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# CHINESE STATE-OWNED ENTERPRISES

Ph.D. in Economics

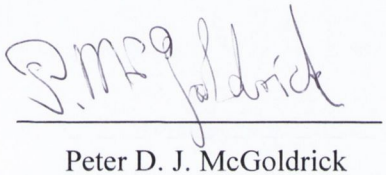
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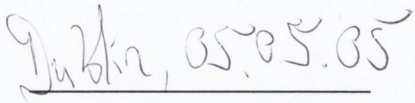
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Peter D. J. McGoldrick



Dublin, 05.05.2005

# SUMMARY

The focus of this thesis is an empirical analysis of the process of operational reform and restructuring in Chinese state-owned enterprises, with a view to examining associated effects on performance, as well as the determination of enterprise characteristics that affect the likelihood of enterprises' gaining state aid.

From four sets of questionnaires, covering the years from 1980 to 1994, a data panel was constructed, which is 681 enterprises wide and fifteen years long. These enterprises are located in four different provinces and classified into forty industries. A key feature of the empirical analysis is the marriage of quantitative data with qualitative data. This yields information essential for the estimation of production functions, as well as revealing, otherwise unobserved, information regarding enterprise characteristics. In particular, these refer to the timing a certain operational reform was implemented, or to whether the enterprise received state aid.

After a brief outline of the reform process in China, as viewed in the literature, and the provision of details regarding the construction of the dataset and its summary statistics, the empirical analysis begins.

The first issue examined is that of soft-budget constraints. In particular, the focus is on uncovering enterprise characteristics that affect the likelihood of being granted state aid. Thus, policy directives regarding the provision of state aid are revealed. The results indicate that enterprises with a large labour force are more likely to receive state aid over the entire period considered. Interestingly, older firms and enterprises with high wages per employee and large pension bills appear to be discriminated against in the early 1990s, which may be suggestive that such enterprises are thought of as burdensome or obsolete by the government. Furthermore, there appears to be a change in industrial and regional development policies in the late 1990s, which swings in favour of raw materials industries and enterprises in poorer provinces at this time. These findings suggest the Chinese Government is pursuing an active and systematic policy with regard to SOEs.

The other two issues dealt with focus on the effects of reforms concerning the decentralisation of decision-making from the party to the managerial level.

Using a production function approach we reinvestigate the question of whether flexible wages, in the form of bonuses, are employed in a way consistent with the efficiency wage argument. Groves et al. (1994) provide weak evidence in this regard

for the 1980s. The analysis here is concerned with the five years following their analysis, which is the period from when on enterprise managers began to gain autonomy in hiring and firing decisions. Thus, this analysis attempts to control for structural reform as well as the endogeneity problem associated with the evaluation of wage bonus related performance evaluation. The results indicate that there is little evidence in favour of efficiency wages. Furthermore, there is significant evidence that a shift in wage bargaining power occurs, which is associated with the adoption of this reform. Thus, the link between value added and bonuses, previously strong, breaks down. Also, once this is taken into account, productivity improvements due to this process appear to materialise. Possibly, employees were engaged in rent-seeking behaviour prior to the existence of a credible threat vis-à-vis the certainty of their employment status. More generally speaking, these results can be viewed as an empirical test of the efficiency wage literature, in particular with regard to employment related uncertainty increasing discipline in wage bargaining.

Another issue related to operational reform is managerial autonomy in investment decisions. In this context, an attempt is made to uncover whether reforms actually have a positive impact on performance. To this end, one needs consistent and unbiased production function estimates, in order to estimate unobservable productivity. Thus two interrelated biases emerge. Since managers observe productivity, and base their input decisions on this, production function parameters are biased, as are resulting productivity estimates. Furthermore, if the selection to capital reform is determined, in part, by performance, then sample selection bias will interfere with our attempt to measure improvements in enterprise performance that accrue due to capital reform. Employing an algorithm developed in Olley and Pakes (1996) these biases are dealt with. Here, unobserved productivity is modelled using information about investment decisions, given the state variables, thus eliminating simultaneity. Selection bias is dealt with by conditioning productivity estimates on the likelihood of being of the reformed type. The results indicate better performing enterprises are more likely to reform, and that further performance improvements are achieved once investment autonomy has been introduced.

The investigation into the effects of operational reforms in SOEs is akin to testing for the effectiveness of dividing control from ownership in state enterprises. Here evidence suggests performance gains are possible from operational reform, even if ownership remains with the state.

# ACKNOWLEDGEMENTS

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Without the dataset, this empirical work would not have been initiated, so I express my gratitude to Professor Changqi Wu for providing me with such.

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# I. INTRODUCTION

Alexis De Tocqueville predicted as early as 1835, that Russia and America would without question become the dominant nations of the world:

> "There are, at the present time, two great nations in the world which seem to tend towards the same end, although they started from different points: I allude to the Russians and the Americans. Both of them have grown up unnoticed; and whilst the attention of mankind was directed elsewhere, they have suddenly assumed a most prominent place amongst the nations; and the world learned their existence and their greatness at almost the same time."
> (A. De Tocqueville, "Democracy in America", 1835)

De Tocqueville clearly stated why he believed this to be true, and did so in Ricardian style. Thus he reduced his argument down to two crucial factors: America had nigh on unlimited resources for capital formation, whereas Russia had an abundance of people within its borders. With these endowments each would become a dominant power.

Since, Russia has receded from its eminent position, leaving the United States of America the sole superpower. However, it is clear that elements of De Tocqueville's prophecy remain important. Russia's fall has been accompanied by the rise of China, and her rise over the past couple of decades appears inexorable. Largely, this appears due to the attribute De Tocqueville originally ascribed to Russia, namely an abundance of labour. Not only does China boast the largest population of all nations in the world, this population is traditionally well organised and educated, as well as increasingly mobile, both within and outside China's borders. The importance of China to the global economy can thus not be overestimated.

In the 15$^{th}$ century China was, by many accounts, the most advanced country in the world. However, she chose to isolate herself from the rest of the world, and destroyed her sea-faring fleet in the process. China remained isolated, and hence little noticed, for centuries thereafter. One of the first to penetrate this country was Marco Polo, who was greatly taken by the culture but, being a true merchant, was awestruck

by the size its market. Ever since, traders of the West have sought to penetrate that market.

It appears the Chinese, with a very strong cultural sense of identity, had little need for Western produce, and so the dream of access to the Chinese market had to be postponed. What did emerge, though, was that the British Empire was increasingly interested in tea from China, which, in the early 20th century, made up some 25% of Government revenue. Desperate to find something other than silver and gold to trade for tea, the British soon noticed that opium was something one could sell cheaply to the Chinese, and the opium wars ensued. At this point, China was forced to deal with the outside world, and these dealings were not to be favourable for some time to come. (Osterhammel, 1989)

Civil war, Japanese invasion and occupation, Communist Revolution and Maoism, marked by episodes such as the *Cultural Revolution*, taxed on China to a degree that this advanced country became a basket case within little more than a century.

It is the period that followed the Maoist era that this thesis is concerned with. Since the death of Chairman Mao, China has continually opened its international borders and engaged in large-scale internal reform and restructuring. Simulatneously, it has become an unparalleled economic success story, especially for a country its size, with average annual GDP growth above 8% over the quarter of a century following 1978. The reform process was not straightforward, nor was China's development solely a straightforward and untroubled affair, as the events of *Tiananmen Square* will remind us of for some time, and many challenges remain.

What makes this economy so interesting to study, especially to economics, is how it is going to impact on the world in general, and the global economy in particular. After centuries of isolation, this geographically vast country, with a large population, is opening up to the world. Its period of isolation has amplified the differences it has with rest of the world, and now its re-exposure is not only affecting China, but also China is affecting the world to a degree probably not witnessed since American culture held sway in the aftermath of the Second World War.

It appears that the theory of comparative advantage would predict that, given the asymmetry in resources and cultures between the developed economies of the West and China, coupled with China's sheer size, this opening up will result in one of the greatest developmental opportunities and challenges in human history. If the strain is not too great on the individual systems, e.g. due to social unrest or inequality, or the

global system, due to potential political imbalances or the availability of raw materials, we may witness one of the largest jumps in economic, and even human, development. While that is a big if, it seems we that we are witnessing a large-scale global transformation. Recent, and prolonged, commodity price rises are clearly portends of things to come, as China's appetite awakens and the developed world sees no reason to curtail its.

The biggest economic challenges that China faces at this moment in time might be considered to be threefold:

First, WTO accession will see China gain greatly, since trade barriers, especially with respect to quota restrictions on textiles and fibres, shall be greatly reduced. However, this full-scale integration of the Chinese economy will limit the control the Communist Party can exercise on the economy. International competitive pressures will affect the country, and it is paramount that China manages this transition smoothly.

The second point is related to this to some extent. China must develop a modern, well organised, and efficient system of capital allocation, in particular in the form of a healthy banking and financial system. Both of these have been hitherto state-controlled, while the government kept a virtual monopoly on the banking sector. Full WTO accession implies that the legal restrictions in place to limit international involvement in this sphere will be reduced, and ultimately abandoned. Further to these adjustments, the state-owned banks in China have large contingencies of non-performing loans, and some analysts believe that, if these non-performing liabilities are taken into account, the Chinese state is bankrupt.

Finally, the third crucial aspect of the Chinese economy, state-owned enterprises (SOEs) is closely related to the second and, to a lesser degree, first point. Chinese SOEs are commonly perceived as being overstaffed and of low productivity, similar to the state enterprises in the former Soviet Union. Indeed, their lack of dynamism, despite large-scale investment, is perceived as slowing down private-sector growth. This is due to the fact that capital is scarce in this labour rich economy and that the government, which had a strong bias toward SOEs, decided on virtually all aspects of capital allocation. Part of the WTO accession process involved the dismantling of state aid, and hence the government had the state banks allocate capital assets. This did not change matters significantly, as the banks were given state-directives to indulge in a policy biased toward SOEs. Thus, the Chinese state banks amassed large

contingencies of non-performing loans. As China opens up to international banks, competition for funds will intensify, and the Chinese, with one of the highest savings rates in the world, are likely to relocate their funds. If this happened at a large scale, it is feared the banking system may collapse.

At the same time, the Chinese government is trying to reduce the number of badly performing SOEs. If this is not achieved in an advantageous manner, the strains on the state will become large, as, apart from financial stability being threatened, one of China's rulers' traditionally biggest fears could rear its head, social unrest. Mass lay-offs, due to closure or restructuring of vast SOEs, could have a systemic backlash, as local unemployment rises. It is noteworthy, that SOEs have been used in order to quell exactly such fears. Therefore, it is not surprising that the introduction of hiring and firing in this area only took place relatively late on.

It is the third of these crucial issues in modern China's economic development, Chinese state-owned enterprises and their reform, that this thesis is concerned with. SOEs are considered overstaffed and inefficient, whilst they attract large state-funded investment and carry large levels of debt. This thesis examines various issues relating to SOE performance, reforms, and attitude toward debt. The main contribution is the empirical analysis of 681 Chinese SOEs in the period from 1980 to 1994, which are selected from four provinces and are classified in one of forty industries.

From this, a unique panel was constructed that contains information on aspects of enterprises, such as output and employment levels, investment and capital structure. Furthermore, this panel provided details on such important issues as the timing a certain operational reform was introduced at the firm level, or whether significant state aid had been received. Thus, it is the marriage of qualitative and quantitative data that is a key feature of this thesis. Furthermore, the ability to qualify and quantify reform status allows for a unique setting that may be likened to a laboratory set-up, or at least as close to it as an economist is going to come. Therefore, apart from being able to make specific statements about the Chinese reform process and SOE enterprise performance, it is also possible to draw general economic conclusions, or in other words, to test theory in a unique way.

Another interesting view of the Chinese reform process, especially with a view to SOEs, is that one may also look at it as a form of protected development. Thus, the twin track approach, which allows for the coexistence of conflicting allocation systems, plan and market, is designed such that elements that are constituent to the

inefficient part, i.e. the plan, can restructure in their own time. As they do so successfully and performance improves, exposure to competitive pressures is gradually increased. Over time, the entire economy is either restructured or obsolete. The aim is to have the restructured enterprises compete in a market environment, being structurally no different to their competitors, whereas obsolete companies are abandoned. Thus, the process of creative destruction is slowed down, as allowing a complete collapse of the system would irrevocably lead to the loss of social and institutional capital.

In the remainder of this introduction the elementary facets of this thesis are recounted. The central thesis is that *committed* reform and restructuring of Chinese state-owned enterprises has brought about improvements in enterprise performance. The qualification *committed* is due to the observation that partial reform may lead to some performance improvements, but invariably partial reform also leads to abuse, as the co-existence of opposing systems, that allow for the violation of, for example, the law of one price, can be exploited by arbitrage. Thus, the view held in this work is that initial reforms, introduced in the decade after 1978, were merely preparatory, in the sense that they helped to build the social and institutional capital necessary for full-scale reform. Thus, decentralisation, marginal price liberalisation, or the use of marginal incentives, cannot have brought about permanent performance improvements. Rather, these new incentives were quickly abused and likely became obstacles to reform, as those that had gained from initial liberalisation, but might lose out in further reform, viewed the *half-way house* as the legitimate status quo.

The thesis is structured as follows. Chapter II briefly relates the reform process in China, as it has unfolded since 1978, in a broad-brush manner. No attention is paid to the period after 1994, as this period is not relevant to our empirical analysis. Chapter III contains a brief outline of the data, as well as summary statistics of the variables the analysis is based on. Every chapter that contains explicit reference to the data has sections at its end, which contain the tables and figures that are referenced in the text proper.

Chapter IV is concerned with the soft budget constraint (SBC), which is often thought of as a critical source of inefficiency in Chinese SOEs. J. Kornai was the first to elaborate on this phenomenon, initially associated only with planned economies. Gradually, economists realised that this concept could also be used to analyse

problems in market economies. Soft budget constraints are associated with types of behaviour that are considered uneconomical, and are hence a source of inefficiency.

In China, where contingencies of SOEs to state-owned banks are non-performing for a large part, this issue is critical. Indeed, as the economy opens up to international markets, the question remains, whether the system can absorb a shock of having these contingencies written off. Attempts are being made to reduce the size of these contingencies, for example a large amount of money from foreign exchange resources was used to decrease the size of non-performing debt. However, claims have been made, that once these contingencies are taken into account, the Chinese state may be bankrupt.

Our data provide information on whether or not an enterprise has received state aid in significant amounts in the five years preceding 1990 and 1995, respectively. Thus, in a probit setting, we regress a dummy variable, which is equal to one if the enterprise had received aid, and zero otherwise, on various enterprise characteristics, for which we have annual information. Due to the implicit difference in sampling frequency between explanatory and dependent variables, we are unable to detect the idiosyncratic shocks that lead to the need for aid.

Rather, we are able to identify systematic peculiarities regarding state aid: Thus, the results indicate that enterprises with large a labour force are more likely to be granted state aid. This confirms common perceptions about the existence of state-sponsored labour hoarding in Chinese SOEs. Interestingly, it appears that firms with high average wage and large pensions bills are less likely to receive state aid in the early 1990s. This stands in stark contrast to the common perception, and may well indicate that state policy had adjusted at this stage, in order to alleviate such strain on the system. Likewise, the probability of receiving state aid falls with the age of the enterprise in the latter period. This would be consistent with the notion that the state, at that point in time, decided to slowly *starve* old, and presumably obsolete enterprises of vital state funded investment. The fact that age remains significant, while pension bills are included in the analysis, suggests that using age as a proxy for the size of the pensions bill, as suggested in the literature, is not good in the case of Chinese SOEs. Furthermore, we witness a policy shift in the granting of state aid to industries and regions, as the coefficient estimates for provincial and industry dummies, whilst remaining significant, change their sign over the two time-periods. Specifically, while enterprises in poorer provinces were less likely to receive state aid

in the late 1980s, it is those in wealthier provinces that found themselves in that position in the early 1990s. In anticipation of current raw material shortages, it appears, enterprises engaged in this industry were favoured in the early 1990s. These results are interesting, as they indicate systematic attempts at reorganising SOEs in a strategic way.

Chapter V contains our first empirical analysis of the effect of reforms regarding managerial autonomy in enterprise operations. Groves et al. (1994) provide weak evidence for the hypothesis that efficiency wages are driving the wage-bonus allocation process in the 1980s, while controlling for endogeneity among wage bonuses and productivity. This analysis also controls for endogeneity, but investigates a further aspect of labour market reform, and its effect on the wage-bonus allocation process in the early 1990s. The aspect considered is the granting of autonomy in managerial decisions regarding the hiring and firing workers and, in particular, how this may affect the relationship among wage bonuses and productivity, as well as the wage bargaining process itself. This is interesting, especially since the results are consistent with those of the previous chapter, which indicated that in this period some pressure, in terms of lower probability of state aid, appears to have been exerted on enterprises with high wage bills.

The data provides information, at the enterprise level, about when a manager was granted the autonomy over hiring and firing workers. Prior to that point, hiring and firing was a centralised process, guided by policy considerations as much as by profit maximisation. It is important to point out that the security of SOE employee status had been described as the *iron rice-bowl*, meaning that the employee would have something to eat from, whatever happened. Therefore, I argue in this chapter that bonus payments, without the threat of loss to these payments, cannot induce lasting and significant performance improvements. On the evidence provided, it is the case that, while bonus payments do indeed increase with real value-added, once the manager obtains the autonomy in hiring and firing the link between real value-added and bonuses breaks down. One may postulate that the reason for this is that the manager can now make a credible threat related to individual employee performance, in terms of terminating their employment. These results would indicate that unemployment indeed acts as a worker-disciplining device.

This stands in contrast to Groves et al. (1994), who use a superset of 769 firms, in the years from 1980 to 1989, since they cannot control for this aspect of labour market

reform, as it is largely introduced thereafter. Thus it appears, partial reform resulted in rent-sharing at best, or rent-seeking at worst, as the bargaining power of managers was limited so long as they had no mechanism for effectively punishing workers, i.e. by firing them, but could only favour them, by increasing bonuses. The results regarding in this chapter then tie in well with those regarding wages in the early 1990s of the previous chapter.

Chapter VI deals with the analysis of operational reforms that relate to the investment autonomy of the enterprise managers and the effect of these on productivity. In the late 1980s on, firm managers were given the autonomy with regard to short- and long-run investment decisions, as well as the buying and selling of enterprise assets. Given this institutional change, the interest is of course to see if these reforms had any effect on enterprise performance. These are by no means partial reforms, as the autonomy in investment decisions is tantamount to the division of control and ownership. In order to establish whether reforms are successful, one needs to find dynamic estimates of unobservable productivity. Since this requires consistent production function estimates, we encounter two forms of bias.

First, we encounter a simultaneity problem. Managers know their enterprise's productivity type, but the econometrician does not, and the productivity of the firm will influence input decisions. Therefore, capital and labour estimates will be upwardly biased, thus, in turn, affecting the productivity estimates. Further, since it is likely that managers of more productive firms are more likely to be granted autonomy in crucial capital related decisions, we face a selection problem. The companies that are selected for reform are selected, in part, on behalf of their productivity type. If this is the case, we will be attributing better performance to the reform, rather than the reform to the already better performance.

By adopting an algorithm developed in Olley and Pakes (1996) unobservable productivity is modelled by assuming investment decisions, given the state variables, reveal information about the productivity of an enterprise, thus dealing with simultaneity. Also, selection bias is dealt with by adopting a selection rule, from the same algorithm, based on productivity realisations.

This is a novel use of the Olley-Pakes algorithm, and allows a unique evaluation of reforms and their effects, hitherto hampered by the problem that enterprises are often selected to reforms on the basis of certain characteristics. If this is the case, it is difficult to see whether enterprises actually change characteristics, in this case

improve productivity, due selection into a different group, here a group of reformers, or whether they were already of a certain type, in this case already exhibiting better productivity, and hence selected into the other group. The specific findings in this analysis are that enterprises with autonomy on capital formation decisions indeed are more likely to select into the reform group and, controlling for that fact, that reforms actually improve the already better, reformed enterprises.

Finally, section VII concludes the thesis by summarising the main points made. Three appendices are provided; the first provides a detailed explanation of how the data was created. The second and third appendices relate the industries and provinces that the enterprises are drawn from.

# II. China and Its Reforms since 1978

"China succeeded because it unleashed the forces of competition." (McMillan, 1994)

This section summarises some of the more important aspects of the Chinese Economy from the beginning of modern reforms up until 1994, with a particular emphasis on state-owned enterprises. After chairman Mao's demise in September 1976 Deng Xiaoping, a moderate reformer, took control of the communist party, and hence, of the country. When he stepped in, China was in serious need of reform. This was so especially given the damage inflicted by the past decades. Grand episodes of party idealism were manifest in movements such as the *Great Leap Forward* and the *Cultural Revolution*, which resulted in disastrous consequences.

Illustrations of this are, for example, the facts that famine remained an ever-present threat or that 60 percent of the population lived on less than one dollar a day, as well as the lack of rule of law. These ideological concepts appear to be symptomatic of a leadership that has lost touch with reality. In the *Great Leap Forward* Mao aimed at collectivising agriculture, with the consequence of a prolonged and stark fall in agricultural output; it took decades to take the country back to former levels of agricultural output. In the *Cultural Revolution* Mao attempted the Orwellian ploy of erasing all cultural memory from the populace, with the aim of instilling only the pure doctrine of Maoist ideology. Apart from the loss and destruction of cultural identity, this movement nurtured fear and mistrust, as the focus shifted away from real issues, such as improving economic activity and general well being, to the repetition of slogans and mass denunciations. With Mao's death a strong shift in the opposite direction was apparent. While in the political arena reforms might have been limited, many economic reforms were introduced in the years following 1978.

The two interlinked features of Chinese reforms sum up the spirit with which they were undertaken. The concept of the *dual-track* implied that, while the authorities understood the system was ailing, they did not want to abandon it wholly. Rather, two different allocation mechanisms were allowed to co-exist, the old, centrally planned system, and a new, market based system. Thus, the new was

allowed to grow around the old. The planned part of the economy continued to exist, but where there was place, the market was allowed to fester. In this fashion, the market aspect of the economy emerged, and slowly began to replace the central plan, though, to the present day, this remains an ongoing process. This is where the Chinese approach differed from the Russian, where fault in the system was initially not appreciated until the point was reached, where the decision was made to abandon the entire old system for a new one.

The second aspect of Chinese reforms is that they are marginal, i.e. change is introduced gradually and selectively, rather than across the board. Hence, reform is not only introduced gradually, but selectively, and selectivity not only refers to the timing and sequencing of a reform, but also where to introduce it, and where not. Therefore, the cost of re-organising, in terms of effort and increased uncertainty, is spread out. This allows reforms to be introduced in a fashion that can minimise disruption and maximise gains. A specific feature of this marginal approach was that quotas, set out in the plan, still had to be met, but produce in excess of that could be sold in the market, at market prices.

Especially the state-owned sector profited from this policy, which has strong resemblance with trade-protected industrial development, where a sector is isolated, to some degree, from the full effects of competition. In this case, the inefficient state sector is protected from competitive forces as it restructures. The more successful the sector is, the more it is opened up to competitive forces. It appears the aim is to restructure the state sector to such a degree that it becomes akin to the market. When the barriers between market and centrally planned economy are eventually removed, the state-owned sector should be able to operate well in a competitive environment.

In this fashion, we notice a gradual redistribution of allocation, away from the plan and toward the market, as decentralisation and liberalisation gradually take effect. Naturally, not all elements of the planned economy can be successfully restructured, and it would be naïve to believe otherwise. Reform processes invariably produce losers as well as winners. And, unless the veil of state protection is maintained, certain elements will succumb to the competitive pressures. Thus, as the market economy grows, competition will displace resources that had been allocated to the state sector. The fact, that state-owned enterprises received the largest part of investment up until the mid 1990s, implies that this displacement is a slow process.

'The Dual Track Approach'

Instead of following a big-bang approach of mass privatisation, the Chinese preserved, as J. Stiglitz describes in his seminal paper "*Whither Reform: Ten Years of the Transition*" (Pleskovic and Stiglitz, 2001), their social and institutional capital. The Chinese achieved this by following a gradual pace of reforms, rather than implementing them all at once, as was recommended the countries of Central and Eastern Europe do after the fall of Communism, with the well known ills befalling these economies, such as stark initial drops in output, mass unemployment, and the general failing of old and new institutions, political, social and economic, alike.

Timing and sequencing of reforms is of great importance. The manner in which China seems to have achieved this appears to be simply by giving in to pressure from below, i.e. the "government's role often has been to permit change rather than to initiate it." (McMillan, 1994) The agricultural reforms in particular seem to have been initiated from the grassroots, and indeed the responsibility system introduced there served as the model for the "Management Responsibility System" introduced for SOEs.

Thus, reforms introduced in one sector could serve as experience for the initiation of reforms in other sectors. The fact that China followed what has been termed the *dual-track approach* to reform, i.e. leaving the old while allowing the new to develop, has been criticised. The main reason is that the two allocation mechanisms, market and central plan, are competing for the same goods, at potentially different prices. Furthermore, due to scarcity, the coexistence of two allocation systems may cause the crowding out of crucial resources.

A commonly mentioned aspect of this is the fact that scarce capital investment is crowded out from the private sector, because of prior allocation of funds by the central authorities to SOEs, or because of state-owned banks', which enjoy a virtual monopoly in China, bias toward state-owned enterprises. However, it is also argued that, by adhering to the dual-track, less people may lose out due to reform. (Qian, 1999)

Indeed, this mode of gradual reform appears key to China's successful reform process. Reforms create winners and losers, and the disruption of economic activity due to them is initially costly. The fact that initial reforms are introduced in areas where there is only a small cost associated with their implementation, and where few people are actually going to be subject to negative consequences of these, means not

only that the fiscal strain of implementing reforms is small, but also that few are likely to resist initial reform. Hence the gains from reform accrue to those subject to them, which implies they have the incentives to pursue them. This process has been coined *building constituencies* for reform. Gains thus made can be used to compensate those groups that lose out when more crucial reforms are introduced, as well as relieving the exchequer of some strain that arises due to the implementation of further reform. In this fashion, marginal liberalisation, if successful, can lead to increasing momentum in the pace of reforms.

However, partial reform has its very own dangers, namely the possibility of groups emerging that have vested interests in maintaining the status quo of partial reform, since they gain social rents from these. A good example of this is the dual-price system, discussed below, where the existence of two prices on the same good implied that those that could trade in both markets could exploit this artificial price difference by arbitrage. The fact that these rents accrued only to a small group, who had access to both types of allocation process, implied an increase in social tensions and an opposition to reforms in general. Social unrest, abhorred by any Chinese leadership over millennia, was a symptom of the reform process, as inequality grew and the free market begged the question of free politics. The *Tiananmen Square* massacre resembles only the poignant climax of this unrest.

Still, the early and cumulative reform success led to the commitment for further reform by building constituencies in favour of reform, since these had benefited, and were likely to continue benefiting, from future reform. Nevertheless, it is important, at some stage to, make the drastic decision to abandon the old, which will always hurt a significant part of the population. However, those who gain from reform may compensate losers to a degree for their loss. (Laffont & Qian, 1999; Dewatripont & Roland, 1995; Fang, X., 1994)

The notion that China decided to reform, but did not define exactly how it would reform, or indeed what the exact goal of the process was, has been captured by the metaphor *crossing the river by touching stones*. As it became apparent that social frictions were getting too great to tolerate this form of limbo, where communist- and capitalist-type systems coexist, the metaphor used evolved into more definite statements about the final goal of reforms, and how these were to be met.

Initial Reforms

The countryside was the focus of initial reforms, where the cost of implementation was least, given that the population was unofficially already doing business in a way that circumvented the central plan. In a move that effectively represented a reversal of Mao's *Great Leap Forward*, agricultural communes were broken up, and farms were privatised in the form of granting families long-term leases on plots of land. (McMillan, 1994) Farms had to deliver a fixed quota of produce to the state (the price at which it was bought at was set centrally), but could keep surplus produce and sell it either to the state or on the market, the latter at non-planned prices. 'Agricultural output increased by 67 percent between 1978 and 1985.' (McMillan, 1994) This increase was mainly due to increases in productivity, which 'increased by nearly 50 percent, compared with no increase in productivity over the previous two and a half decades'. (McMillan et al., 1989) The increase in earnings led to a boost in savings and demand for consumer goods, much of which was directed toward the Township and Village Enterprises (TVEs), created during the Great Leap Forward. The increases in productivity also freed up labour, which reduced the cost of further reform.

Further Reforms

The introduction of private enterprise appears to have been successful, despite the lack of rule of law, clearly defined property rights, or law of contract, as well as the fact that capital markets remained underdeveloped. According to Whiting (1996) output of these units grew by some 25 percent per annum in the period from 1985-1991. Twelve years into reforms they contributed fifty percent of industrial output. TVEs are a form of, usually collectively owned, private enterprise, and by 1984 the share of TVEs' in industrial production had increased from 22 to 30 percent, and even to 36 percent by 1988. 'Throughout the 1980s, TVE output grew at an average rate of 30 percent a year.'(Kennedy et al., 1988) It appears that 'the village-owned firms have been the main source of China's dynamism under reform.' (McMillan, 1994)

An important accompanying reform in this marginal economic liberalisation was the introduction of the above-mentioned 'dual-price' system. All output produced over and above the quotas could be traded on the market, where prices were determined in a decentralised fashion, and were usually higher than the planned prices. The degree of state produced output sold at market prices rose steadily, and

averaged 38 percent of state-owned firms' output by 1989, and, in particular cases, even amounted to all output. By the same time, as regards inputs to state production, on average 56 percent was procured at market prices. (McMillan, 1994) As long as output exceeds the quota this reform will have an immediate impact on firm behaviour, since, for above quota quantities, free-market behaviour is introduced. Full market pricing was achieved in the aftermath of the above-mentioned social tensions arising due to the abuse of the system, i.e. post 1989. This marginal liberalisation would introduce free-market economic thinking. Simultaneously, it would reduce one of the most serious problems common to centrally planned economies: stockpiling. As there was no incentive to report good performance, i.e. a surplus of production above the planned quota, typical behaviour for enterprises was to build up stockpiles of surpluses, which may be used to cushion a period of lower production levels, thus leaving resources unused, often until they were obsolete.

Another area of reform was the liberalisation of foreign direct investment, which grew from a mere $57 million in 1980 to $2.7 billion in 1990. 'It exploded after 1993, jumping from $7.2 billion to $42 billion in 1996.' (Kennedy et al., 1988) This has continued until the present, and China is the biggest global sink for FDI. The way China has structured its reform, and the controlled conditions under which it allows them to work, implies a need for understanding the quality of the reform process. As the developed countries attempt to realise the gains possible from operating in China, a deeper understanding of what is on offer is essential. The party still controls to a large extent the access of foreign firms to the domestic market. Many entrants to this market are required to enter strategic partnership with incumbent, usually state-owned, firms.

Generally, it can be said of SOEs, that, although they cannot be termed efficient market enterprises, they have increased their efficiency, although they lag behind the bulk of the economy. They have thus contributed to the economic miracle of China, despite the fact that in 1992 two-thirds of SOEs were losing money, and government subsidies to SOEs increased from 2 percent of GDP in 1985 to 3.1 percent in 1990. (The World Bank, 1997).

# III. SUMMARY STATISTICS

This section describes the data and provides summary statistics of the key variables that are used in this analysis of Chinese state-owned enterprises. Accompanying tables and figures are located at the end of the chapter, in sections III.1 and III.2, respectively. The section of the Appendix with the title *Data Creation* should be consulted for an exhaustive discussion on the type of questionnaires and resulting data, and on how exactly the variables used in the empirical analysis were constructed.

A cornerstone of this thesis is the marriage of qualitative data with quantitative data in the empirical analysis. The qualitative data reveal certain, otherwise unobservable, firm characteristics, which allow us to identify them by type. The key qualitative characteristics we are interested in are whether or not financial aid was received, and from when on a manager had autonomy over certain critical enterprise level decisions. The quantitative surveys contain the information, amongst many other things, necessary to estimate production functions. The particular choice of variables depends on quality of reporting and on the consistency among time-periods. Also, not all data was sampled at the same rate, which means they may refer to the same period, but there may not be as many observations for one variable as for another. This will become clear as we proceed through this chapter.

