functions of agricultural production and market wage employment are estimated separately, as in Sicular and Zhao (2004). The dependent variable is the hours worked per working age adult. For explanatory variables, we focus on the log of the agricultural shadow wage, market wage rate, non-labour income, a set of household characteristics, village-level variables and regional dummies. The supply equations are specified as below:

$$\log H_A = \alpha_0 + \alpha_A \ln W_A + \alpha_M \ln W_M + \alpha_X X + \varepsilon_A$$

$$\log H_M = \beta_0 + \beta_A \ln W_A + \beta_M \ln W_M + \beta_X X + \varepsilon_M$$

where W_A is the estimated agricultural shadow wage rate, and W_M is the market wage rate. H_A and H_M are hours worked on farm and off farm (i.e., market employment) respectively. I is non-labour income such as land rent and transfers. X is a vector of individual or household-specific characteristics.

The labour supply error terms, which represent unobserved heterogeneity in preference for leisure, are correlated with shadow wages. Instruments used for the marginal products here are the same as in Section 4.4, i.e., household composition variables and community- level variables. The IV estimation results for labour supply in agricultural household production are presented in the Table 4.6. The own price elasticity of agricultural work is positive and significant, and it means that a 1% increase in agricultural shadow wages will increase the agricultural labour supply by 2.686%. The market employment wage is not significant.

The OLS regression results for labour supply in market employment are presented (see Table 4.6). Hours worked off-farm is not sensitive to the market wage rate, and the sign of the coefficient is contrary to theoretical prediction. Hours worked off-farm is negatively related to the agricultural shadow wage, i.e., a 1% increase in the shadow wage will decrease market supply by 1.030%. Not surprisingly, enterprises present in villages are positive for market labour supply and negative for agricultural labour supply.

Table 4.6 Estimation of labour supply equations

	Log agricultural hours		Log market employment hours	
	IV	Standard error	OLS	t-statistic
Log agricultural shadow wage	2.686	(2.24)*	-1.030	(4.62)**
Log market employment wage	0.202	(0.55)	-0.192	(0.62)
Number of dependents	-0.158	(1.30)	0.010	(0.20)
Head age	-0.089	(2.93)**	0.090	(3.65)**
Head age squared	0.001	(3.17)**	0.001	(3.16)**
Head education	-0.091	(1.10)	0.097	(2.08)*
Head education squared	0.003	(0.86)	-0.003	(1.07)
Enterprise present in village	-1.326	(1.92)	1.963	(2.61)**
Male labour ratio	0.088	(0.26)	-0.228	(1.26)
Constant	15.236	(4.77)**	2.285	(2.42)*
Observations	1091		804	
R-squared	0.18		0.20	

Robust t statistics in parentheses

* significant at 5%; ** significant at 1%

4.7 Estimation of the labour elasticity of transformation

Powell and Gruen (1968) defined the elasticity of transformation between two products in the analysis of production frontier as the responsiveness of product-mix ratio to changes in the marginal rate of substitution. Similarly, the elasticity of transformation of labour to be derived in this chapter refers to the responsiveness of labour allocation ratio to changes in wage ratios in agricultural and wage employment sectors. By construct, the elasticity of transformation is symmetrical, i.e., the responsiveness of the ratio of on-farm to off-farm hours to the ratio of the agricultural wage rate to employment wage is identical to the responsiveness of the ratio of off-farm to on-farm hours to the ratio of the employment wage to agricultural wage rate.

As suggested in Sichular and Zhao (2004), the elasticity of transformation of labour between agricultural and wage employment sectors is derived by deducting each equation from one another:

$$\log(H_A/H_M) = (\alpha_0-\beta_0) + (\alpha_A-\beta_A)\log(W_A/W_M) + (\alpha_M-\beta_M+\alpha_A-\beta_A)\log(W_M) + \ldots$$

$$\log(H_M/H_A) = (\beta_0-\alpha_0) + (\beta_M-\alpha_M)\log(W_M/W_A) + (\beta_A-\alpha_A+\beta_M-\alpha_M)\log(W_A) + \ldots$$

$(\alpha_A-\beta_A)$ is the responsiveness of $\log(H_A/H_M)$ relative to $\log(W_A/W_M)$, which is equal to (2.686+1.030)=3.716. It implies that a one percent increase in the ratio of the agricultural wage rate to employment wage rate raises the ratio of on-farm hours to off- farm employment by about 3.716%. This estimate is fairly elastic, and it is close to the elasticity of 2.165% estimated by Sicular and Zhao (2004, pp 257, and their other estimate is 0.605%)

In theory, the responsiveness of log (H_M/H_A) relative to $\log(W_A/W_M)$, i.e., $(\beta_M - \alpha_M)$, should be equal to $(\alpha_A-\beta_A)$. However, due to the interaction from other terms, such as $(\alpha_M-\beta_M+\alpha_A-\beta_A)\log(W_M)$ and $(\beta_A-\alpha_A+\beta_M-\alpha_M)\log(W_A)$, the empirical estimation produces non-symmetrical elasticities of transformation of labour. Moreover, because the signs of the coefficients for market wage in both equations are contrary to the theoretical expectation and are not statistically significant, 3.716% is the elasticity of labour transformation chosen to be used in the CGE analysis in the following chapter. To ensure the robustness of the elasticity of transformation used in the CGE model, the next chapter compares the CGE analysis results using different values of the elasticity.

4.8 Conclusions

This chapter provides new estimates of the labour mobility elasticity between farm and non-farm sectors in China using a method which allows for non-separability of households' production and consumption decisions. Based on the household survey data in rural China, I estimate agricultural shadow wages from a Cobb-Douglas production function. The analysis shows that there is a sizable gap between shadow wages and market employment wages, which indicates low labour productivity in Chinese agriculture.

The estimated shadow wages and data on market wages are then used to explain households' labour allocation decisions. The labour allocation between agricultural production and wage employment was not sensitive to changes in wages, but rather sensitive to changes in agricultural marginal productivity. This is in line with the findings of Sicular and Zhao (2004) in that labour is not pulled out of agriculture by higher market wages, but pushed out of agriculture by lower agricultural returns. The Constant Elasticity of Transformation (CET) between agriculture and non-agriculture is estimated to be 3.716%, which is relatively elastic. This confirms the view that China's labour market is relatively open, despite the existing institutional barriers. This elasticity will be taken into the GTAP model in the next chapter to examine the impact of labour mobility limitations on the modelling results. The results also show that labour mobility is influenced by education, household characteristics, province dummies and the development of town and village enterprises.

Chapter 5: Labour Market Imperfections and the Implications of Doha for China

5.1 Introduction

The CGE analysis in Chapter 3 confirms the findings of previous studies on the aggregate welfare gains for China from further trade liberalisation (Anderson, Martin and Van der Mensbrugge, 2006; Polaski, 2006; Hertel and Keeney, 2005; Diao, Diaz, Bonnila, Robinson and Orden, 2005). The analysis makes rather strong assumptions as regards labour markets, i.e., skilled and unskilled labour is assumed to be perfectly mobile between sectors within a region, and total labour supply is fixed exogenously. As one of the most important factors in determining the distribution of welfare within an economy, labour markets have drawn increasing attention from researchers (Meng, 2000; Hertel and Zhai, 2004; Ianchovichina and Martin 2004). Whether workers in poor-performing sectors are able to take advantage of the boom in other sectors and whether these expanding sectors can avail themselves of the abundant cheap labour in China are extremely crucial in determining the impacts of Doha on China, and will be examined in this chapter.

Labour markets restrictions also have important implications for agricultural and non-agricultural supply responses. If labour is perfectly mobile between agriculture and non-agriculture, as is commonly assumed in standard CGE models, we would expect high supply responses to trade policy reforms, as the expansion in one sector can be achieved by freely drawing labour from other sectors. However, if labour movement between sectors is constrained, as observed in many developing countries, including China, then the expanding sectors would not be able to draw labour resources from other sectors. Supply responses are limited in this sense.

Another caveat of the analysis in Chapter 3 is that it assumes full, or fixed, employment. General equilibrium models with full employment can only expand agricultural production by taking labour from non-agricultural activities (or vice versa), which is a constraint on the welfare effects projected in models with that specification (Diao et. al. 2005). China has experienced the existence and persistence of significant underemployment, particularly in rural areas. Expansion in either agriculture or non-agriculture should be allowed to draw labour supply from the pool of underemployed, instead of pulling labour from other sectors. Underemployment is therefore assumed for China in this chapter.

The income gap between rural and urban income in China is already very high compared to other countries studied, and it has grown at an increasing rate since the mid-1990s (for more detail, see Chapter 3). Many believe that the existence of the Hukou system of permanent registration in China has supported growing relative inequality over the last 30 years (e.g. Whalley and Zhang 2004), by preventing rural people from migrating into the urban areas, and has helped to create a wide rural-urban income gap. The poverty and income inequality impact of the DDA in China is broadly studied in Chapter 3, but it fails to distinguish unskilled labour between agricultural and non-agricultural sectors. By splitting unskilled labour between agriculture and non-agriculture, this chapter is able to examine the changes of the returns to unskilled farm and non-farm workers separately, and thus provide a more accurate picture of the Doha impact on poverty and rural-urban income inequality.

The structure of the Chapter is as follows. In the next section, I provide a description of the methodology for modeling labour immobility. Section 5.3 uses the labour mobility elasticity estimate derived in Chapter 4 to conduct a CGE analysis under the fixed employment assumption. These results are compared with the results from simulations in Chapter 3 where a perfect labour mobility assumption was employed. Section 5.4 relaxes the fixed employment assumption and Section 5.5 concludes.

5.2 Modelling Agricultural Unskilled Labour Mobility

The unrealistic assumption of perfect unskilled labour mobility has recently been tackled by many CGE modellers in their trade reform analyses (MIRAGE model (Bchir *et.al.* 2002), GTAP-AGR model, Polaski 2006, Hertel and Zhai 2004, Anderson, Huang and Ianchovichina 2004). The general practice is to model the substitution between farm and nonfarm labour with a Constant Elasticity of Transformation (CET) function while assuming full employment. Assume that unskilled labour is imperfectly mobile between the agricultural and the non-agricultural sector, and that the return to the skilled labour in agricultural activities is different from that in non-agricultural activities. The unskilled labour makes its decision between farm and non-farm sector participation according to the ratio of wage returns in these two sectors. That is, if the return in the agricultural sector increases relative to the return in the non-agricultural sector, then the supply of workers in the agricultural sector increases and the supply of labour in the non-agricultural sector decreases, and vice versa.