Our analysis is carried out on unique set data, derived from four surveys undertaken by the Chinese Academy of Social Sciences (CASS), with the assistance of academics from Oxford University, the University of Michigan, and the University of California, San Diego. Two of the surveys include qualitative, or institutional, information about the state of each enterprise. The two others contain annual information on the accounts of the firm. With the institutional questionnaire the enterprise manager answered questions on issues such internal incentives, autonomy in decision-making, managerial characteristics, financial assistance and employee relations. These questionnaires were sent out twice, in 1990 and in 1995.

As for the accounts data, these surveys were undertaken in two waves covering the periods 1980-89 (769 enterprises) and 1990-1994 (681 enterprises).

From these one can construct a balanced panel of 681 Chinese SOEs during the years 1980 and 1994 for key variables.

The data covers four provinces, Jiangsu, Jilin, Shanxi and Sichuan of China. Given the existence of differing policies and levels of development across regions, such as *Special Economic Zones* earmarked for large-scale investment and fast-track growth, this feature of the data is beneficial, as Jiangsu is considered wealthier and more progressive than Jilin and Shanxi, which are so again vis-à-vis, Sichuan a large, but relatively undeveloped province.

The sample covers forty industries, but is clustered into homogeneous goods industries such as the manufacturing of machinery, textiles, chemicals and building materials.

All monetary values are reported in prices adjusted to the levels of 1980, with figures in tables quoted in 10,000 Yuan. Observations relating to the enterprise with the identification number 559 have been dropped from all our analyses, since this observation is a crass outlier in terms of its very large size, by virtually all measurements.

We now turn to the summary statistics, reported in Table III.1. The enterprises represented in this sample are on average 20 years old in 1980, the oldest being 74 years in operation, and the youngest being just established. Roughly ten percent, or 63 units, are older than 35 years, and 49 units are established for less than three years.

The average size of the enterprises included in our sample in terms of value of output, $y$, is 29,815,360 Yuan. However, there is much dispersion around the mean, with the standard deviation nearly double the mean value. Output is of course restricted to be non-negative, and hence some very large firms must account for this large standard deviation. A total of 755, or 7.4%, of the observations register a value of output in excess of 100,000,000 Yuan.

As for raw materials, $m$, consumed, one notices an even larger dispersion around a mean of 10,445,940, with a standard deviation about two and a half times the mean. While 'inputs consumed' is by definition non-negative, 876 observations, which is nearly 8.6% of the sample, report raw material consumption in excess of 100,000,000 Yuan.

Real value added, *rva*, is unfortunately not limited to be non-negative, with a mean of 19,299,770 Yuan, and a standard deviation of just over double that level. A mere 156, or 1.5%, of the observations record negative value added, whereas 1030

observations returned a value added in excess of 100,000,000 Yuan, which is about 11% of the sample.

With regard to labour related variables, such as number of employees, *l*, and payment of wages, *w*, and bonuses, *b*, the data appears to exhibit slightly lower levels of heterogeneity. The mean number of employees is 1730, with a standard deviation of 2738. Restricted to being non-negative, 773 observations, or 7.5%, record a number of employees in excess of 5,000.

The mean wage-bill is 1,833,775 Yuan, with a standard deviation of roughly twice the mean. Interestingly, the standard deviation for bonuses paid is about two and a half times a large as the mean value of 4,150,551. Naturally, average wages and bonuses are a lot less dispersed around their mean. The average wage is around 1022 Yuan, with a standard deviation just under that size. The average bonus paid is about a fifth of the average wage, namely 224 Yuan; its dispersion is slightly less again than the size of the mean. As regards the percentage of bonuses in the total wage bill, one finds a figure of 21%, the standard deviation being just over half that value.

In terms of capital structure, the mean reported productive capital stock, *k*, in our sample is 20,561,060 Yuan, with a standard deviation of about two and a quarter times that, whereas average investment over this period has been 3,161,282 Yuan. The level of investment, *i*, varies widely, and is the most volatile variable in our dataset.

In order to relate the behaviour of these variables over time to the recipient, we provide a graphical analysis of the development of the mean values. Figure III.1 shows that output, and hence real value added, grows at a much faster rate than does raw material consumption, thus, real value added more than triples over the fifteen years. With a beginning value of just under a million Yuan in the early 1980, it peaks in 1993 at nearly three million Yuan.

By comparison, the number of employees only increases by about 35%, from 1440 employees to just over 1900 in 1994, as is apparent from Figure III.2. Wages and bonuses are clearly not measured in the same way across both sample periods. Average wages grow by nearly 60% between 1980 and 1989, and, after a jump in 1990, oscillate around that point thereafter. Bonuses more than double in the first ten years, but after a jump in 1990 we witness them fall noticeably.

Interestingly, as Figure III.4 reveals, the only variable to move in synch with real value added is the productive capital stock, which also triples over the fifteen

years. Investment, too, has been growing, though not as quickly as the capital stock. Thus, this expansion may only be temporary, as the capital stock grows and depreciation rates eat into the investment to capital ratio.

For completeness, provincial summary statistics are provided in Table III.2 – Table III.5. It appears that Jiangsu, with low levels of employment and capital, has the highest average output levels, underlining its status as a developed part of China. Shanxi and Jilin have somewhat lower realisations of value added, with Sichuan coming in a good bit behind, highly labour intensive.

An important part of our empirical analysis is the evaluation of reforms. The institutional questionnaire contains information on the date from which managers obtained the autonomy in certain decision-making aspects concerning enterprise activity. We have information of the following six variables:

- Autonomy in determining output.
- Autonomy in hiring and firing employees.
- Autonomy over short-run investment, with a horizon under two years.
- Autonomy over long-run investment, with a horizon in excess of two years.
- Autonomy in buying and selling assets.
- Autonomy to import and export inputs.

We have coded these one if the enterprise had autonomy in the current year, and zero otherwise.

Table III.6 shows the percentage of observations that have autonomy in the various categories. Clearly, output autonomy is the most readily granted area. It is also the reform that is eventually taken up by virtually every enterprise in the sample. Hiring and firing autonomy is the next likely to be granted, though short-run investment decisions are about as likely to be granted, though the process of granting autonomy in this area initially lagged hiring and firing. Less than 18% in the sample are allowed to enter foreign markets, a mere 15% may make long-run investment decisions, and autonomy in buying and selling of assets is only granted to 12% of managers.

Table III.7 – Table III.10 give these details by province. Though Jiangsu is clearly further advanced in this respect also, the remaining provinces do not appear to differ in a systematic way. Each of these reforms will receive more attention in the following chapters, as the discussion requires.

## III.1 TABLES

**Table III.1 Summary Statistics of Key Variables**

| Variable[a] | Observations | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Age | 680[b] | 20 | 12.92 | 0 | 74 |
| Output | 10061 | 2981.54 | 5452.299 | 0 | 130901.6 |
| Raw Materials | 9423 | 1064.59 | 2547.15 | 0 | 110991.4 |
| Value Added | 9370 | 1929.98 | 4087.361 | -52516.5 | 124683.8 |
| Labour | 10040 | 1718.77 | 2703.577 | 0 | 38921 |
| Wages | 10200 | 183.37 | 359.041 | 0 | 6675.2 |
| Bonuses | 10034 | 41.51 | 100.721 | 0 | 2020.11 |
| Average Wage | 10004 | 0.102 | 0.0956 | 0 | 7.61 |
| Average Bonus | 10005 | 0.022 | 0.0181 | 0 | .3578 |
| Bonuses in Wages | 10005 | 21.12 | 12.44 | 0 | 100 |
| Capital | 9284 | 2056.10 | 4630.975 | 0 | 89000.62 |
| Investment | 9358 | 316.13 | 2442.33 | 0 | 86859.07 |

Note: This table provides summary statistics for the key variables of our analysis: The number of observations considered, their mean value and standard deviation, and the minimum and maximum values.

[a] All Variables are in 10,000Yuan, with the exceptions of 'Age' (years), 'Labour' (number of employees), and 'Bonuses in Wages' (percentage of bonuses in total wage bill).

[b] We report here only the age of each firm in 1980.

**Table III.2 Jiangsu Summary Statistics of Key Variables**

| Variable[a] | Observations | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Age | 209[b] | 22.60 | 13.68 | 0 | 74 |
| Output | 3107 | 3669.75 | 6146.35 | 0 | 130901.6 |
| Raw Materials | 3014 | 1299.44 | 2197.73 | 0 | 31523.26 |
| Value Added | 2993 | 2321.84 | 4546.37 | -3290.266 | 124683.8 |
| Labour | 3067 | 1206.16 | 1120.39 | 0 | 13196 |
| Average Wage | 3065 | 0.101 | .058 | 0 | 1.78 |
| Average Bonus | 3060 | 0.026 | .02 | 0 | 0.14 |
| Bonuses in Wages | 3070 | 22.86 | 12.6 | 0 | 100 |
| Capital | 2982 | 1264.17 | 1620.19 | 0 | 12597.1 |
| Investment | 2902 | 193.88 | 392.27 | 0 | 5601.48 |

Note: This table provides summary statistics for the key variables of our analysis for observations in the Jiangsu province: The number of observations considered, their mean value and standard deviation, and the minimum and maximum values.

[a] All Variables are in 10,000Yuan, with the exceptions of 'Age' (years), 'Labour' (number of employees), and 'Bonuses in Wages' (percentage of bonuses in total wage bill).

[b] We report here only the age of each firm in 1980.

**Table III.3 Sichuan Summary Statistics of Key Variables**

| Variable[a] | Observations | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Age | 142[b] | 17.40 | 13.23 | 0 | 69 |
| Output | 2099 | 2795.23 | 5243.33 | 31.52 | 56540 |
| Raw Materials | 1854 | 1002.30 | 1862.55 | 0 | 23243.89 |
| Value Added | 1853 | 1769.42 | 3669.45 | -6241.27 | 47873.02 |
| Labour | 2095 | 1932.42 | 2428.55 | 62 | 19577 |
| Average Wage | 2095 | .094 | .03 | 0 | .61 |
| Average Bonus | 2090 | .023 | .015 | 0 | 0.133 |
| Bonuses in Wages | 2087 | 23.46 | 12.04 | 0 | 94.18 |
| Capital | 1812 | 2138.79 | 4378.28 | 0 | 38141.59 |
| Investment | 1923 | 203.03 | 514.43 | 0 | 7227.43 |

Note: This table provides summary statistics for the key variables of our analysis for observations in the Sichuan province: The number of observations considered, their mean value and standard deviation, and the minimum and maximum values.

[a] All Variables are in 10,000Yuan, with the exceptions of 'Age' (years), 'Labour' (number of employees), and 'Bonuses in Wages' (percentage of bonuses in total wage bill).

[b] We report here only the age of each firm in 1980.

**Table III.4 Shanxi Summary Statistics of Key Variables**

| Variable[a] | Observations | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Age | 141[b] | 19.8 | 10.961 | 0 | 60 |
| Output | 2083 | 2441.17 | 4784.083 | 0 | 65838.12 |
| Raw Materials | 1892 | 797.82 | 1438.615 | 0 | 17264.35 |
| Value Added | 1872 | 1693.1 | 3902.953 | -4719.29 | 64969.96 |
| Labour | 2097 | 2151.53 | 3614.727 | 42 | 30638 |
| Average Wage | 2097 | 0.099 | 0.17 | 0 | 7.612975 |
| Average Bonus | 2077 | 0.018 | 0.015 | 0 | .0938 |
| Bonuses in Wages | 2072 | 17.88 | 11.92 | 0 | 94.5 |
| Capital | 1928 | 2434.56 | 5933.12 | 0 | 80042.1 |
| Investment | 1936 | 276.47 | 1347.53 | 0 | 44400.8 |

Note: This table provides summary statistics for the key variables of our analysis for observations in the Shanxi province: The number of observations considered, their mean value and standard deviation, and the minimum and maximum values.

[a] All Variables are in 10,000Yuan, with the exceptions of 'Age' (years), 'Labour' (number of employees), and 'Bonuses in Wages' (percentage of bonuses in total wage bill).

[b] We report here only the age of each firm in 1980.

**Table III.5 Jilin Summary Statistics of Key Variables**

| Variable[a] | Observations | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Age | 188[b] | 19.22 | 10.97 | 0 | 67 |
| Output | 2766 | 2755.37 | 5163.33 | 0 | 76925.6 |
| Raw Materials | 2657 | 1033.32 | 3677.43 | 0 | 110991.4 |
| Value Added | 2646 | 1763.48 | 3899.71 | -52516.5 | 47384.6 |
| Labour | 2775 | 1799.96 | 3203.51 | 0 | 38921 |
| Average Wage | 2771 | 0.103 | .08 | 0 | 1.13 |
| Average Bonus | 2771 | 0.021 | .02 | 0 | 0.36 |
| Bonuses in Wages | 2770 | 19.8 | 12.1 | 0 | 90.32 |
| Capital | 2556 | 2640.97 | 5789.76 | 0 | 89000.62 |
| Investment | 2592 | 566.12 | 4441.26 | 0 | 86859.07 |

Note: This table provides summary statistics for the key variables of our analysis for observations in the Jilin province: The number of observations considered, their mean value and standard deviation, and the minimum and maximum values.

[a] All Variables are in 10,000Yuan, with the exceptions of 'Age' (years), 'Labour' (number of employees), and 'Bonuses in Wages' (percentage of bonuses in total wage bill).

[b] We report here only the age of each firm in 1980.

**Table III.6 Autonomy in Operations**

| Variable | Observations | Percentage |
|---|---|---|
| Output Autonomy | 10194 | 32.1 |
| Hiring/Firing Autonomy | 10194 | 20.7 |
| Import/Export Autonomy | 10194 | 17.7 |
| Short-run Investment Autonomy | 10194 | 19.9 |
| Long-run Investment Autonomy | 10194 | 14.6 |
| Buy & Sell Assets Autonomy | 10194 | 11.9 |

Note: This table reports the number and percentage of total observations that have achieved managerial autonomy with respect to decisions regarding various types of enterprise operations

**Table III.7 Autonomy in Operations, Jiangsu Province**

| Variable | Observations | Percentage |
|---|---|---|
| Output Autonomy | 3134 | 37.4 |
| Hiring/Firing Autonomy | 3134 | 25.9 |
| Import/Export Autonomy | 3134 | 23.8 |
| Short-run Investment Autonomy | 3134 | 23.1 |
| Long-run Investment Autonomy | 3134 | 18.1 |
| Buy & Sell Assets Autonomy | 3134 | 14.6 |

Note: This table reports the number and percentage of total observations that have achieved managerial autonomy with respect to decisions regarding various types of enterprise operations for Jiangsu Province

**Table III.8 Autonomy in Operations, Sichuan Province**

| Variable | Observations | Percentage |
|---|---|---|
| Output Autonomy | 2130 | 28.5 |
| Hiring/Firing Autonomy | 2130 | 17.1 |
| Import/Export Autonomy | 2130 | 14.6 |
| Short-run Investment Autonomy | 2130 | 20.9 |
| Long-run Investment Autonomy | 2130 | 13.1 |
| Buy & Sell Assets Autonomy | 2130 | 12.0 |

Note: This table reports the number and percentage of total observations that have achieved managerial autonomy with respect to decisions regarding various types of enterprise operations for Sichuan Province

**Table III.9 Autonomy in Operations, Shanxi Province**

| Variable | Observations | Percentage |
|---|---|---|
| Output Autonomy | 2110 | 30.2 |
| Hiring/Firing Autonomy | 2110 | 17.5 |
| Import/Export Autonomy | 2110 | 13.6 |
| Short-run Investment Autonomy | 2110 | 14.6 |
| Long-run Investment Autonomy | 2110 | 12.1 |
| Buy & Sell Assets Autonomy | 2110 | 10.5 |

Note: This table reports the number and percentage of total observations that have achieved managerial autonomy with respect to decisions regarding various types of enterprise operations for Shanxi Province

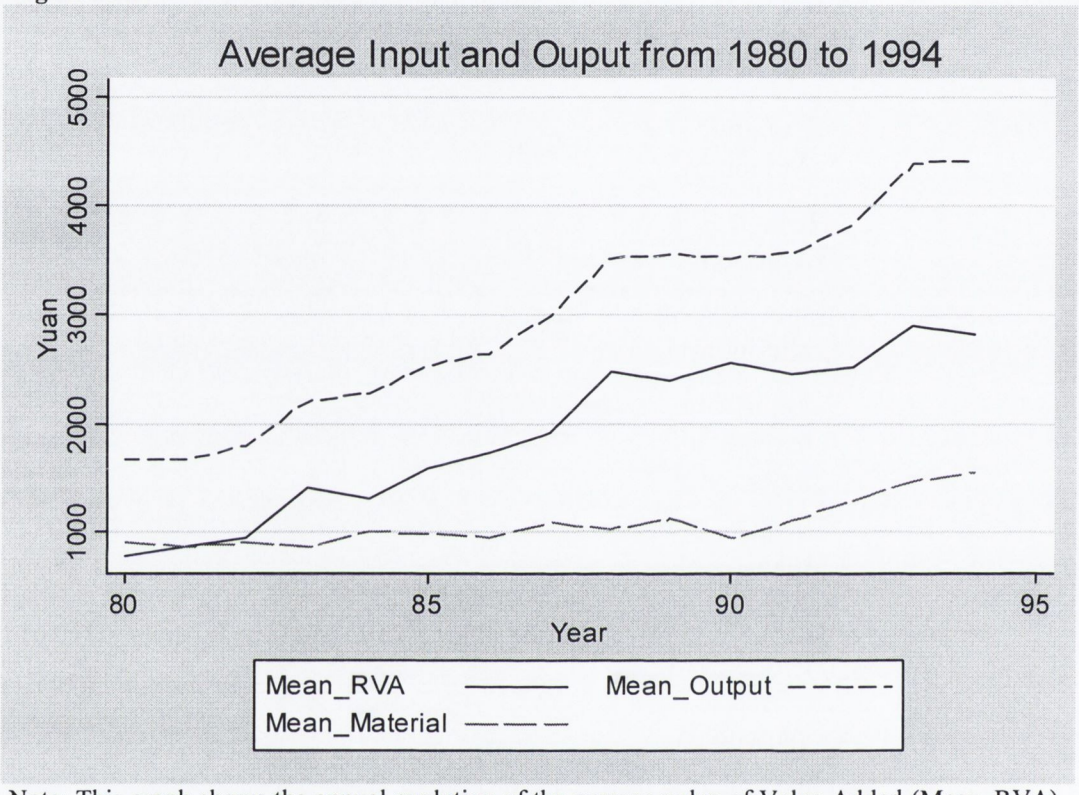
**Table III.10 Autonomy in Operations, Jilin Province**

| Variable | Observations | Percentage |
|---|---|---|
| Output Autonomy | 2820 | 30.2 |
| Hiring/Firing Autonomy | 2820 | 20.1 |
| Import/Export Autonomy | 2820 | 16.6 |
| Short-run Investment Autonomy | 2820 | 19.7 |
| Long-run Investment Autonomy | 2820 | 13.9 |
| Buy & Sell Assets Autonomy | 2820 | 10.5 |

Note: This table reports the number and percentage of total observations that have achieved managerial autonomy with respect to decisions regarding various types of enterprise operations for Jilin Province

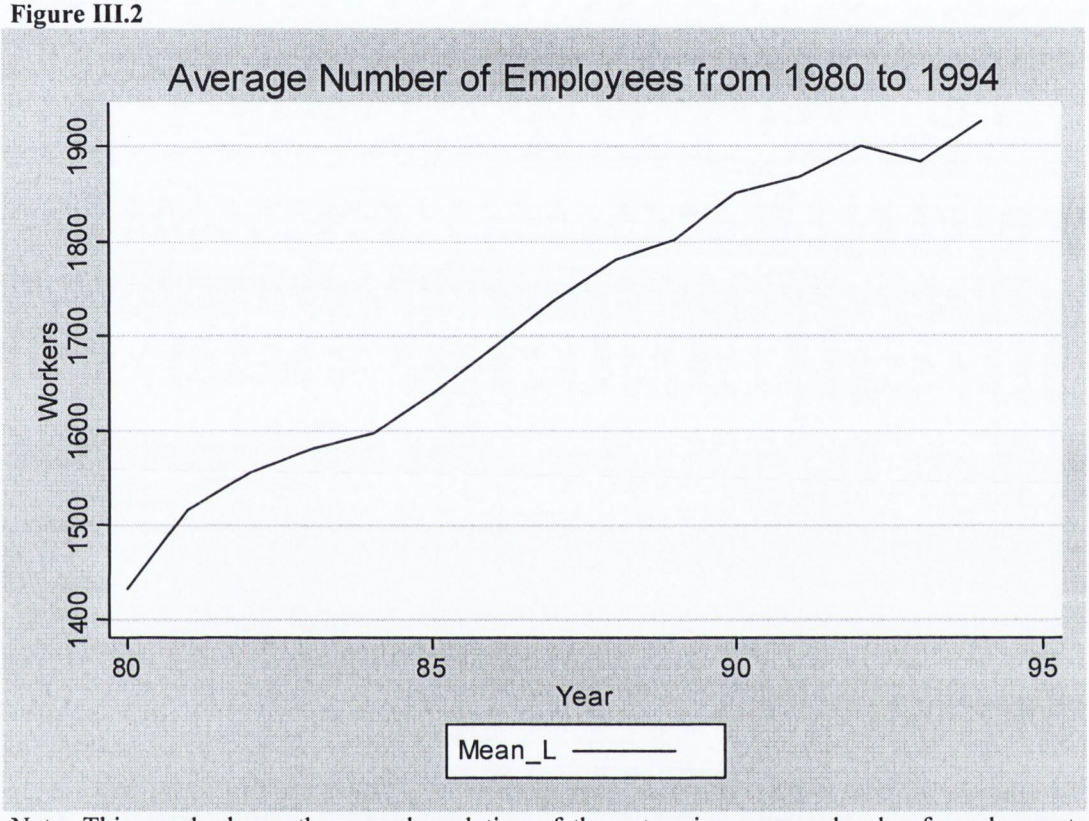
## III.2 FIGURES

**Figure III.1**



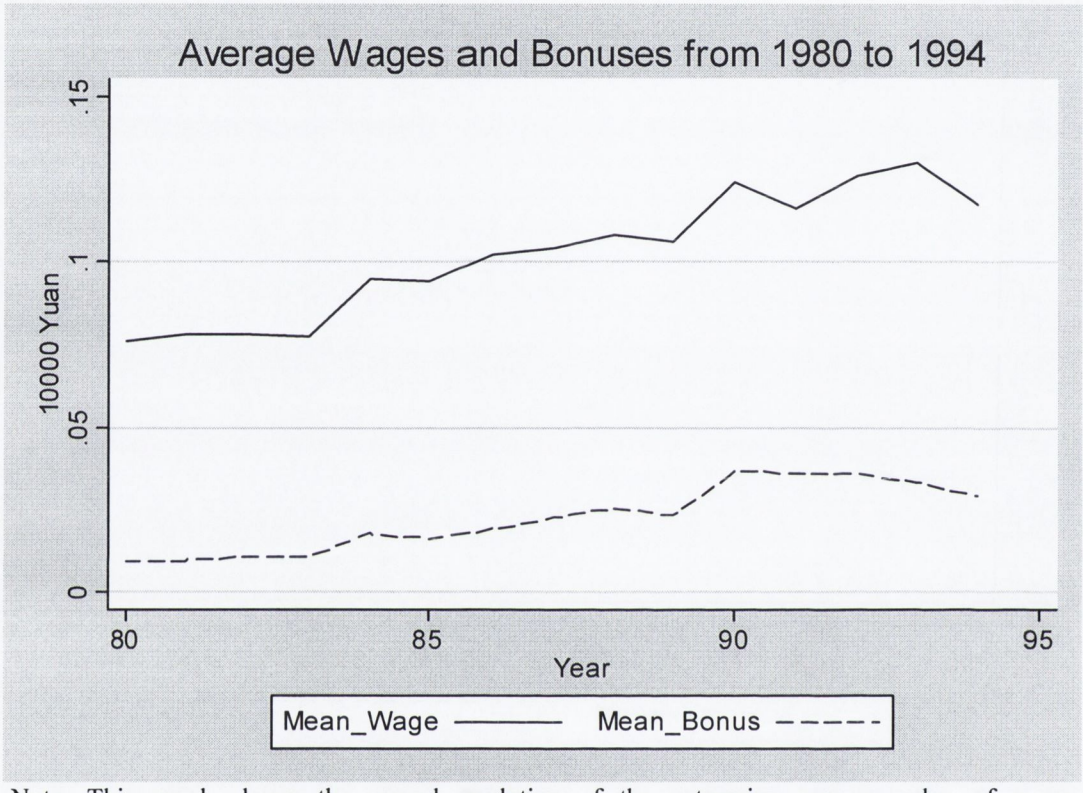

Note: This graph shows the annual evolution of the average value of Value Added (Mean_RVA), Output (Mean_Output), and Raw Materials (Mean_Material) over the Years 1980 – 1994 in 10,000Yuan.

**Figure III.2**



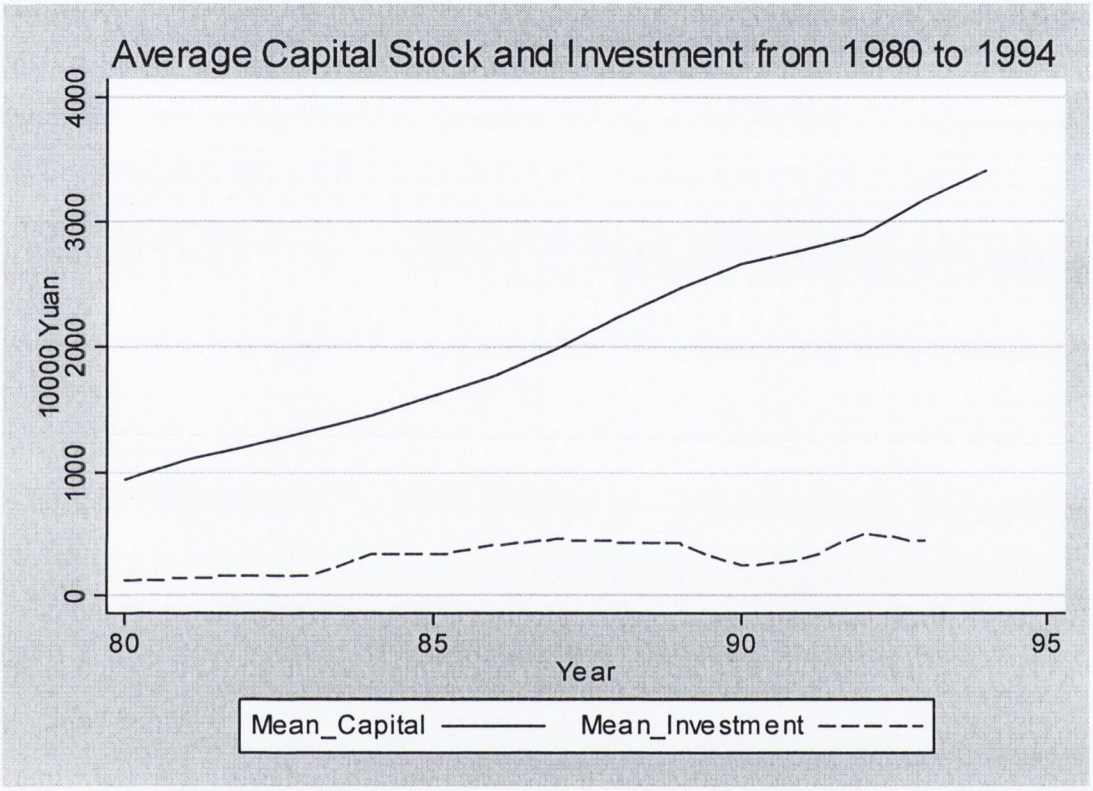

Note: This graph shows the annual evolution of the enterprise average levels of employment (Mean_L) over the Years 1980 – 1994.

**Figure III.3**




Note: This graph shows the annual evolution of the enterprise average value of wage (Mean_Wage) and bonus (Mean_Bonus) in 10,000Yuan over the Years 1980 – 1994.

**Figure III.4**




Note: This graph shows the annual evolution of the enterprise average value of capital stock (Mean_Capital) and investment (Mean_Investment) in 10,000Yuan over the Years 1980 – 1994.

# IV. Soft Budget Constraints

## IV.1 Introduction

The relative inefficiency of state-owned enterprises (SOEs) vis-à-vis privately owned enterprises is often blamed on the fact that SOEs have a soft budget constraint (SBC). Indeed, this is considered a very important aspect of the Chinese economy, as SOEs are said to attract most of institutional investment, thus crowding out much needed investment in the private sector. An economic unit has a soft budget constraint when it does not regard its budget as an entity that must have a strictly non-negative value, given the unit's self-generated discounted future stream of income, less costs. Generally, an enterprise will disregard this constraint because it has an *ex ante* high expectation it will be bailed-out *ex post* by an institution it has a potentially dependent relationship with.

The symptoms of this *attitude* are generally perceived as a tolerance of behaviours that are not consistent with profit-maximising behaviour. This may take the form of rent seeking, or the indifference toward, or even encouragement of, unprofitable projects, or a lack of improvement in economic performance. In the case of a SOE as the economic unit, the state is usually the institution it stands in dependence to, or an organisation affiliated to the state, such as a state owned bank. A bailout can take on many different forms, such as subsidies, tax relief, non-enforcement of bill-payment, interest relief, the rolling over of debt, debt forgiveness, or administrative pricing.

In this chapter the focus shall be on the issue of soft budget constraints in Chinese state owned enterprises in two time periods, 1985-1989 and 1990-1994, where the enterprise manager admits to having received significant aid from the government. The state is likely to select only certain companies for lenient financial treatment, and of course only certain types of firms will be in need of financial assistance. In this analysis I will attempt to uncover state directed policies, which may guide the state in selecting some companies for financial lenience. Furthermore, it would be interesting to identify rent seeking behaviour, such as excessive wage payments or large pension payments, which result from government leniency. Since

each enterprise will have an idea about the likelihood of it receiving state aid, and it will attempt to obtain as much aid as possible, enterprises that feel they are likely to receive aid will not feel compelled to respect the budget constraint. This provides the enterprise with a slack budget constraint, which will allow it to allocate resources toward uneconomic projects, including indulging in rent seeking.

A unique feature of this analysis is the fact that the existence of a soft-budget constraint need not be deduced from circumstantial evidence, as is usually the practice in empirical analyses of the soft budget constraint. Rather, this analysis makes use of the fact that enterprises are characterised by their managers as having a hard or soft budget constraint.

The results we obtain indicate that SBC-type is persistently significantly and positively associated with the size of the labour force, a feature that is often pointed out in the literature. Interestingly, while wages did not appear to impact on SBC-type in the late 1980s, there is a clear hardening of budget constraints for firms with large wage and pensions bills. Also, whereas capital intensity reduced the likelihood of receiving state aid in the late 1980s, this ceased to be a feature of the 1990s. On the other hand, state aid was significantly less likely to be received in the 1990s the older and enterprise was, whilst it was not relevant in the earlier period.

Furthermore, whether or not a firm received aid depended on geographic location and industrial affiliation, and the implications of these characteristics in terms of their effect on the likelihood of receiving state aid changed over the time-periods under consideration. While in the late 1980s the poorer provinces were held to tighter discipline, this feature is reversed in the early 1990, with enterprises in richest province least likely to receive aid. Similarly, while consumer goods industries were more likely to benefit from state aid in the 1980s, in the 1990s raw materials and mining, and plastics and chemicals industries appear to have been included in this privileged category, vis-à-vis the remainder of industries.

Thus, this analysis uncovers systemic features associated with Chinese SOEs' likelihood of receiving state aid, whereas idiosyncratic shocks do not feature due to data constraints. It appears that policy is a large determinant of the likelihood of receiving state aid and policy aims appear to have changed over the periods under examination, as the relevance of certain characteristics changes, as do their implications.

The remainder of this chapter will develop as follows. Section IV.2 will take the recipient through the main contributions in the literature on the soft budget constraint. The focus will largely be on contributions that are pertinent to our analysis, namely those that focus on SOEs and China. Importantly, this section provides a strict definition of what the soft budget constraint is. Section IV.3 is concerned with the data employed in the analysis. In particular it provides details of our taxonomy of classifying enterprises as SBC versus non-SBC, which is motivated in section IV.2. Furthermore, it addresses some of the more salient characteristics of enterprises classified as being of the SBC-type versus those that are not. Section IV.4 outlines the estimation procedures and corresponding results. Section IV.5 summarises the conclusions of this chapter. The tables referred to in the text can be found in section IV.6.