Recent studies on China (Hertel and Zhai 2004, Anderson, Huang and Ianchovichina 2004) have applied this methodology to model labour market imperfections in China. They adopt the econometric estimate of the transformation elasticity (which is 2.67) by Sicular and Zhao (2002 and 2004). This elasticity implies that a 1% decrease in the return to farming activities, relative to the market wage, results in a 2.67% increase in off-farm labour supply. In the CGE model used by Polaski (2006), unemployment is also introduced. Agricultural labour may migrate if there is an increased demand in urban unskilled labour markets, depending on the level of unemployment in these markets and rural/urban wage differentials. The elasticity of transformation of unskilled labour between agriculture and non-agriculture is assumed to be 1.

Following the literature, I modify the standard GTAP model in the following ways to address the issue of unskilled labour mobility in China. Such labour is assumed to be perfectly mobile within agriculture (and non-agriculture), but imperfectly mobile between these two sectors. The mobility between these two sectors is represented by a constant elasticity of transformation (CET) function:

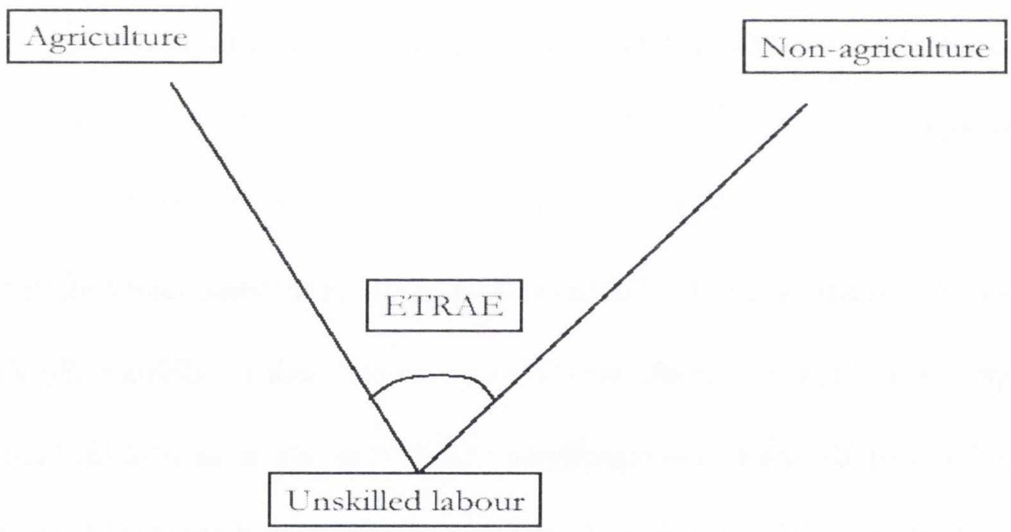
$$L_A / L_W = (W_A / W_W)^{-ETRAE}$$

where L_A is the number of non-farm unskilled workers, L_W is the number of farm unskilled workers, and W_A and W_W are the wage rates in agriculture and non-agriculture respectively. ETRAE is the elasticity of transformation and it is non-positive.

There are several important characteristics of the CET function under the fixed employment assumption. Firstly, increased supplies of labour to manufacturing and services must be drawn from agriculture. Again, there are some concerns about assuming full employment and these will be addressed later in the chapter. Secondly, a finite elasticity of transformation permits wages to diverge between the farm and non-farm sectors. And thirdly, the elasticity of transformation has been calibrated for China in Chapter 4 using rural household survey data (Rozelle *et al*, 2000). This estimate is plugged into the GTAP model. A further simulation is also conducted where the estimated elasticity is raised to reflect a further reform of the rules governing off-farm labour migration. For all the other regions in the model, the perfect labour mobility assumption is kept for both skilled and unskilled workers.

The CET specification implies that there are effectively two sectors for unskilled labour as depicted by Figure 5.1: agriculture being comprised of all primary agricultural sectors, and non-agriculture including all other sectors including processed food, beverage and tobacco, other manufacturing and the services sector.

Figure 5.1: Unskilled Labour Mobility between Agriculture and Non-Agriculture



In order to handle this task in the model, first price and quantity variables for agricultural and non-agricultural unskilled labour are defined, as shown in Table 5.1, where the index *i* represents the mobile production factors (skilled labour, unskilled labour and capital) and *r* is a regional index.

Table 5.1: New variables and parametres introduced in the model

Variable	Description (all variables in percent change)
qoagr(i, r)	Supply of endowment to agricultural sectors
qonagr(i, r)	Supply of endowment to non-agricultural sectors
qo(i, r)	Total supply of endowment
pm(i, r)	Market price for endowment
pmagr(i, r)	Market price for endowment in agriculture
pmnagr(i, r)	Market price for endowment in non-agriculture

Parameter	Description
ETRAEAGNAG(i, r)	Elasticity of Transformation between ag. and non-ag use

Second, the elasticity of transformation parameter, ETRAEAGNAG, is introduced. ETRAEAGNAG(i, r)= elasticity of transformation for unskilled labour, i.e., how easy or hard it is to transform agricultural unskilled labour into non-agricultural unskilled labour. It is, by definition, non-positive. We expect a decline in agricultural unskilled labour supply when there is an increase in the price of unskilled labour in non-agriculture. Specifically, the two equations below represent the mobility of unskilled labour between the two broad sectors.

$$qoagr(i, r) = qo(i, r) + ETRAEAGNAG(i, r)*[pm(i, r)-pmagr(i, r)] \quad (1)$$

$$qonagr(i, r) = qo(i, r) + ETRAEAGNAG(i, r)*[pm(i, r)-pmnagr(i, r)] \quad (2)$$

The description of the variables and parameters can be found in Table 5.1.

Third, the following market clearing conditions must be satisfied. The first equation assures market clearing for unskilled labour in the agricultural sector, while the second equation assures market clearing for unskilled labour in the non-agricultural sector.

VOMAGR(i,r)*qoagr(i,r)=**sum**(j,AGRI_COMM,VFM(i,j,r)*qfe(i,j,r))

VOMNAGR(i,r)*qonagr(i,r)=s**um**(j,NAGR_COMM,VFM(i,j,r)* qfe(i,j,r))

Note that the estimated labour transformation elasticity σ = 3.716%, which is in contrast to the assumption of perfect labour mobility (i.e., $\sigma = \infty$) used in most CGE analyses. This means that the post-shock supply of agricultural and non-agricultural products will be less price-responsive.

After re-coding[1] the model, the implications of unskilled labour mobility were investigated by applying the model to Doha Round trade liberalisation again. Using the estimated transformation elasticity, and other values, the same scenario of modelling the December 2008 package as described in Chapter 3 (see Simulation 1 in Box 1, Chapter 3 for a description of the scenario) is examined and compared against one another.

5.3. Empirical implications of imperfect unskilled labour mobility under fixed employment

[1] See Appendix 5.1.

The issue of imperfect unskilled labour mobility is of great importance for China due to its possible implications for output changes and sectoral reallocations given the relatively high share of agriculture in the Chinese economy and the unskilled labour-intensive character of agriculture. As depicted in Table 5.2 below, cost shares of unskilled labour in agricultural sectors are extremely high, accounting for the majority of the production cost. For instance, in the production of wheat, fruits and vegetables, the costs of unskilled labour measured at market prices are as high as 59%, while the costs of skilled labour are close to zero. In this section, how the results are affected by different treatments of labour with regard to inter-sectoral mobility are highlighted.

Table 5.2: Cost shares of primary factors in agricultural sectors in China in the baseline (2001)

	Rice	Wheat	Oilseeds	Sugar	Plant-based fibre	Livestock & meat	Fruit & vegetables
Land	0.19	0.29	0.29	0.25	0.29	0.28	0.29
UnSkLab	0.46	0.59	0.59	0.55	0.59	0.58	0.59
SkLab	0.02	0.00	0.00	0.01	0.00	0.01	0.00
Capital	0.34	0.12	0.12	0.19	0.12	0.14	0.12

Source: GTAP 6 Database.

First, we look at the output changes of all sectors with perfect and imperfect labour mobility ($\sigma = \infty$ and 3.716%) separately (see Table 5.3). The first column in Table 5.3 gives the output response when unskilled labour is treated as imperfectly mobile between agriculture and non-agriculture. The immobility is two-way, i.e., both the mobility from agriculture to non-agriculture and from non-agriculture back to agriculture are restricted. The second column assumes free movement of unskilled labour. The results are consistent with theoretical expectations: when factors are perfectly mobile between sectors, supply responses are higher compared to the imperfect mobility case.

Table 5.3 Impact of Unskilled Labour Mobility on Output Response %

Sector	Imperfect mobility (σ=3.716)	Perfect Mobility ($\sigma=\infty$)
Rice	5.76	5.83
Wheat	0.45	0.56
Oilseeds	-0.04	0.16
Sugar	3.32	3.45
Plant-based fibre	2.49	2.52
Live animals and meat	0.42	0.52
Fruits and vegetables	0.20	0.24
Other Agricultural Products	4.16	4.34
Other Primary Products	-0.60	-0.61
Processed Food	-0.04	0.04
Beverage and Tobacco	0.28	0.30
Textile	2.62	2.63
Apparel	7.75	7.73
Leather Products	8.10	8.21
Light Manufacturing	-1.35	-1.37
Chemical & Petroleum Products	-1.71	-1.72
Automobiles and parts	-4.71	-4.74
Electronic machinery	-2.36	-2.42
Metals	-1.80	-1.85
Other Manufacturing	-0.53	-0.56
Services	-0.03	-0.04

Source: GTAP simulation results

These results bear out economic intuition. When trade distortions are reduced, demand in all the sectors change according to price changes. Derived demand for labour and other factors will go up in expanding sectors while decreasing in contracting sectors. If unskilled labour is freely mobile between sectors, unskilled labour is easily reallocated. The easier it is to re-allocate labour and other production factors, the bigger the supply change. On the other hand, if barriers in the labour market prevent unskilled labour from moving back to agricultural sectors (not only the *hukou* system but any bias against farming), the increase of labour demand in some expanding agricultural sectors (eg. rice, sugar, and fruit and vegetables, etc.,) has to be satisfied by pulling labour from other agricultural sectors, such as oilseeds. As a result, output of oilseeds drops under the imperfect labour mobility assumption.