## IV.2 Literature on SBCs

This section summarises the most important contributions in the literature on soft budget constraints to date in three subsections. It begins with an exposé of the core literature, which provides the background necessary to place this contribution in the body of work already undertaken in this area. A subsection on the various reasons for the existence of the SBC, and various manifestations thereof, follows. I finish with a reflection on the SBC, in an attempt to capture its precise nature. Thus, I hope to provide a benchmark against which our taxonomy, of classifying enterprises as having a soft or a hard budget constraint, can be judged.

### IV.2.1 The Theory of the Soft Budget Constraint

J. Kornai first developed the concept of the soft budget constraint in his seminal work "Resource-Constrained Versus Demand-Constrained Systems" (1979), in which he states that firms' efforts to increase production can come up against three types of constraints:

> "the constraints of physical resources, demand constraints, and the firm's budget constraint." (Kornai, 1979: p.801)

Planned economies have been described as supply constrained, whereas market economies are generally thought of as being demand constrained. As Keynes noted, an element of unemployment in market economies is the result of constrained demand. In an attempt to explain the persistent symptom of shortage in planned economies, J. Kornai formulated his theory of the soft-budget constraint. In this theory Kornai explains that planned economies are resource constrained, given full employment of resources toward the goals laid out in the plan.

> *"The demand of firms for inputs is almost insatiable.* It goes by all means up to the supply limits of inputs. Therefore, in the sphere of inter-firm input-output relationships, the system becomes resource constrained" (Kornai, 1979: p.809)

He posits that the persistent macroeconomic symptom of shortage in planned economies is due to the fact that producers are unrestrained in their attempts to increase output, and hence have unlimited investment demand.

> ""Shortage" is the collection of millions of submicro-level elementary shortage events." (Kornai, 1979: p.805)

Thus, bottlenecks in essential investment goods arise and create a limit to output expansion.

> "Summarily, it can be stated that *quantity drive creates an almost insatiable demand for inputs of current production, and expansion drive creates an almost insatiable demand for investment goods.*" (Kornai, 1979: p.814)

Full employment, government sponsored expansion, and a seller's market, without much incentive for quality improvement, all lead to a situation of shortage. Furthermore, given the complementary nature of inputs, slack and shortage are not mutually exclusive. (Kornai, 1979)

> "Refinancing, subsidies, and bailouts of bad projects happen frequently, and unprofitable firms survive indefinitely. This in turn increases demand for investment *ex ante*. Compared to the case of the hard budget constraint in

> capitalist economies, demand for inputs from the firm sector is higher, other things being equal." (Qian, Y., 1994: p.146)

The underlying reason for SBCs can vary, and they are by no means limited to planned economies. SBCs, can be a characteristic of an enterprise in any system, so long as it receives aid such that it has some slack in its budget constraint.

> "... soft budget constraints reflect a universal dynamic commitment problem that is potentially present in any form of finance and in any financial system." (Bergloff and Roland, 1998: p.38)

The reason for a SBC appearing can vary, though the motivation for tolerating uneconomic behaviour tends to be similar. Furthermore, bad behaviour that goes unchecked under a SBC can take various manifestations.

Dewatripont and Maskin (1995) outline an approach that does not require a paternalistic state in order for the SBC to appear. Instead, they forward a theoretical model that applies to market economies as well as planned economies, thus gaining a result where the SBC can appear due to information asymmetry and time-inconsistency among profit maximising entities. In this setting, unprofitable projects may be financed *ex ante* because of adverse selection. The asymmetry takes the form, such that the entrepreneur has knowledge of the projects type, but the creditor gains this knowledge only over time. Given the prior investment, projects that prove to be bad *ex post* may continue to be financed if sufficiently high sunk costs have been incurred, such that the lender stands to lose less money by refinancing the project, rather than termination it. As this result is linked to the existence of a single large lender, credit decentralisation can cause financial discipline, since many small lenders are likely to terminate the project.

Bergloff and Roland (1998) note that ¾ models reviewed are of the Dewatripont and Maskin (1995)-type. Kornai (1998b) refers to the Dewatripont and Maskin (1995)-type of SBC as an endogenous explanation for the existence of the SBC, since its existence is due to a firm's efforts, whereas he sees the involvement of a paternalistic state as an exogenous explanation of how the SBC arises, since the state has a policy that favours some over others.

Li and Tan (1999) motivate a third version, coined as *the state's accountability problem*, the root cause of which is the state plan and shortcomings in resource allocation. Symptoms of this are large retirement pensions and welfare costs, as well as redundant workers. I concur with all three of these views as potential sources of the SBC in general, and it is likely that all of these factors are present in Chinese state-owned enterprises.

IV.2.2 Reasons for and Manifestations of the SBC Syndrome in SOEs

State-owned enterprises are traditionally deemed inefficient, which is typically explained by their adherence to objectives that compromise pure profit maximisation. An important aspect of non-profit-maximising entities is that either their revenues are not maximised and/or their costs are not minimised, since they are either subject to some other constraints or other factors enter the utility function, which may reduce the importance of mere profit maximisation to the owner. Among the generally accepted non-profit-maximising objectives of SOEs often cited are the creation, or maintenance, of regional employment, payment of excessive wages, and provision of secure and large pensions, as well as the creation of strategic capital intensive industries. (Li and Liang, 1998)

Thus, redundant workers, large wage payments, and large capital or output levels are all potential causes of the SBC. Shleifer & Vishny (1994) lend support to the role of political influence, while the lack of information and the commitment problem feature in Dewatripont & Maskin (1995), and insider control arguments are outlined in Li (1995).

> "The most frequently quoted reason for external help is protection of jobs. [...] An important argument, closely related to (a) and (c) in favour of softening the budget constraint is the demand for security and stability: to protect the individual and ultimately the society as a whole against fluctuations and uncertainties. [...] This desire for security and stability is the motivation for impeding the 'natural selection' executed by the market, for guaranteeing the survival of malfunctioning banks and producing firms."(Kornai, 1986: p.25)

As for the bias toward capital-intensive industries:

> "In a capital-scarce economy, the capital intensive enterprises industries are not competitive by nature. However, the state views the capital-intensive industries as strategically important and the SOE's are instructed to operate in those industries. [...] The SOE's bear a heavy burden from retirement pensions, other social-welfare costs, and redundant workers. [...]The older an SOE is the more retired workers it has, and the heavier the burden from retired workers pensions and social-welfare expenditures it carries." (Lin et al., 1998: p.425)

The result of sponsoring capital-intensive industries at the micro-level can have macroeconomic effects. Capital-intensive firms do not generate enough employment in the cities, which then need to employ redundant workers for social stability reasons. The policy burden implies losses that the state carries blame for. However, how can one distinguish policy induced losses and enterprise losses? Again, an exogenous policy guided selection for financial leniency results in a SBC that allows for uneconomic behaviour, the extent of which is tolerated is endogenous. (Lin et al., 1998)

In post *World War I*, Russia's and, in post *WW II*, China's, economy placed emphasis on a fast development of heavy industry, even if this did not suit the endowment of the economy, in terms of technological attainment or capital intensity. Both scenarios, promotion of strategic, capital-intensive industries and employment creation, would appear to be relevant features of the Chinese economy. This is reflected in the concept of a paternalistic state, Kornai's main explanation for the existence of SBCs, which is a state that will bail enterprises out that are important to it, usually for reasons such as maintaining/creating regional employment or because it has a policy of setting up and maintaining capital intensive and strategic industries.

Thus, this *exogenous* selection due to policy directives is likely to be reflected in enterprise characteristics. Given that the creation of regional employment or the sponsoring of capital intensive, strategic industries are thought to be the main motivators for governments to indulge unprofitable companies, one might expect to find such policy reflecting characteristics to emerge as critical selection factors in the following analysis.

Kornai elaborates that the soft budget constraint does not arise in horizontal relationships:

> Vertical rather than horizontal links: "However, a different situation arises if there is a degree of dependency, i.e. a relationship of superiority and subordination, between two organizations. In the case of a state-owned enterprise, this vertical relationship occurs because the owner, i.e., the state, is superior to the subordinate agent, i.e., the manager." (Kornai, 1998: p.13)

The importance of this view is due to the concern that inter-enterprises arrears form part of the SBC problem. However, it is argued that inter-enterprise arrears only have an effect via collective bargaining. This occurs if various enterprises lay the blame of lacking performance on inter-enterprise arrears, thus ultimately extracting financial aid from the state, rather than to the debtor enterprise.

My view of the soft budget constraint as it arises in China is as follows: The enterprise, or elements within it, is likely to have some knowledge of its exogenously determined type, in terms of the probability distribution of it gaining at least that level of state aid it will be in need of to survive, based on its characteristics being similar to those favoured by the central authority. Another aspect of its type is endogenous to the enterprise, reflected in a probability distribution of how much state aid it might attain in excess of what can reasonably be attributed to policy induced shortcomings, by, for example, distorting information.

Thus, information asymmetry may drive a wedge between what policy dictates an enterprise has a right to and what it may actually receive. This, in turn, allows rents to be drawn from the state for any gap between genuinely required aid and the amount of support that can be received. Unfortunately, we are unable to test for more than company characteristics affecting the SBC status of a firm, since the data does not provide us with credible measures of financial performance, or the incidence of liquidity crises.

Rent seeking by the employees and/or management may take the form of excessive wage and bonus payments, or the provision of welfare. Similarly, large pensions to formerly state-owned enterprise employees are important. The last two points regarding wages and bonuses form part of the empirical analysis.

IV.2.3 Exactly how should one think about the SBC?

Many empirical papers on the SBC suffer from a very serious flaw, which I hope this approach corrects for. Many fail to classify firms according the definitions of the SBC, as outlined above. Rather, they attempt to classify firms according to certain standards, which are tested using accountancy type data. This is done even though, throughout the theoretical literature, it is stressed that this is not correct. Naturally, researchers may not have any better information at hand.

This section closes with an outline of the core points made in the literature as to what exactly signifies a SBC, and certain instances of what does not.

> "[...] the budget constraint is not a bookkeeping identity nor a technical relation, but a rational planning postulate." (Kornai, 1986: p.4)

Given the nature of a large portion of empirical work on the SBC phenomenon hitherto, the point made in the preceding quote cannot be stressed enough. Many papers have attempted to identify a SBC using accounts data by imposing certain models on the behaviour of variables. Thus, a frequently used identifier for SBCs is the co-existence of the following three conditions in the balance sheet of a firm. If a firm makes a loss, increases its level of indebtedness, and loses market value, then it must be obtaining soft credit. Of course this could only hold in the most mathematically perfect of markets. Many firms that have been characterised as such in the past would hence be deemed to have been exhibiting symptoms reflecting a SBC, whereas in actual fact they often may have been restructuring and *tightening their belts*, rather than engaging in uneconomic behaviourisms usually associated with SBCs, such as outlined above.

> "In particular, I argue that one cannot conclude that firms have SBCs simply because they continue to make losses or because they have large stocks of overdue debts. Firms can be loss-making, or have large debts in arrears, and still have hard budget constraints so long as neither their creditors nor the state are rescuing the firm with net injections of cash or subsidies." (Schaffer, 1998: p.81)

As the following highlights, the breakdown of the balance among earnings and costs is only a necessary condition for the existence of the SBC. Sufficiency requires that the enterprise manager hold a *subjective* view of the probability of full compensation for an imbalance among costs and earnings.

> "The 'softening of the budget constraint appears when the strict relationship between the expenditure and the earnings of an economic unit (firm, household, etc.) has been relaxed, because excess expenditure will be paid by some other institution, typically b[y] the paternalistic state. The higher the subjective probability that excess expenditure will be covered by external assistance, the softer the budget constraint." (Kornai, 1986: p.29)

Kornai elaborates this use of a probabilistic framework in order to describe the SBC, which to him is then the realisation of a random variable, the prior distribution of which is known to the manager.

> "Another way to express this idea is to use probabilistic terms: external assistance is a random variable. The decision-maker has a subjective perception of the probability distribution of this random variable. The higher the subjective probability that excess expenditure will be covered by external assistance, the softer the budget constraint." (Kornai, 1986: p.5)

> "But here we are facing a stochastic problem: subjective expectations concerning external assistance and the enforcement of financial discipline. Therefore, intermediate positions between a strictly binding and a totally redundant constraint may exist." (Kornai, 1986: p.7)

> "There is one more reason to think in terms of a stringency-scale rather than a 'yes or no' framework, in which a completely ineffective budget constraint are mutually exclusive possibilities. External assistance is usually not granted automatically, as some effort is needed to obtain it." (Kornai, 1986: p.7)

An important concept to grasp is how the manager forms this subjective view.

> "[...] the subjective probability distribution of external assistance will depend on collective experience. The decisive question in this respect is this: what was the regular experience of a larger number of firms over a longer period in the past? And can it be expected, that similar experiences will occur in the future?" (Kornai, 1986: p.7)

A rational manager will form a subjective idea of the probability distribution of his enterprise's likelihood of receiving state aid by observing more than its own, a related firm's, or group of firms, past experience. The manager will certainly take the prevailing policy doctrine to heart, something that higher echelons of Chinese society are aware of, especially managers of SOEs, since they generally have a strong party background, or a senior political officer is attached to their enterprise. Thus, policy will tend to favour enterprises of certain characteristics over others at certain points in time. Of course policy changes, and so managers would be unwise to assume their industry is preferred given past experiences, when the state has only just declared they are about to dismantle said industry. Thus, I argue that the subjective probability distribution is formed due to knowledge of the prevailing policy consensus. This motivates our taxonomy of SBC classification, which is outlined in the following section.

This, however, deals only with the exogenous feature of the budget constraint. As outlined above there exists an endogenous element to SBCs; it is our belief that enterprise managers will attempt to create a wedge between what, according to policy, would be deemed reasonable, and what it actually obtains. What is reasonable is some upper limit to how much an enterprise should get given that policy is at fault for the enterprise's financial shortcoming. Fault arises out of the fact that policy includes non-profit maximising for SOEs. Even though I do not specify a limit reasonable for financial leniency, I do believe that one should be able to witness excessive amounts of financial aid, if one has an idea about where this money may go. Given that the seeking-out of excessive financial leniency should be linked to rent-seeking behaviour, one can formulate various hypotheses regarding where such misappropriation may be directed. Thus, I will test a particular hypotheses regarding rent seeking: excessive bonus payments are thought to be a central feature of SBCs.

* * *

## IV.3 DATA

This section provides the recipient with information regarding the data and subsets of data to be used in our analysis. Given that we are interested in SBCs, one must of course be able to mark companies as exhibiting a hard or soft budget constraint according to our understanding of what a soft budget constraint is, which is set out in the previous section. Thus, the taxonomy of soft and hard budget constraint enterprises is outlined, following which units in our dataset are classified. Then, I shall present the enterprise summary statistics, with an emphasis on differences across different budget constraint types and time-periods.

While there have been many papers on the subject of soft budget constraints in state owned enterprises in general, and in Chinese SOEs in particular, our contribution has some unique features that correct for some well-known shortcomings of previous analyses. One of the biggest weaknesses of previous empirical work on the SBC has been the attempt to identify its very existence. Usually this has been attempted via theoretical arguments about what the symptoms a SBC should exhibit in accounts data. An example of such classification attempts is given in the preceding section. Rather, according to the taxonomy employed in this analysis an enterprise classifies as having a hard or soft budget constraint according to the importance the enterprise manager indicated state-intervention has been.

Specifically, the questionnaires ask the individual managers in 1990, and again in 1995, to judge, on a scale from (1), very important, to (5), not important, how important government intervention has been to their enterprise over the past five years in their opinion. Answers coded (1) and (2) are classified as being indicative of a hard budget constraint, and those coded between (3) and (5) as soft-budget constraint enterprises.

It is important to stress the innovation made here. Enterprises are classed into two groups of firms, a soft and a hard budget constraint group. The soft-budget constraint group has two characteristics: They credibly (to the state) claimed to be in need of a significant level of state aid (a necessary condition), and they actually received state aid (a sufficient condition). The hard-budget constraint group is composed of all those that required no state aid and those that required state aid but did not receive aid.

Naturally, one may argue that institutional ex ante allocation may circumvent the need for ex post aid. However, this is not a feature of the soft-budget constraint as outlined by J. Kornai, which is an ex ante attitude about the probability of an ex post bailout by some other party, here the state, and the resulting wanton disregard of a constraint that balances income with expenditures.

Thus, the sample is split into two groups, soft and hard budget constraint enterprises, over two different time-periods, the former between 1985 and 1989 and the latter between 1990-1994. Since there exists enterprise level heterogeneity in SBC-type across time-period, one may be able to detect differences in the state's enterprise policy over these time-periods, 1989 being one of the most cataclysmic in modern Chinese history.

Summary Statistics by Soft Budget Constraint Type

The first thing to note regarding our division of the data is the fact that, according to our taxonomy, between the years 1985 and 1989, approximately two thirds of firms that can be classified by budget constraint type, 417 firms (2085 observations), are of the soft budget constraint type, and 221 enterprises (1105 observations) are classified as the hard budget constraint type; 42 enterprises (205 observations) could not be classified.

The proportion of enterprises classified as having a hard budget constraint increases substantially in the latter period, from 1990 to 1994. In this period, 347 enterprises were of the hard budget constraint type (1735 observations), with 332 enterprises (1660 observations) classified as having a hard budget constraint.

This is indicative of a significant shift in policy, even though one should be aware that, whilst the questionnaires remained the same, directives for the later questionnaire might have influenced manager's answers regarding their experience of state aid. However, a closer look at the data reveals that this is unlikely to completely explain this phenomenon, since enterprises move up and down these classifications, often more than one rung at a time. Therefore, this change in managerial perception appears to reflect to some extent actual policy change by the government.

* * *

Degrees of autonomy achieved

For consistency, it is necessary to show that levels of operational autonomy achieved by managers does not vary systematically with SBC-type. Table IV.3.1 through Table IV.3.4 list the fraction of enterprises that have achieved managerial autonomy in various areas of operations by budget constraint type for the periods 1985-1989 and 1990-1994.

For the years 1985-1989, as can be seen from Table IV.3.1 and Table IV.3.2, the differences do not appear marked other than for the reforms regarding investment projects with a recovery period in excess of two years, and the right to buy and sell assets. In these categories the SBC-type enterprises have achieved marginally more autonomy. This may seem unexpected, since one might imagine that financially autonomous companies would have proven their financial discipline in order to gain that very autonomy.

Interestingly, as apparent from Table IV.3.3 and Table IV.3.4, the differences across groups in these areas have virtually disappeared in the 1990-1994 period, with the remaining areas of autonomy revealing no increase in differences vis-à-vis the earlier period. This may suggest that firms that were among the early achievers of investment and asset allocation autonomy were more likely to be bailed-out when in financial need. This practice appears to have been discontinued, as an increasing number of enterprises were granted such autonomy.

Summary Statistics on Key Variables from the Accounts Dataset:

1985-1989 Period

The summary statistics by SBC-type for the 1985 to 1989 period is provided in Table IV.3.5 and Table IV.3.5. Enterprises with a hard budget constraint are on average a year younger in age in 1980 than are those of the soft budget constraint type. Some may argue, that this is due to pensions payments, which are larger on average, *ceteris paribus*, the older a company is. However, our measure of pensions, though only present for the latter sub-sample of the observations, does not suggest a significant difference across type.

What is noticeable, however, is the fact that enterprises that have received aid in the period from 1985 to 1989 are about 27% larger in terms of value added (which

may be partly due to government price distortions in inputs and outputs), and nearly 27% larger in terms of the number of employees. Furthermore, the average wage of HBC enterprises is 4% higher than that of the less disciplined firms, and bonuses are 5% higher. This may come as a surprise, given the general impression that the abuse of bonuses had caused problems with financial discipline. In terms of capital, SBC enterprises have 23% more productive capital, and even 19% more investment in productive capital than do adherents to a hard budget constraint.

1990-1994 Period

For the period 1990-1994, we observe, detailed in Table IV.3.7 and Table IV.3.8, the following summary traits of enterprises by budget constraint type:

The SBC enterprises are markedly younger than the counterparts, with SBCs 30 and HBC registering 33 years of age on average, which is a reversal from above. While SBC enterprises are still larger than HBC firms, they are only so by 4.8% in terms of value-added. However, they remain nearly unchanged in terms of the difference in number of employees, which has fallen to just over 25%. Interestingly, the soft budget constraint type enterprises have a near 4% lower wage, with a 6% difference in bonuses, which is also a marked difference to the earlier time-period, though SBC type enterprises do record a slightly higher bonus contribution to their wage package than do workers from a hard budget constraint enterprise. Another striking point is that our measure for pension payments (now much more complete in terms of reported observations) is 16% larger for the hard budget constraint type enterprises, which would go against any argument suggesting Government is likely to sponsor companies with large pensions payments to make. In terms of productive capital, HBC companies possess 34.5% more, and they invest on average a staggering 82% more, than do the SBC firms.

It appears that the above analysis would provide a good background in order to justify policy change has actually taken place, in terms of the characteristics of companies that can obtain government aid versus those that cannot.

## IV.4 Estimation and Results

A general model concerning the relationship between the probability of a company being selected as a soft budget constraint type and its inherent characteristics is the framework we use here. Ultimately, one would also like to develop a model that provides us with a framework for testing whether rent-seeking behaviour accommodates the soft budget constraint, and also tests for whether SBC enterprise investment decisions and capital usage is less efficient than that of HBC enterprises. Unfortunately, the imbalance in sampling frequency of dependent and explanatory variables implies we can only identify general enterprise characteristics that go along with SBC-type. A possible way around this would be to employ an approach that more heavily weights those observations that appear have the largest distance from the enterprise average of that variable. Thus, one might pick up spikes in variables, such as large wage bills or investment levels, or low output levels, that might have precipitated state aid.

At this stage, the analysis is limited to identifying characteristics of enterprises that increase or decrease the likelihood of an enterprise receiving such aid. This is in and of itself a valuable pursuit, as it can highlight changes in Government policy vis-à-vis SOEs across different periods in time. Thus, I simply set out to model the likelihood of an enterprise receiving state aid via the use of core characteristics that are included in the literature. Hence, we estimate parameters for the various variables that accommodate the SBC, and establish whether these lend support to or reject our hypotheses concerning the soft budget constraint.

In a lognormal probit setting SBC-type, the binary variable that is our classifier of hard versus soft budget constraint enterprise, is regressed on various pertinent enterprise characteristics. Though only the most robust regressions are reported here, many regressions were attempted. The selection of the final parameters to be included was done using a statistical methodology of adding to the most significant variables other variables that came in as less significant by them selves. The reverse procedure was also employed, where all variables are included, and the least significant ones are then dismissed.

The results of these regressions are reported in Tables IV.4.1 and IV.4.2, with marginal effects calculated about the mean in Table IV.4.3 and for discrete changes from zero to unity for the dummy variables in Table IV.4.4. Columns (1) and (2) refer

to regression of the SBC-type of a firm in the 1985-1989 period on *Value added*, *Age*, *Capital*, and *Labour*. In the second regression dummy variables are added to capture industry and location effects. Similarly, columns (3) – (6) report the estimates for regressions that use the 1990-1994 SBC-type as dependent variable. The *Average Wage* level is added to the regressors in regressions (3) and (5), and the *Pension* bill is again added in regressions (4) and (6).

At this point one should note that the industry categories are no longer the original classification, but rather represent a reclassification into 8 generic industries, which are *Raw Materials*, *Consumer Goods*, *Textiles*, *Other Manufacturing*, *Chemicals and Plastics Machinery*, *Electrics*, and *Processed Raw Materials*. This step was undertaken in the interest rendering the interpretation of these characteristics more tractable. The base category for industry is *Raw Materials* and for province is *Jiangsu*.

We proceed by reporting the results for the 1985-1989 period. In Table IV.4.1 we see that, while value added appears significant at the 98% level in the late 1980s, the significance and magnitude of the coefficient on this variable is erased once location and industry are accounted for. Age is also not significant in this period. However, capital has a negative and significant coefficient of -0.11 and -0.08 in regressions (1) and (2), respectively. On the other hand, labour has a positive and significant coefficient estimate 0.21 and 0.28 in equation (1) and (2), respectively.

In Table IV.4.2 we note the estimate for the industry and region effects. In this earlier period it appears that consumer goods enterprises are slightly more likely to receive state aid, since its coefficient of 0.44 is significant at the 95% level, with the remainder of industry dummies remaining insignificant over raw materials industry enterprises. The regional dummies for Shanxi, -0.59, and Jilin, -0.42, are negative and significant at the 99% level. As for the pseudo $R^2$, it is reported as 0.013 in regression (1) and 0.0457 in regression (2).

The results of regressions (4) – (6) are somewhat different, and are highlighted in what follows. As evident from Table IV.4.1, *Value Added* and *Capital* are insignificant in regressions (3) – (6). *Age*, however, is negative and significant at the 99% level in all but regression (6), where it is significant at the 98% level. Its estimate is in lower than –0.22 in regressions in (3) and (5), and somewhat in excess of -0.2 in (4) and (6). Interestingly, the estimates on *Labour* in (4) and (6) are virtually identical to those in (1) and (2); the estimate is only 0.1 and 0.13 in (3) and (5), significant at

the 99% and 95% levels, respectively. The *Pension* coefficient is estimated as negative and significant at the 99% level in regressions (4) and (6); -0.14 and -0.15 respectively.

As for regional and industry effects, the results in Table IV.4.2 reveal negative estimates that are significant at the 99% level vis-à-vis Raw Materials for all but Consumer Goods and Plastics and Chemicals, which do not have significant, though positive, estimates. The regions of Sichuan and Jilin have positive and significant at the 99% level estimates vis-à-vis Jiangsu of about 0.47.

Discussion of the Results

Differences in the significance of coefficients on characteristics across time-periods provide us with evidence of policy switching. In essence, the source of lack of financial discipline can be thought of arising from two sources, a 'paternalistic' state, as in J. Kornai (1980), or information asymmetry and time-consistency problems, as outlined in Dewatripont and Maskin (1990). Kornai's paternalistic state is represented by 'policy decisions' about who should receive aid, whereas the information asymmetry and time-inconsistency argument is reflected in enterprise behaviours such as rent-seeking, given the enterprise is aware of the state's policy.

We note, that the significance of coefficients can be affected by the specification. This has been a feature of many of the preliminary regressions. Also, once industry and provincial dummies are included, one observes that some individual firm characteristics become insignificant.

The pervading feature across both periods and all specifications is that enterprises with large employment levels are much more likely to receive state aid. This corroborates theoretical considerations and general beliefs, as it is widely accepted that the industrial bureau has an interest in maintaining excessive employment at the expense of productive efficiency, given the demographic pressures at hand, also see Boycko, Schleifer and Vishny (1993).

Another feature that is of interest is the fact that age seems to have a negative impact on the likelihood of receiving state aid in the 1990 to 1994 period. Furthermore, while average wages never entered significantly in the 1985-1989 period, the latter period consistently marks them out as reducing the likelihood of receiving aid. Similarly, pension payments seem to have a negative association in this

period as well. This is contrary to much of the theoretical literature and other empirical research and, hence, noteworthy.

Perhaps, the lack of significance of so many variables that appear important ex ante is the most intriguing aspect of the analysis. The fact that bonuses, real value added, and capital or investment levels have no significance is contrary to all expectation. Even more drastic is the evidence that wage and pension payments actually provide evidence contrary to the hypothesis that large wage payments precipitate a softening of the budget constraint. This supports the notion that the Chinese authorities have attempted to reduce the level of abuse of the system that appeared endemic in SOEs'.

However, as outlined above, the difference in sampling frequency between explanatory and dependent variables is likely to diminish the impact of an idiosyncratic shock, due to a fall in output, or unusually high bonus or wage payments, or a sudden jolt in investment. Therefore, our analysis deals more with systemic features of SBC-type and disregards idiosyncratic shock. It may be feasible to bring the effect of idiosyncratic shocks on the likelihood of having received aid by weighting observations by the magnitude of a variables deviation form the mean value of that enterprise.

Furthermore, we do note a switch in policy. The pool of SBC enterprises in the late 1980s is by no means similar to that of the early 1990s. Another important point is that the sign and significance on the coefficients of many industry and provincial dummies change. This is indicative of the fact that the state selects enterprises it grants aid to on policy grounds, rather than on individual assessment.

In particular, enterprises in the poorer provinces of Shanxi and Jilin were 20% less likely to receive state aid in the late 1980s, whereas they were 20% more likely to receive aid compared to the wealthy Jiangsu province in the early 1990s. As for industries, enterprises producing consumer goods appear to have had a 15% greater chance of receiving aid over all others in the late 1980s. In the 1990s this contrast is exacerbated by the fact that, apart from those operating in raw materials and mining, and chemical and plastics, enterprises in other enterprises were 20% less likely to receive state aid at a statistically highly significant level, with enterprise in electrics were even 30% less likely to receive state aid.

## IV.5 Conclusion

To conclude this chapter, a summary of the findings is provided. This chapter began with a general outline of the literature on soft budget constrains. Many potential sources have been identified in this regard, but one may distinguish between exogenous, policy driven, sources, and endogenous sources. This analysis dealt mainly with the exogenous type, because of the fact that the sampling frequency between explanatory and dependent variables differs is the reason for this. Important to this contribution is the nature of the SBC-type marker: There was no need to estimate enterprise type, but rather we can take this as a given, since this is revealed by the information supplied by the manager. Summary statistics across the two periods indicated a lot of changing of type by enterprises. Furthermore, the characteristics of the enterprises in either SBC or HBC samples changed markedly.

The analysis lends support to the hypothesis that the likelihood a state owned enterprise has an ex post soft budget constraint is indeed linked to that enterprise's characteristics. The most persistent feature across both time periods is that enterprises with a large pool of labour are more likely to receive aid. This is entirely consistent with ex-ante expectation and confirms many statements from the literature.

Furthermore, the fact that industry and provincial dummies are highly significant implies that the granting of financial aid is indeed guided at a policy level. Indeed, the switch in sign of the coefficients across time-periods indicates that a policy change took place, which moved from subsidising the wealthier areas to providing aid to poorer regions. Thus, there may well have been a policy switch around 1989/1990. This is also suggested by reports of political reform emanating from China since the 1989 *Tiananmen* Square massacre.

The inclusion in the 1990s of enterprises engaged in raw materials, mining, plastics, and chemicals industries with those more favoured for state aid in the 1980s, namely those engaged in consumer goods, is interesting and may well indicate the authorities had an eye on developing these industries at that stage. This would appear justified given current hikes in commodity prices.

The fact that age appears to have a significantly negative impact on the likelihood of receiving state aid in the 1990s may imply that the state policy is to invest in more modern facilities, while allowing the older units to wind down.

Finally, enterprises with large pensions and wage bills were significantly less likely to receive state aid in the early 1990s. This finding stands in stark contrast to ex ante expectations about rent seeking being a central feature of SBCs, and may well give reason to suspect the authorities are attempting to reduce abuse of the system in these enterprises. It also suggests that using enterprise age as a proxy for the burden of pensions bills is flawed, as both are simultaneously significant.

**Table IV.3.1 Reform Status for Observations of the Hard Budget Constraint-Type, 1985-1989**

| Reform | Observations | Percentage Reformed |
|---|---|---|
| Output Autonomy | 1105 | 18 |
| Hiring/Firing Autonomy | 1105 | 6 |
| Import/Export Autonomy | 1105 | 7 |
| Short-Run Investment Autonomy | 1105 | 5 |
| Lon-Run Investment Autonomy | 1105 | 1 |
| Buy/Sell Autonomy | 1105 | 2 |

Notes: This table reports the total number of observations of the Hard Budget Constraint-type in the time-period 1985-1989 and the percentage of those observations that have undertaken reform of various types of operations, listed by row.

**Table IV.3.2 Reform Status for Observations of the Soft Budget Constraint-Type, 1985-89**

| Reform | Observations | Percentage Reformed |
|---|---|---|
| Output Autonomy | 2085 | 19 |
| Hiring/Firing Autonomy | 2085 | 7 |
| Import/Export Autonomy | 2085 | 5 |
| Short-Run Investment Autonomy | 2085 | 4 |
| Lon-Run Investment Autonomy | 2085 | 3 |
| Buy/Sell Autonomy | 2085 | 3 |

Notes: This table reports the total number of observations of the Soft Budget Constraint-type in the time-period 1985-1989 and the percentage of those observations that have undertaken reform of various types of operations, listed by row.