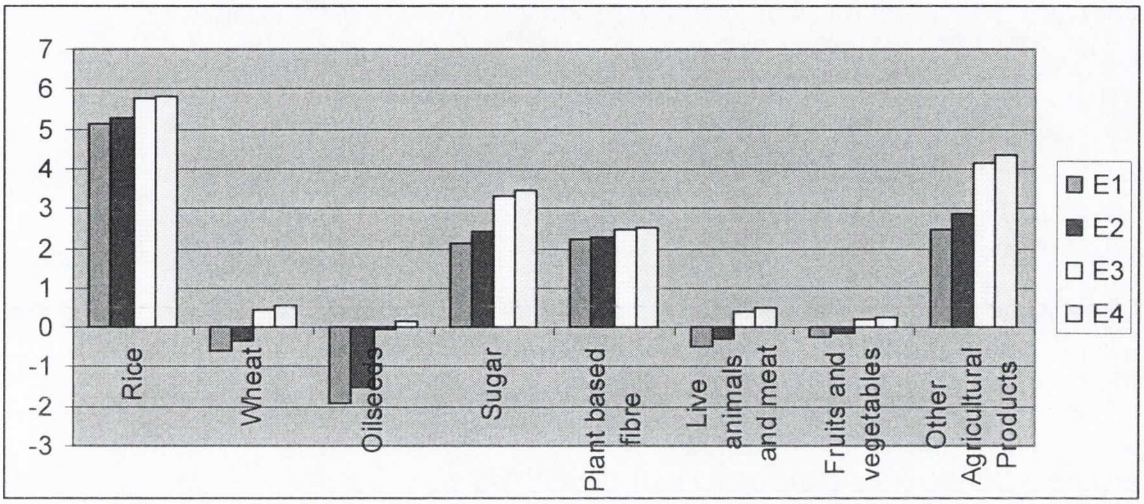
The results indicate that labour migration between farm and non-farm sectors matter. As shown in Table 5.3, under imperfect labour mobility, trade liberalisation tends to punish unskilled-labour-intensive sectors, including agricultural sectors and some manufacturing sectors that intensively use unskilled labour, such as textiles, apparel and leather products. These sectors will benefit more from trade liberalisation when labour market restrictions are removed.

Let us go one step further by first assuming zero transformation elasticity between agricultural and non-agricultural sectors in China and then relaxing it step by step until it is close to perfect mobility. The different values of labour transformation elasticity between farm and non-farm sectors taken are: $\sigma = 0$, 0.1, 3.716, and 500, corresponding to Experiments 1- 4 (E1 to E4). For all the other regions except China in the model, σ is set to be 500 so that it is very close to free mobility. When the $\sigma = 0$, there is no way of pulling agricultural unskilled workers into non-agriculture, no matter how large the wage differential is, and vice versa. The two broad sectors are completely cut off from each other in terms of unskilled labour usage. At the same time, unskilled labour is still mobile within each sector.

Figure 5.2 shows the output response in agricultural sectors from the four experiments mentioned above. The results indicate that output changes for the expanding sectors get larger as we increase the mobility of labour between farm and non-farm sectors. The increase in output is smallest when unskilled labour is assumed to be perfectly immobile between agriculture and non-agriculture. It slowly increases as we relax this assumption. For example, rice output increases by 5.12% with zero labour transformation elasticity, but expands to 5.26%, 5.76% and 5.83% when σ is set at 0.1, 3.716 and 500 respectively.

Due to the immobility of unskilled labour in Experiment 1, the increase of supply in rice, plant-based fibre and sugar is gained at the sacrifice of other sectors such as wheat, oilseeds, live animals and meat, and fruit and vegetables. As we move towards free labour mobility, the decrease of production in these sectors becomes smaller (as in E2), and eventually all agricultural output increases (as in E4). Note that since the impact on China's agricultural production from further liberalisation on China is overall very small (as in Chapter 3), we get very small changes as we relax the labour market assumption as well.

Figure 5.2 Output Responses from Various Experiments, %



Source: GTAP simulation results

The expansion in agricultural production in China as shown in Table 5.3 would cause increased employment of primary factors in agriculture sectors, including unskilled labour. Table 5.4 provides the estimates of changes in unskilled labour wage and employment levels. With increasing labour mobility, agricultural unskilled labour employment increases while non-agricultural employment decreases. At the same time, returns to unskilled workers in agriculture decreases but increases in non-agriculture.

If unskilled labour is allowed to move freely, as in Experiment 4, unskilled labour supply in the agricultural sectors will increase by 1.47% while its supply to non-agricultural sectors will drop by 0.41%. Unskilled labour is pulled back to farms due to expansion of agriculture. Since labour mobility is nearly perfect in this case, prices of unskilled labour in both agriculture and non-agriculture converge.

Table 5.4 Changes in price and quantity of unskilled labour, %

	E1	E2	E3	E4
Agricultural unskilled labour supply	0	0.29	1.33	1.47
Non-agricultural unskilled labour supply	0	-0.08	-0.38	-0.41
Wage rate of agricultural unskilled labour	5.96	5.06	1.98	1.57
Wage rate of non-agricultural unskilled labour	1.04	1.15	1.52	1.57

Source: GTAP simulation results

As we gradually move from elastic to inelastic and to perfectly inelastic labour mobility scenarios (see E3-E1, Table 5.4), it becomes harder to transfer unskilled workers from urban sectors to rural sectors. Expansion in rice production, for instance, has to depend gradually more on drawing resources from other agricultural sectors. The competition for primary factors within agriculture drives the agricultural unskilled wage up and hence creates a wage response differential between farm and non-farm unskilled wages. When labour movement between farm and non-farm sectors is completely forbidden (E1), changes in unskilled labour supply are zero. The wage rate of agricultural unskilled labour increases by almost 6%, while the wage rate of non-agricultural unskilled labour increases by only 1%.

The implication of different assumptions of labour immobility for prices of various sectors can be found in E1-E4, Table 5.5. In all the four experiments, trade liberalisation puts upward pressure on prices in China. The price increase is biggest when there is perfect immobility between the farm and non-farm sector. When labour movement restrictions are gradually removed, the magnitudes of the price increases are reduced. This is explained partly by lower farm unskilled labour wages in Experiments 2, 3 and 4.

Table 5.5 Price changes under different degrees of labour immobility assumption %

Sector	E1	E2	E3	E4	E5
Rice	2.99	2.76	1.94	1.83	1.87
Wheat	2.63	2.40	1.60	1.49	1.54
Oilseeds	3.44	3.12	2.05	1.90	1.99
Sugar	3.39	3.07	1.97	1.82	1.84
Plant based fibre	2.56	2.34	1.59	1.49	1.54
Live animals and meat	3.61	3.25	2.02	1.86	1.91
Fruits and vegetables	3.87	3.48	2.14	1.96	2.04
Other Agricultural Products	3.41	3.14	2.21	2.09	2.15
Other Primary Products	0.26	0.27	0.32	0.32	0.45
Processed Food	2.37	2.18	1.56	1.47	1.49
Beverage and Tobacco	1.77	1.67	1.31	1.26	1.23
Textile	0.72	0.70	0.64	0.64	0.58
Apparel	0.54	0.56	0.63	0.64	0.52
Leather Products	1.19	1.12	0.89	0.86	0.78
Light Manufacturing	0.71	0.72	0.79	0.80	0.70
Chemical & Petroleum Products	0.41	0.43	0.49	0.50	0.46
Automobiles and parts	-0.21	-0.18	-0.06	-0.04	-0.11
Electronic machinery	0.19	0.23	0.34	0.36	0.29
Metals	0.46	0.49	0.62	0.63	0.55
Other Manufacturing	0.60	0.63	0.73	0.74	0.67
Services	0.68	0.72	0.85	0.86	0.78

Source: GTAP Simulation Results

5.4 Modelling labour market imperfections with unemployment (E5)

So far, the analysis shows that a successful Doha Round is likely to boost production in almost all agricultural sectors in China and therefore increase the demand for unskilled labour in these sectors. However, because of the fixed employment assumption, the increased demand for unskilled labour in agricultural sectors has to be satisfied by drawing resources from industrial sectors. De-industrialisation thus occurs, contrary to what might be expected for a country's usual growth path. In reality, China boasts an abundant supply of labour, especially in rural areas. By assuming unemployment in China, expansion in agricultural production after the Doha Round simulation may take full advantage of the rural excess labour supply, instead of competing with industrial sectors for resources. In the case of all the other countries in the model, the standard assumption still applies, that is, the level of total employment remains fixed, and real wages change to clear labour markets.

In order to model unemployment, the new assumption is that the GTAP base data reflects only employment, not the total endowment of unskilled labour in China. The employment of unskilled labour in China's agriculture is endogenised, while at the same time the real wage of unskilled labour is fixed (exogenised) relative to CPI. Any change in the employment level is covered from an unspecified pool of unemployed, or, more likely, underemployed.

There are some changes to the results after the modification of the model (this new experiment is named E5). First of all, the positive output responses in the agricultural sectors are bigger than before (Table 5.6), given that increased unskilled labour demand can now be covered from an unspecified pool of unemployment. As shown in the table, the overall employment of unskilled labour increases by 0.89 per cent. Some of the contracting manufacturing industries do not have to compete with the expanding agricultural sectors for resources, and thus the decrease of their output is smaller than before.

Table 5.6: Impact of Unskilled Labour Mobility on Output Response %

Sector	Perfect mobility	Imperfect mobility and fixed employment (E3)	Imperfect mobility and unskilled labour unemployment (E5)
Rice	5.83	5.76	6.02
Wheat	0.56	0.45	0.91
Oilseeds	0.16	-0.04	0.43
Sugar	3.45	3.32	3.73
Plant-based Fibre	2.52	2.49	2.98
Live Animals and Meat	0.52	0.42	0.90
Fruits and vegetables	0.24	0.20	0.46
Other Agricultural Products	4.34	4.16	4.59
Other Primary Products	-0.61	-0.60	-0.33
Processed Food	0.04	-0.04	0.34
Beverage and Tobacco	0.30	0.28	0.63
Textile	2.63	2.62	3.10
Apparel	7.73	7.75	8.29
Leather Products	8.21	8.10	8.59
Light Manufacturing	-1.37	-1.35	-0.90
Chemical & Petroleum Products	-1.72	-1.71	-1.31
Automobiles and Parts	-4.74	-4.71	-4.33
Electronic Nachinery	-2.42	-2.36	-1.92
Metals	-1.85	-1.80	-1.35
Other Manufacturing	-0.56	-0.53	-0.12
Services	-0.04	-0.03	0.36
Unskilled Labour Employment	-	-	0.89

Source: GTAP Simulation Results

Secondly, the increase of agricultural unskilled labour supply is stronger than before (see column E5 in Table 5.7). This increase does not have to be pulled from the unskilled labour employed in manufacturing. As shown in the table, the supply of unskilled labour in non-agriculture also increases by 0.60 per cent, in contrast to the drops in the previous experiments. Further, because of the unemployment of unskilled labour, the increase in the market wage of unskilled labour becomes much smaller. The response of the non-agriculture wage is also very small.