**Table IV.3.3 Reform Status for Observations of the Hard Budget Constraint-Type, 1990-94**

| Reform | Observations | Percentage Reformed |
|---|---|---|
| Output Autonomy | 1735 | 80 |
| Hiring/Firing Autonomy | 1735 | 60 |
| Import/Export Autonomy | 1735 | 51 |
| Short-Run Investment Autonomy | 1735 | 57 |
| Lon-Run Investment Autonomy | 1735 | 46 |
| Buy/Sell Autonomy | 1735 | 36 |

Notes: This table reports the total number of observations of the Hard Budget Constraint-type in the time-period 1990-1994 and the percentage of those observations that have undertaken reform of various types of operations, listed by row.

**Table IV.3.4 Reform Status for Observations of the Soft Budget Constraint-Type, 1990-94**

| Reform | Observations | Percentage Reformed |
|---|---|---|
| Output Autonomy | 1660 | 82 |
| Hiring/Firing Autonomy | 1660 | 59 |
| Import/Export Autonomy | 1660 | 53 |
| Short-Run Investment Autonomy | 1660 | 63 |
| Lon-Run Investment Autonomy | 1660 | 48 |
| Buy/Sell Autonomy | 1660 | 37 |

Notes: This table reports the total number of observations of the Soft Budget Constraint-type in the time-period 1990-1994 and the percentage of those observations that have undertaken reform of various types of operations, listed by row.

**Table IV.3.5 Summary Statistics for Hard Budget Constraint-Type Enterprises, 1985-1989**

| Variable[a] | Observations | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Age | 1105 | 26.43 | 12.08 | 5 | 76 |
| Value Added | 1034 | 1675.35 | 2402.4 | 0 | 21036.17 |
| Capital | 1016 | 1726.42 | 2754.15 | 26.259 | 23932.81 |
| Investment | 1093 | 241.8 | 529.45 | 0 | 7227.43 |
| Labour | 1088 | 1431.6 | 1561.88 | 0 | 10252 |
| Wages | 1105 | 163.86 | 295.19 | 0 | 4024.39 |
| Bonuses | 1105 | 32.5 | 50.17 | 0 | 560.39 |
| Average Wage | 1087 | 0.105 | 0.075 | 0 | 1.06 |
| Average Bonus | 1087 | 0.021 | 0.013 | 0 | 0.15 |
| Bonuses in Wages | 1096 | 19.98 | 90.61 | 0 | 54.54 |

Notes: This table reports the summary statistics for key variables of enterprises of the Hard Budget Constraint-Type in the period from 1985-1989.

[a] All Variables are in 10,000Yuan, with the exceptions of 'Age' (years), 'Labour' (number of employees), and 'Bonuses in Wages' (percentage of bonuses in total wage bill).

**Table IV.3.6 Summary Statistics for Soft Budget Constraint-Type Enterprises, 1985-1989**

| Variable[a] | Observations | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Age | 2085 | 27.48 | 13.28 | 5 | 83 |
| Value Added | 1941 | 2132.57 | 3939.8 | 0 | 79390.58 |
| Capital | 1882 | 2025.1 | 4118.72 | 20.766 | 39294.35 |
| Investment | 2082 | 286.31 | 718.75 | 0 | 12332.74 |
| Labour | 2085 | 1822.32 | 2800.7 | 0 | 37801 |
| Wages | 2085 | 190.52 | 309.1 | 0 | 3929.7 |
| Bonuses | 2085 | 38.3 | 62.5267 | 0 | 626.01 |
| Average Wage | 2084 | 0.101 | 0.05 | 0 | 1.12 |
| Average Bonus | 2084 | 0.02 | 0.017 | 0 | 0.358 |
| Bonuses in Wages | 2073 | 20.23 | 9.87 | 0 | 61.99 |

Notes: This table reports the summary statistics for key variables of enterprises of the Soft Budget Constraint-Type in the period from 1985-1989.

[a] All Variables are in 10,000Yuan, with the exceptions of 'Age' (years), 'Labour' (number of employees), and 'Bonuses in Wages' (percentage of bonuses in total wage bill).

**Table IV.3.7 Summary Statistics for Hard Budget Constraint-Type Enterprises, 1990-1994**

| Variable[a] | Observations | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Age | 1735 | 33.34 | 13.47 | 10 | 88 |
| Value Added | 1635 | 2593.24 | 4212.03 | -1147.14 | 47384.59 |
| Capital | 1600 | 2547.51 | 4223.574 | 43.81503 | 53377.31 |
| Investment | 1388 | 259.7 | 761.4324 | 0 | 10742.4 |
| Labour | 1730 | 1676.99 | 1893.418 | 103 | 14738 |
| Wages | 1735 | 211.78 | 290.77 | 12.1708 | 5368.621 |
| Bonuses | 1710 | 61.35 | 88.468 | 0 | 839.367 |
| Average Wage | 1730 | 0.124 | 0.062 | .01155 | 1.7771 |
| Average Bonus | 1705 | 0.035 | 0.02 | 0 | 0.12758 |
| Bonuses in Wages | 1710 | 28.62 | 14.55 | 0 | 78.23 |
| Pension Bill | 1665 | 88.045 | 187.183 | 0.87 | 2782 |

Notes: This table reports the summary statistics for key variables of enterprises of the Hard Budget Constraint-Type in the period from 1990-1994.

[a] All Variables are in 10,000Yuan, with the exceptions of 'Age' (years), 'Labour' (number of employees), and 'Bonuses in Wages' (percentage of bonuses in total wage bill).

**Table IV.3.8 Summary Statistics for Soft Budget Constraint-Type Enterprises, 1990-1994**

| Variable[a] | Observations | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Age | 1660 | 30.69 | 12.24 | 10 | 82 |
| Value Added | 1555 | 2718.97 | 5985.13 | -52516.5 | 64969.96 |
| Capital | 1450 | 3462.11 | 8064.09 | 20.071 | 89000.62 |
| Investment | 1328 | 472.5 | 3063.03 | 0 | 60736.24 |
| Labour | 1660 | 2100.73 | 3860.27 | 108 | 38921 |
| Wages | 1660 | 252.83 | 556.03 | 11.406 | 6675.2 |
| Bonuses | 1655 | 72.79 | 187.8 | 0 | 2020.11 |
| Average Wage | 1660 | 0.12 | 0.196 | 0.0204 | 7.61 |
| Average Bonus | 1655 | 0.03 | 0.021 | 0 | 0.2283 |
| Bonuses in Wages | 1655 | 29.47 | 13.88 | 0 | 100 |
| Pension Bill | 1582 | 76.36 | 149.55 | 1 | 1900 |

Notes: This table reports the summary statistics for key variables of enterprises of the Soft Budget Constraint-Type in the period from 1990-1994.

[a] All Variables are in 10,000Yuan, with the exceptions of 'Age' (years), 'Labour' (number of employees), and 'Bonuses in Wages' (percentage of bonuses in total wage bill).

**Table IV.4.1 Probit Regression of Soft Budget Constraint-Type on Significant Company Characteristics**

| | (1) SBC90 | (2) SBC90 | (3) SBC95 | (4) SBC95 | (5) SBC95 | (6) SBC95 |
|---|---|---|---|---|---|---|
| Constant | -1.0*** (0.25) | -0.94*** (0.31) | -0.67* (0.32) | -1.1*** (0.35) | 0.11 (0.36) | -0.31 (0.4) |
| Value Added | 0.08** (0.03) | -0.001 (0.03) | -0.04 (0.02) | -0.03 (0.02) | 0.01 (0.03) | 0.015 (0.03) |
| Age | 0.04 (0.05) | 0.04 (0.05) | -0.25*** (0.06) | -0.19*** (0.06) | -0.22*** (0.07) | -0.16** (0.07) |
| Capital | -0.11*** (0.04) | -0.08* (0.04) | 0.003 (0.03) | -0.0003 (0.04) | -0.05 (0.04) | -0.06 (0.04) |
| Labour | 0.21*** (0.05) | 0.29*** (0.06) | 0.13*** (0.05) | 0.25*** (0.06) | 0.1* (0.06) | 0.23*** (0.07) |
| Average Wage | - | - | -0.37*** (0.08) | -0.27*** (0.08) | -0.17* (0.08) | -0.05 (0.09) |
| Pension | - | - | - | -0.14*** (0.04) | - | -0.15*** (0.04) |
| Industry Dummies | No | Yes | No | No | Yes | Yes |
| Provincial Dummies | No | Yes | No | No | Yes | Yes |
| Pseudo $R^2$ | 0.013 | 0.0457 | 0.016 | 0.02 | 0.0485 | 0.0485 |
| Observations | 2656 | 2618 | 2804 | 2684 | 2804 | 2804 |

Notes: SBC90 & SBC95 are the dependent variables of probit regressions. Thus, these variables take the value zero if the enterprise received significant state aid in the five years prior to 1990 (for SBC90) or 1995 (for SBC95), and one otherwise. Each column, (1) – (6) denotes a regression of these limited dependent variables on the regressors, the coefficient estimates of which are reported in the rows of the table. Numbers in brackets denote the standard error associated with the estimates for the regression coefficients. Levels of statistical significance of the coefficients are indicated by the number of asterisks: rejection of the $H_0$: 'Coefficient is equal to zero' at the ***99% level, **98% level, *95% level.

**Table IV.4.2 Estimates of Coefficients on Industry and Provincial Dummy Variables**

| | (1) SBC90 | (2) SBC90 | (3) SBC95 | (4) SBC95 | (5) SBC95 | (6) SBC95 |
|---|---|---|---|---|---|---|
| | | | *Industry Dummies* | | | |
| Raw Materials[a] | - | - | - | - | - | - |
| Consumer Goods | - | 0.44* (0.2) | - | - | -0.25 (0.17) | -0.15 (0.18) |
| Textiles | - | -0.07 (0.17) | - | - | -0.57*** (0.15) | -.55*** (0.15) |
| Other Manufacturing | - | 0.15 (0.2) | - | - | -0.38* (0.18) | -0.45** (0.19) |
| Chemicals & Plastics | - | -0.02 (0.17) | - | - | -0.29 (0.15) | -0.26 (0.15) |
| Machinery | - | 0.05 (0.16) | - | - | -0.4*** (0.14) | -0.41*** (0.15) |
| Electric | - | -0.13 (0.18) | - | - | -0.89*** (0.16) | -0.88*** (0.16) |
| Processed Materials | - | 0.05 (0.17) | - | - | -0.51*** (0.15) | -.54*** (0.15) |
| | | | *Provincial Dummies* | | | |
| Jiangsu[b] | - | - | - | - | - | - |
| Sichuan | - | 0.04 (0.08) | - | - | 0.46*** (0.08) | 0.47*** (0.08) |
| Shanxi | - | -0.59*** (0.08) | - | - | 0.15 (0.08) | 0.15 (0.08) |
| Jilin | - | -0.42*** (0.07) | - | - | 0.47*** (0.07) | 0.52*** (0.07) |

Notes: As in Table IV.4.1. Explanatory variables are dummy variables.
[a]Raw Materials and Mining is the default category for industry dummy variables
[b]The province of Jiangsu is the default category for provincial dummy variables.

**Table IV.4.3 Marginal Results of the Probit Regression of Soft Budget Constraint-Type on Significant Company Characteristics**

| | (1) SBC90 | (2) SBC90 | (3) SBC95 | (4) SBC95 | (5) SBC95 | (6) SBC95 |
|---|---|---|---|---|---|---|
| Value Added | 0.03** | -0.0003 | -0.015 | -0.01 | 0.003 | 0.006 |
| | (0.01) | (0.013) | (0.01) | (0.01) | (0.011) | (0.01) |
| Age | 0.016 | 0.013 | -0.1*** | -0.07*** | -0.09*** | -0.064** |
| | (0.02) | (0.02) | (0.024) | (0.03) | (0.02) | (0.03) |
| Capital | -0.04*** | -0.03* | 0.001 | -0.0001 | -0.019 | -0.02 |
| | (0.01) | (0.01) | (0.14) | (0.014) | (0.015) | (0.016) |
| Labour | 0.07*** | .11*** | 0.05*** | 0.1*** | 0.04* | 0.1*** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.026) |
| Average Wage | - | - | -0.14*** | -0.11*** | -0.07* | -0.02 |
| | | | (0.03) | (0.03) | (0.03) | (0.03) |
| Pension | - | - | - | -0.05*** | - | -0.06*** |
| | | | | (0.154) | | (0.015) |
| Industry Dummies | No | Yes | No | No | Yes | Yes |
| Provincial Dummies | No | Yes | No | No | Yes | Yes |
| Pseudo $R^2$ | 0.013 | 0.0457 | 0.016 | 0.02 | 0.0485 | 0.0485 |
| Observations | 2656 | 2618 | 2804 | 2684 | 2804 | 2804 |

Notes: SBC90 & SBC95 are the dependent variables of probit regressions. Thus, these variables take the value zero if the enterprise received significant state aid in the five years prior to 1990 (for SBC90) or 1995 (for SBC95), and one otherwise. Each column, (1) – (6) denotes a regression of these limited dependent variables on the regressors, the coefficient estimates of which are transformed and reported are the marginal effects, calculated around the mean. Numbers in brackets denote the standard error associated with the estimates for the regression coefficients. Levels of statistical significance of the coefficients are indicated by the number of asterisks: rejection of the $H_0$: 'Coefficient is equal to zero' at the ***99% level, **98% level, *95% level.

**Table IV.4.4 Estimates Marginal Values of Coefficients on Industry and Provincial Dummy Variables for discrete Changes from Zero to Unity**

| | (1) SBC90 | (2) SBC90 | (3) SBC95 | (4) SBC95 | (5) SBC95 | (6) SBC95 |
|---|---|---|---|---|---|---|
| | | | *Industry Dummies* | | | |
| Raw Materials[a] | - | - | - | - | - | - |
| Consumer Goods | - | 0.15* (0.07) | - | - | -0.1 (0.06) | -0.06 (0.07) |
| Textiles | - | -0.03 (0.07) | - | - | -0.22*** (0.05) | -0.21*** (0.05) |
| Other Manufacturing | - | 0.05 (0.07) | - | - | -0.15* (0.06) | -0.17** (0.07) |
| Chemicals & Plastics | - | -0.01 (0.06) | - | - | -0.11 (0.06) | -0.1 (0.06) |
| Machinery | - | 0.02 (0.06) | - | - | -0.15*** (0.06) | -0.16*** (0.06) |
| Electric | - | -0.05 (0.07) | - | - | -0.31*** (0.05) | -0.31*** (.05) |
| Processed Materials | - | 0.02 (0.06) | - | - | -0.2*** (0.05) | -0.2*** (0.05) |
| | | | *Provincial Dummies* | | | |
| Jiangsu[b] | - | - | - | - | - | - |
| Sichuan | - | 0.0003 (0.03) | - | - | 0.18*** (0.03) | 0.19*** (0.03) |
| Shanxi | - | -0.2*** (0.03) | - | - | 0.06 (0.03) | 0.06 (0.03) |
| Jilin | - | -0.18*** (0.03) | - | - | 0.19*** (0.03) | 0.2*** (0.02) |

Notes: As in Table IV.4.1. Explanatory variables are dummy variables. The marginal values are calculated for discrete changes in the dummies from zero to unity.
[a]Raw Materials and Mining is the default category for industry dummy variables.
[b]The province of Jiangsu is the default category for provincial dummy variables.

# V. The Effect of Autonomy in Hiring and Firing on Bonus Payments

## V.1 Introduction

This chapter reinvestigates the issue of payments of wage bonuses being linked to productivity in Chinese state-owned enterprises. In a previous analysis of the issue, Groves et al. (1994) analyse initial labour market reforms and provide weak evidence for the existence of efficiency wages in Chinese state-owned enterprises in a sample of 769 Chinese SOEs in the period from 1980 to 1989. In this study a dataset is used, which is comprised of a subset of those enterprises, 680 units remain, for the five years that follow, 1990 to 1994. Similar to Groves et al. (1994), the results of the initial analysis do indeed suggest that the percentage of wages paid out in bonuses moves with value added in a statistically significant sense. However, the focus of our analysis is to deal with two caveats that render the analysis of the relationship among bonuses and productivity in Chinese SOEs in the early 1990s somewhat difficult:

- First, one must consider the impact of structural changes in the labour market, such as the introduction of managerial autonomy in hiring and firing, since such may alter the perception of the value of bonuses, or affect the wage bargaining process.
- Second, one must take account of endogeneity among productivity and wage bonuses. A possible way of dealing with this caveat is to instrument for the wage bonus variable.

The first objective of this chapter, then, is to show how a change in the structure of the labour market, via the introduction of firm-level managerial autonomy in hiring and firing decisions, affects the relationship among productivity levels and bonus payments, which may have been inefficiently allocated hitherto. In the analysis of Groves et al. (1994) this important stage of labour market reform was not considered and was only beginning to be introduced at the end of the period they considered.

The second objective of this chapter is to deal with the problem of endogeneity. If endogeneity exists among the variables to be examined, conclusions regarding the direction of causality and nature of the relationship may be flawed. When analysing

the effect of bonuses on productivity one encounters the difficulty that bonuses and wages tend to move with value added. Unfortunately, it is not clear which way causality runs. Naturally, it may be that bonuses are employed in order to motivate workers to deliver more effort, thus to obtaining higher levels of output for any amount of labour employed. Conversely, wages and bonuses may represent that part of economic rent obtained that is shared with employees. In the former scenario we are dealing with efficiency wages, whereas the latter scenario is described as rent sharing.

A shortcoming in this analysis is that we have not modelled the selection process underlying to this reform, thus risking some bias. Unfortunately, it is not at all clear what the selection process is, and hence modelling it as exogenous would minimise the ex ante expected bias. Thus, this analysis is very similar to the one conducted by Groves et al. (1994).

The conclusions of this chapter are twofold: Once the right to hire and fire is granted at the managerial level we observe a severe reduction in the significance of the positive relationship among bonuses and productivity is registered. This is indicative of a change in bargaining power in wage negotiations. Furthermore, once this is taken into account, the empirical results imply significant productivity improvements that accrue due to this reform process. In terms of the *carrot and stick* allegory of how to motivate a mule to move, the carrot was over-employed as an incentive, whereas the stick was not used enough. As the stick is employed more often, one finds less need to use a carrot. There is a shift away from pure rewards for working, to punishment for not working.

Furthermore, if wages are instrumented for, thus attempting to account for endogeneity, the relationship among productivity and bonuses disappears, unless the structural changes due to reform in the right to hire and fire is taken into account. Our conclusion is that bonus payments in Chinese state-owned enterprises are simply that part of economic rent, which accrues to the labour force, i.e. is shared, given that evidence to the contrary is weak. In fact, significant supporting evidence in favour of the concept of efficiency wages in Chinese SOEs survives only if hiring and firing decisions at the managerial level are taken into account.

The remainder of this paper is structured as follows. The following section briefly recounts the evolution of labour-related reforms in Chinese state-owned enterprises. Section V.3 provides summary statistics relevant to our analysis of wage-

bonuses. Then, the recipient is provided with the framework employed to test our hypotheses regarding bonus payments. Section V.5 relates the results of our regressions. Section V.6 draws the conclusions that might be drawn from this investigation into bonus payments in Chinese SOE that are engaged in important structural reform in the labour market. Sections V.7 and V.8, respectively, provide tables and figures referred to in the text.

## V.2 The Evolution of Labour Market Reforms in Chinese SOEs

The aim of this section is to briefly recount the evolution of labour market reforms in China, as related in the literature on this subject. It is against this backdrop that the analysis is couched, and it acts as a motivator for the particular model chosen for the empirical analysis. The main aspects are the use of wage bonuses and managers' right to hire and fire employees.

Groves et al. (1994) take a very positive view of what were tentative and partial labour market reforms. In particular, they examine two elements of the labour market, namely the use of bonuses in wages and the employment of fixed-term contract workers. While they provide strong evidence that firms make use of their right to pay bonuses out of retained profits, they fail to supply convincing evidence that bonuses effected efficiency gains at the enterprise level. Furthermore, they admit that, even though they attempt to control for endogeneity, two-way causality is an important issue. Thus, they cannot effectively determine whether bonuses bring about measurable productivity improvements, i.e. they are efficiency wages, or whether more productive firms can afford to share, in the form of bonuses, a larger economic rent.

With respect to the use of fixed-term contracts, as opposed to the regular form of SOE permanent employment with secure pension rights, they do find strong evidence in favour of a link between productivity and the use of this form of employment. However, the use of fixed-term contracts is very limited in their sample, when compared to overall employment levels, and hence, this reform can only be viewed as marginal. Fundamentally, it is a mere preparatory framework for the cataclysmic reform analysed in this section, namely the introduction of the possibility of terminating any employees contract at any time. Evidence of large scale hiring and

firing in state-owned enterprises in the 1990s is rife, as it has had severe social effects for many regions.

Another important point regarding wages and bonuses in Chinese SOEs is that it is most likely that SOE workers were 'bonus-sharing'. Coady and Wang (2000) provide strong supporting evidence for this, by summarising a survey of the legal and contractual framework for a good many of SOE wage setting agreements. The authors recount that fixed wages are largely determined by seniority and job-title, in a multi-tiered structure. Furthermore, bonuses are divided up in a similar, though more egalitarian, fashion. Thus, bonuses are largely linked to group performance, rather than to individual merit, although they do admit there is a small degree of individual reward. Thus, *common pool* problems would persist to a large extent.

Also, bonuses in the eighties grew at a rate that clearly outpaced enterprise performance enhancement. This points to clear attempts at rent seeking. The fact that the central government passed a law in the late eighties dictating that wage bonuses should only increase at a rate commensurate with productivity gains is a strong signal that bonuses were *de facto* abused as a rent-seeking device. (Naughton, 1995) A final fact, that underscores our interpretation of employment relations in Chinese SOEs and is central to our analysis, is that SOE workers, generally speaking, were very difficult to fire:

> "[By 1989 little] attempt was made, however, to introduce factor markets in the state-enterprise sector." In fact, "firms continued to complain about being compelled to employ excess workers, and workers could not leave without permission." (Gordon and Lee, 1991)

## V.3 Summary Statistics

This section provides the summary statistics of variables used in this particular analysis of bonuses and autonomy in hiring and firing. As indicated in the preceding section, observations prior to 1990 are omitted. This is entirely due to rational considerations and by no means arbitrary.

To begin with, the evidence supplied in Groves et al. (1994) is quite weak and, furthermore, firms' right to hire and fire workers only emerges very late, though explosively, in the 1980s, see Figure V.3.1. A mere 250 observations in the 1980-

1989 series had the autonomy to hire and fire, versus 6550 observation that did not. Thus, Groves et al. could not control for this important and final aspect of labour market reform. It is likely that the absence of such autonomy would lead to a stark distortion in wage allocation, given the thereby relatively unchallenged bargaining power held by employees, and an apparent lack of disciplining power held by managers when they observe shirking. In this study, the managerial right to hire and fire is controlled for at the firm level over time, as this should affect employer and employee bargaining power. This hypothesis is backed by results obtained in regressions, provided below.

The main reason for not including the years from 1980 to 1989 in this study, however, is the plain fact that the bonus variable of the data we use in our empirical analysis in the 1990s' series is not consistent with the bonus variable reported in that of the 1980s.

The summary statistics of this sub-sample are reported in Tables V.3.1. The 680 firms that remain in this sample are on average 30 years old in 1990. They deliver a mean of 29,698,810 Yuan worth of value added, while valuing their productive capital stock at 33,617,990 Yuan, on average. Heterogeneity in these variables is large across enterprises, since the standard deviation for each is well in excess of three times the size of the mean value. In terms of number of employees, these firms have a mean of 1,949 people working for them, with a standard variation less than twice that value. These employees earn an average per worker wage and bonus of 1,226 and 340 Yuan, respectively. The average percentage of bonuses in the total wage package over the years 1990 to 1994 is 29%. However, this value varies largely across firms and over time.

Table V.3.2 reports the annual evolution of the average percentage of wages paid out in bonuses and the percentage of enterprises with autonomy in hiring and firing of workers is reported in Table V.3.3. The persistently gradual fall in the percentage of bonuses in overall wages is noteworthy: beginning with 32% in 1990, this figure falls to 25% in 1994, which reflects a gradual decline by about 1.5 – 2% per annum; This is also evident from Figure V.3.1., where the annual average percentage of bonuses in wages is plotted against time.

Interestingly, as evident from Table V.3.3 and Figure V.3.2, one observes a similarly steady adoption rate of autonomy in hiring and firing over these years, which only tapers off in 1994. In 1990, 36% of enterprises had the right to hire and

fire, which increases at an annual rate of between 8 and 13% until 1993, followed by a meagre increase of three percent in 1994, culminating in 70% of enterprises in our sample reporting autonomy with respect to hiring and firing employees. Thus, these variables appear to be moving steadily in opposite directions.

This offers mild encouragement for the hypothesis that the proportion of wages paid out in bonuses may be decreasing due to increased bargaining power of enterprises, as the *iron rice-bowl* is broken, and workers have reduced employment security vis-à-vis their managers.

## V.4 The Model

This section conveys the framework within which the hypothesis that bonuses are indeed used in the sense of efficiency wages is tested against the alternative hypothesis that they have largely been abused as a rent-sharing device. Essentially, the focus is on the effect the decentralisation of decisions regarding the hiring and firing of employees, from a central authority to the management level of the enterprise, has had on the relationship between enterprise performance and bonus payments. What is the effect on output generated by the introduction of the possibility of hiring and firing workers into an environment where this was hitherto largely determined by state decree? Equally important to our analysis is the issue of how the introduction of managerial autonomy in hiring and firing affects the wage bargaining process.

> "It is a commonplace in industrial relations that a wise firm uses wages as an instrument to 'recruit, retain and motivate' its workers. It does not passively pay some going wage, but actively adopts that wage which maximises profits." (Layard, et al., 1991)

According to Groves et al. (1994) the introduction of performance-linked bonuses in SOEs has had a limited positive effect on productivity, which is evidence for the idea that factor markets have been far from perfect under central planning, where creating employment in order to maintain social stability was the goal, rather than profit-maximisation. The fact that workers could not be fired implied that, while bonuses may have induced some effort, fear of unemployment was not an issue.

Hence, efficiency gains should be possible if uncertainty regarding employment is introduced, since workers will value their position more. Also, the decentralisation of hiring and firing decisions from a central and politically motivated authority to the managerial level implies that the threat of job-loss, or loss of access to bonuses, becomes real. The autonomy regarding employment decisions in SOEs emerged gradually over the late 1980s and became more widespread in the early 1990s. With the introduction of this right, managers gained a disciplining device over workers, where they could choose to punish workers for lack of effort, rather than having only the option of creating incentives for providing effort. Hence, the value of both basic wages and bonuses should rise, as the threat of losing either becomes credible. Effort levels should rise for every level of bonuses and wages, and by the same token, the use of this threat may lead to a decrease in the use bonuses as a motivator.

Thus, it appears that a natural model suited to this analysis is given by the models on efficiency wages, which take into account the effect of paying above average wages and the unemployment levels, or threat of likely long-term loss of access to wages, as factors affecting the level of effort supplied by a worker. As regards wages:

> "One function is to hire labour and the other is to create incentives that reduce efficiency costs." (Konings & Walsh, 1993)

Three reasons are usually given for the positive effect above market wages may have on productivity (Layard, 1991).

- Higher wages may increase a workers' identification with his employer and, hence, his general willingness to co-operate with his employer.
- They might discourage individual shirking, by having the worker facing a greater loss if he were caught shirking and fired.
- Higher wages could discourage collective disruption, including the danger of union organisation (the 'threat effect').

I shall focus on the second argument in this analysis.

> "Wages are higher, the lower is the unemployment rate and the chance of being caught - and the higher the required effort." (Layard, et al., 1991)

This analysis views the introduction of firm-level autonomy in hiring and firing not only as the introduction of employment related uncertainty, but also as a factor that enhances the credibility of threats to workers who are observed shirking. Although there was virtually no recorded unemployment in China by 1994, the potential job loss will be perceived as a real threat if remuneration levels are high enough in relation to the outside option. By the same token, the loss of bonuses due to an observed lack of effort will increase the cost of shirking, where non-performance related wages are the outside option. Hence, if there is no possibility of job loss, then the elasticity of output with respect to wages should be lower, i.e. one has to pay a lot for an increase of productivity. However, the introduction of uncertainty regarding employment should increase the elasticity of output with respect to wage. In this sense, if there exist decreasing returns to marginal increases in wage payments, then it should be that a marginal increase in productivity requires increasingly large increases in wages.

On the other hand, if jobs are entirely secure, there should exist increasing returns to introducing any level of uncertainty regarding employment. Therefore, it may be that, in a scenario where bonuses have been inefficiently high, a further increase in bonuses by itself may cease to affect output in any significant form. The introduction of employment related uncertainty would change this; the responsiveness of effort for any given level of remuneration above market rates may then increase at a substantial rate.

> "If wages are very high, workers will value their job for two reasons: (a) the high wages themselves, and (b) the correspondingly low level of employment. (due to the low demand for labour at high wages)." (Shapiro & Stiglitz, 1984).

> "Hence these models predict that any variables which raises the cost of job loss will also raise productivity." (Wadhwani & Wall, 1991)

> "Thus unemployment works as a 'worker-disciplining' device" (Layard, et al., 1991)

The fact that high relative wages are associated with higher levels of productivity may just reflect the existence of either unobserved human capital characteristics or rent sharing. Therefore it is important to control for this reverse causality. In what follows a model is developed that may be used to analyse the effect the introduction of a marked risk of unemployment may have on output and the link among wage bonuses and productivity. It is an adaptation of a model used by Wadhwani and Wall (1991).

Consider the following Cobb-Douglas production function:

$$(1)\quad Y_{it} = A_i K_{it}^{\alpha} L_{it}^{\beta} e^{\phi(t)}$$

The subscript *it* denotes enterprise *i* in year *t*, $Y_{it}$ is value added, $K_{it}$ is the value of fixed assets for production, $L_{it}$ is the number of employees, $\varphi_t$ time effects that are common to all firms, and $A_i$ is a firm-specific fixed effect, designed to capture a plethora of possible reasons (which may be unobservable) why one enterprise may be more productive than another from the outset. This specification attributes productivity growth to increased utilisation of existing labour and capital, since labour and capital are measured by what the enterprise has in place, as well as firm-specific fixed effects, $A_i$.

If effort levels are introduced in a labour-augmenting way, then $L_{it}$ can be replaced by $(e(.)L_{it})exp(\beta)$, where $e(W_{it}/W_{it}^*, R_{it})$ is effort supplied, which depends on relative wages, $W_{it}/W_{it}^*$, and also on the probability of losing access to these wages for failing to provide effort, which in our analysis enters only once managers have the autonomy to hire and fire, and is given by $R_{it}$, which is equal to one when autonomy in hiring and firing is achieved. In this analysis it is assumed that this effect can be measured by an increase in the effect of relative wages on real value-added for the time after autonomy in hiring and firing was acquired.

Specifically, it will be assumed that the effort supply function takes the form:

$$(2)\quad e(.) = -a + b\left(\frac{W_{it}}{W_{it}^*}\right)^{\Psi}\left(\frac{W_{it}|R=1}{W_{it}^*|R=1}\right)^{\kappa}$$

Thus, $W_{it}$ are performance related wages paid by firm $i$ at $t$, and $W_{it}$* are the outside wage option, i.e. in this setting they can be interpreted as non-performance related fixed wages.

If equation (2) is substituted into (1), and a log-linear transformation is performed, the contribution made by the term *(e(.)L)exp(β)* is approximately

$$(3)\ \beta \ln L + \lambda_1 \ln\left(\frac{W_{it}}{W_{it}^*}\right) + \lambda_2\left(\frac{W_{it}|R=1}{W_{it}^*|R=1}\right)$$

Thus, output will be affected not only by the level of labour employed, but also by effort supplied. Effort will increase with the feeling that one actually has something to lose, i.e. payments above market rate, as well as increases in the probability of this loss occurring due to performance-related factors. Clearly, the probability of incurring a loss due to performance related factors rises substantially once the manager has the autonomy to hire and fire workers according to the needs of the enterprise and employee performance. Thus, until such autonomy is achieved, what is not certain is just the bonus component of wages. However, after autonomy is achieved, it is the entire part of the wage package above market wages that may be lost. Indeed, here we find a unique setting under which the importance of outside options is with respect to the efficiency wages, since uncertainty approaches zero prior to autonomy, and hence we actually appear to have a laboratory-type experimental set-up, with which can be used to test theory.