Table 5.7 Changes in price and quantity of unskilled labour, %

	E1	E2	E3	E4	E5
Agricultural unskilled labour supply	0	0.29	1.33	1.47	1.90
Non-agricultural unskilled labour supply	0	-0.08	-0.38	-0.41	0.60
Wage rate of agricultural unskilled labour	5.96	5.06	1.98	1.57	1.28
Wage rateof non-agricultural unskilled labour	1.04	1.15	1.52	1.57	0.94

Source: GTAP Simulation Results

Overall, the simulated 2008 Doha scenario has a positive impact on poverty reduction in China. Firstly, the Doha Round trade negotiations are expected to bring opportunities to China's agriculture, which will increase the level of employment and hence benefit the unemployed or underemployed in rural areas. Secondly, although the real factor return of unskilled labour remains unchanged (due to model assumption), both agricultural and non-agricultural unskilled market wages increase.

At least, unskilled workers are not worse off. Thirdly, the supply prices of the agricultural products increase across the board, implying a real income increase for farmers. Lastly, the real return of land also goes up by 5.3 per cent, which is also likely to boost farmers' real incomes.

Relaxing the fixed employment assumption in China in the standard GTAP model brings a much bigger benefit for China (see Table 5.8) but does very little for the rest of the world[2]. China's national welfare gain more than doubles when unemployment or underemployment is considered (see Table 5.8). The biggest contributor to welfare gains comes from the endowment effect, which results from a higher employment level following the expansion of agricultural sectors. Allocative efficiency effect also doubles, due to a better allocation of resources when the unemployed or underemployed are pulled back to work.

Table 5.8: Impact of labour market imperfections on Doha Round welfare implications in China *(US$ Million)*

Welfare Change	*Perfect labour mobility with fixed employment*	*Imperfect labour mobility with unemployment*
Total	2,560	6,717
Allocative Efficiency Effect	587	1,295
Terms of Trade Effect	2,487	2,212
Investment-Saving Price Effect	-474	-411
Endowment effect	n.a.	3,622

Source: GTAP Simulation Results

[2] See Appendix 5.2 for welfare changes for other countries.

5.5. Conclusions

Labour market imperfections are prevalent in most developing countries, and are important factors in determining the implications of trade reforms. This chapter tries to analyse the implications of labour market conditions for the analysis of the impact of the Doha Development Agenda on China.

Labour mobility with full or fixed employment is first examined due to its possible effects on sectoral reallocation of factors of production, output response, prices and wages. The implications of treating agricultural unskilled labour as less than perfectly mobile in the context of Doha trade liberalization were examined. The results indicate that the degree of mobility of the agricultural unskilled labour has different effects on sectoral reallocations and output responses. The higher the degree of unskilled labour mobility between farm and non-farm sectors, the higher the output response, and the lower the real earnings increase of unskilled labour in agriculture. The analysis also shows that farm unskilled wages go up more than unskilled non-farm wages under imperfect labour mobility assumptions, indicating a positive poverty effect and a possible reduction in rurual-urban income inequality.

Incorporating unemployment into the model also matters. The responses in production and labour supply are greater once unemployment is accounted for in the model, given that unskilled labour can be drawn from the pool of unemployment.

Moreover, by relaxing the full employment assumption, the analysis shows a much bigger effect on China's national welfare - about 6,700 million US dollars, compared to 2,560 million US dollars when full employment is assumed. When employment is endogenised, the real wage of unskilled labour is fixed. But, nominal unskilled farm wages increase more than non-farm wages, implying a positive poverty and rural-urban inequality effect.

The author appreciates the limitations of any macro level study on poverty and rural-urban income inequality, as is done here. A broad glance at the macro level fails to take account of heterogeneities across households and across different regions within a country. In the next chapter, an attempt to overcome this problem will be made by applying the changes in prices and wages predicted at the macro level to micro households in order to fully examine what Doha means to different types of households.

Appendix 5.1: Modelling Unskilled Labour Mobility in GTAP

! Modify standard model GTAP.TAB for the unskilled labour immobility. Unskilled labour is assumed to be perfectly mobile within agriculture (and within non-agriculture), but imperfectly mobile between these two sectors. According to this specification there are two sectors for unskilled labour: agriculture and non-agriculture. !

!To introduce a new set including all agricultural commodities !

Set

AGRI_COMM # *agricultural production commodities* #

maximum size 10 **read elements from file** GTAPSETS **header** *"AGRI"*;

Subset

AGRI_COMM **is subset of** TRAD_COMM;

Set

NAGR_COMM # *non-agricultural commodities* # = PROD_COMM - AGRI_COMM;

!Define price and quantity variables for agricultural and non-agricultural unskilled labour!

Variable (**all**,i,ENDWM_COMM)(**all**,r,REG)

pmagr(i,r) # *market price of agr endowment i in r* #;

Variable (**all**,i,ENDWM_COMM)(**all**,r,REG)

pmnagr(i,r) # *market price of non-agr endowment i in r* #;

Variable (**all**,i,ENDWS_COMM)(**all**,j,PROD_COMM)(**all**,r,REG)

pmes(i,j,r) # *market price of sluggish endowment i used by j, in r* #;

Coefficient(**ge** 0)

(**all**,i,ENDW_COMM)(**all**,j,PROD_COMM)(**all**,r,REG)

VFM(i,j,r) # *producer expenditure on i by j in r valued at mkt prices* #;

Update (**all**,i,ENDWM_COMM)(**all**,j,AGRI_COMM)(**all**,r,REG)

VFM(i,j,r) = pmagr(i,r) * qfe(i,j,r);

Update (**all**,i,ENDWM_COMM)(**all**,j,NAGR_COMM)(**all**,r,REG)

VFM(i,j,r) = pmnagr(i,r) * qfe(i,j,r);

Update (**all**,i,ENDWS_COMM)(**all**,j,PROD_COMM)(**all**,r,REG)

VFM(i,j,r) = pmes(i,j,r) * qfe(i,j,r);

Read

VFM **from file** GTAPDATA **header** "*VFM*";

!Link domestic and firm demand prices through taxes on unskilled labour input i, employed in sector j, in region r, which capture the effect of taxation of firms' usage of unskilled labour. In level form, tax on input i in sector j in region r is given by value of firms' purchases at agent's prices over market prices !

Equation AGRPFACTPRICE

eq'n links domestic and firm demand prices (HT 16)

(**all**,i,ENDWM_COMM)(**all**,j,AGRI_COMM)(**all**,r,REG) pfe(i,j,r) = tf(i,j,r) + pmagr(i,r);

Equation NAGRPFACTPRICE

eq'n links domestic and firm demand prices (HT 16)

(**all**,i,ENDWM_COMM)(**all**,j,NAGR_COMM)(**all**,r,REG)

pfe(i,j,r) = tf(i,j,r) + pmnagr(i,r);

! In order to have separate market clearing conditions for agriculture and non-agriculture, we need to segment these factor markets, with a finite elasticity of transformation. We also have separate market prices for each of these sets of endowments!

Coefficient (**all**,i,ENDWM_COMM)(**all**,r,REG)

VOMAGR(i,r);

Formula (**all**,i,ENDWM_COMM)(**all**,r,REG)

VOMAGR(i,r) = **sum**(k,AGRI_COMM, VFM(i,k,r));

Variable (**orig_level**=VOMAGR)(**all**,i,ENDWM_COMM)(**all**,r,REG)

qoagr(i,r) # *agr endowment of i in region r* #;

Variable (**all**,i,ENDWM_COMM)(**all**,r,REG)

endwslackagr(i,r) # *slack variable in mktcl for i in region r* #;

Equation MKTCLENDWAGR

eq'n assures mkt clearing in agriculture for labor

(**all**,i,ENDWM_COMM)(**all**,r,REG)

VOMAGR(i,r)*qoagr(i,r)

= **sum**(j,AGRI_COMM, VFM(i,j,r) * qfe(i,j,r))

+ endwslackagr(i,r);

Coefficient (**all**,i,ENDWM_COMM)(**all**,r,REG)

VOMNAGR(i,r);

Formula (**all**,i,ENDWM_COMM)(**all**,r,REG)

VOMNAGR(i,r) = **sum**(k,NAGR_COMM, VFM(i,k,r));

Variable (**orig_level**=VOMNAGR)(**all**,i,ENDWM_COMM)(**all**,r,REG)

qonagr(i,r) # *non-agr endowment of i in region r* #;

Variable (**all**,i,ENDWM_COMM)(**all**,r,REG)

endwslacknagr(i,r) # *slack variable in mktcl for i in region r* #;

Equation MKTCLENDWNAGR

eq'n assures mkt clearing in non-agriculture for labor and capital

(**all**,i,ENDWM_COMM)(**all**,r,REG)

VOMNAGR(i,r)*qonagr(i,r)

= **sum**(j,NAGR_COMM, VFM(i,j,r) * qfe(i,j,r))

+ endwslacknagr(i,r);

Equation ENDWAGRI_PRICE

eq'n generates the composite price for nonland endowments in agr

(**all**,i,ENDWM_COMM)(**all**,r,REG)

VOM(i,r)*pm(i,r) = VOMAGR(i,r)*pmagr(i,r) +

VOMNAGR(i,r)*pmnagr(i,r);

Coefficient(**PARAMETER**) (**all**,i,ENDWM_COMM)(**all**,r,REG)

ETRAEAGNAG(i,r)

 # agr/ nonagr el of trans for nonland primary factor endowments #;

Read

ETRAEAGNAG **from file** GTAPPARM **header** *"ETAG"*;

!<

ETRAEAGNAG is the elasticity of transformation for labor and capital endowments. It is non-positive, by definition. >!