Inside this framework one assumes that output is increasing in $W_{it}/W_{it}$*, but decreasingly so. Furthermore, any rise in the prospect of loss of higher wages should increase effort levels in the margin, also decreasingly so. Thus, the elasticity of output with respect to bonuses should be decreasing in bonuses. Firms without the managerial autonomy to hire and fire must employ ever-increasing increments in effort-inducing wages for relatively lesser gains in performance. We assume implicitly, that the relocation of the level of decision making from the centre to the manager will not affect technology in the short-run. Once the reform is introduced, two effects may be measured:

- The threat of disciplining workers should be larger for firms that have autonomy in hiring and firing, thus increasing effort, and hence efficiency and output, for any level of bonuses.
- To the extent that bonuses were over-employed in a pre-autonomy environment, one should notice a post-autonomy reduction in these vis-à-vis any level of output.

## V.5 Estimation and Results

In what follows, the results from testing our hypothesis of higher wages effecting higher levels of value added, as well as that of the autonomy in hiring and firing having a negative impact on the relationship between bonuses and real value-added are presented. The first set of results reported refer to a naïve model, from which a link among wage bonuses and real value added is evident. We then proceed by augmenting this model by allowing for a structural change in the labour market, captured by a dummy variable equal to one from that point in time on that managers have autonomy in hiring and firing decisions, to affect value added by itself. The next step is to allow this change in the labour market to affect the relationship between value added and wage bonuses, by including a variable that is an interaction term among the percentage of bonuses in wages and the reform dummy.

Next, we proceed by addressing the issue of endogeneity among the bonus variable and productivity by instrumenting for bonuses. Three sets of instruments are generated by using the predicted values of wage bonuses from three regressions of this variable on its lagged values and average wages. The three regressions are OLS, and GLS random and fixed effects. We then repeat the above analysis by substituting the instruments for wage bonuses.

What we conclude from the results of these regressions is that there is evidence for a change across hiring and firing regime in bonus allocation and productivity levels. Furthermore, the results reported here do not lend significant support the hypothesis that increased bonuses induce increased levels of productivity.

To begin with, a simple production function approach is implemented, where real value-added is a stochastic log-linear function of productive fixed capital and labour. All regressions that follow include time-dummies, which are statistically significant throughout. Furthermore, all regressions that are not of the fixed-effect

GLS within estimator class include industry and provincial dummies. All provincial, and a large proportion of the industry dummies are of considerable statistical significance, and hence it appears the decision to include them is well founded, not just on ex-ante economic considerations, but also on statistical grounds.

The results reported in columns (1) – (3) in Table V.5.1.are the output from regressing value-added on factor inputs, beginning with an OLS estimator, and then employing panel techniques, i.e. GLS estimators. One should note that in the OLS estimator case, the coefficient on labour is 0.71, with a t-statistic of 21.28, and that of productive capital is 0.35, with a t-statistic of 14.7. The R-squared is reported as 0.63. In regression (2) the coefficient on the labour variable has decreased to 0.63, with a t-statistic of .04. The coefficient on productive capital has increased to .4, with a t-stat of 13.01. As for the fixed effects estimator, the coefficient on labour is lower again, .51, with a significantly reduced t-statistic of 7.29. The coefficient on productive capital remains similar, at .4, but is also somewhat less significant than in the previous regressions. The Overall R-squared is lower for the fixed-effects regression when compared to the random effects estimator.

Regressions (4) and (5) add the labour reform dummy into the production function. While there is no marked change in the estimates of labour or capital variables, the coefficients on the dummy are small and insignificant, which implies that there appears to be no intercept-shifting effect of this reform.

Then, a modified log-linear production function approach is implemented, which incorporates the percentage of bonuses in total wages. This setting tests for efficiency wages under the hypothesis that they exist. Thus, the effect of bonuses on efficiency would form part of the error term in a model that would not incorporate these:

$$(4)\ y_{it} = \alpha_i + \varphi_t + \beta_{ind} I + \beta_{\Pr ov} P + \beta_k k_{it} + \beta_l l_{it} + \beta_{bw} bw_{it} + \varepsilon_{it}\,.$$

The log of value added, $y_{it}$, is a linear function of the log of productive capital, $k_{it}$, the log of labour, $l_{it}$, and bonuses relative to wages, $bw_{it}$; $\varepsilon_{it}$ is the stochastic error term, with standard assumptions, $\varphi_t$ represent time dummies, and $I$ and $P$ are industry and province dummies, respectively.

Table V.5.2 reports the results of the regressions implied by equation (4). The results, reported in columns (6) and (7), show that adding $bw_{it}$ to the initial

production function leave previous estimates for the logs of capital and labour, as well as the R-squared, unchanged. However, the coefficient on $bw_{it}$ is positive in the random- and fixed-effects models, .26 and .31, respectively. Furthermore, the t-statistics above the value of two point to their statistical significance.

As indicated above, this does not account for structural changes in the labour market, nor does it for endogeneity. In columns (8) – (11) of Table V.5.2 results of regressions are reported that are to capture the effect of this structural change. Endogeneity is then considered below. In regressions (8) and (9) the reform dummy variable is added to regressions (6) and (7):

$$(5)\ y_{it} = \alpha_i + \varphi_t + \beta_k k_{it} + \beta_l l_{it} + \beta_{bw} bw + \beta_{ref_hf} ref_hf_{it} + \varepsilon_{it}$$

Again, its introduction does not affect previous estimates in a noteworthy way, other than reducing the level of significance of $bw_{it}$ to the 98% level in the GLS random effects estimator in column (9).

Finally, we add in an interaction term among the reform dummy and $bw_{it}$, with results reported in Columns (10) and (11). Hence, our stochastic model from above now takes the following form:

$$(6)\ y_{it} = \alpha_i + \varphi_t + \beta_k k_{it} + \beta_l l_{it} + \beta_{bw} bw + \beta_{ref_hf} ref_hf_{it} + \beta_{bw_ref_hf} [bw_ref_hf_{it}] + \varepsilon_{it}$$

The results of implementing equation (6) are very interesting. While the estimates for coefficients on the log of labour and capital are not affected, there is an effect on $bw_{it}$ and the labour reform dummy, whilst the interaction term is also significant. First, the coefficient estimate on $bw_{it}$ jumps to 0.43 and 0.51 in the fixed and random effects models, respectively. A t-statistic about 3.0 indicates strong statistical significance. Further, the reform dummy coefficient estimates of 0.1 and 0.12 of fixed and random effects, respectively, are now borderline significant, with t-statistics of (1.89) and (2.28). However, was is of great interest are the estimates for the coefficients of the interaction term. These are negative, with the random effects model generating a value of -0.31 and the fixed effect model –0.38. The former is significant at the 95% level, while the latter is at the 98% level.

Thus, we note that, while there is a positive relationship among wage bonuses and real value added, this relationship breaks down to a large extent once the labour market reform is implemented. Also, there appears to be an intercept shifting effect

due to the labour market reform itself. These points hold, of course, only if endogeneity is ignored, which we control in what follows.

The incidence of firms' paying higher wages may result in firms being more productive. Yet, at the same time, it may also be true that, more productive firms may pay higher wages. If better firms pay higher wages, one is dealing with rent sharing, whereas the reverse scenario, of higher wages leading to higher productivity, is described as the incidence of efficiency wages. In order to deal more effectively with this issue, an instrument for bonuses should be estimated and substituted in for the endogenous variable in the original analysis.

Three sets of instruments are generated here are: the predicted values for bonuses in wages which derive from regressing these on the lagged values of *bw* and the current values for average wage. Since we employ OLS, and GLS random and fixed effects estimators in this setting, we obtain three different sets of instruments.

The results of our instrumenting regressions are reported in Table V.5.3. Regression (12) is OLS, whereas GLS random and fixed effects estimators are reported in (13) and (14), respectively. The OLS and GLS random effects estimators achieve R-squares in excess of 0.82, whereas the fixed effects estimator only scores 0.53 in this category. While lagged values of the percentage of bonuses in wages, $bw_{i,t-1}$, have very high t-statistics, this is significantly reduced for the fixed effects estimator. This may be attributable to firm-level persistence in the bonus in wages variable. Also, current average wages, $aw_{it}$, is both significant and negative when regressed on current bonuses in wages, $bw_{it}$, which is to be expected. Negativity and significance are higher for the fixed effects model. Thus, given their higher R-squared values and the persistence of wage bonuses at the firm level we would argue in favour of the OLS or GLS random effects generated instruments.

Thus, by implementing the first step procedure we obtain predicted values for that part of wages paid out in the form of bonuses, $p^k_bw_{it}$, which I can employ as instruments for the actual values of $bw_{it}$. The index $k$ will be denoted *OLS*, *fe* or *re*, depending on whether the instrument was derived from an OLS, or GLS random effects or fixed effects estimator, respectively.

In what follows, the regressions (6) – (12), which tested for the effect of structural change in the labour market and efficiency wages, are simply repeated by substituting $p^k_bw_{it}$ as our instrument for $bw_{it}$. Thus we test our model of efficiency

wages in a setting that controls for both, endogeneity and structural change in the labour market, with three different sets of instruments. The results of this instrumentation procedure are reported in three tables, where Table V.5.4 reports the results from using $p^{OLS}_bw_{it}$, Table V.5.5 those generated using $p^{re}_bw_{it}$, and Table V.5.6 those using $p^{fe}_bw_{it}$.

The results from the regressions using the OLS and GLS random effects model generated instruments are virtually identical. Neither the Labour nor the Capital variable coefficients are significantly different from those reported in the un-instrumented regressions. However, the instrumented variable, bonuses in wages fails to be statistically significant in any of the regressions, barring borderline significance in the fixed-effects regressions that include the reform dummy and interaction term, reported in columns (20) and (26), with values of 0.45 and t-statistics centred tightly around 2.0. The coefficient on the reform dummy and the interaction term are insignificant in all of these regressions.

The estimates derived from using $p^{fe}_bw_{it}$, reported in Table V.5.6, are somewhat different to the preceding and are not easily interpreted. The coefficients on labour are slightly larger, with similar significance levels to prior regressions, while those on capital are slightly lower, with similar significance levels, also. However, there is a stark contrast in the estimates for the instrumented variable from the preceding. To begin with, regressions (27) – (30), which include $p^{fe}_bw_{it}$ and the reform dummy, have highly significant and negative coefficients on the instrumented variable, and the magnitude of the coefficient is very large, centred about -1.

The coefficient on the reform variable itself remains minute and insignificant in regressions (29) and (30). However, once the interaction term is included in regressions (31) and (32) the instrumented bonus in wages variable becomes insignificant, while the reform dummy and the interaction term remain insignificant.

How should we interpret these somewhat perverse seeming results? Apart from taking the view that the instruments generated by the fixed effects model are probably not suitable given the persistence in the wage bonus variable, we may take the following points from these results: If the instrument is generated from a fixed effects model the firms that already are better appear to have higher bonus levels to begin with. This appears to be the interpretation of the results generated from the instrumenting regressions, where the significance of the lagged wage bonus variable drops sharply when compared to the OLS and random effects models. Thus, the

negative sign on the instrument of the coefficients in regressions (27) - (30) would indicate that improved performance actually resulted in these firms increasing their fixed wages over their bonuses. The fact that the full model leaves all coefficients other than labour and capital insignificant indicates that the reform did indeed affect the wage bargaining process. However, further interpretation of these results seems somewhat daunting.

Thus, since our analysis provides limited evidence in favour of the efficiency wage hypothesis once the structural change is taken into account, and does not provide any evidence in favour of efficiency wages once endogeneity is controlled for, it appears that bonuses were used as a rent-seeking device prior to labour market reform. This impression is accentuated by the fact that the introduction of autonomy in hiring and firing at the managerial level actually affects the relationship between the percentage of total wages paid in bonuses and real value added in such a way that this reform, once implemented, actually acts to offset this previously positive relationship, indicating a shift in employee-employer bargaining power. Furthermore, there may be a positive effect of autonomy in hiring and firing on real value-added once the bonus effect has been taken into account.

## V. 6 Conclusion

This chapter has tested for the hypothesis that wage bonuses induced performance improvements in Chinese state-owned enterprises over the period 1990-1994 under the assumption that efficiency wages exist. This hypothesis has found weak supporting evidence in previous findings, such as Groves et al. (1994), who argue for the existence of efficiency wages. A re-examination of the issue can be motivated by the fact that, supported by the literature, the early period of their examination, i.e. the early 1980s, was subject to abuse of such payments. Furthermore, ex ante, the shift in *autonomy in hiring and firing* from the centre to the enterprise manager should have some measurable impact, and this shift only began at the end of the period of their analysis.

The results provided here fail to find significant support the hypothesis of efficiency wages in Chinese SOEs for that period, once structural labour market reform is allowed to affect the wage bargaining process, or when the issue of endogeneity among wages and productivity is controlled for. The labour market

reform results in the breakdown of the positive link between productivity and the wage bonus variable. This seems to suggest a fundamental shift in wage bargaining power, away from the employees, and toward the enterprise manager. Hence, prior to managerial autonomy in hiring and firing it is likely that wage bonuses were used as a rent-seeking vehicle. Thus, with reform in this area, managers reduced the percentage of bonuses in wages. Furthermore, once this effect is taken into account, we also note a shift in productivity that accrues due to the reform itself.

Likewise, when using instrumented variables to control for endogeneity in wage and productivity variables, we find that the relationship disappears, unless the reform variable is taken into account. Thus, if efficiency wages exist in Chinese SOEs, it is only in a fully reformed labour market, with employment uncertainty as well as wage flexibility. This represents results that are very similar to those predicted in the Shapiro and Stiglitz (1984) efficiency wage model and appear to be a good empirical test of such.

## V.7 TABLES

**Table V.3.1 Summary Statistics**

| Variable | Observations | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Value Added | 3195 | 2969.88 | 9907.02 | -52516.5 | 342279.1 |
| Capital | 3055 | 3361.8 | 11460.28 | 20.07 | 306050.1 |
| Labour | 3395 | 1949.35 | 3465.42 | 103 | 46892 |
| Average Wage | 3395 | 0.123 | 0.14 | 0.0115 | 7.612 |
| Average Bonus | 3365 | 0.034 | .0203 | 0 | 0.23 |
| Bonuses in Wages | 3370 | 14.25 | 14.25 | 0 | 100 |

Notes: This table reports the summary statistics, in the form of the number of observations, mean value, standard deviation, and minimum and maximum value, for the key variables in this chapter's analysis. All Variables are reported in 10,000Yuan, with the exceptions of 'Labour' (number of employees), and 'Bonuses in Wages' (percentage of bonuses in total wage bill).

**Table V.3.2 Enterprise-Average Percentage of Bonuses in Wages, by Year**

| Year | Observations | Mean | Std. Dev. |
|---|---|---|---|
| 1990 | 674 | 32.9 | 15.16 |
| 1991 | 674 | 30.8 | 14.31 |
| 1992 | 674 | 29.2 | 14.01 |
| 1993 | 674 | 26.97 | 13.40 |
| 1994 | 674 | 25.2 | 12.9 |

Notes: This table reports the average and the standard variation of the percentage of wages paid out as bonuses, by year.

**Table V.3.3 Percentage of Enterprises with Autonomy in Hiring & Firing, by Year**

| Year | Observations | Mean |
|---|---|---|
| 1990 | 680 | 36.47 |
| 1991 | 680 | 45.88 |
| 1992 | 680 | 54.41 |
| 1993 | 680 | 67.21 |
| 1994 | 680 | 70.15 |

Notes: This table reports the percentage of enterprises that have received autonomy in hiring and firing decisions, by year.

**Table V.5.1 Real Value Added in a Log-Linear Production Function**

| Variable \ Estimator | (1) OLS | (2) GLS Random Effects | (3) GLS Fixed Effects | (4) GLS Random Effects | (5) GLS Fixed Effects |
|---|---|---|---|---|---|
| Labour | 0.72*** (21.28) | 0.63*** (13.74) | 0.52*** (7.29) | 0.63*** (13.73) | 0.52*** (7.29) |
| Capital | 0.36*** (14.70) | 0.41*** (13.01) | 0.41*** (9.85) | 0.41*** (13.03) | 0.41*** (9.86) |
| Labour Reform | - | - | - | 0.017 (0.62) | 0.023 (0.79) |
| Year Dummy | Yes | Yes | Yes | Yes | Yes |
| Industry Dummy | Yes | Yes | No | Yes | No |
| Provincial Dummy | Yes | Yes | No | Yes | No |
| Observations | 2809 | 2809 | 2809 | 2809 | 2809 |
| R-Squared | 0.63 | 0.63 | 0.49 | .63 | 0.49 |

Notes: Real value added is the dependent variable in regressions (1) – (5), sorted by column. Estimators are ordinary least squares (OLS) or generalised least squares (GLS), with Fixed or Random Effects. The independent variables are listed in the first column, by row.
Numbers in brackets are the t-statistics associated with the estimates for the regression coefficients. Levels of statistical significance of the coefficients are indicated by the number of asterisks: rejection of the $H_0$: 'Coefficient is equal to zero' at the ***99% level, **98% level, *95% level.
The reported R-Squared statistics are the adjusted type for OLS, within for GLS Random Effects, and overall for GLS Fixed Effects estimators.

**Table V.5.2 Value Added in a Log-Linear Production Function, Taking the Effect of Structural Labour Market Reform into Account**

| Estimator / Variable | (6) GLS Random Effects | (7) GLS Fixed Effects | (8) GLS Random Effects | (9) GLS Fixed Effects | (10) GLS Random Effects | (11) GLS Fixed Effects |
|---|---|---|---|---|---|---|
| Labour | 0.63*** (13.74) | 0.52*** (7.34) | 0.63*** (13.73) | 0.52*** (7.33) | 0.63*** (13.72) | 0.51*** (7.3) |
| Capital | 0.41*** (13.0) | 0.41*** (9.97) | 0.41*** (13.01) | 0.41*** (9.98) | 0.41*** (13.0) | 0.41*** (9.96) |
| Bonuses in Wages | 0.27* (2.22) | 0.31** (2.33) | 0.26* (2.2) | 0.31* (2.29) | 0.43*** (2.93) | 0.51*** (3.2) |
| Labour Reform | - | - | 0.01 (0.4) | 0.015 (0.52) | 0.1025 (1.89) | 0.13* (2.28) |
| Bonuses in Wages*Labour Reform Dummy | - | - | - | - | -0.31* (-1.96) | -0.38** (-2.36) |
| Year Dummy | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Dummy | Yes | No | Yes | No | Yes | No |
| Provincial Dummy | Yes | No | Yes | No | Yes | No |
| Observations | 2789 | 2789 | 2789 | 2789 | 2789 | 2789 |
| R-Squared | 0.63 | 0.49 | 0.63 | 0.49 | 0.63 | 0.49 |

Notes: Real value added is the dependent variable in regressions (6) – (11), sorted by column. Estimators are generalised least squares (GLS), with Fixed or Random Effects. The independent variables are listed in the first column, by row.
Numbers in brackets are the t-statistics associated with the estimates for the regression coefficients. Levels of statistical significance of the coefficients are indicated by the number of asterisks: rejection of the $H_0$: 'Coefficient is equal to zero' at the ***99% level, **98% level, *95% level.
The reported R-Squared statistics are the adjusted type for OLS, within for GLS Random Effects, and overall for GLS Fixed Effects estimators.

**Table V.5.3 First Step: Instrumenting for the Percentage of Wages as Bonuses**

| | (12) OLS | (13) GLS Random Effects | (14) GLS Fixed Effects |
|---|---|---|---|
| Average Wage | -0.03*** (-7.98) | -0.03*** (-7.97) | -0.08*** (-14.4) |
| Lagged Bonuses in Wages | 0.86*** (102.97) | 0.84*** (93.83) | 0.26*** (13.98) |
| Year Dummy | Yes | Yes | Yes |
| Industry Dummy | Yes | Yes | No |
| Province Dummy | Yes | Yes | No |
| Observations | 2692 | 2692 | 2692 |
| R-Squared | 0.82 | 0.82 | 0.53 |

Notes: The percentage of bonuses in wages is the dependent variable in regressions (12) – (14), sorted by column. Estimators are ordinary least squares (OLS) or generalised least squares (GLS), with Fixed or Random Effects. The independent variables are listed in the first column, by row. Regressors are the current average wage level and the previous year's value of the percentage of bonuses in wages.

Numbers in brackets are the t-statistics associated with the estimates for the regression coefficients. Levels of statistical significance of the coefficients are indicated by the number of asterisks: rejection of the $H_0$: 'Coefficient is equal to zero' at the ***99% level, **98% level, *95% level.

The reported R-Squared statistics are the adjusted type for OLS, and overall for GLS Random Effects and GLS Fixed Effects estimators.

**Table V.5.4 Using Bonus-Wage Instruments Generated by OLS**

| Variable \ Estimator | (15) GLS Random Effects | (16) GLS Fixed Effects | (17) GLS Random Effects | (18) GLS Fixed Effects | (19) GLS Random Effects | (20) GLS Fixed Effects |
|---|---|---|---|---|---|---|
| Labour | 0.65*** (12.66) | 0.52*** (7.16) | 0.65*** (12.66) | 0.57*** (7.16) | 0.65*** (12.67) | 0.57*** (7.2) |
| Capital | 0.41*** (11.35) | 0.44*** (8.67) | 0.41*** (11.34) | 0.44*** (8.66) | 0.41*** (11.31) | 0.43*** (13.0) |
| Instrumented Bonuses in Wages | 0.18 (1.18) | 0.26 (1.15) | 0.18 (1.19) | 0.26 (1.52) | 0.31 (1.54) | 0.46* (2.02) |
| Labour Reform | - | - | -0.01 (-0.26) | -0.01 (-0.23) | 0.05 (0.72) | 0.07 (1.03) |
| Instrumented Bonuses in Wages*Labour Reform | - | - | - | - | -0.21 (-0.97) | -0.29 (-1.33) |
| Year Dummy | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Dummy | Yes | No | Yes | No | Yes | No |
| Provincial Dummy | Yes | No | Yes | No | Yes | No |
| Observations | 2223 | 2223 | 2223 | 2223 | 2223 | 2223 |
| R-Squared | 0.63 | 0.49 | 0.63 | 0.49 | 0.63 | 0.49 |

Notes: Real value added is the dependent variable in regressions (15) – (20), sorted by column. Estimators are generalised least squares (GLS), with Fixed or Random Effects. The independent variables are listed in the first column, by row. The bonuses in wages variable is instrumented for by using the predicted values generated in regression (12).

Numbers in brackets are the t-statistics associated with the estimates for the regression coefficients. Levels of statistical significance of the coefficients are indicated by the number of asterisks: rejection of the $H_0$: 'Coefficient is equal to zero' at the ***99% level, **98% level, *95% level

.The reported R-Squared statistics are the adjusted type for OLS, and overall for GLS Random Effects and Fixed Effects estimators.

**Table V.5.5 Using Bonus-Wage Instruments Generated by GLS Random Effects**

| Estimator / Variable | (21) GLS Random Effects | (22) GLS Fixed Effects | (23) GLS Random Effects | (24) GLS Fixed Effects | (25) GLS Random Effects | (26) GLS Fixed Effects |
|---|---|---|---|---|---|---|
| Labour | 0.63*** (13.73) | 0.57*** (7.16) | 0.65*** (12.66) | 0.57*** (7.16) | 0.65*** (12.67) | 0.57*** (7.19) |
| Capital | 0.41*** (13.03) | 0.44*** (8.66) | 0.41*** (11.34) | 0.44*** (8.66) | 0.406*** (11.31) | 0.43*** (8.63) |
| Instrumented Bonuses in Wages | 0.17 (1.12) | 0.26 (1.45) | 0.18 (1.13) | 0.26 (1.46) | 0.31 (1.49) | 0.45* (1.98) |
| Labour Reform | - | - | -0.01 (-0.25) | -0.01 (-0.22) | 0.05 (0.72) | 0.08 (1.03) |
| Instrumented Bonuses in Wages*Labour Reform | - | - | - | - | -0.2 (-0.97) | -0.3 (-1.33) |
| Year Dummy | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Dummy | Yes | No | Yes | No | No | No |
| Provincial Dummy | Yes | No | Yes | No | No | No |
| Observations | 2223 | 2223 | 2223 | 2223 | 2223 | 2223 |
| R-Squared[a] | 0.63 | 0.49 | 0.63 | 0.49 | 0.63 | 0.49 |

Notes: Real value added is the dependent variable in regressions (6) – (9), sorted by column. Estimators are ordinary least squares (OLS) or generalised least squares (GLS), with Fixed or Random Effects. The independent variables are listed in the first column, by row. The bonuses in wage variable is instrumented for by using the predicted values generated in regression (13).
Numbers in brackets are the t-statistics associated with the estimates for the regression coefficients. Levels of statistical significance of the coefficients are indicated by the number of asterisks: rejection of the $H_0$: 'Coefficient is equal to zero' at the ***99% level, **98% level, *95% level.
[a]The reported R-Squared statistics are the adjusted type for OLS, within for GLS Random Effects, and overall for GLS Fixed Effects estimators.

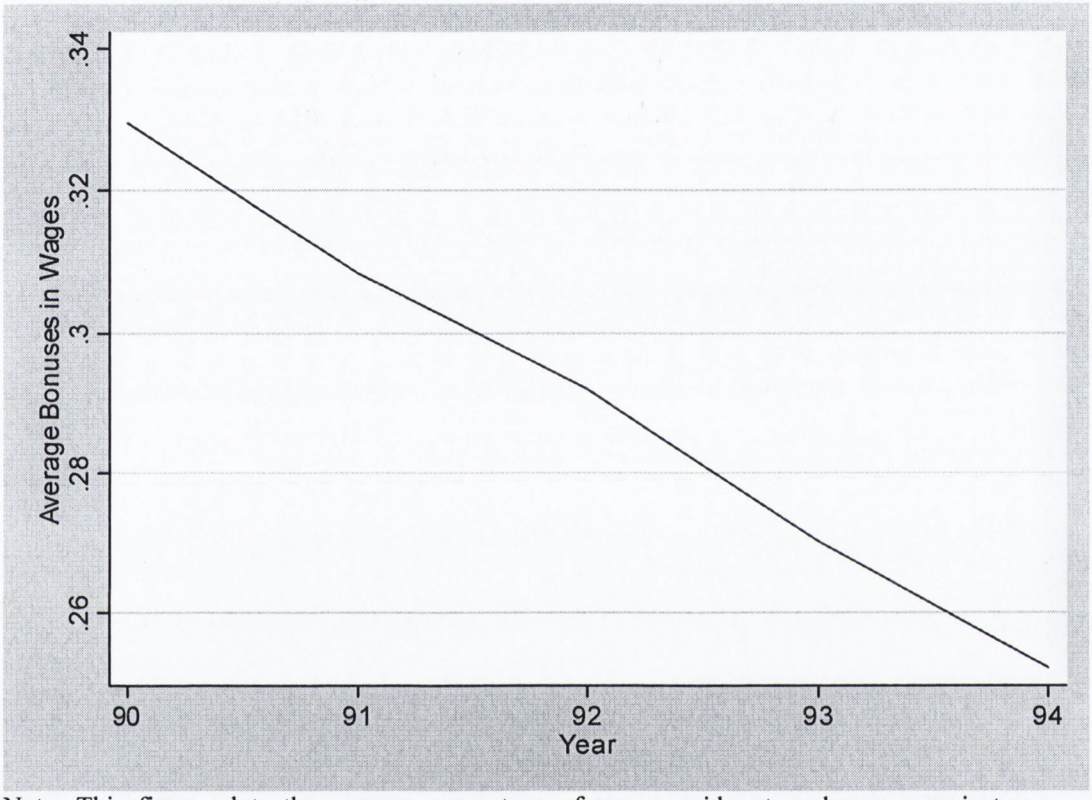
**Table V.5.6 Using Bonus-Wage Instruments Generated by GLS Fixed Effects**

| Estimator / Variable | (27) GLS Random Effects | (28) GLS Fixed Effects | (29) GLS Random Effects | (30) GLS Fixed Effects | (31) GLS Random Effects | (32) GLS Fixed Effects |
|---|---|---|---|---|---|---|
| Labour | 0.68*** (13.08) | 0.63*** (7.65) | 0.68*** (13.08) | 0.63*** (7.65) | 0.68*** (13.11) | 0.63*** (7.71) |
| Capital | 0.38*** (10.59) | 0.41*** (8.0) | 0.39*** (10.58) | 0.41*** (8.0) | 0.38*** (10.55) | 0.41*** (7.97) |
| Instrumented Bonuses in Wages | -1.17*** (-3.21) | -0.94** (-2.37) | -1.2*** (-3.2) | -0.95** (2.37) | -0.84 (-1.7) | -0.49 (0.92) |
| Labour Reform | - | - | 0.003 (.03) | 0.005 (0.15) | 0.13 (0.97) | 0.183 (1.32) |
| Instrumented Bonuses in Wages*Labour Reform | - | - | | - | -0.45 (-0.98) | -0.62 (-1.33) |
| Year Dummy | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Dummy | Yes | No | Yes | No | Yes | No |
| Provincial Dummy | Yes | No | Yes | No | Yes | No |
| Observations | 2223 | 2223 | 2223 | 2223 | 2223 | 2223 |
| R-Squared[a] | 0.49 | 0.63 | 0.49 | 0.63 | 0.63 | 0.49 |

Notes: Real value added is the dependent variable in regressions (6) – (9), sorted by column.
Estimators are ordinary least squares (OLS) or generalised least squares (GLS), with Fixed or Random Effects. The independent variables are listed in the first column, by row. The bonuses in wage variable is instrumented for by using the predicted values generated in regression (14).
Numbers in brackets are the t-statistics associated with the estimates for the regression coefficients.
Levels of statistical significance of the coefficients are indicated by the number of asterisks: rejection of the $H_0$: 'Coefficient is equal to zero' at the ***99% level, **98% level, *95% level
.[a]The reported R-Squared statistics are the adjusted type for OLS, within for GLS Random Effects, and overall for GLS Fixed Effects estimators.

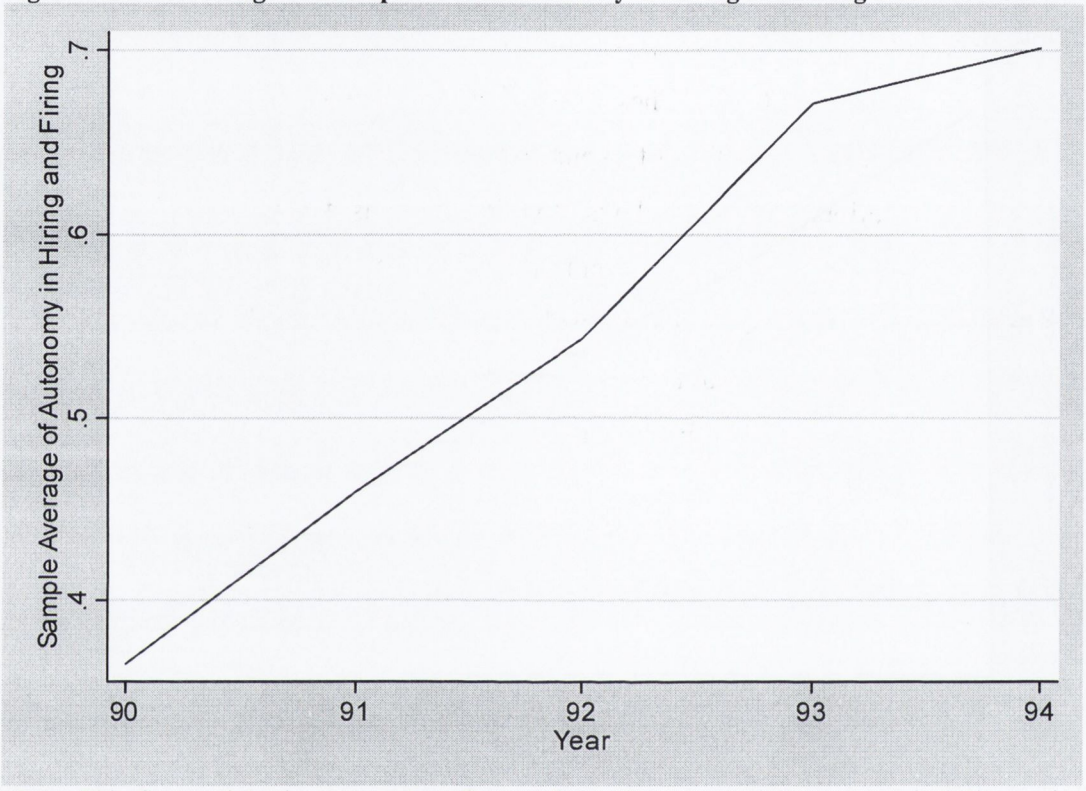
## V.8 FIGURES

**Figure V.3.1 Enterprise Average Percentage of Bonuses in Wages from 1990-1994**




Note: This figure plots the average percentage of wages paid out as bonuses against year.

**Figure V.3.2 Percentage of Enterprises with Autonomy in Hiring and Firing from 1990-1994**




Note: This figure plots the percentage of enterprises with managerial autonomy in hiring and firing against year.

# VI. Capital Reforms and Productivity Dynamics

## VI.1 Introduction

The focus of this chapter is to estimate the parameters of a production function for Chinese State-Owned Enterprises (SOEs) in the industrial sector of the economy during the period 1980 to 1994. Such estimates are required in order to examine changes in the distribution of enterprise level productivity, paying particular attention to a set of enterprise level reforms. These reforms refer to the granting of managerial autonomy in the buying and selling of capital assets, in investment decisions and in operating on international markets. Thus, the intention is to examine how such reforms have affected productivity at the enterprise level, controlling for simultaneity and selection bias. Simultaneity bias can result from a tendency for high productivity enterprises to hire more labour and invest more capital. Selection bias results from the fact that unobservable productivity can make enterprises more likely to select to, or engage in, advanced reform.

Groves et al. (1994), (1995) and Li, (1997) have used the data covering the period 1980-89 and Li and Wu (2002) for the period 1980 and 1994. These papers also use a production function approach to evaluate the reform process but there are three key issues not addressed by them that are the focus of this chapter. First, they correct for simultaneity bias in their production functions by using a *naïve* within group estimator. This requires the enterprise component of productivity to be time invariant. Secondly, they do not allow for selection bias coming from an endogenous reform process. The Central Government may have become more open to allowing enterprises to undertake reforms over time, but this does not imply that enterprises get selected on non-economic grounds or by random selection. Below, evidence, supported by the literature, is provided that the decision to select into reform came from the grassroots, which depended on enterprise level characteristics, some of which are observable to us, whereas others not, i.e. productivity.

Finally, this analysis incorporates a set of reforms, overlooked by other studies. These reforms are advanced, since they give enterprise managers autonomy in decisions regarding the buying and selling of capital assets, investment, and operating in international markets. These were largely granted to enterprise managers from the

late 1980s and through early 1990s.[1] Such reforms allowed enterprises to distance themselves from Government in day-to-day operations, while Government remained the equity holder. Essentially, this is akin to separating control and ownership. There are two important observations concerning the take-up of advanced reforms. The adoption was not industry or region specific, though there exists some heterogeneity across regions, as can be seen from Tables III.7 – Table III.10. The data allows us to differentiate between those who did, and those that did not, select to reform across all industries and regions. Secondly, once enterprises embrace an advanced reform there is a push to select further reforms. This indicates that the set of capital reforms were considered complementary in nature. Thus, while the overall reform process in China has been gradual, it is apparent that the complementary nature of reforms was appreciated for these critical reforms.

We witness initial reforms in the 1980s, which increased output autonomy, the payment of wage bonuses, and devolution of general control from the centre to the regions, usually the municipality, and the use of market prices on the margin. In a second wave, managerial autonomy in hiring and firing labourers was introduced. The previous chapter analysed this reform's affect on the wage bargaining process. This variable is included in this analysis for consistency's sake, though this is not critical to our results, as an exogenous variable, which only affects labour's share of productivity. There are several reasons for treating labour market reform differently to reforms in capital and investment. Autonomy in hiring and firing was extended earlier, much more liberally and explosively than were reform in capital markets. Most importantly for this analysis, however, is that the choice of framework, the Olley-Pakes estimation algorithm, lends itself best, in my opinion, to modelling capital reforms.

While the early reforms improved incentives, the transmission of information, and the internal organisation of enterprise, researchers have not been able to link productivity to initial reforms, see Li and Wu (2002) and Groves et al. (1994). Indeed,

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[1] Li and Wu (2002) do consider the issue of increased competitive pressure coming from a second stage of reforms in the late 1980s and early 1990s, which are related to our set of reforms. They proxy competitive pressure at the enterprise level with the ratio of input to output prices and the ratio of private to state controlled investment. These are included as additional regression variables in the production function. The ratio of input to output prices (motivated as a price cost mark-up) is constructed from variables that are used as deflators for output and raw materials in the production function. Their proxies for competitive pressure seem endogenous.

Coady and Wang (2000) provide evidence that rent sharing was driving the allocation of bonuses in Chinese SOEs with little efficiency gain, a central theme of the previous chapter. Here, I allow for, and find evidence significantly in favour of an impact of labour market reform on labour's contribution to real value added, although this effect is quite small. However, the focus is to document productivity gains from a more advanced stage of largely capital related reforms.

Thus, our goal is to estimate consistent production function parameters dealing with two interrelated estimation biases. Simultaneity bias arises out of the fact that input demands are, in part, determined by the manager's knowledge of productivity levels. Selection bias stems from the notion that productivity is likely to affect the decision to select, or be selected, into capital reform. The estimation algorithm developed in Olley & Pakes (1996) is adapted in order to deal with both of these biases in the current setting.

Why use Olley & Pakes (1996) to deal with simultaneity bias? Blundell, Bond and Windmeijer (2000) suggest a "system" GMM estimator to deal with simultaneity bias in production functions. The problem with this approach is that there is no behavioural model for the unobservable productivity variable. They model the unobservable as a dynamic error component model and use linear and non-linear moment restrictions on the error structure to estimate the parameters of the production function with some precision. The benefit of the Olley & Pakes (1996) approach is that there is a structural model of the unobservable. This suggests the optimal investment dynamics of enterprises, given the observable state variables, should allow one to control effectively for the omitted unobservable using non-parametric techniques.

One key question is whether the investment dynamics present in Chinese State Owned Enterprises would tell us anything about enterprise level productivity. Clearly, one may appeal to the first welfare theorem: Planners try to make decisions that mimic what prices do in a decentralised economy. During the sample period enterprises were at least signed up to a "contract responsibility system". The contract had profit and tax targets to be paid to the government and, in return, managers and workers would be paid agreed bonuses. They also had the right to divert retained profits to a welfare and investment fund. Even though incentive problems were not solved, clearly planners would target investment at enterprises where profit and taxes

were coming back to government. Such investment dynamics should be enough to back out the unobservable productivity type.

Clearly, the adoption of capital reforms should induce enhanced investment dynamics to reflect productivity type. I will allow the non-parametric relationship between investment and the observable and unobservable state variables to be different across unreformed and reformed enterprises. In addition, ex-post, the results confirm that investment and productivity estimates at the enterprise level are positively correlated over-time in both sub-samples.

The use of the Olley & Pakes (1996) algorithm deals with selection to reform bias. With respect to the Blundell, Bond and Windmeijer (2000) "system" GMM estimator, it is hard to see how the parametric instrumented variable approach deals with selection bias, particularly in the presence of endogenous dummy variables. Thus, selection to reform is allowed to be endogenous, and the resulting selection bias is corrected for by formulating an entry rule to reform similar to the Olley and Pakes (1996) exit rule. Their 3-step semi-parametric approach can deal with simultaneity and selection bias in a simple way. The main contribution of this paper is to adapt their estimation procedure to allow for bias arising from a selection to reform. Allowing for the endogenous nature of reform/internal organisation within companies is absent in most literatures (mainly due to a lack of data and estimation procedures).

Turning to the results: To begin with, reform is treated as an exogenous, rather than choice, variable that is randomly allocated across enterprises. Simultaneity bias is controlled for in a two-step procedure, using Olley & Pakes (1996). Given that there appear to be significant differences in the productivity estimates across reformed and unreformed firms, splitting the sample according to reform status seems to suggest itself; thus, a three-step Olley & Pakes (1996) procedure can be employed in order to control for the selection to the advanced sample. Thus, the selection into the reformed or not reformed sub-samples is endogenous to an enterprise's productivity type, and production technology can differ across reform-type.

Our results indicate that enterprises that embrace capital reform under Sate Ownership exhibit higher productivity compared to enterprises in the initial stages of reform, controlling for simultaneity and selection biases. Most western studies that have failed to find efficiency gains from privatisation argue that State Owned Companies tend to operate with competitive pressures in factor and product markets pre-privatisation and hence the contributions of privatisation are hard to isolate, see

Walsh and Whelan (2001) for an overview. This analysis presents a natural experiment that supports this previously untested view. Exposure to competitive forces in factor and product markets does induce important efficiency gains at the enterprise level pre-privatisation.

The remainder of the paper is structured as follows. Section VI.2 provides the recipient with the background of enterprise reform in China. Then the behavioural model of Olley and Pakes (1996) is described, as is its adaptation to our particular problem, in section three. Section VI.4 summarises the estimation procedure. Our results and conclusions are set out in sections VI.5 and VI.6, respectively. The tables referred to in the text can be found in section VI.7, and the figures are located in section VI.8

## VI.2 Chinese State-Owned Enterprises, Again

In this section I shall elaborate on the nature of the reform process in State-Owned Enterprises. Two main characteristics of reform are highlighted. First, reforms were not assigned randomly, but rather due to pressure from 'able' enterprises, which fully appreciated their ability to profit from implementing reforms. Furthermore, while the overall reform process has been gradual, crucial reforms in capital and investment were clustered together.

There exists a wide consensus that the authorities, lacking an initial clear vision of the reform goal, and hence could also not have planned a reform path, gave in to grassroots (enterprise) pressure. It appears that the grassroots appreciation of the potential offered by the market, beginning with the agricultural sector, caused the reform process to advance. In this sense initial reforms cannot be seen as the initiation of a plan, which was to bring to reality some grand vision. Also, the quality of their impact in isolation is widely disputed. Over time a clearer vision of reforms was developed, and commitment to reform intensified. Thus, initial reform was preparatory which allowed a second stage of reforms to become a possibility.

Interestingly, evidence suggests that capital reforms were likely to be undertaken all together by an enterprise or were not implemented at all. The fact that they were taken up as a package indicates that the authorities/enterprises realised the complementary nature of such deep reforms. Thus, it appears that China, accidentally or otherwise, allowed the short-term inefficiency of gradual reform, while at the same

time building the institutions/social capital that would provide the infrastructure to support crucial reforms in capital and investment autonomy. In this section I support the above view of the reform process in more detail.

Reform in China was initiated in 1978, and the process refers to institutional changes that move the economy from planned to a market economy. The crucial difference is reflected in prices, which are set by the planner in the former, and set in the market in the latter case. Prices under planning are often set such that inputs are cheap and final goods are expensive, especially industrial goods. Thus, profits from the industrial sector are the main source of government revenue, rather than taxes as in market economies. Hence, the allocation of goods in the economy is not achieved by demand and supply creating a price that reflects the value/scarcity of a product. Rather, the planner must process a wealth of information and then use this information in order to gear the economy toward arriving at some set of desirable goals, defined by quotas. Information and incentive problems lead to stockpiling and loss of economic prowess. Over time this system has had to reform due to these inefficiencies and stagnation. (Naughton, 1995).

Since the act of planning is so complex, partial reform within planning may not improve efficiency significantly, but may, in fact, lead to distortions, which adversely affect efficiency and the commitment to further reform, see Dewatripont & Roland (1995). However, a big bang approach, that removes all aspects of planning without the institutions of a market economy in place, could result in a period of disorganisation, which could in turn result in an initial massive fall in output as witnessed in the former Soviet Union; see (Repkine and Walsh, 1999) and (Konings and Walsh, 1999).

In 1978 the Chinese tentatively sought for a way to avoid this problem, where the "*government's role often has been to permit change rather than to initiate it*" (McMillan, 1994). The planned economy was upheld, while units bought and sold goods in the market, at market prices, if they were in excess of quotas regulations. While initial reforms in industry were deemed unsuccessful, with some retrenchment by 1983, there was a strong push for reforms again after 1983 (Naughton, 1995). Thus, we witness the birth of the *Dual-Track* system, which allows both planned and market prices to coexist for goods produced to quotas and excess goods respectively.

> "Beginning in 1978 [...], China reformed its industrial sector. Enterprises that had been largely controlled by the state were given some market or market-like incentives. [...] State owned enterprises were allowed to keep some fraction of their profits, where before all profits had to be remitted to the state. Enterprises began to sell some of their outputs and buy some of their inputs in free markets, rather than selling and procuring everything at state-controlled prices" (Groves et al., 1994; see also Byrd 1991, Naughton 1995, Qian, 1999).

In 1978 SOE's accounted for 78 percent of industrial output, 19 percent of total employment (Kennedy & Marquis, 1988). The degree of state produced output sold at market prices rose steadily, and averaged 38 percent of state-owned enterprises' output by 1989, and, in particular cases, even amounted to all output. By the same time on average 56 percent of inputs to state production was procured at market prices. (McMillan, 1994)

By the end of the 1980s most SOEs in our sample had engaged in this type of reform, now having the right to determine output value, pay bonuses, retain excess profits, and sell and produce at market prices. Also, the level of control was devolved from the state or provincial level to the municipal level. I view these reforms as initial steps toward creating a market economy environment. The effect of these reforms by themselves is overviewed in Li and Wu (2002), who conclude that their effect was indeed limited. Groves et al. (1994) take a more benevolent view of initial reforms, but they fail to establish a strong link from the reform process to productivity enhancement.

Thus, the main function of initial reforms appears to be the creation of institutions necessary for the second stage of reforms to be successful. A standstill at the level of initial reform was counterproductive, as certain agents made use of the status quo in this halfway house by trading between the co-existing parts of the economy. This reportedly led to a rise in social tension in the late 1980s (See Laffont & Qian, 1999; Dewatripont & Roland, 1995; Fang, 1994).

It is at this point that the authorities began to appreciate the necessity to advance further reforms, but still they lacked a clear goal or path, which is summed up in the slogan *"crossing the river by touching stones". "[U]ncertainty over its vision of the future and aversion to risk help explain China's initial groping reform strategy. ...and success has sustained the continuity of a gradual evolutionary*

*approach to reform*" ( Jefferson & Singh, 1999). It was appreciated that the growth in the private sector could not be matched by the state-sector. One can say with respect to this phenomenon that, rather than destroying the old institutions and starting from scratch, China let its new economy grow around what already existed, i.e. was *"[g]rowing out of the Plan"* (Naughton, 1995).

Further reforms were initiated. Figure VI.2.1 and Figure VI.2.2 show how capital reforms evolved over time in our sample of enterprises. We see how these *deep* reforms begin in the late 1980s, but only permeate most of the sample by the early 1990s. Even though our data on reforms only goes to 1995, careful analysis of the data shows that an enterprise's endeavour in one of these areas tended to be followed by further reform in another critical area. Also, contrary to our prior beliefs there is no clear sequencing in the adoption of capital reform. Thus, these later reforms were not taken up gradually: enterprises tended to select to the full package, or did not undertake any of the capital reforms.

Regarding the causality of reforms, which is an important part of our analysis, I find support for our view that it runs from enterprise performance to reform and vice-versa.

> "Virtually all of the literature on the enterprise reform examines the impact of reform on performance. Causality also operated strongly in the other direction. Poor or declining performance, particularly among enterprises operated at lower levels of government, motivates new rounds of reform. Indeed, the industrial innovation ladder predicts that causality should run from enterprise to reform" (Jefferson & Singh, 1999).

The dataset provides information on various types of reform undertaken by enterprises by year. The strong heterogeneity across enterprises, regions, industries and time, does not support a view of top-down initiated reforms that affect enterprise autonomy. Naughton (1995) supports our view when he states that the ex-post consistency of the reform process came about only because reforms were introduced in a heterogeneous/experimental fashion, where failures were disguised in the mass or by retrenchment. The information gathered in these initial, localised experiments were then reapplied to most SOEs in the mid-1980s, thus reducing the cost of implementation due to trial and error (McMillan and Naughton, 1992; Qian, 1999). It was not then a grand vision and divine leadership that has produced seemingly successful reform in

Chinese SOEs, as one might be led to believe, but rather, the process was initiated from pressure at the grassroots level.

With respect to SOEs, prior to 1992 they were not privatised. Over the coming years there was a marked increase in levels of privatisation. Small SOEs were privatised at the county level and layoffs emerged at the city-level. This form of holding on to large enterprises was promoted by the slogan "*grasping the large and letting go of the small*". Small- and medium-sized enterprises made up 95 percent of SOEs in 1993, and in many provinces about half of these were privatised by 1996. At this stage some ten million workers had been laid off from SOEs, and a further 11.5 million in 1997. This appears typical of China's initially slow pace of reform, which then accelerates. Large-scale layoffs were never a feature in modern China prior to this. This analysis does not evaluate the benefit of privatisation after 1994. However, it does attempt to estimate the impact of competitive pressure on productivity at the enterprise level under state ownership.

## VI.3 The Behavioural Model

As outlined above, the aim is to analyse changes in the distribution of productivity that is accompanied by enterprise-level institutional change, i.e. the initiation of deep reform. A necessary condition for this is the computation of consistent estimates of production function parameters. Our data indicate a great deal of heterogeneity in type and completeness of reform realised, even across industries and regions. The reforms that changed enterprise managers' and workers' incentives internally are classed as *initial* or early reforms. Reforms that induced external competitive pressure (managerial autonomy to buy and sell capital assets, invest, and buy and sell into international markets) on the enterprise, that came later, are classified as *advanced* or *capital* reforms. Productivity will be allowed to be a major determinant of *selection* to deep reform.

Since the productivity variable is not measured directly in our data, the assertion that selection to deep reform and choice of factors of production should depend on productivity type leads to two complications when attempting to estimate a production function. The first complication appears if productivity levels observed by managers determine input levels. Thus, we face the classic simultaneity problem

analysed by Marshak and Andrews (1944). The second complication arises out of the fact that some enterprises select to reform, while others do not. The evidence suggests selection to reform is related to productivity type. Hence we must deal with the fact that selection to deep reform implies a higher productivity type to begin with and thus, a higher productivity realisation may not be related to the reform per se. The problems associated with entry and exit of companies is widely discussed in western literatures.

Here we have a balanced panel of enterprises, but unbalanced panels of reformed and unreformed enterprises, since not all firms engage in advanced reform, and those that do, select at different points in time. If the decision to induce reform is related to their productivity level, then our unbalanced panels of reformed and unreformed enterprises result in part due to an endogenous selection process based on unobserved productivity. This would create selection bias in the production function estimates of our unbalanced samples of unreformed and reformed enterprises.

Olley & Pakes (1996) provide us with a dynamic behavioural model that allows for productivity differences within firms across time, and also across firms. This allows us to examine the effects of simultaneity and selection problems. In order to address simultaneity, the model specifies the information available when input decisions are made. The model develops a 'selection' rule in order to tackle the selection problem. As in Ericson and Pakes (1995), it is assumed that current profits are a function of a firm's state variables, factor prices, and the state variables of all other firms active in the market. It is assumed the vector of firm specific state variables consists of a firm's age, $a_{it}$, its capital stock, $k_{it}$, and firm productivity, a measure denoted by $\omega_{it}$. A market structure consists of a list of these triples for all active firms. I make the strong assumption that factor prices are common across firms and evolve according to an exogenous first-order Markov process.

Each period a firm is assumed to face three decisions. First, the manager/government will decide whether or not a firm should embrace advanced reform. If it does, the manager faces a cost, such as larger risk-levels through increased exposure to competitive pressures and enhanced responsibility for firm performance, of doing this while reaping potential rewards, namely higher expected profits, given the manager has better knowledge of the enterprise's ability and is more profit oriented, than is the central government. Given that decision, the firm will then choose its labour and investment level. Another assumption is that some authority, the

manager or the central authority, freely chooses labour and real investment levels. Real investment, together with firm-level depreciation, $\delta_t$, determines next period's capital stock.

The accumulation equations for capital and age are given by

(1) $$k_{t+1} = (1 - \delta_t)k_t + i_t \quad and \quad a_{t+1} = a_t + 1.$$

These hold with a probability of one. Productivity, $\omega$, is known to the firm and evolves according to an exogenous Markov process, as in Hopenhayn and Rogerson (1993). Its distribution at $t + 1$ conditional on all information known at $t$ is determined by the family of distribution functions,

(2) $$F_\omega = \{F(\cdot\,|\omega), \omega \in \Omega\}$$

Firms are assumed to maximise the expected discounted value of future cash flows. In this fashion a firm's decision to reform, as well as its choice of investment, depends on its perception of the future market structure given available current information, which in turn affects the future market structure. Similar to Olley and Pakes (1996), I subsume the existence of a Markov perfect Nash equilibrium in investment strategies for our particular problem, which is similar to that defined and proved in Ericson and Pakes (1995).

In equilibrium, the profit and value functions depend on factor prices and the structure of the market. However, since it is assumed that these do not vary across competitors in any given period, they are suppressed in our notation. Profit and value functions are thus indexed by time. In this way we take note of the fact that the relationship between a firm's state variables and profit functions depends on factor prices and market structure.

The Bellman equation for an incumbent firm can be written as:

(3) $$V_t(\omega_t, a_t, k_t) =$$
$$Max\{\Phi_t(\omega_t, a_t, k_t, r_t = 0), \sup \pi_t(\omega_t, a_t, k_t, r_t = 1) - c(r_t = 1, i_t) +$$
$$\kappa E[V_{t+1}(\omega_{t+1}, a_{t+1}, k_{t+1}, r_{t+1} = 1)\,|\,J_t]\},$$

where $\pi_t$ ( · ) is the restricted profit function, which gives current profits as a function of the vector of state variables and reform status, $c(i_t, r_t)$ is the cost of current investment, $i_t$, and reform $r_t$. $\kappa$ is the firm's discount factor, and $J_t$ represents information available at time $t$. $\Phi_t$, the value of not reforming, naturally depends on the firm's state variables. As noted in Olley and Pakes (1996), this lack of independence will have no effect on the sign of the biases so long as the difference between reformed and unreformed earnings is increasing in the state variables.

The max operator in (3) indicates that a firm compares the value of 'languishing' with the expected return from selecting to reform. If the current state variables of the firm indicate reform is not worthwhile, it chooses investment and labour to maximise profits. Otherwise it reforms and chooses investment and labour appropriately. The solution to this control problem generates a reform rule, and an investment demand function. Let $r_t$ be zero for 'no reform' choices, then the 'entry to reform' rule and the investment demand equation can be written as

$$(4)\ r_t = 1 \quad \text{if } \omega_t \geq \underline{\omega}_t(a_t, k_t)$$
$$= 0 \quad \text{otherwise}$$

$$(5)\quad i_t = i_t(\omega_t, a_t, r_t, k_t)$$

Thus, a firm will choose to reform if its perceived productivity realisation is greater than the threshold productivity level, $\underline{\omega}_t$, which depends on a firm's age and capital stock at time $t$. The functions $\underline{\omega}_t$ ( · )and $i_t$ ( · ) are determined as part of the Markov perfect Nash equilibrium, and will depend on all the parameters determining equilibrium behaviour.

## VI. 4 The Estimation Procedure

Enterprises across different industries are assumed to produce homogeneous products with Cobb-Douglas technology. The log-linear production function to be estimated is given by

$$(6)\qquad y_{it} = \beta_0 + \beta_a a_{it} + \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + \eta_{it}$$

Thus, the log of enterprise $i$'s value added at time $t$, $y_{it}$, is modelled as a function of the log of that enterprise's state variables at $t$, namely age, $a_{it}$, capital, $k_{it}$, and the choice variable labour, $l_{it}$. The error structure is comprised of a stochastic component, $\eta_{it}$, with zero expected value, and a component that represents unobserved productivity differences, $\omega_{it}$. Both $\omega_{it}$ and $\eta_{it}$ are unobserved, but $\omega_{it}$ is a state variable, and thus affects firm's choice variables. On the other hand $\eta_{it}$ has zero expected value given current information, and hence does not affect decisions.

Simultaneity means OLS estimates should provide biased estimates for inputs if $\omega_{it}$ is serially correlated, and the bias should be higher for more readily adjusted inputs. On the other hand, selection to the reform process has a negative bias on the capital coefficient. To see this, assume for the moment there are no variable inputs. The expectation of output at $t$ conditional on current inputs, selection to reform, and information available at $t-1$ includes the term, $E_{it}[\omega_{it}|\ a_{it},\ k_{it},\ \omega_{it-1},\ r_{it} = 1]$. But, the necessary and sufficient condition for $r_{it} = 1$ is that productivity is above some threshold level, $\omega_{it} \geq \underline{\omega}_{it}(a_{it},\ k_{it})$. Also, I assumed the profit function is increasing in $k$, which implies the value function is also increasing in $k$. Thus, the threshold productivity level, $\underline{\omega}_{it}(\cdot)$, will be decreasing in $k$. Firms with a higher capital stock have higher profits, *ceteris paribus*, and hence can select to reform with lower realisations of $\omega$. The entry to the reform process implies that $E_{it}[\omega_{it}|\ a_{it},\ k_{it},\ \omega_{it-1},\ r_{it} = 1]$ is decreasing in $k$, producing a negative bias in the estimate of the capital coefficient.

The remainder of this section is an exposé of Olley and Pakes (1996) estimation algorithm, recast for our particular problem. The choice variables, labour and investment, are assumed to be the only variables that are affected by current productivity. Age and capital are fixed factors, and are only affected by the distribution of current productivity conditioned on the information available in the previous period, and past realisations of productivity. Specifically, the optimisation of (3) yielded the investment equation (5). If current investment is strictly increasing in current productivity levels, we can invert the investment equation $i_{it} = i_{it}(\omega_{it},\ a_{it},\ k_{it})$ for $i_I > 0$ and write,

$$\omega_{it} = h_{it}(i_{it},\ a_{it},\ k_{it}). \tag{7}$$

This makes the unobservable productivity variable a function of observable variables, which allows us to control for $\omega_{it}$ in our estimation. The two assumptions here are a positive relationship between investment and productivity, and also the assumption that productivity is the only unobserved firm specific state variable. Substituting (7) into (6) gives;

$$y_{it} = \beta_l l_{it} + \varphi_{it}(i_{it}, k_{it}, a_{it}) + \eta_{it} \tag{8}$$

where,

$$\varphi_{it}(i_{it}, k_{it}, a_{it}) = \beta_0 + \beta_a a_{it} + \beta_k k_{it} + h_{it}(i_{it}, k_{it}, a_{it}). \tag{9}$$

The partially linear equation (8) is a semi-parametric regression model, which defines the coefficient on labour while the parameters on the state variables are left unspecified. Thus, one is unable to distinguish the effect of capital and age on the investment decision from that on output. In order to identify $\beta_k$ and $\beta_a$, we will need estimates of the probability of selection to reform in addition to the estimates on $\beta_l$ and $\varphi_{it}(.)$.

The probability that a firm, the $i$ subscript is suppressed, is reformed next period given the, currently known, threshold productivity next period and all information available at present is required.

$$\begin{aligned} Pr\{X_{t+1} = 1 \mid \underline{\omega}_{t+1}(a_{t+1}, k_{t+1}), J_t\} & \\ &= Pr\{\omega_{t+1} \geq \underline{\omega}_{t+1}(a_{t+1}, k_{t+1}) \mid \underline{\omega}_{t+1}(a_{t+1}, k_{t+1}), \omega_t\} \\ &= \rho_t(\underline{\omega}_{t+1}(a_{t+1}, k_{t+1}), \omega_t) \\ &= \rho_t(i_t, a_t, k_t) \\ &\equiv P_t \end{aligned} \tag{10}$$

Thus, the probability an enterprise will reform can be reduced to $i_t$, $a_t$, and $k_t$ because productivity can be calculated from these by (5), and threshold productivity is a function of age and capital, which result from the realisation in the previous period of $i_t$, $a_t$, $k_t$. A proxy for the adoption of early stage reform is incorporated, by including a measure for autonomy in output decision.

Though not required for the results but for consistency with the previous chapter, increased autonomy in hiring and firing is incorporated. For simplicity it is assumed to only affect $l_{it}$ in a linear fashion, and selection issues are ignored. Hence, I attempt to capture changes in the return on labour due to changes in $l_{it}$, by including an interaction term between labour and a dummy variable, $ref_hf_{it}$, which is one for firms that have autonomy in hiring and firing, and zero otherwise.

The expectation of output at $t+1$ cleaned of the part attributable to labour at $t+1$ and conditional on selection to reform

$$(11) \qquad E[y_{t+1} - \beta_l l_{t+1} \mid a_{t+1}, k_{t+1}, r_{t+1} = 1] = \beta_0 + \beta_a a_{t+1} + \beta_k k_{t+1} + E[\omega_{t+1} \mid \omega_t, r_{t+1} = 1] \equiv \beta_a a_{t+1} + \beta_k k_{t+1} + g(\underline{\omega}_{t+1}, \omega_t)$$

where,

$$g(\underline{\omega}_{t+1}, \omega_t) = \beta_0 + \int_{\underline{\omega}t+1} \omega_{t+1} [F(d\omega_{t+1}|\omega_t) / \int_{\underline{\omega}t+1} F(d\omega_{t+1}|\omega_t)].$$

In order to measure the impact of the unobservable I need a measure of both productivity and the threshold level, i.e. the productivity value that sees a company as just indifferent between reforming and maintaining the status quo.

The selection equation (10) can be inverted provided $F(d\omega_{t+1}|\omega_t) > 0$ about $\omega_{t+1}$, at every $\omega_t$, which allows us to express $\underline{\omega}_{t+1}$ as a function of $P_t$ and $\omega_t$, which naturally extends to $g(.)$. By conditioning on selection we can condition on the value of one of the indices needed. Then, for given $\beta_a$ and $\beta_k$ we can condition on the second index by conditioning on the semi-parametric equation in (8).

Substituting $P_t$ and $\varphi_t$ into g(.), and letting $\xi_{t+1}$ be the innovation in $\omega_{t+1}$ I have

$$(12) \qquad y_{it+1} - \beta_l l_{it+1} = \beta_a a_{t+1} + \beta_k k_{t+1} + g(P_t, \varphi_t - \beta_a a_t - \beta_k k_t) + \xi_{t+1} + \eta_{t+1}$$

where,

$$\xi_{t+1} = \omega_{t+1} - E[\omega_{t+1} \mid \omega_t, r_t = 1]$$

and from (9), (10), and (11),

$$g(\underline{\omega}_{t+1}, \omega_t) = g[\rho_t^{-1}(P_t, \varphi_t - \beta_a a_t - \beta_k k_t), \varphi_t - \beta_a a_t - \beta_k k_t] \equiv g(P_t, \varphi_t - \beta_a a_t - \beta_k k_t)$$

Since labour can adjust to shock productivity realisations this variable is not independent of $\xi_{t+1}$, which explains the need for the first stage estimation. The equations to be estimated are (8), (10), and (12). Our estimate for labour and $\varphi_t$ is

obtained by running ordinary least squares with current value added as the dependent variable on the independent variables current labour and $\varphi_t$, which is a Nth-order polynomial with a full set of interactions of the current variables age, capital, and investment. The probability of reform, $P_t$, is modelled in (10), which states that this can be found by formulating a probability on the joint-outcome that productivity will exceed the threshold level, defined by the firm's state variables, and last period's productivity realisation, estimated by using $\varphi t$. This is essentially a probit regression of the reform-realisation on last period's investment, age, and capital realisations.

The estimates for age and capital in (12) are obtained by minimising the squared errors in a non-linear search routine

(13) $$y_{it+1} - \beta_l l_{it+1} = \beta_a a_{it+1} + \beta_k k_{it+1} + \sum_{j=0}^{4-m} \sum_{m}^{4} \beta_{mj} h_{it}^{m} P_{it}^{j} + e_{it}$$

Where, $P_{it}$ was estimated in (10) and $h_{it}(i_{it}, k_{it}, a_{it}) = \varphi_{it} - \beta_0 - \beta_a a_{it} - \beta_k k_{it}$. Intercept shifts are allowed for each year, in order to take out any common trend.