Equation ENDWAGR_SUPPLY

 # eq'n distributes the non land endowments btwn agr and nonagr #

(**all**,i,ENDWM_COMM)(**all**,r,REG)

qoagr(i,r) = qo(i,r) + ETRAEAGNAG(i,r) * **[**pm(i,r) - pmagr(i,r)**]**;

Equation ENDWNAGR_SUPPLY

 # eq'n distributes the non land endowments btwn agr and nonagr #

(**all**,i,ENDWM_COMM)(**all**,r,REG)

qonagr(i,r) = qo(i,r) + ETRAEAGNAG(i,r) * **[**pm(i,r) - pmnagr(i,r)**]**;

! Labour immobility tablo End!

Appendix 5.2 Welfare Implications of the DDA by region

WELFARE	*Perfect labour mobility with fixed employment*	*Imperfect labour mobility with unemployment*
EU	7,347	7,356
USA	-2,255	-2,207
Japan	16,065	16,080
China	2,560	6,717
Hongkong	512	551
ASEAN	2,253	2,262
XASIA	686	686
Taiwan	-189	-188
Brazil	2,191	2,194
Korea	3,093	3,097
AUandNZ	1,451	1,466
NewEU	-88	-88
EU Candidates	442	438
Russia	-764	-750
India	1,784	1,776
SSA	476	491
Canada	406	414
MERCOSUR	332	340
Mexico	-96	-96
ROW	236	307
Total	36,482	40,848

Source: GTAP Simulation Results

Chapter 6: Poverty Implications of The Doha Round for Rural China: a Micro-simulation Analysis

6.1 Introduction

The past 30 years of domestic reform and open-door policy has seen China emerging as one of the world's biggest and fastest-growing economies. This great reform initially started in the rural areas of China. With the introduction of the Household Contract Responsibility System, agricultural production expanded enormously over a short period of time and the incomes of farmers increased significantly during the early years of the reform. However, as the reform deepened in the urban areas, farmers were forgotten, until recently, when millions of peasant workers flooded into the cities.

In line with rapid industrialization, China's agriculture sector has been declining in terms of its contribution to GDP, from just below 30% in 1990 to 15% in 2003. However, agriculture is still a very important contributor in employment, employing some 40% of the overall labour force in 2003 (National Bureau of Statistics, China). In addition, about 60% of the total population live in rural areas. The coexistence of a low GDP share and a high population proportion is an indicator of a low living standard for farmers. According to the World Bank, over 100 million people in China fell below the poverty line in 2006 (www.worldbank.org).

China is the world's biggest producer and consumer of many agricultural products, including wheat, rice, corn, potatoes, apples, pears, garlic, onion, pork, mutton and eggs (FAOSTAT: OECD, 2005). Agricultural production is run by households as a unit, built on a large surplus of labour, a low level of land endowment, and low levels of mechanisation, technology and productivity. As a result, China has a comparative advantage in producing labour-intensive products such as rice, fruit and vegetables, rather than land-intensive products such as wheat, corn and oilseeds.

Debates have been much focused on whether the Doha Round of trade liberalization is "pro-poor". Some economists (Sachs and Warner 1995, Edwards 1998) believe that in the long run openness contributes significantly to growth, and consequently to poverty reduction. However, empirical work (Dollar and Kraay 2002, White and Anderson 2001) fails to establish this link. Generally speaking, the impacts of trade liberalization on poverty within a country depend on many factors. Firstly, the impacts depend on the level of initial tariff rates and the magnitude of the tariff cut. If the initial tariff level is high or the tariff cut is deep, countries benefit from trade liberalization in terms of national welfare gains, particularly through allocative efficiency effects. Farmers and the poor are likely to gain from this increased national welfare.

Second, the impacts depend on the pre-existing distribution of assets and wealth. For example, if trade liberalization benefits agriculture, and if land holdings are highly concentrated, smaller farmers may be adversely affected by trade liberalisation. Historically, China's assets have been rather equally distributed by developing country standards. Land is usually distributed to farmers according to the number of people living in the households. The poverty impact of trade liberalisation is therefore expected to be felt relatively equally among farmers. If agriculture is predicted to benefit from trade liberalisation (as in Chapter 5), it would possibly increase farmers' incomes and hence have positive impact on poverty reduction.

Thirdly, the trade liberalization impacts on poverty come through functions of product markets, in particular, whether price changes at the border will be transmitted to the inland and rural parts of the country, and whether households will be able to respond to price changes by moving to the production of more profitable commodities or by switching occupations. Huang and Rozelle (2002) found that China's national markets are integrated and prices are transmitted to different areas of the economy. Therefore, any price change post-Doha would likely have rather direct and immediate effect on rural households' incomes and activities.

Factor markets also play an important role in allocating resources and re-distributing wealth. In the past decades, rural-urban and inter-regional labour migration has increased significantly in China, indicating a more mobile and responsive labour market, and a possible positive effect on poverty reduction if impoverished rural workers can easily move to more prosperous sectors after the Doha trade liberalisation. However, some observers (e.g., Knight and Song, 1999) believe that under the current *Hukou* system, rural workers still face difficulties in seeking employment in the urban areas. So poverty alleviation may be adversely affected by labour market imperfections.

These factors may have counterbalancing effects on welfare changes among various households in China. This chapter describes a detailed case study to examine the potential impacts of the Doha Round on the rural poor at the micro level. The next section provides a summary of the approach taken. Section 6.3 examines the determinants of differences between households' incomes, and Section 6.4 presents the results of the micro-simulation. Section 6.5 concludes the chapter.

6.2 Approach

Linking macro and micro analysis together has become a popular approach to disaggregating welfare implications for various types of farmers (e.g. Cogneau and Robilliard 2000, Chen and Ravillion 2004, and Herault 2006). Macro CGE analysis has been widely used to quantify the impacts of trade reforms (see Chapter 2). Trade policy changes can be easily simulated within a CGE framework. However, most CGE models have only a limited number of representative households. Linking a micro-simulation model at the household level to a CGE model captures the heterogeneity among various household characteristics, and allows the advantages of both models to be utilized.

This chapter adopts this sequential macro-micro approach. Section 6.2.1 briefly describes the GTAP analysis at the macro level and presents changes in prices and wages derived in Chapter 5. Section 6.2.2 gives an introduction of the first-order welfare method used in the micro simulation and provides analysis of the household survey data. Section 6.2.3 links the macro and micro analysis by matching sectors, occupations, labour income, etc., between the GTAP model and the household survey data.

6.2.1 The GTAP Model

GTAP modelling is used in Chapters 3 and 5 to analyse and quantify the impacts of trade liberalization. A detailed description of the GTAP model can be found in Chapter 2. Modifications of the standard GTAP model in previous chapters ensured greater accuracy and captured specific features of the Chinese economy. Such modifications included (a) updating the GTAP 2001 database to take account of relevant policy changes since 2001, including the full implementation of China's WTO entry commitments and the enlargement of the EU; (b) taking full account of the existence of tariff binding overhang, as well as the impact of a harmonising formula, using the MacMaps database and TASTE program; (c) relaxing the assumption of full labour mobility to capture the limitations on rural labour mobility in China under the hukou system; (d) relaxing the fixed employment assumption by accounting for unemployment in the unskilled labour market in China.

This modified model was used to perform two simulation experiments: agricultural trade liberalisation and manufacturing trade liberalisation. Details of the simulation results from the GTAP analysis were presented in Chapter 5. Table 6.1 (same as E5 in Table 5.5) lists the changes in prices that are used to derive the welfare changes for households in the micro-simulation.

6.2.2 Micro-simulation

For analysis at the household level, this chapter applies a standard method of first-order welfare analysis to define impacts of the Doha Round at the household level, as used by Chen and Ravallion (2004) and other researchers. The equation for the welfare change is defined as:

$$w_i \equiv \frac{du_i}{v_{\pi i}} = \sum_{j=1}^{m} \left[p_{ij}^s q_{ij}^s \frac{dp_{ij}^s}{p_{ij}^s} - p_{ij}^d (q_{ij}^d + z_{ij}) \frac{dp_{ij}^d}{p_{ij}^d} \right] + \sum_{k=1}^{n} (w_k L_{ik}^s \frac{dw_k}{w_k}) \qquad (6.1)$$

where u_i is the utility for household i and $v_{\pi i}$ is the marginal utility of income for household i. p^s is the vector of supply prices, p^d is the price vector for consumption, q^s is the vector of quantities supplied, q^d is the vector of quantities for consumption, and z^i are quantities of commodities used as production inputs. The first bracket is useful when calculating income changes in agricultural own production. The second bracket calculates welfare changes due to changes in returns to labour. L_{ik}^s is labour input, and w_k is the vector of wage rates. Note that any gain from increases in labour return in agricultural own-production is offset by the use of labour as an input.

Table 6.1 Price and wage changes at the macro level after the simulated Doha trade liberalisation (%)

Sector	Price and wage changes
Rice	1.87
Wheat	1.54
Oilseeds	1.99
Sugar	1.84
Plant-based fibre	1.54
Live animals and meat	1.91
Fruits and vegetables	2.04
Other agricultural Products	2.15
Other primary products	0.45
Processed food	1.49
Beverage and tobacco	1.23
Textile	0.58
Apparel	0.52
Leather products	0.78
Light manufacturing	0.7
Chemical & petroleum products	0.46
Automobiles and parts	-0.11
Electronic machinery	0.29
Metals	0.55
Other Manufacturing	0.67
Services	0.78
Price of agricultural unskilled labour	1.28
Price of non-agricultural unskilled labour	0.94

Source: GTAP Simulation Results

The advantage of micro-simulation is that it reflects the heterogeneity of various households, including their respective endowments, their labour allocation choices and their consumption and production patterns. However, this model is not without its shortcomings. It does not capture the responses to price and wage changes by households. It is static, and short-term in nature. It simply applies price changes to households' income and consumption accounts to impute the impact on welfare, which is only the first round of the trade liberalisation impacts felt at the household level.

Data. The micro-simulation analysis is based on a rural household survey conducted in 2000 by a team led Scott Rozelle *et al.* A detailed description of the data was provided in Chapter 4. Although the sample coverage is small compared to the total population of China, geographical areas are chosen to represent various regions across China, including two coastal provinces, two midland provinces and two provinces in the west of China (see map in Chapter 4). The survey year 2000 provides a baseline for analyzing various policy changes relating to China's agricultural and rural development. Since then a series of policy changes have taken place, including China's admission into the WTO and many domestic agricultural policy reforms.

Poverty in the baseline

There are a number of different criteria to measure poverty and income distribution in China. In 2000, when the survey utilized in this paper was conducted, the official Chinese poverty line was 625 Chinese Yuan (CNY) per year, equivalent to about US$

75 using the nominal exchange rate that year ($100 = CNY 827.84). According to this criterion, the number of rural poor decreased from 250 million in 1978 to 32 million in 2000 and then to 21 million in 2006, corresponding to 30.7, 3.4 and 2.3 per cent of the total rural population respectively (National Bureau of Statistics, China). Most of the poor live in the west of China and their income is highly dependent on agriculture (e.g. Shaanxi in the survey).

It has been suggested that the official national poverty line has been set excessively low, and that the actual number of people living in poverty is much higher. By the World Bank's $1 per day standard, about 126 million people live in poverty in rural China, about one tenth of the total population and 16 per cent of the rural population. This figure reflects a serious poverty problem in China. In this chapter both standards are adopted to estimate the poverty effects of the Doha Round.

Table 6.2 summarizes the poverty statistics given by the survey sample. The average income per person in the sample is about 4,100 Chinese Yuan, which is approximately in line with the official statistics by the National Bureau of Statistics of China. As one of the affluent areas, Zhejiang boasts a per capita income of over 7,000 Yuan, well above the national average. On the other hand, Sichuan province, situated in southwest of China, has a relatively low average income level. Although the poverty incidence is usually positively related to the average income, Sichuan is not the worst region in terms of poverty ratio. Using the official poverty line, over 20 per cent of the surveyed individuals in Shaanxi province live below the poverty line, and Hebei also has a high ratio at almost 10 per cent. Zhejiang, Hubei, and Liaoning are better performers with regard to the proportion of people living in poverty, at 3 to 4 per cent. The poverty poverty ratio (8%) calculated from the survey are higher than the national poverty ratio published by the National Bureau of Statistics of China, which is 3.4 per cent in 2000.

Table 6.2: Income distribution and poverty ratio in the baseline (2000)

		Official Poverty Line			**$1 per day line**		
Province	Income / person (CNY)	No. of hhds	Head counts	Poverty Ratio	No. of hhds	Head counts	Poverty Ratio
Hebei	3035	21	71	0.095	129	502	0.673
Shaanxi	3968	42	159	0.214	149	583	0.785
Liaoning	4319	8	28	0.042	89	330	0.495
Zhejiang	7039	6	24	0.034	73	275	0.392
Sichuan	2588	14	50	0.066	152	601	0.795
Hubei	3642	5	23	0.030	119	495	0.643
Total	4096	96	355	0.080	711	2786	0.630

Source: Own calculations from survey data

Income sources

The survey data provides rich information on households' income sources, allowing for estimation and comparison of the impact of agricultural and non-agricultural employment on income, and examination of the income gap between different households. Presenting this information helps to shed some light on how the Doha Round might be translated to different types of rural households.

There are three major sources of income for each household - agricultural production, self-employment and non-farm wage employment (see Table 6.3). Net income consists predominantly of these three sources, plus other incomes and transfer income. Income per capita is obtained by dividing the earnings by numbers of persons in each household. The income levels are summarized by province in Table 6.3. It appears that self-employment and wage employment contribute more to the overall income than agriculture. Other incomes and transfer income are only a small proportion of the total income. The richest province, Zhejiang, has almost half of the income from self employment and another one third from wage employment. At the other end, the poorest province, Sichuan, mostly relies on agriculture to generate income.

Table 6.3 Per Capita Income by Sources and Province (Chinese Yuan, 2000)

Province	Agriculture	Wage employment	Self employment	Other income	Transfer income	Average income
Hebei	1635	872	476	173	112	3035
Shaanxi	1176	1003	1723	151	75	3968
Liaoning	2642	1338	265	231	189	4319
Zhejiang	1327	2018	3185	391	207	7039
Sichuan	1208	957	282	134	136	2588
Hubei	1447	1443	655	65	207	3642

Source: Survey Data, Rozelle et.al. *(2000)*

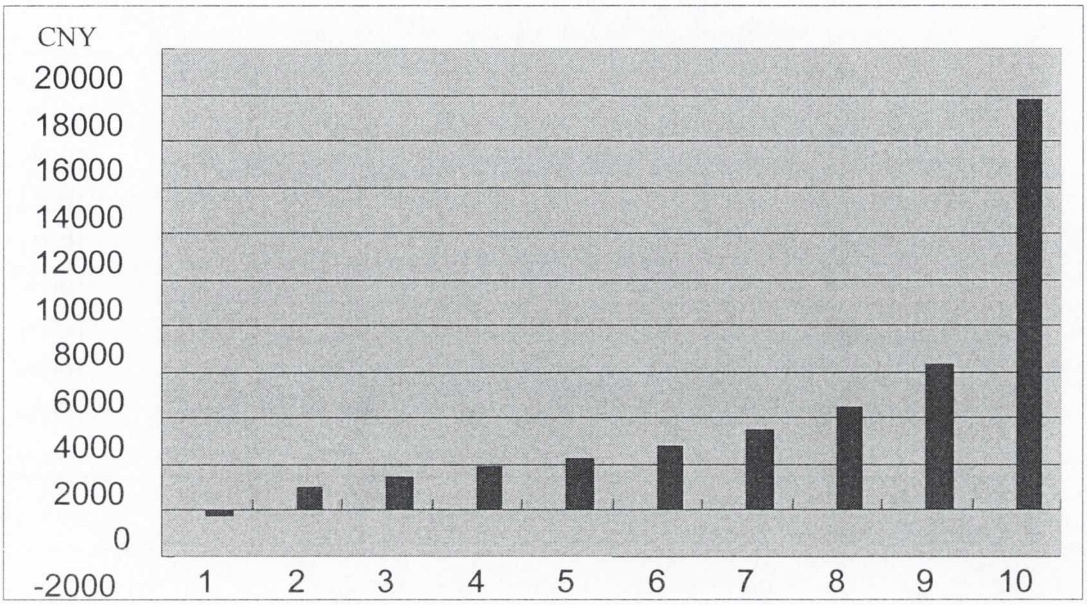
The survey also shows that income inequality is high in the rural areas in China (see Table 6.4 and Figure 6.1). There are about 1,200 households in the sample, so that each decile contains about 120 households. The top 10 per cent of the households possess over 40 per cent of the overall income, and the top 20 percent of the households possess nearly 60 per cent of the overall income. The negative incomes in the bottom decile result from the losses incurred from self-employed businesses. Even without losses in self-employment, incomes in the bottom decile are still very low, at about 760 Chinese Yuan.

Table 6.4 Per Capita Income by Sources and Income Decile (Chinese Yuan, 2000)

Decile	Agriculture	Wage Employment	Self Employment	Other Income	Transfer Income	Average Income
1	464	80	-789	159	59	-190
2	848	135	80	17	58	984
3	943	410	85	42	84	1416
4	1284	423	208	16	121	1862
5	1535	582	201	54	126	2286
6	1455	846	493	49	119	2793
7	1703	1234	555	143	93	3522
8	2030	1697	655	210	130	4517
9	2589	2413	941	413	272	6354
10	2888	4946	8644	811	487	17759

Source: Survey Data, Rozelle et.al. *(2000)*

Figure 6.1 Per Capita Income by Income Decile



Source: Survey Data, Rozelle et.al *(2000)*

Table 6.5 shows that the majority of the income for the poorest households comes from agriculture. For richer households, agriculture is less important but still remains a big contributor to income, while at the same time wage employment is high in importance as a source of income. Wage income is almost negligible in the poorest deciles, but accounts for over 30 per cent of the income in richer deciles. The contribution of self-employment also increases continuously when total income increases, until it becomes the single most important factor in determining total income in the top decile. Other incomes and transfer income are negligible.

Table 6.5 Per Capita Income by Sources and Income Decile (%)

Decile	Agriculture	Wage employment	Self employment	Other income	Transfer income	Average income
1	-244%	-42%	415%	-84%	-31%	100%
2	86%	14%	8%	2%	6%	100%
3	67%	29%	6%	3%	6%	100%
4	69%	23%	11%	1%	6%	100%
5	67%	25%	9%	2%	6%	100%
6	52%	30%	18%	2%	4%	100%
7	48%	35%	16%	4%	3%	100%
8	45%	38%	15%	5%	3%	100%
9	41%	38%	15%	6%	4%	100%
10	16%	28%	49%	5%	3%	100%

Source: Survey Data, Scott et.al (2000)

6.2.3 Linking macro and micro analysis

Sectors. In the previous GTAP analysis, the initial 57 sectors were mapped into 21 new categories, comprising 11 agricultural, food and primary sectors, 9 manufacturing sectors and 1 service sector (see Table 3.2 in Chapter 3 for a full list of sectors). The rural household survey has over 100 categories of consumption and production commodities, and they have been matched to the closest category in GTAP. For example, the oilseeds sector in GTAP includes peanut, rapeseed, sesame, sunflower and soybean. Cotton, jute and benne are placed in the category plant-based fibres. Sugar cane and sugar beet go to the category sugar.

Occupations and labour income. The GTAP analysis in Chapter 5 assumes that unskilled labour is imperfectly mobile between the agricultural and non-agricultural sectors while skilled labour is mobile across all sectors. Three types of labour are thus defined: skilled labour, unskilled agricultural labour and unskilled non-agricultural labour. Farm workers are categorized as unskilled labour. For non-farm workers, the rural household survey categorizes the labour force into 16 occupations, with information on education then combined to define skilled or unskilled labour. Those households whose heads have received 12 years of schooling or above are classified as skilled labour and the rest as unskilled labour.

Own production and consumption. The micro-simulation analysis takes into account own production and consumption by rural households. The gains and losses from own consumption will cancel out those from production, so will feeds and seeds. Expenditures on other production costs, including fertilizers, pesticides, etc., are also considered, but they are included in the category "chemical and petroleum products".

Labour input is captured in the last term in Equation 6.1. Gains or losses in earnings from labour used in own production are matched by changes in wages to own production. As this is only a short-term static model, the equation does not take into account possible responses in terms of labour allocation.

Returns to land and capital. In China, land is collectively owned, and is allocated to farmers within the village. Farmers have rights to use land but not to sell it, although they are allowed to subcontract land to another farmer. The changes in land price from GTAP modeling can are applied to land rentals and therefore captured in farmers' welfare changes.

Expenditure. The expenditure side of the data is not as complete as the income side. Expenditures were recorded for only half of the households in the survey (about 600 households). For all the missing observations, the average welfare change for the observed households is applied.

6.3 Determinants of household income

Before I present the results of the macro-micro simulation in Section 6.4, it is useful to examine the microeconomic determinants of differences in rural household income in China, in order to understand why the rich are rich and the poor are poor. An income generation function is estimated for this purpose, where net income is specified as a function of labour inputs, land input, and other household or provincial characteristics.