## VI.5 Results

In this section the results of the regressions are reported. An important issue will be to determine whether reform in capital autonomy is a state, exogenous, or an enterprise level choice variable. To begin with, the reform status of an enterprise is treated as exogenous, or randomly assigned, i.e. as a state variable. In this context OLS and GLS within estimators are contrasted with the Olley-Pakes estimator, which corrects for possible simultaneity bias. The findings suggest that the Olley-Pakes 2-step productivity estimate is consistently and significantly larger for the set of reformed versus the unreformed enterprises after 1984. This suggests that the reform status of an enterprise may be endogenous to its productivity type. Hence, I progress by computing a predicted probability of being reformed in a probit model, and, using the Olley-Pakes 3-step framework, find productivity estimates, which are corrected for simultaneity and our selection to reform bias. By splitting the sample according to reform status, technology is implicitly allowed to vary across the sub-samples. This leaves consistently higher productivity estimates for our sample of deep reformers. The standard errors of the Olley-Pakes coefficients are bootstrapped and clustered by 2-digit industry odes.

Table VI.5.1 documents the descriptive statistics. Enterprises in the state of deep reform are bigger in terms of employment and capital. They produce more value added and invest more in capital. Turning to our estimates of the parameters of the production function in Table VI.5.2 I note that the OLS and GLS estimates for the co-efficient on labour are consistently higher than the Olley-Pakes first-stage estimates. Also, the OLS and GLS estimates for the co-efficient on capital are significantly lower than the Olley-Pakes second stage estimates. The coefficients on age and reform have a positive but lower impact on value-added in Olley-Pakes two-step estimates. Table VI.5.5 and VI.5.6 report aggregate productivity measures for each year aggregating over reformed and unreformed enterprises using our 2-step Olley-Pakes consistent estimates, where productivity is measured as $TFP_{it} = exp(y_{it} - \beta_l l_{it} - \beta_a a_{it} - \beta_k k_{it})$. Productivity in Table VI.5.6 is a weighted average of enterprise productivity, weighted by real value added. We clearly see that the reformed enterprises have larger productivity estimates, particularly in larger reformed enterprises.

This begs the question whether productivity may actually be endogenous to capital reform status. Thus, one can correct for this by computing the likelihood of being selected to reform as a result of being a higher productivity type. This is achieved by first computing a predicted probability of being reformed in a probit model, where reform status is regressed on a polynomial of $i$, $a$, and $k$, and time dummies. Time dummies capture the gradual change in the environment of the enterprise, namely the increasing willingness of the centre to relinquish control over time. The sample is split according to reform status. After estimating the labour coefficient for both sub-samples, one progresses by estimating coefficients for age and capital, equation (13), allowing non-parametrically for our theory of simultaneity and selection bias to back out, or control for, productivity.

In Table VI.5.7 we note that the coefficient for labour is significantly higher for the unreformed sub-sample. There is a stark difference in the capital coefficients for the two unbalanced panels. Reformers thus appear to get a greater rate of return from capital vis-à-vis the non-reformed sample. Interestingly, the age estimate for the reformed sample is higher for the unreformed vis-à-vis the reformed enterprises.

Table VI.5.8 and Table VI.5.9 addresses whether investment dynamics present in Chinese State Owned Enterprises are, at least ex-post estimation, correlated with

enterprise level productivity. We see that investment and productivity estimates at the enterprise level are positively correlated over-time in both sub-samples, though the correlation is larger for the reformed sample.

Table VI.5.10 and Table VI.5.11 again report unit and output weighted average aggregate TFP estimates. It seems clear that productivity for the reformers, after controlling for selection bias, is on average higher for the reformed enterprises vis-à-vis the unreformed enterprises. Thus, it appears that, while productivity influences the decision to undertake advanced reform, productivity is also higher for the reformed enterprises. Finally, in Figures VI.5.1 and VI.5.2 the estimates of productivity across reformed and non-reformed enterprises are compared, by graphing the log distributions computed from using a simple OLS model, 2-step and 3-step Olley and Pakes procedure. The imposed distribution allows us to easily compare productivity distributions across graphs. While the 3-step Olley and Pakes procedure produces lower productivity estimates, on average, across reformers and non-reformers, the difference between the reformed and non-reformed population is much more pronounced. It appears, that this highlights the importance of correcting for selection bias when one is evaluating the impact of reform on productivity dynamics. The adapted 3-step Olley and Pakes procedure allows us to do this with relative ease.

## VI.6 Conclusion

Using a unique balanced panel of 680 State-Owned Enterprises in the Industrial sector of China during the period 1980 to 1994 the effect of a set of capital reforms on the productivity dynamics of enterprises was estimated. These reforms include the granting of managerial autonomy in buying and selling capital, operating in international markets, and in making short- and long-run investment decisions. Consistent production function estimates were found using an adapted algorithm put forward by Olley and Pakes (1996), which allows one to control for simultaneity and (our innovation) selection to reform biases with relative ease. The conclusion of this analysis is that enterprises that exhibited better performance were more likely to be selected to this reform, but that exposure to capital reform, and hence competitive pressures, has induced further productivity improvements under state ownership, pre-privatisation.

## VI.7 TABLES

**Table VI.5.1 Summary Statistics for the Whole Sample, and Reformed & Non-Reformed Sub-Samples**

| Sub-Sample Variable | Whole Sample | | Non-Reformed | | Reformed | |
|---|---|---|---|---|---|---|
| Age | Obs | 10185 | Obs | 7287 | Obs | 2898 |
| | Mean | 27.04 | Mean | 24.93 | Mean | 32.32 |
| | Std. Dev. | 13.59 | Std. Dev. | 13.12 | Std. Dev. | 13.31 |
| Value Added | Obs | 9355 | Obs | 6650 | Obs | 2705 |
| | Mean | 1899.6 | Mean | 1659.9 | Mean | 2488.924 |
| | Std. Dev. | 3975.7 | Std. Dev. | 3777.5 | Std. Dev. | 4370.535 |
| Labour | Obs | 10025 | Obs | 7133 | Obs | 2892 |
| | Mean | 1719.5 | Mean | 1682.2 | Mean | 1811.5 |
| | Std. Dev. | 2705.5 | Std. Dev. | 2662.5 | Std. Dev. | 1992.9 |
| Capital | Obs | 9269 | Obs | 6618 | Obs | 2651 |
| | Mean | 2056.8 | Mean | 1813.473 | Mean | 2664.1 |
| | Std. Dev. | 4634.5 | Std. Dev. | 4100.22 | Std. Dev. | 5711.6 |
| Investment | Obs | 9344 | Obs. | 7062 | Obs | 2282 |
| | Mean | 316.0 | Mean | 09.82 | Mean | 335.09 |
| | Std. Dev. | 444.0 | Std. Dev. | 2573.0 | Std. Dev. | 1992.9 |
| Capital Autonomy Dummy | Obs | 10185 | Obs | 7287 | Obs | 2898 |
| | Mean | 0.28 | Mean | 0 | Mean | 1 |
| | Std. Dev. | 0.45 | Std. Dev. | 0 | Std. Dev. | 0 |

Notes : This table provides the summary statistics for the entire sample of, and sub-samples of non-reformed and reformed, enterprises of variables central to the analysis. All variables are in 10,000 Yuan, apart from Age (Years), Labour (average number of workers), and Capital Autonomy Dummy (equal to one if enterprise has undertaken reform at that time, and zero otherwise). Statistics reported are: the number of observations (Obs.) considered, and their mean score (Mean) and standard deviation (Std. Dev.) on that variable.

**Table VI.5.2 Alternative Estimates of Production Function Parameters Assuming Random Selection into an Exogenous State of Reform**

| Variable \ Estimator | (1) OLS | (2) GLS | (3) Two-Step Olley-Pakes |
|---|---|---|---|
| Labour[a] | 0.56*** | 0.83*** | 0.51*** |
| | (0.02) | (0.04) | (0.02) |
| Labour AND Hiring/Firing Autonomy[a] | - | - | 0.11*** |
| | | | (0.03) |
| Constant | -0.67*** | -1.92*** | -0.71*** |
| | (0.08) | (0.26) | (0.17) |
| Capital | 0.36*** | 0.19*** | 0.34*** |
| | (0.01) | (0.02) | (0.02) |
| Age | 0.25*** | 0.33*** | 0.16*** |
| | (0.02) | (0.05) | (0.03) |
| Capital Reform Dummy | 0.02 | 0.15 | 0.12*** |
| | (0.02) | (0.02) | (0.03) |
| Time Dummies | Yes | Yes | Yes |
| Fifth Order Polynomial Expansion in h | - | - | Yes |
| | | | $\chi 2$ (5) = 4,680 |
| Observations | 8,330 | 8,330 | 6,026 |
| R-sq | 0.56 | 0.55 | 0.95 |

Notes: The dependent variable in regressions (1) and (2) is the log of value added. The dependent variable in (3) is the log(Value Added) – $b_1$*log(Labour). Figures in brackets are standard errors. The Olley-Pakes 2-step standard errors are bootstrapped with 1000 replications, clustered by industry.

[a] In regression (3) these variables were estimated in a first step, where the log(Value Added) was the dependent variable. The regressors were the sum of Labour, the interaction term, and the polynomial in Age, Capital, and Investment.

**Table VI.5.3 Correlation Coefficients among Variables in the Reformed Sample**

| Correlation | TFP | Labour | Age | Capital | Investment |
|---|---|---|---|---|---|
| TFP | 1 | | | | |
| Labour | 0.06 | 1 | | | |
| Age | 0.01 | 0.17 | 1 | | |
| Capital | 0.09 | 0.75 | 0.11 | 1 | |
| Investment | 0.16 | 0.43 | 0.09 | 0.52 | 1 |

Note: This table reports the correlation coefficients in the reformed sub-sample among various variables used in the analysis

**Table VI.5.4 Correlation Coefficients among Variables in the Unreformed Sample**

| Correlation | TFP | Labour | Age | Capital | Investment |
|---|---|---|---|---|---|
| TFP | 1 | | | | |
| Labour | 0.09 | 1 | | | |
| Age | 0.11 | 0.2 | 1 | | |
| Capital | 0.10 | 0.82 | 0.14 | 1 | |
| Investment | 0.2 | 0.6 | 0.11 | 0.66 | 1 |

Note: This table reports the correlation coefficients in the un-reformed sub-sample among various variables used in the analysis

**Table VI.5.5 Unit-Weighted Average TFP from the 2-Step Procedure**

| | Unreformed Sample | Reformed Sample |
|---|---|---|
| Year | Mean TFP | Mean TFP |
| 81 | 1.22 | - |
| 82 | 1.32 | - |
| 83 | 1.69 | 1.64 |
| 84 | 1.58 | 1.14 |
| 85 | 1.76 | 2.01 |
| 86 | 1.87 | 2.22 |
| 87 | 1.94 | 2.07 |
| 88 | 2.35 | 2.56 |
| 89 | 2.18 | 2.35 |
| 90 | 2.22 | 2.66 |
| 91 | 1.89 | 2.47 |
| 92 | 1.72 | 2.59 |
| 93 | 2.06 | 2.71 |

Note: This table reports the unit-weighted average total factor productivity estimate generated by the 2-Step Olley-Pakes algorithm, by year, for reformed and un-reformed sub-samples.

**Table VI.5.6 Output-Weighted Average TFP from the 2-Step Procedure**

| | Unreformed Sample | Reformed Sample |
|---|---|---|
| Year | TFP*($y_i/\Sigma y$) | TFP*($y_i/\Sigma y$) |
| 81 | 1.43 | - |
| 82 | 1.52 | - |
| 83 | 2.05 | 1.80 |
| 84 | 1.81 | 1.22 |
| 85 | 2.01 | 2.28 |
| 86 | 2.13 | 2.55 |
| 87 | 2.20 | 2.29 |
| 88 | 2.72 | 2.84 |
| 89 | 2.49 | 2.64 |
| 90 | 2.57 | 3.03 |
| 91 | 2.15 | 2.85 |
| 92 | 2.03 | 2.98 |
| 93 | 2.47 | 3.20 |

Note: This table reports the output-weighted average total factor productivity estimate generated by the 2-Step Olley-Pakes algorithm, by year, for reformed and un-reformed sub-samples.

**Table VI.5.7 OP 3-Step Productivity Estimates with Endogenous ReformSelection**

| Variable \ Sample | (4) Reformed Sample | (5) Non-Reformed Sample |
|---|---|---|
| Labour | 0.44***<br>(0.05) | 0.52***<br>(0.02) |
| Labour AND Hiring/Firing Autonomy | 0.004***<br>(0.001) | 0.006***<br>(0.002) |
| Constant | - 0.31<br>(0.41) | -0.93<br>(0.51) |
| Capital | 0.38***<br>(0.04) | 0.47***<br>(0.03) |
| Age | 0.22*<br>(0.08) | 0.33***<br>(0.07) |
| Time Dummies | Yes | Yes |
| Third Order Polynomial Expansion in P & h | Yes<br>$\chi2$ (15) = 1,783 | Yes<br>$\chi2$ (15) = 3,415 |
| Observations | 1,083 | 4,543 |
| R-sq | 0.96 | 0.93 |

Note: The dependent variable in regressions (4) and (5) is log (Value Added) – $b_l$*log(labour). Olley-Pakes 3-step standard errors in brackets, bootstrapped with 1000 replications clustered by industry.

**Table VI.5.8 Correlation Coefficients among Variables in the Reformed Sample**

| Correlation | TFP | Labour | Age | Capital | Investment |
|---|---|---|---|---|---|
| TFP | 1 | | | | |
| Labour | 0.1 | 1 | | | |
| Age | -0.01 | 0.18 | 1 | | |
| Capital | 0.1 | 0.75 | 0.12 | 1 | |
| Investment | 0.17 | 0.43 | 0.09 | 0.52 | 1 |

Note: This table reports the correlation coefficients in the un-reformed sub-sample among various variables used in the analysis

**Table VI.5.9 Correlation Coefficients among Variables in the Unreformed Sample**

| Correlation | TFP | Labour | Age | Capital | Investment |
|---|---|---|---|---|---|
| TFP | 1 | | | | |
| Labour | 0.1 | 1 | | | |
| Age | -0.01 | 0.2 | 1 | | |
| Capital | 0.11 | 0.82 | 0.14 | 1 | |
| Investment | 0.05 | 0.6 | 0.11 | 0.66 | 1 |

Note: This table reports the correlation coefficients in the un-reformed sub-sample among various variables used in the analysis

**Table VI.5.10 Unit-Weighted Average TFP Estimates from 3-Step OP**

| | Unreformed Sample | Reformed Sample |
|---|---|---|
| Year | Mean TFP | Mean TFP |
| 81 | 0.32 | - |
| 82 | 0.34 | - |
| 83 | 0.41 | 2.31 |
| 84 | 0.39 | 1.2 |
| 85 | 0.42 | 1.7 |
| 86 | 0.44 | 2.71 |
| 87 | 0.44 | 2.48 |
| 88 | 0.52 | 2.62 |
| 89 | 0.48 | 2.65 |
| 90 | 0.48 | 2.73 |
| 91 | 0.40 | 2.66 |
| 92 | 0.35 | 2.78 |
| 93 | 0.42 | 2.71 |

Note: This table reports the unit-weighted average total factor productivity estimate generated by the 3-Step Olley-Pakes algorithm, by year, for reformed and un-reformed sub-samples.

**Table VI.5.11 Output-Weighted Average TFP Estimates from 3-Step OP**

| | Unreformed Sample | Reformed Sample |
|---|---|---|
| Year | TFP*($y_i/\Sigma y$) | TFP*($y_i/\Sigma y$) |
| 81 | 0.35 | - |
| 82 | 0.37 | - |
| 83 | 0.47 | 2.5 |
| 84 | 0.42 | 1.21 |
| 85 | 0.46 | 1.84 |
| 86 | 0.47 | 2.99 |
| 87 | 0.47 | 2.65 |
| 88 | 0.57 | 2.81 |
| 89 | 0.51 | 2.82 |
| 90 | 0.52 | 2.96 |
| 91 | 0.34 | 2.97 |
| 92 | 0.43 | 3.09 |
| 93 | 0.39 | 3.01 |

Note: This table reports the output-weighted average total factor productivity estimate generated by the 3-Step Olley-Pakes algorithm, by year, for reformed and un-reformed sub-samples.

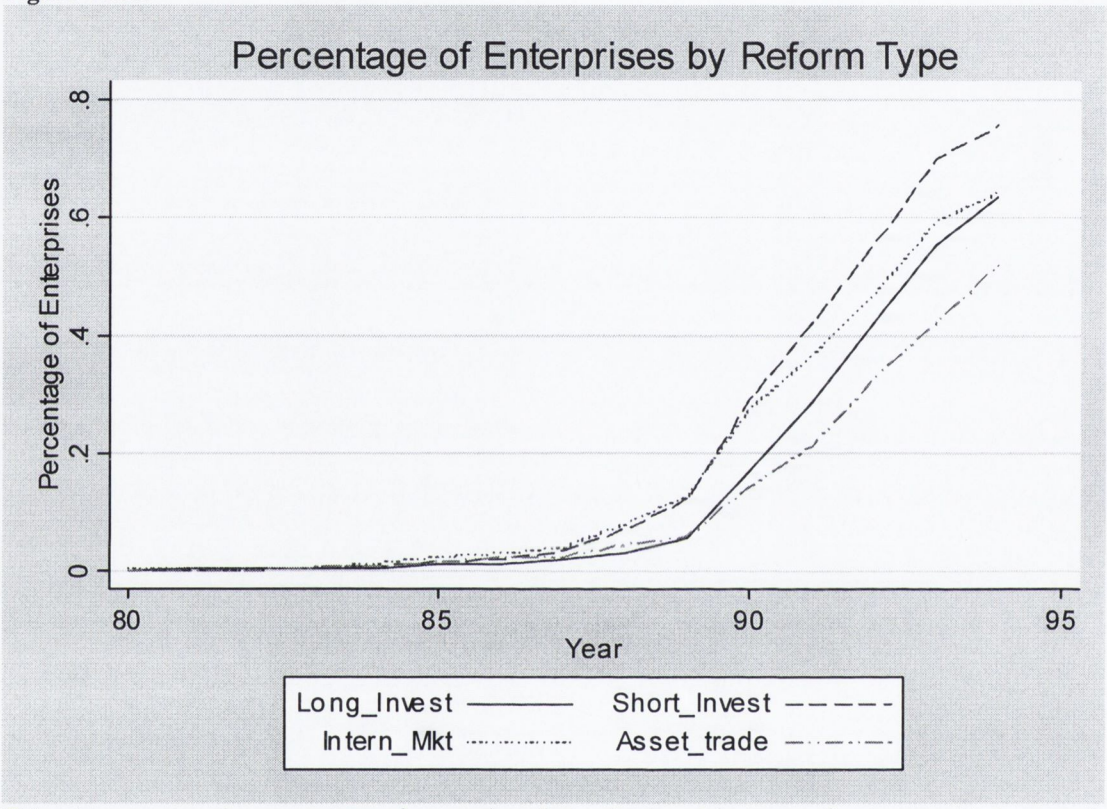
**Table VII.5.12 The Correlation of Total Factor Productivity Measures with Investment**

| Correlation | TFP OLS | TFP GLS | TFP OP |
|---|---|---|---|
| Investment | 0.15 | 0.13 | 0.19 |

Note: This table reports the correlation coefficients of investment with total factor productivity estimates generated by OLS (TFP OLS), GLS fixed effects (TFP GLS), and Olley Pakes (TFP OP) estimators. All variable are in logs.

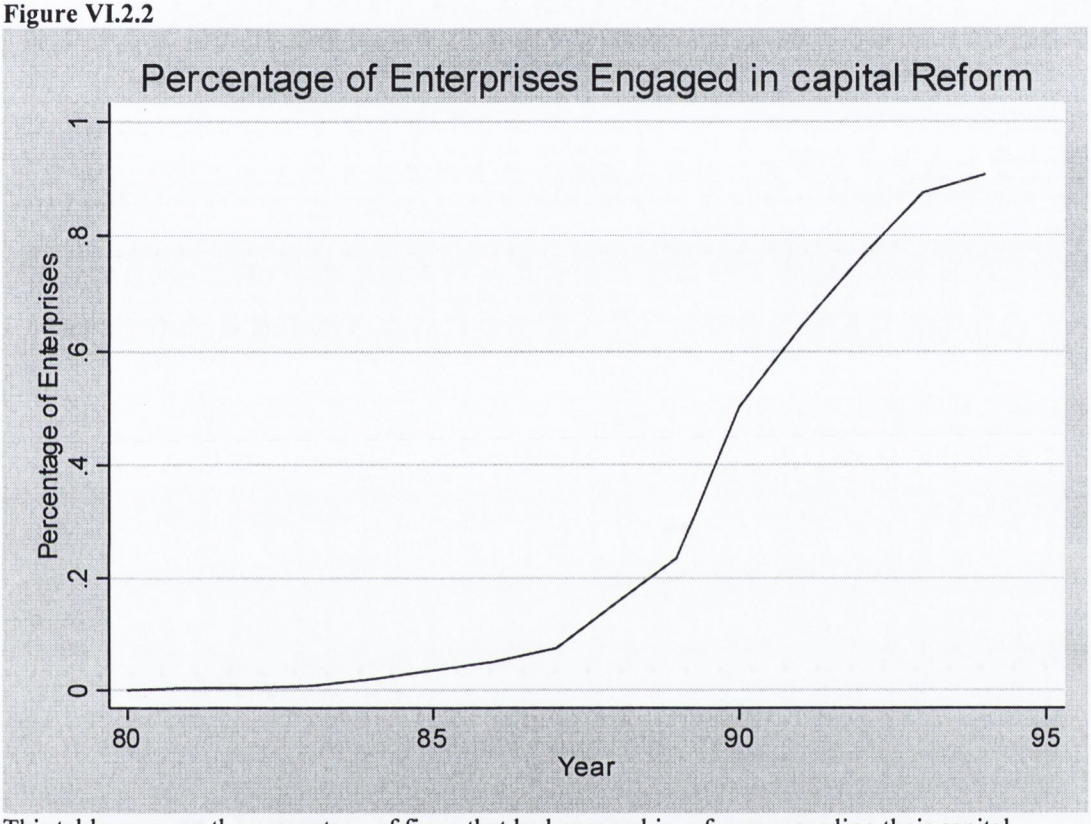
## VI.8 FIGURES

**Figure VI.2.1**



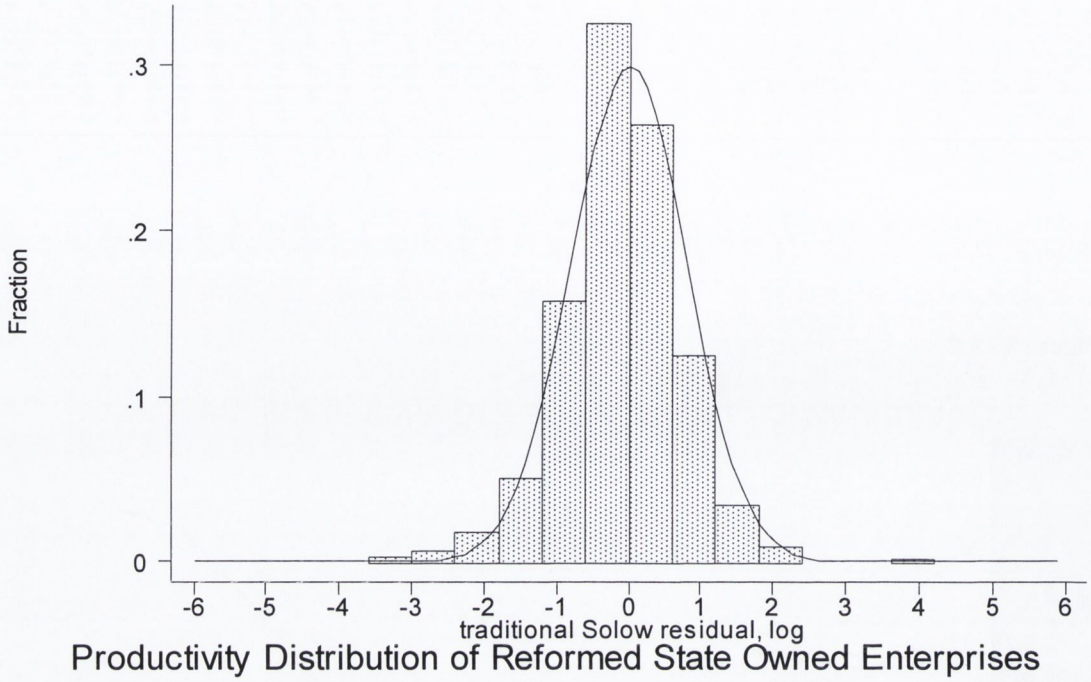

This table sums up the percentage of enterprises that gained certain types of autonomy [Autonomy in long-run investment (Long_invest), short-run investment (Short_invest), importing and exporting (Intern_Mkt), and buying and selling of assets (Asset_trade) over the 1980-1994 period.

**Figure VI.2.2**

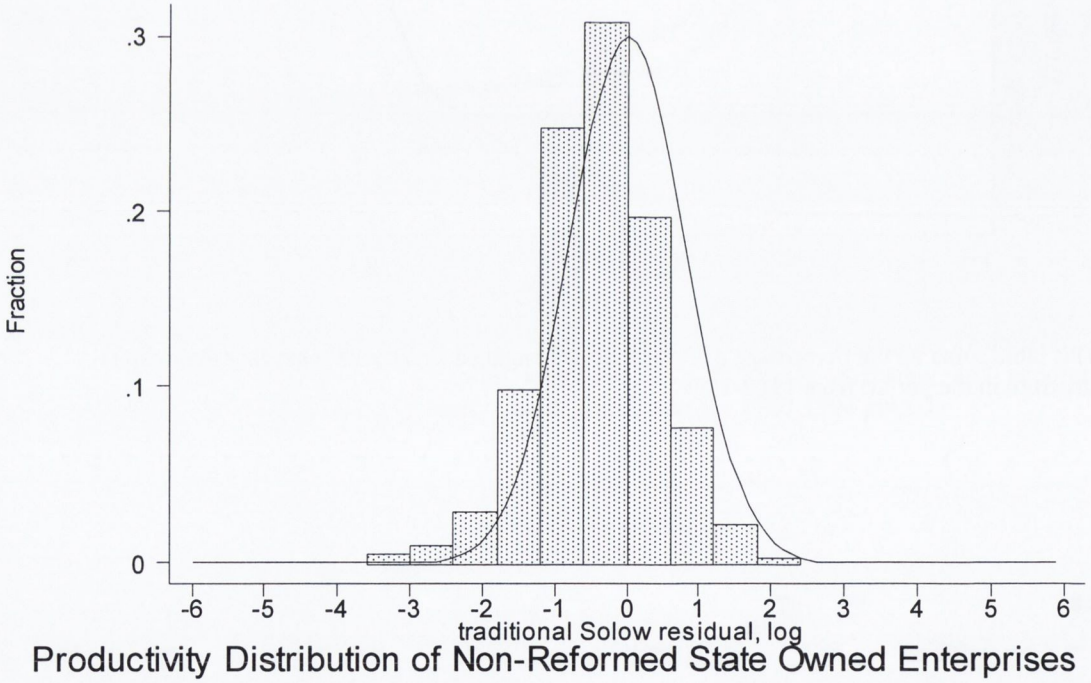



This table sums up the percentage of firms that had engaged in reforms regarding their capital structure in the period from 1980-1994.

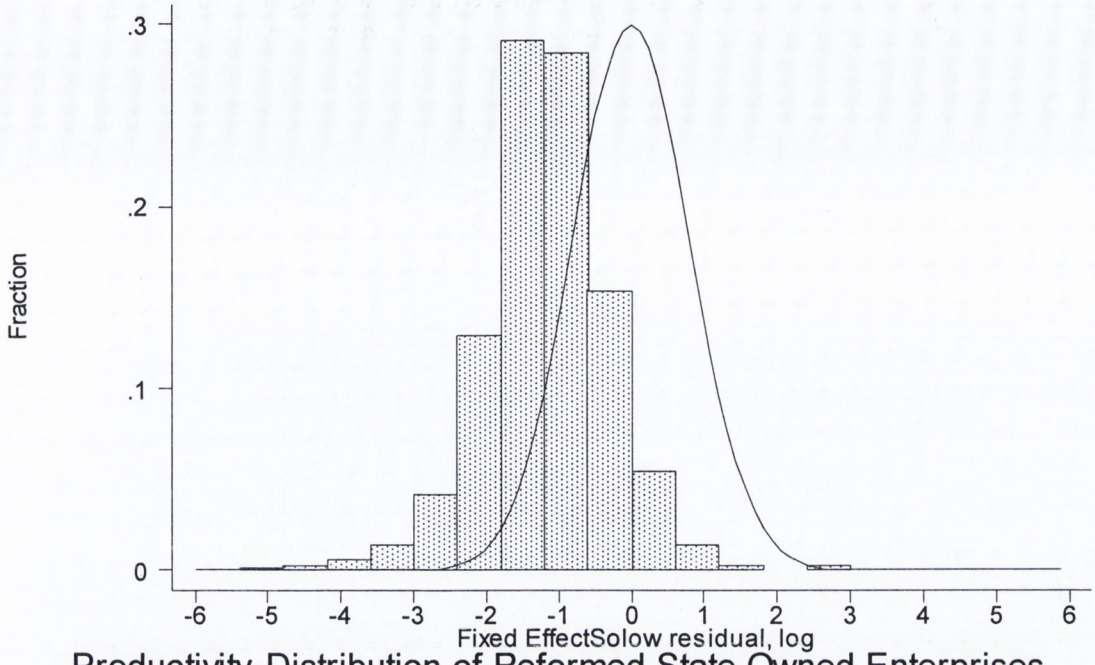
**Figure VI.5.1: Reformed versus Unreformed State-Owned Enterprises' Productivity Estimate Distributions (Estimated from OLS, GLS, and OP 2-Step Procedures, respectively)**