The dependent variable of the function is total income, at the household level. This explains why incomes are much higher than in Table 6.4 and 6.5 where per capita income is used. Explanatory variables include actual labour hours in agricultural production, self-employed non-farm business and wage employment, land area in *mu*[1],

[1] *mu* is a Chinese unit of area. One *mu* is about 667 square metres, or 1/15 a hectare.

education and regional dummies. The summary of the data is contained in Table 6.6.

Table 6.6 Description of the Variables for the Income Generation Function

	Mean	Standard Deviation
Total households earnings	12,613	21,028
Agricultural production labour hours	2,518	2,472
Wage employment labour hours	996	1,118
Non-agricultural self-employment labour hours	504	959
Age of Head	45	11
Years of schooling of head	6.6	2.6
Land area (in *mu*)	8.7	11.1
Household size	3.60	1.3
Number of children	0.85	0.4
Hebei	0.2	0.4
Liaoning	0.2	0.4
Zhejiang	0.2	0.4
Sichuan	0.2	0.4
Hubei	0.2	0.4

Source: Survey data, Rozelle et.al. (2000)

The estimated coefficient for agricultural hours of work is negative, but statistically insignificant (see Table 6.7). The coefficient for labour hours in non-farm businesses is 1.75, and that for hours in market employment is 1.71, statistically significant at 5% and 1% level respectively. These results indicate that income differences among households are generated more by non-agricultural work than by agricultural work. The results are roughly in line with Sicular and Zhao (2004) and Meng (2000)'s work.

Table 6.7: Estimation of Income Generation Function, linear form

Dependent variable: household net earnings

	Coefficient	t-statistic
Agricultural production labour hours	-0.188	-0.59
Wage employment labour hours	1.714	(2.63)**
Non-agricultural self-employemtn labour hours	1.754	(2.06)*
Age of Head	41.647	0.52
Years of schooling of head	880.808	(3.11)**
Land area	65.544	0.96
Household size	1,175.80	1.62
Number of children	-961.764	-0.83
Hebei	1,102.67	0.47
Liaoning	2,185.90	0.92
Zhejiang	11,613.52	(4.74)**
Sichuan	Default	
Hubei	2,110.14	0.94
Constant	-4,345.62	-0.86
Observations	858	
R-squared	0.07	

t statistics in parentheses, * significant at 5%; ** significant at 1%

Note: observations in Shaanxi are dropped in this model. When observations in Shaanxi are included most of the variables presented in the table are not significant.

The analysis also shows that education has a significant effect on household income. An additional year of schooling for the most educated worker in the household increases household net income by more about 880 Yuan. The age of household head has a non-significant effect on household earnings. Other variables, such as land area, and number of people living at home, do not have a significant effect on household earnings. The only regional dummy that is significant and large is Zhejiang province, which reflects the fact that households in Zhejiang have much higher earnings than those from other provinces.

The linear income generation functions are easy to interpret in theory but cause serious problems in empirical work. Many of the variables in the equation are not normally distributed, such as the total income, hours worked and land area. The estimates of the coefficient are therefore not unbiased, efficient, consistent or normally distributed. To overcome this problem, a log-linear form of the function is estimated. The results are indeed more plausible (see Table 6.8). Again hours worked in agricultural production do not improve economic well-being of a household income, while the hours worked in wage employment and non-farm business are important. A one per cent increase in non-agricultural employment will increase the income by 0.09 per cent, while a one per cent increase in non-farm business labour hours will increase the income by 0.06 per cent.

Education has an important impact on household income. The coefficient of 0.035 indicates that an additional year of schooling will increase the income by 3.5 per cent, which is about 441 Yuan on average. Land and capital (measured as value of equipment) have significant and positive effect on household earnings. A one per cent increase in land area will increase household income by 0.133 per cent, and a one per cent increase in the equipment value increase the household income by 0.046. The significant coefficients of provincial dummy variables also indicate that location of the residence is important in determining the income.

Table 6.8 Estimation of income generation function, log form

Dependent variable: Log of household net earnings

	Coefficient	t-statistic
Log of agricultural production labour hours	-0.028	-1.26
Log of wage employment labour hours	0.094	(12.31)**
Log of Non-farm business labour hours	0.058	(6.59)**
Log of land area	0.133	(3.71)**
Log of value of equipment	0.046	(4.56)**
Age of Head	0.111	(5.74)**
Age of Head squared	-0.001	(5.89)**
Years of schooling of head	0.035	(3.49)**
Household size	0.10	(3.79)**
Number of children	-0.073	-1.79
Hebei	-0.09	-0.96
Shaanxi	-0.42	(4.50)**
Liaoning	0.26	(2.67)**
Zhejiang	0.43	(4.38)**
Hubei	0.14	-1.64
Constant	5.26	(12.11)**
Observations	1019	
R-squared	0.35	
Absolute value of t statistics in parentheses		

t statistics in parentheses, * significant at 5%; ** significant at 1%

6.4 Poverty and Income Distribution Effects - Micro Simulation Results

Changes in relative prices and wages at national level from GTAP analysis can be found in Table 6.1. Based on these changes and the rural household survey the net welfare change at micro level is calculated. Both income and expenditure data are used to impute welfare changes. Similar to the income generation model, the welfare gains originate from three major sources, i.e. agricultural production, wage employment and self employment in non-farm business. However, due to the limited information on sectoral classification of non-farm businesses, it is impossible to derive direct welfare effects from the last source, especially in terms of changes in revenues/profits. For this reason the returns to labour in the formal sector are used to approximate income changes for those who are self-employed in non-agricultural sector. There are also losses on the expenditure side, given that prices for most consumption goods are predicted to increase after Doha.

The results at household level are summarized in Table 6.9. The first row gives the mean gains. Overall rural households are better off after the simulated Doha trade liberalization, but the magnitude of the benefit is rather small. Per capita income for rural households will go up by about 16 Yuan (about \$1.9), or 0.4 per cent of the income. This small effect is expected, as the first-order welfare analysis only captures the first round effects of price and wage changes. When the dynamic effects are taken into account, the impacts of the Doha Round on rural households are expected to be larger.

The majority of mean income increase – about 13.7 Yuan comes from agricultural production. This is in line with the prediction at the national level that price increases in the agricultural sector are beneficial to farmers. There is also an increase in wage income, which is about 6.8 Yuan on average. The welfare loss results from the increase in the price of consumption goods. The overall effects depend on the magnitude of the losses and the gains.

Table 6.9 Impacts of the Doha Round on rural household welfare

Mean gains (Chinese Yuan/capita)	15.83	
Inequality (Gini index)	Baseline	Simulated
	0.525	0.549
Poverty	Baseline	Simulated
Official	0.08	0.08
$1/day	0.636	0.633

Source: Calculation from micro simulation

Given that relative rural incomes increase more than urban incomes, rural-urban income inequality in China is expected to improve after Doha. The impacts on income inequality among rural households are also measured, using the Gini coefficient, as shown in the second show of Table 6.9. The Gini coefficient has values between 0 and 1. A low index indicates a near-equal distribution, while a high value indicates severe inequality. After the simulation, the Gini coefficient increases slightly, implying a negative impact of the Doha Round on income inequality in rural China. Note that the Gini Index measures the income inequality among rural households here, as urban households are not recorded in the survey sample used in this analysis.

The third panel of the Table 6.9 gives the poverty ratio as measured by different poverty lines. Given the increase in mean income, one would expect poverty headcounts to fall slightly. However, using the official poverty line, the poverty headcount index stays the same as the baseline. This again indicates that poor people do not benefit from the simulated trade reforms as the rich do. Using the World Bank's $1 per day standard, poverty ratio falls slightly, from 63.6 per cent to 63.3 per cent.

In the aggregate, it appears that the Doha Round has a relatively small impact on poverty and inequality. Most households experience a net welfare gain from the Doha liberalisation, although about one third of households lose out. Further disaggregation allows for the identification of losers and winners. It is evident from Table 6.10 that impacts differ widely across regions. The mean absolute gains tend to be higher in the richer provinces - Liaoning and Zhejiang, but the poorer provinces - Shanxi and Sichuan – also appear to gain slightly from trade liberalization.

Table 6.10: Gains and Losses from the Doha Round by Province (Chinese Yuan in 2000)

	Sampled households	Original income	Post-Doha income	Gain /loss	% change	No.of losers	% losers
Hebei	192	3035	3046.7	11.7	0.39%	56	29%
Shaanxi	196	3968	3977.6	9.6	0.24%	75	38%
Liaoning	195	4319	4344.7	25.7	0.59%	43	22%
Zhejiang	191	7039	7060.7	21.7	0.31%	76	40%
Sichuan	193	2588	2597.2	9.2	0.35%	79	41%
Hubei	195	3642	3659.08	17.1	0.47%	51	26%
Rural China	1162	4098.5	4114.327	15.8	0.39%	380	33%

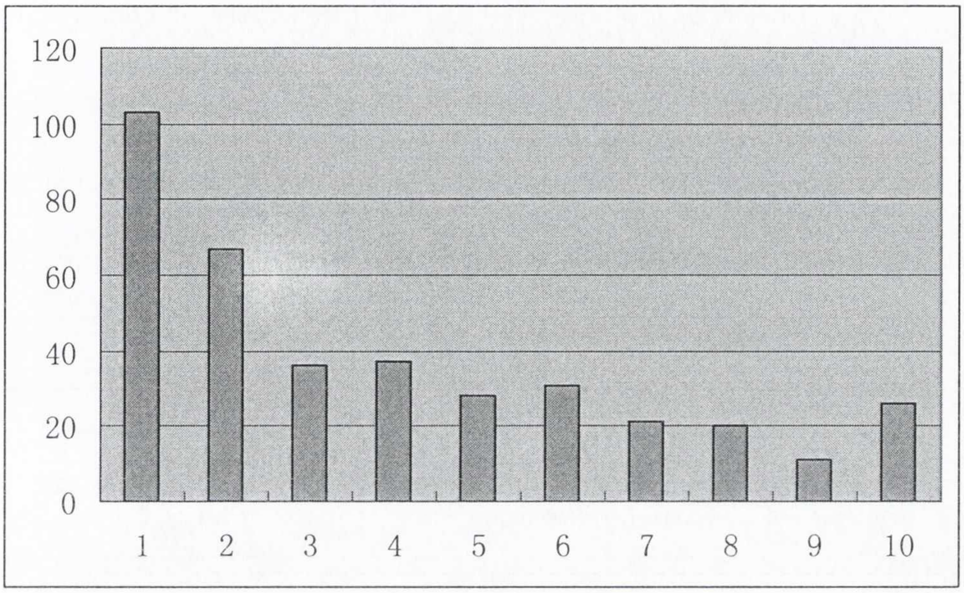
When households are ranked by income (see Table 6.11), there is a notable pattern in the welfare changes. Households in the bottom two deciles suffer from a net income loss from Doha. Although most of these poorer households do benefit from the increased returns to agricultural production, the negative impact of the increases in consumption prices more than offset the benefits. Households in all the other income deciles experience a net welfare gain. The absolute gains tend to be higher for higher-income households and lower for lower-income households. However, when we look at the percentage gains, this pattern seems to reverse. Due to a low income base, lower income households tend to gain more in relative term.

Table 6.11: Gains and Losses from the Doha Round by Income Decile

Decile	Number of losers	Original income	Post-Doha income	Gain/ loss	% change	% losers
1	103	-190.4	-195.3	-4.9	2.57%	85.83%
2	67	984.4	983.2	-1.2	-0.12%	55.83%
3	36	1416.4	1419.0	2.6	0.19%	30.00%
4	37	1861.6	1864.8	3.2	0.17%	30.83%
5	28	2285.8	2292.1	6.3	0.27%	23.33%
6	31	2792.9	2801.7	8.8	0.32%	25.83%
7	21	3522.3	3537.8	15.5	0.44%	17.50%
8	20	4517.1	4540.3	23.2	0.51%	16.67%
9	11	6353.9	6389.1	35.2	0.55%	9.17%
10	26	17758.7	17829.1	70.4	0.40%	21.67%

The first and second deciles include all the people below the official poverty line, who would be very vulnerable to trade liberalization. About 103 and 67 households suffer an income drop in these two groups respectively (see Table 6.11 and Figure 6.2), corresponding to 86 per cent and 56 per cent of each decile. As they move up the income ladder, the number of losers decreases steadily. Wealthier households tend to benefit more than poorer households. The latter may even suffer losses in some cases.

Figure 6.2 Number of Losers from the Doha Round by Income Decile



6.4.2 Determinants of gains and/or losses

In order to determine the characteristics that impact upon whether a household gains or loses from trade liberalisation, an econometric regression is carried out. The dependent variable is a dummy variable, which is equal to 1 if the household gains from the Doha Round and 0 otherwise. It is estimated as a function of the household size, the age of the household head and its quadratic form, land area, education, number of dependents, provincial dummies, and whether telephone is present in the village. The results are given in Table 6.12.

The only variables that are significant in explaining whether the household will gain from Doha are the log of land area, age of household head, and the number of children in the family. As a fixed factor of production, land tends to contribute positively to rural households' welfare change as the price of land increases under the simulated Doha scenario. The age of household head also has a positive impact on whether the household benefits from Doha, while the number of children in the family appears to have a negative impact on household welfare changes. Other household characteristics, such as the years of schooling of the household head, number of people living at home, and number of elderly, and provincial dummies, do not have a significant effect on welfare changes.

Table 6.12: Estimated incidence of gains or loses

Dependent variable=1 if welfare change>0	Coefficient	t-statistic
Log of land area	0.076	(4.23)**
Age of household head	0.05	(4.48)**
Age of household head- squared	-0.001	(-4.49)**
Years of schooling	0.001	0.11
Number of people living at home	-0.015	-0.27
Number of people living at home-squared	0.005	0.79
Number of children	-0.049	(-2.15)*
Number of elderly	-0.051	-1.8
Phone present in village	0.043	0.87
Shanxi	-0.072	-1.49
Liaoning	0.044	0.92
Zhejiang	-0.044	-0.85
Sichuan	-0.025	-0.48
Hubei	0.083	1.65
Constant	-0.489	-1.89
Observations	1030	
R-squared	0.09	

* significant at 5%; ** significant at 1%

6.5 Conclusions

This chapter examines the poverty and income distribution effects of the Doha Development Agenda on rural households in China. The commodity price and wage changes from the Doha Round are taken from the GTAP analysis in Chapter 5 to perform a household level analysis using data from a household survey sample. After calculating the welfare changes for each household using a first-order approximation method, the determinants of welfare effects of Doha are also examined.

Overall there are modest welfare gains for rural households in China. On the one hand, farmers benefit from increased returns to agricultural production, including increased producer prices for agricultural products, and the higher unskilled agricultural wage rate. On the other hand, farmers lose out from the increased price of consumption. On balance, the magnitude of the welfare change is very small. Consequently, the income distribution effect of Doha is not significant either.

However, there are winners and losers among rural households. The majority of the losers are households in the lower income deciles. Poorer households appear to be worse off under the Doha Round, as the negative impacts from increased consumption prices outweigh the positive impacts of increased agricultural supply prices. Land area, age of household head, and the number of children in the family have a significant impact on whether the household wins or loses after a Doha Round conclusion.

Chapter 7 Conclusions

7.1 Summary of findings

This thesis sets out to estimate the impacts of a successful Doha Round conclusion on the Chinese economy, including the impacts on sectoral production and trade performances, national economic welfare, prices of commodities and factors of production, as well as poverty and income distribution. These impacts are first examined at the national level in Chapter 3 using a standard CGE model. By more accurately modelling the tariff cuts, the analysis suggests that China benefits from the Doha Round in terms of economic welfare, particularly from manufacturing trade liberalisation. Labour-intensive sectors, such as textiles and apparel, leather products, rice and fruit and vegetables, are expected to expand both production and exports. On the other hand, capital-intensive sectors, such as automobiles, parts and electronic machinery, are likely to be adversely affected. A broad examination on changes in prices and wages suggests that poverty and income inequality are likely to be reduced following the simulated Doha scenario.

However, the analysis in Chapter 3 is not without limitations. For instance, the standard CGE assumption assumes that unskilled labour is perfectly mobile between sectors. This issue is addressed in the following two chapters. Chapter 4 derives the elasticity of labour transformation between rural and urban sectors using a household sample survey. The empirical analysis shows that labour allocation choices between agricultural production and market wage employment are not responsive to changes in market wages, but are rather sensitive to changes in shadow wages in agricultural production. This indicates that labour is not "pulled" out of agriculture by higher market wages, but "pushed" away by low agricultural returns. The Constant Elasticity of Transformation (CET) of labour between farm and non-farm sectors is estimated to be 3.716%.

Chapter 5 re-examines the impact of the Doha Development Agenda on China, by including labour transformation elasiticity and underemployment into the GTAP model. The sensitivity analysis shows that labour movement is an important issue in determining the allocation of production factors between sectors, output responses and changes in prices and wages: the higher the degree of unskilled labour mobility between the farm and non-farm sectors, the bigger the output responses and the narrower the gap between agricultural and non-agricultural wages. When unemployment in the agricultural sector is also modelled, China's post-Doha economic welfare gains increase significantly due to the increase in the level of employment.

Chapter 6 estimates the poverty and income distribution effects of the Doha Development Agenda on rural China at the household level. The first-order welfare approximation estimates suggest that in aggregate the Doha Round has a modest but positive welfare impact on rural households in China, but the gains are not equally distributed. There are winners and losers among rural households. Characteristics of the household partly explain the differences in the level of gains and losses across households.

7.2 Directions for future research

The possible failure of the Doha Round of trade negotiations has serious consequences for the multilateral trading system, one being the increasing attention to regional and free trade agreements. A free trade agreement is a negotiation between two or more countries to eliminate all tariff and non-tariff trade barriers between the markets of the participating countries. Individual countries may still apply differentiated tariffs and other trade barriers to countries that are not signatories of the agreement. These FTA agreements are likely to have adverse impacts on smaller and poorer countries, since they have less negotiating power than they would have in the multilateral WTO negotiations.

There are already a significant number of these agreements operating under existing WTO rules. The United States has implemented FTAs with Mexico and Canada (NAFTA), Israel, Chile, Australia, etc. The EU is currently in negotiations with Korea and India, and is expecting to complete these agreements soon. EU-ASEAN (Association of South East Asia Nations) and EU-Central America FTA negotiations are also being considered and examined. After the WTO trade talks collapsed in 2006, India initiated a series of bilateral trade negotiations with Korea and Japan.

As a new member to the WTO, China is also pursuing a more active strategy with respect to bilateral or regional free trade agreements. In November 2001, China and ASEAN began negotiations to set up the world's largest free trade area. It is planned to come into force in 2010 for the six original ASEAN members and in 2015 for the other four. An FTA for agricultural produce took effect between China and Thailand in October 2003 under which tariffs for 188 types of fruits and vegetables have been cut to zero. A second FTA was signed with Chile in 2005, to enter into force in July 2006. China also signed an FTA agreement with New Zealand in 2008. Another FTA negotiation with Australia was launched in April 2005. FTAs are also under review with Japan and India, and an FTA with the US might become a possibility were the Doha Round talks to be abandoned.

Future work building on this dissertation will involve a CGE analysis on the economic impacts on China of a number of existing and potential bilateral FTAs, with and without a successful Doha Development Round. The results will be compared with the MFN treatment within the WTO framework to determine whether it is preferable for China to negotiate in a multilateral framework under Doha or in a bilateral framework. The GTAP model will be modified to provide a comprehensive assessment of the likely economic effects.

Other possible future research projects could include examining many areas of domestic policies in China, using methods and data used in this thesis. For instance, in terms of agricultural policy, the Chinese government has recently shifted priorities from increasing production, especially of grain products, to rural income support and more recently to environmental concerns (OECD, 2005). These policy changes can be modeled in a CGE framework in order to examine their impacts on different variables of the Chinese economy, including impacts on agricultural development, poverty, income inequality, etc. Moreover, the labour markets analysis in the thesis can be extended to study other aspects of labour markets, such as geographical migration decisions by workers, barriers of migrating back from non-agriculture to agriculture, the formal and informal labour markets, and possible future labour markets policies.

If data is available, the micro-simulation analysis in Chapter 6 could be extended to include the second round effect of the Doha Round on rural households, i.e., how rural household would respond to changes in prices and wages after the trade liberalisation, especially in terms of labour markets participation, labour allocation, job choices, and consumption and production decisions. This second round feedback will allow for a more accurate estimation of the poverty effect of the Doha Round on rural households in the long term.

Therefore, this dissertation provides foundations for new research in several aspects of the Chinese economy.

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