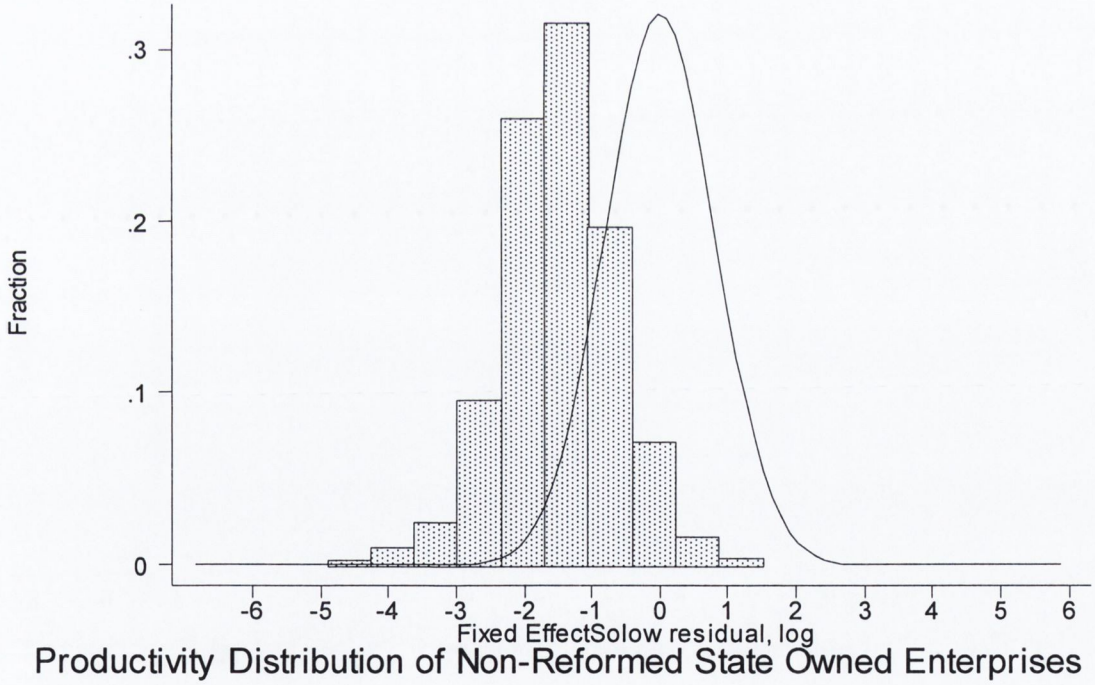

Productivity Distribution of Reformed State Owned Enterprises



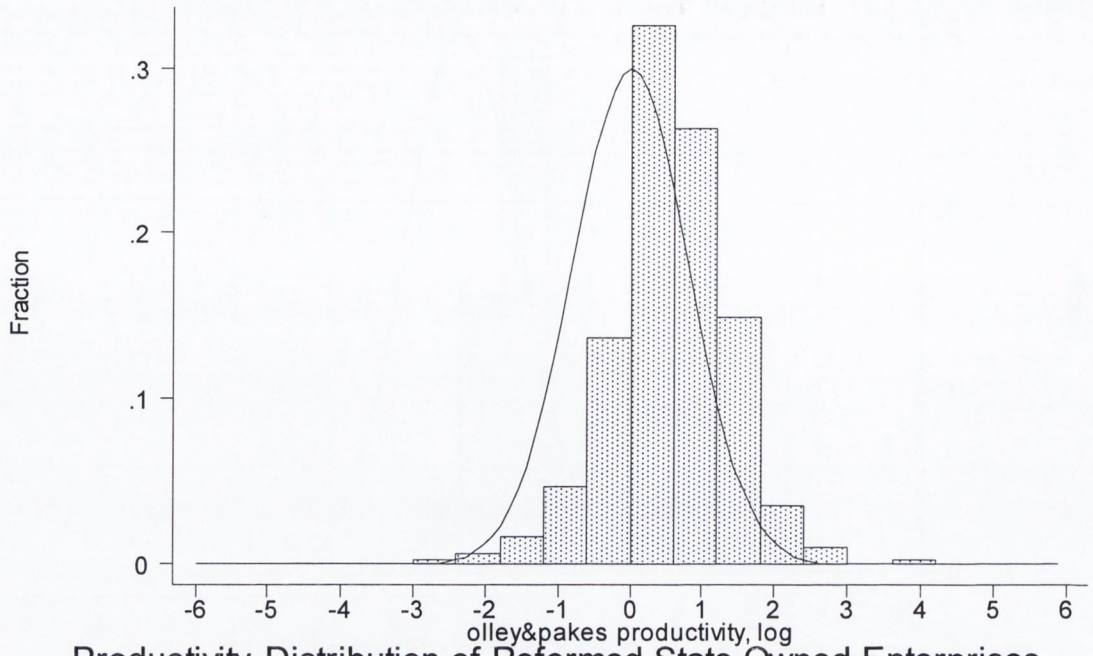

Productivity Distribution of Non-Reformed State Owned Enterprises



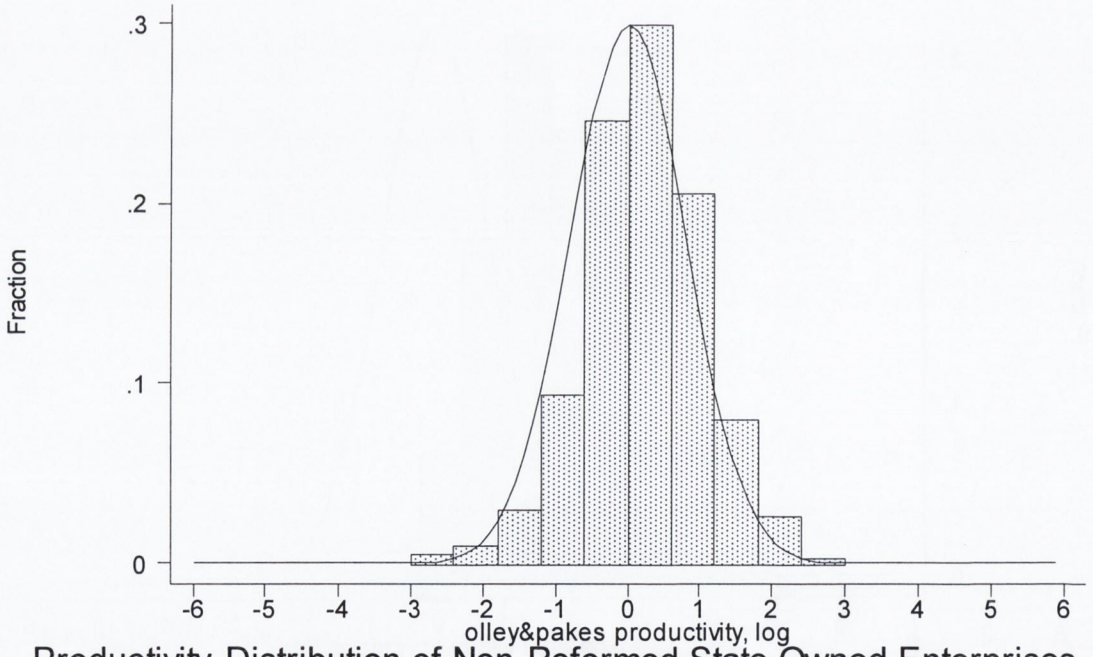

Productivity Distribution of Reformed State Owned Enterprises




Productivity Distribution of Non-Reformed State Owned Enterprises



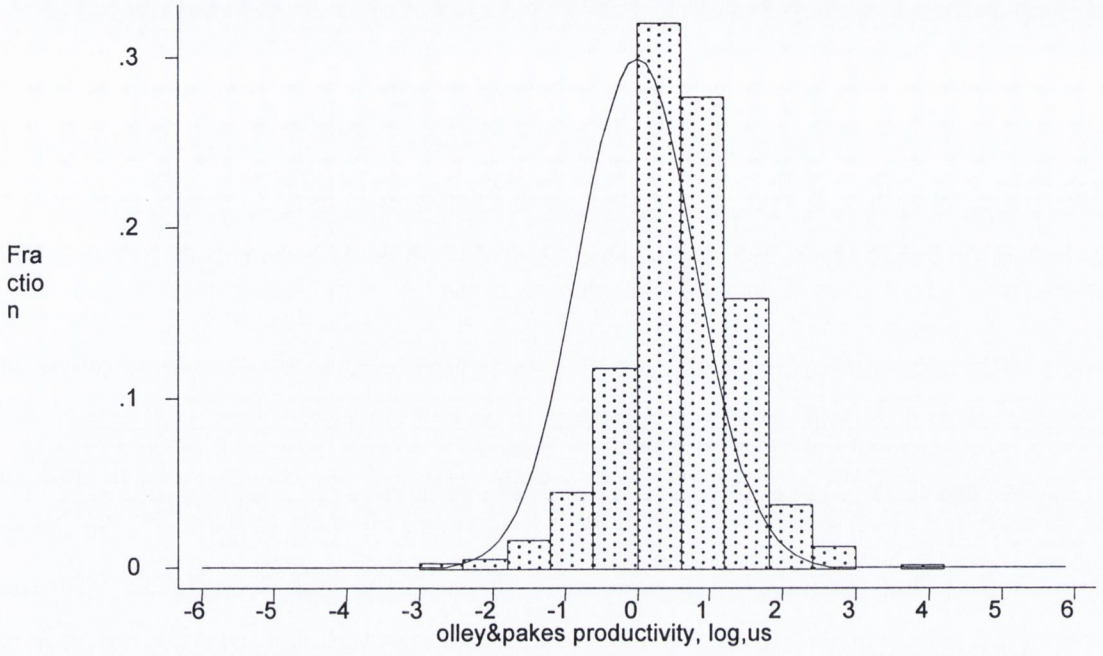

Productivity Distribution of Reformed State Owned Enterprises



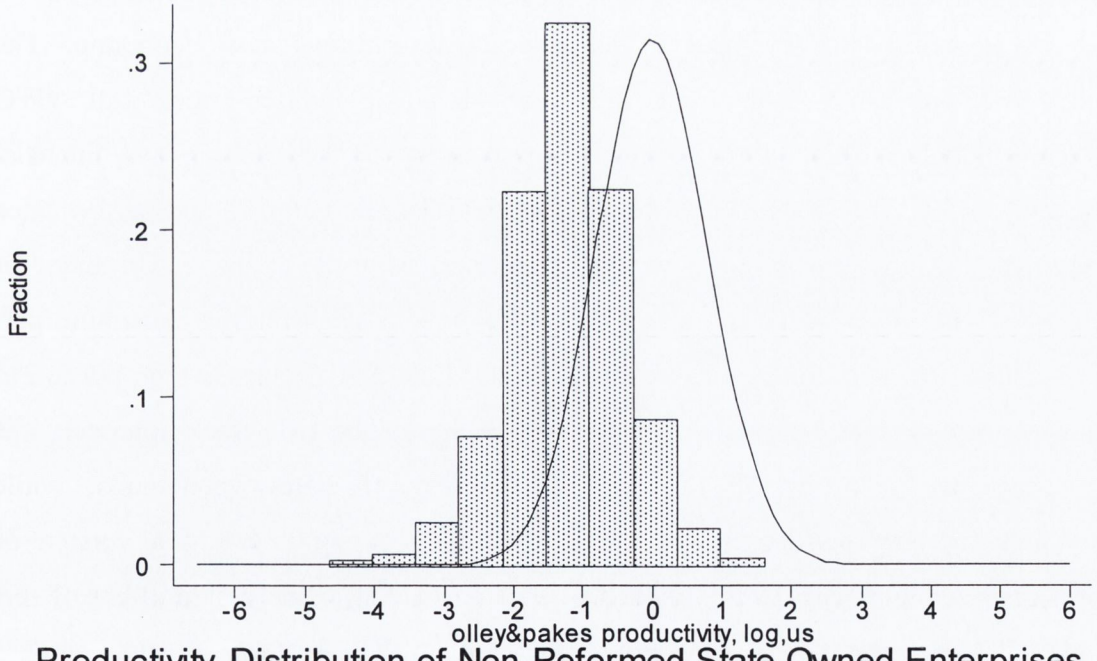

Productivity Distribution of Non-Reformed State Owned Enterprises

Note: This figure plots the distribution of the log of productivity estimates, generated by OLS, GLS fixed effects, and using the Olley-Pakes 2-Step procedure for reformed and non-reformed sub-samples. The 'Normal' curve is simply superimposed and centred on zero for illustrative purposes.

**Figure VI.5.2: Reformed versus Unreformed State-Owned Enterprises' Productivity Distribution Estimates from the OP 3-Step Procedure.**




**Productivity Distribution of Reformed State Owned Enterprises**




Productivity Distribution of Non-Reformed State Owned Enterprises

Note: This figure plots the distribution of the log of productivity estimates, generated by using the Olley-Pakes 3-Step procedure for reformed and non-reformed sub-samples. The 'Normal' curve is simply superimposed and centred on zero for illustrative purposes.

# VII. CONCLUSION

The object of this thesis has been an economic analysis of Chinese state-owned enterprises in the years from 1980 to 1994. In particular, this thesis has concerned itself with the impact of introducing managerial autonomy in crucial areas of operations on aspects such as enterprise performance, as well as the characteristics that coincide with soft budget constraints. To this end, surveys on 681 enterprises were combined, thus yielding a panel of data, 680 enterprises wide and fifteen years long. Central to this empirical analysis was the marriage of qualitative (institutional) data with quantitative (accounts) data. This feature allows the econometrician to identify otherwise unobserved enterprise characteristics.

The importance of the China to global affairs is no longer doubted, and its impact on the world economy in recent times has been felt in many ways, from rising commodity prices, to falls in the price of textiles. As she integrates further with the global economy, the effect on the rest of the world should increase. And, not only is China influencing the world but, in a truly *Daoist* way, China is being changed by its exposure to the world.

However, many obstacles remain, social, political and economic. The economic problems range from full international integration since full WTO membership has been gained, through improvement of the banking and financial system, to the very focus of this thesis: The need for restructuring and performance improvement of Chinese state-owned enterprises, as well as the enforcement of financial discipline on these units, which often have a slack budget constraint, part responsible for inefficiency of SOEs and directly linked to the massive proportion of non-performing loans by state-owned banks to these. The twin-track approach was described as a means of allowing restructuring of state-owned units, while encouraging new market activity, thus resembling to some extent a version of protected development. However, it has been noted that a likely side effect of this policy is to crowd out much-needed investment in the more dynamic private sector.

This thesis examined the initial period after 1978, from when on reforms were initiated. Note was taken of the fact that preparatory reforms had been implemented, such as decentralisation, price liberalisation, and the introduction of marginal incentives. However, partial reform, stopping short of full commitment, cannot be

successful. Rather, the final measures must be implemented, and usually these are associated with greater costs to those units that are lagging behind in the process. Thus, reforms bring about winners and losers; inequality and social tensions are often a corollary of this process.

The reforms under scrutiny here were concerned with labour and capital market reform, as well as the incidence of soft budget constraints. Thus, the background to the Chinese reform process was outlined in Chapter II. Then, details of the dataset, and corresponding summary statistics, were provided. Chapter IV focused on enterprise characteristics that could be associated with the likelihood of an enterprise receiving state aid. Chapter V considered the effect of the introduction of managerial autonomy in hiring and firing decision on enterprise performance and the wage bargaining process, while Chapter VI concerned itself with investment reform and enterprise productivity.

The key findings can be summarised as follows. Chapter IV focuses on soft budget constraints and the company characteristics associated with the likelihood of receiving state aid over two time-periods, the late 1980s and the early 1990s. Due to differences in the sampling frequency between dependent and independent variables, the effect of idiosyncratic shock is not measurable. However, systemic tendencies, such as policy directives for the granting of state aid, do appear to have crystallised during the analysis.

The most persistent feature is that enterprises with a large number of employees are more likely to receive state aid. This confirms common perceptions about SOEs in general, and is seen to be a specific feature of SBCs in particular, since the government is assumed to have an interest in maintaining employment levels, in order to avoid social unrest.

Further evidence of policy directives is the fact that geographic location and industry affiliation are largely significant in all probit regressions. Interestingly, we seem to witness a policy switch after 1989, since enterprises in poorer provinces were discriminated against in the late 1980s, while they are favoured for state aid in the early 1990s. Also, whilst only consumer goods industry enterprises appear to have been favoured in the late 1980s, this is extended to those engaged in raw materials, mining, plastics, and chemicals industries. There is further evidence of a change in policy directives around 1989, since those firms that have higher average wages and

larger pensions bills are less likely to receive state aid. This also applies to older enterprises in the early 1990s.

Surprisingly, value added, bonuses, and investment levels were all insignificant. However, this may be entirely due to the fact that these may be more indicative of an idiosyncratic type of event.

These findings are interesting, since they are indicative of systematic and strategic use of state aid to promote certain groups over others, whilst enterprises with undesirable characteristics such as high wages, which can be indicative of rent-seeking, or age, which often may signify obsolescence, are placed at a disadvantage. Obviously, maintaining high employment levels is still perceived to be a key strategic function of SOEs. The fact that age remains significant when pensions are considered indicates that age is not a good proxy for pensions burdens, as has been suggested in the literature.

In Chapter V, the relationship among value added and wage bonuses was considered, under the hypothesis that efficiency wages exist in Chinese SOEs. This is a similar topic to that in Groves et al. (1994) for the years 1980 – 1989. They conclude that bonuses were employed in an efficiency-enhancing manner. We considered a subset of the enterprises in their analysis, but only examine the period from 1990 – 1994. While the issue of wage flexibility remains central, we include a further important consideration in the analysis, namely that of flexibility in employment status. Thus, we control for two caveats of efficiency wage analysis: endogeneity among productivity and flexible wages, as well the threat of unemployment, which signifies an important structural change in the Chinese SOE labour market.

The structural reform considered is the granting of managerial autonomy in hiring and firing decisions. It appears that once this reform is taken into account, the relationship among wage bonuses and value added breaks down. Furthermore, once we control for endogeneity, by instrumenting for the wage variable, there is no significant relationship among value added and wage bonuses unless autonomy in hiring and firing is taken into account.

Hence, we appear witness a change in the wage bargaining process due to the reform in the labour market. The ratio of flexible wages to fixed wages decreases once the reform is implemented. This indicates that flexible wages, in the absence of employment uncertainty, were used as rent-seeking devices, especially since better

firms appear to have had higher levels of fixed wages relative to flexible wages. Also, managers with autonomy in hiring and firing should have more bargaining power in wage negotiations. It is noteworthy that this feature of increased wage discipline in the early 1990s is in line with the results of the previous chapter concerning SBCs.

Furthermore, once the change in the relationship of wage bonuses to productivity is taken into consideration, efficiency gains may also be attributed to this process itself, though an obvious flaw of this paper is that selection to labour reform is treated as exogenous, rather than formulating a selection rule for this particular aspect of reform.

Finally, capital market reforms, central to Chapter VI, appear to have brought about efficiency gains, even when correcting for the fact that well-performing enterprises are more likely to be selected to reform. In order to arrive at these conclusions one needs to assess firm performance by estimating dynamic productivity estimates. An algorithm, developed by Olley and Pakes (1996), was adapted to this particular setting, thereby dealing with two interrelated estimation biases, selection bias and simultaneity.

By simultaneity, firms of high productivity will also employ larger amounts of factors of production, thus leading to biases in the estimates for production function parameters, which, in turn, leads to a bias in the, unobservable, productivity estimate. Also, if firms are selected to reform based on their performance, then we incur sample selection bias. Therefore, the selection rule in Olley and Pakes (1996) was employed to deal with this issue. The results indicate that better performers were selected to capital reforms, and that once reformed, these enterprises improved in performance.

Summing up, it appears that Chinese Government is pursuing a discrete and cohesive reform strategy, which is selective in timing and sequencing. The effects attributed to the operational reforms considered lend support to this notion of cohesion in the reform process. Firms appear to be selected for progressive reforms on the basis of their performance, or ability to cope. Similarly, the general reduction in the number of enterprises that have received state aid is encouraging. Furthermore, the fact that, in the early 1990s, state aid appears to have been taken away from enterprises with undesirable characteristics, such as high wages or age, in favour of younger firms with less profligacy in wages or pensions is a point in kind. Thus, this truly reflects an active, cohesive, selective, and discrete industrial development policy.

On a note of more general economic significance, it appears that separating control from ownership of SOEs can indeed provide the necessary environment for significant performance improvements, without changing ownership. The combination of tighter budgetary discipline, linked with significant operational reforms, especially with regard to hiring, firing and investment, seems sufficient in this regard. Hence, the set of reforms considered in this thesis appear to have had real effects on the performance and internal organisation of enterprises, given that initial reforms were already in place. Yet, to answer the question of whether control or ownership is the more important for improving state-owned firms' performance, future research should focus on the effects of privatisation, which was only implemented in the years following 1994. Either way, ten years on in time, it is obvious that many issues to do with state-owned enterprises remain serious, and the concern of cataclysmic events occurring due to non-performing loans, once true international competitive pressure takes hold, is pervasive.

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# APPENDIX

## A.1 DATA CREATION

The following describes the data. First, the general features of the raw data are outlined, and then the method that generates the actual dataset used in the empirical analysis is detailed. The data are compiled from SOE surveys conducted by the Institute of Economics, Chinese Academy of Social Science (CASS), in consultation with a dozen economists from Michigan and Oxford Universities, as well as from the University of California, San Diego. These surveys are unique in detail and quality.

In total there are four individual sets of data, which can be subdivided into two different types of data. The first type is contained in two sets and contains quantitative information on individual enterprises, which is supplied, on an annual basis, by each enterprise's accountant. These data have been compiled from answers to two questionnaires over two time periods.

The first dataset ranges from 1980 to 1989, and the second ranges from 1990 to 1994. The earlier dataset contains 769 enterprises, while the latter dataset contains a subset of the enterprises represented in the first, namely 681 enterprises. Not all variables are present in both of these 'accounts' datasets. The quality of reporting and responses varies, as do the actual questionnaires. However, for the key variables used in our analysis, it is generally possible to construct a fifteen-year panel that is consistent.

The second type of data is qualitative in nature, since it deals with the institutional environment of the firm, and also comprises two sets. The data represent the answers of each enterprise's manager to a questionnaire in 1990 and 1995. Thus, the institutional questionnaires append the final year of the accounts questionnaires, and hence they each contain information on exactly those enterprises that were present in the respective antecedent accounts datasets. In general terms, the questions

Since some the questions posed have not remained identical, it is important a detailed account of how the variables in our dataset were constructed. Here, the features of the accounts questionnaires are described first, followed by an outline of the institutional ones.

The 1980-1989 quantitative questionnaire contains 321 questions which are subdivided into twelve categories, labelled *Output*, *Production Expenses*, *Wages*, *Labour and Personnel*, *Operations*, *Investment*, *Capital Accounts*, *Profit Accounts*, *Profit Retention and Enterprise Funds*, *Supplementary Materials*, *Costs of Main Products*, and *Other*.

The 1990-1994 accounts questionnaire contains 166 questions, which are subdivided into eight categories, *Output*, *Input*, *Wages*, *Financial Condition*, *Assets*, *Liability and Equity*, *Investment*, and *Utilisation of Capacity*.

The two institutional questionnaires are very similar. The 1990 questionnaire contains seventy questions in five categories. The one from 1995 has eighty-four questions subdivided into six sections. Both have sections entitled *Enterprise Characteristics*, *Contract and Management Appointment*, *Relations Between Enterprise and Its Supervisors*, *Internal Incentive Stem*, and *Management Characteristics*. The 1995 questionnaire has an extra section with the title *Property Rights and asset Structure*, although many of these questions were already present in the 1990 questionnaire.

The remainder of this section deals with the accounts questionnaires, and with how the variables were created from these, which now form our panel of 681 firms over the years 1980 through 1994.

Table A1 describes some of the firm characteristics that are constant. Each of the 681 firms has its own unique identifier, *ID*, in form of a firm identification number, ranging from 1 to 769. An enterprise's location, *loc*, is given by a three digit number, where the first number identifies the province a company resides in, and the last identifies the district in that province; the middle digit is a separator and is always zero.

A provincial variable, *prov*, was created from this, thus suppressing the last two digits of the location variable. The industry affiliation of an enterprise, *ind*, is indicated by its industry code, which is a number between one and forty. The year of operation, *Op_y*, is given by a two-digit number, which indicates the year in the twentieth century that a firm commenced its operation. Thus, subtracting *Op_y* from the year an observation is from leaves us with its age, *age*.

**Table A1: Firm Characteristics**

| Variable \ Dataset | Symbol | 1980-1989 | 1990-1994 |
|---|---|---|---|
| **Enterprise Identifier** | ***ID*** | Unique Identifier for each firm {1 - 769} | |
| **Location** | ***loc*** | Three digit number, first indicates province and last the district | |
| **Province** | ***prov*** | Single digit number, indicating the province the enterprise is located in. | |
| **Industry** | ***ind*** | Number from 0 – 40, indicating the industry the firm belongs to | |
| Operation Year | *Op_y* | Year from which an enterprise commenced operation | |
| **Age** | ***age*** | Current year – *Op-y* | |

Table A2 is concerned with the creation of our Real Value Added Variable, *rva*, which has been constructed from variables in the raw data and some deflators. Reported is the enterprise's value of output in present prices, *yn*, as well as in the prices of the base year for each dataset, namely 1980 and 1990, *yr*. In order to get a consistent series spanning 1980-1994 it was necessary to make use of the 1980-1989 real value of output series, and then apply a deflator, with 1980 as base year, to the present value of output 1990-1994 series. The deflator is the same one as used in Li and Wu (2002), and this procedure results in real value of output in 1980's prices, *y*.

In addition, there is information on the current value of raw materials consumed, *mn*. By making use of the prices of the primary inputs and the quantities they were used in, a firm-level material inputs deflator was generated. Thus, a variable was created, that gives us the value of raw materials consumed at 1980 prices, *m*. Subtracting this real raw materials variable from real output value, results in

a variable that measures the value added, *rva*, for each enterprise in each year in 1980 prices.

**Table A2: Real Value Added**

| Variable \ Dataset | Symbol | 1980-1989 | 1990-1994 |
|---|---|---|---|
| Nominal Output | *Yn* | Current Price Value of Output in 10,000 Yuan | Total Value of Gross Output of Enterprise (present Value) in 10,000 Yuan |
| Base Year Output | *Yr* | Actual Value of Output (1980 Fixed Prices) in 10000 Yuan | Total Value of Gross Output of Enterprise (based on 1990 value) in 10,000 Yuan |
| Output Deflator | *ydef* | Nominal Divided by Real | Output Deflator in 1980 Prices (Li & Wu, 2002) |
| Output | $y = Yn/ydef$ | Actual Value of Output (1980 Fixed Prices) in 10,000 Yuan | Nominal Output divided by 1980 prices Deflator in 10,000 Yuan |
| Materials | *mn* | Total Raw Material Consumption in 10,000 Yuan | Total Raw Material Consumption 10,000 Yuan |
| Material Deflator | *mdef* | Firm level raw material price index as calculated by Changqi, replaced by industry level deflator if missing. 1980 Base Year. | |
| Real Materials | $m = mn/mdef$ | Materials Divided by the 1980 Prices Material Deflator | |
| **Real Value Added** | $y = yr - m$ | **Real Output minus Real Materials** | |

Table A3 provides details of labour related variables. The labour variable itself, L, simply measures the number of employees the enterprise employed at year-

end. Wages, *w*, and bonuses, *b*, are reported at current prices. By constructing a deflator in 1980s prices, based on urban consumer price index figures from the *China Statistical Yearbook*, and dividing nominal wages and bonuses by this, results in values for real wages, *WR*, and bonuses, *BR*. By dividing these by the total number of employees average real wages, *AW*, and bonuses, *AB*, are obtained. The percentage of wages paid out in bonuses, *bw*, is simply the ratio of bonuses to wages.

**Table A3: Labour**

| Variable \ Dataset | Symbol | 1980-1989 | 1990-1994 |
|---|---|---|---|
| **Labour** | ***L*** | **Workers at Year End** | **Total Number of Employees** |
| Nominal Total Wage Bill | *W* | Total Wage in Current prices | Total Wage Bill in Current Prices |
| Nominal Total Bonus Bill | *B* | Total Bonuses in Current Prices | Total Bonuses in Current Prices |
| Real Wage | *WR* | *W* deflated by the Urban Consumer Price Index | *W/C.P.I.* |
| Real Bonus | *BR* | *B/C.P.I.* | *B/C.P.I.* |
| **Average Real Wage** | ***AW*** | ***WR/L*** | ***WR/L*** |
| **Average Real Bonus** | ***AW*** | ***BR/L*** | ***BR/L*** |
| **Percentage of Bonuses in Wages** | ***bw*** | ***B/W*** | ***B/W*** |

Table A4 contains information on how the real capital stock, *k*, and real investment, *i*, variables were created. The 1980 level of the real capital stock is given by the net capital asset position of each enterprise, *netk*. For every following year a new real capital stock value, which is given by the previous year's real capital stock, adjusted for firm-level depreciation, to which real investment is added, which is investment in 1980 prices.

Each of these constituent variables will be discussed in turn. Investment is deflated by a machinery output price index, obtained from the *China Statistical Yearbook*, with 1980 as base year, which yields Real Investment, *i*. Investment itself is given, where available, by productive fixed investment for the years 1980-1989. Where it is not available, which includes the years following 1989, the year on year change in productive capital is used.

Productive Capital, in turn, is given by the cumulative value, that is adding up receipts of purchases, of industrial production related fixed assets for all years. Firm level depreciation rates are obtained by dividing depreciation by the capital stock. For the years 1980 to1989 depreciation is defined as the year on year change in cumulative depreciation. For the years 1990 to 1994 depreciation of fixed assets for the year was employed. The Capital Stock is the cumulative value of fixed assets.

**Table A4: Investment and Capital Stock Variables**

| Dataset / Variable | Symbol | 1980-1989 | 1990-1994 |
|---|---|---|---|
| Net Capital | *netk* | Net Value of Fixed Capital, end of 1980 | N/a |
| Capital | *kn* | Fixed assets, at Purchase Price, year end | Original Price of Fixed Assets |
| Productive Capital | *kprodn* | Industrial Production Fixed Capital Part of Capital | Original Price of Industrial Production Fixed Capital Part of Capital |
| Depreciation | *deprn* | Net change in cumulative nominal depreciation, year on year in 10,000 Yuan | Depreciation of fixed assets of the year in 10,000 Yuan |
| Machinery Price Index | *mpi* | Machinery Output price Index | |
| Real Capital | *kr = kn/mpi* | Capital divided by 1980 based machinery output price index | |
| Real Depreciation | *depr = deprn/mpi* | Depreciation divided by 1980 based machinery output price index | |
| Depreciation Rate | $\delta = depr/kr$ | Depreciation divided by Capital | |
| Investment | *inv* | Productive Fixed Investment/Increment in Real Productive Capital | |
| **Real Productive Investment** | ***i = in/mpi*** | **Investment deflated by 1980 based machinery output price index** | |
| **Real Productive Capital Stock** | ***k*** | **1980** | **1981-1994** |
| | | $\mathbf{k_{80} = netk_{80}}$ | $\mathbf{k_{t+1} = k_t(1-\delta_t)+ i_t}$ |

Table A5 provides details of the various enterprise level reforms that involve the devolution of operational decision making to the managerial level.

**Table A5: Reform Variables**

| Variable \ Dataset | Symbol | 1995 Questionnaire |
|---|---|---|
| **Output Autonomy** | Output | Year from which had autonomy over output, its value, and daily regular decisions |
| **Hiring and Firing Autonomy** | Hire and Fire | Year from which had autonomy over employing and dismissing workers |
| **Import and Export Autonomy** | Export | Year from which had autonomy over exporting products and importing materials |
| **Short-run Investment Autonomy** | Investment_min2 | Year from which had autonomy over investment with a recovery period within two years |
| **Long-run Investment Autonomy** | Investment_max2 | Year from which had autonomy over investment with a recovery period above two years |
| **Autonomy over Buying and Selling Assets** | Buy and Sell Assets | Year from which had autonomy over the purchase and sale of assets |

Table A6 outlines the variables that are to capture a soft budget constraint. We source these variables from both institutional questionnaires. The core question asked of the manager is how important, on a scale from one, not so important, to five, very important, state financial aid has been over the last five years. The variable that marks a company as being of the SBC type or not, *sbc90* and *sbc95*, for the 1990 and 1995 questionnaires respectively, is a dummy variable, equal to one if the manager returned an answer greater than two. Otherwise it has value zero.

**Table A6: Soft Budget Constraint Variables**

| Variable \ Dataset | Symbol | Questionnaire |
|---|---|---|
| **Degree of Financial Aid from State in Years 1985-1989** | SBC90 | 1990: In your opinion, how important was financial aid from the state in the last five years? (1-5) |
| **Degree of Financial Aid from State in Years 1990-1994** | SBC95 | 1995: In your opinion, how important was financial aid from the state in the last five years?(1-5) |
| **Received Financial Aid from State in Years 1985-89** | sbc90 | 1990: sbc90 = 1 if SBC90 > 2 sbc90 = 0 if SBC90 ≤ 2 |
| **Received Financial Aid from State in Years 1990-94** | sbc95 | 1995: sbc95 = 1 if SBC95 > 2 sbc95 = 0 if SBC95 ≤ 2 |
| **Type of Aid from 1984-1989** | sbctype90 | 1990: Which type of financial aid did you receive? |
| **Type of Aid from 1989-1994** | sbctype95 | 1995: Which type of financial aid did you receive? |

## A.2 INDUSTRIES

A. Mining and Quarrying

1. Coal Mining and Processing

3. Ferrous Metals Mining and Processing

4. Non-ferrous Metals Mining and Processing

5. Non-metal Minerals Mining and Processing

8. Logging and transport of Timber and Bamboo

B. Manufacturing

10. Food Production

11. Beverage Production

12. Tobacco Processing

14. Textile Industry

15. Garments

16. Leather, Furs and Related Products

17. Timber Processing, Bamboo, Cane, Palm Fibre and Straw Products

18. Furniture Manufacturing

19. Paper Products

20. Printing

21. Stationary, Educational and Sports Products

22. Arts and Crafts

24. Petroleum Processing

25. Cooking Products

26. Chemical Products

27. Medical and Pharmaceutical Products

28. Chemical Products

29. Rubber Products

30. Plastic Products

31. Building Materials and Non-metal Mineral Products

32. Smelting and Pressing of Ferrous Metals

33. Smelting and Pressing of Non-ferrous Metals

34. Metal Products

35. Machinery

36. Transportation Equipment Manufacturing

37. Electric Equipment

38. Electronics and Telecommunication

39. Instruments, Meters, Cultural and Office Machinery

40. Other Manufacturing

C. Electricity, Gas and Water Production

9. Tap Water Production and Supply

23. Electricity, Steam and Hot Water Production

## A.3 PROVINCES

1. Jiangsu
2. Sichuan
3. Shanxi
4. Jilin