

Growing Like China

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Abstract

This paper constructs a growth model that is consistent with salient features of the growth process of China since 1992: high output growth, high investments with sustained return to capital, large reallocation within the manufacturing sector, low wage growth and accumulation of a large foreign surplus. The theory features only minimum deviations from a neoclassical growth model. Its building blocks are financial imperfections and reallocation between firms with heterogeneous productivity. Some firms use more productive technologies than others, but "bad" firms survive due to their better access to credit markets. Due to the financial imperfections, entrepreneurs must finance investments in their high-productivity firms out of their savings. If these savings are sufficiently large, the high-productivity sector outgrows the low-productivity sector, and attracts an increasing employment share. During the transition, low wage growth sustains the return to capital. The downsizing of the financially integrated sector forces a growing share of domestic savings to be invested in foreign assets, generating a foreign surplus.

JEL No .G18, O11, O16, O47, O53, P31.

Keywords: China, Economic Growth, Entrepreneurship, Financial Market Imperfections, Foreign Surplus, Investment, Loans, Productivity Heterogeneity, Rate of Return to Capital, Reallocation, State-Owned Firms.

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1 Introduction

Over the last thirty years, China underwent a spectacular economic transformation. This involved not only high economic growth and sustained capital accumulation, but also major changes in the sectoral composition of output, urbanization, and a growing importance of markets and entrepreneurial skills. In spite of high investments, there has been no evidence of declining returns to capital. Within the manufacturing sector – which accounts for a third of total GDP in China – labor reallocation from less to more productive firms has been an important source of productivity growth. If investment rates have been high, saving rates have been even higher: in the last fifteen years, China experienced a growing net foreign surplus. Its foreign reserves increased from 21 billion USD in 1992 (5% of its GDP) to 1700 billion USD in March 2008 (43% of its GDP).

The joint observation of high growth and high return on capital, on the one hand, and a large foreign surplus, on the other hand, is puzzling. A closed-economy neoclassical growth model would predict that the high investment rates should have led to a quick fall in the return to capital. An open-economy model would instead predict a large net capital inflow rather than a trade surplus, due to the high domestic return on capital. In this paper, we propose a theory of economic transition that can resolve this puzzle while being consistent with a number of stylized facts about the Chinese experience. The focal points of the theory are financial market imperfections and firms' reallocation. In our theory, the foreign surplus arises due to the reallocation of capital and labor towards young firms that are more productive, on the one hand, but less financially integrated, on the other hand. As the financially integrated sector shrinks, a larger proportion of the domestic savings is invested in foreign assets. Thus, high growth and high investments are consistent with the accumulation of a foreign surplus.

A premise of our theory is that low aggregate total factor productivity (TFP) in developing countries may be due to micro-level resource misallocation (see Parente, Rogerson and Wright, 2000, Caselli and Coleman 2002, Banerjee and Duflo 2006, Hsieh and Klenow, 2007, and Restuccia and Rogerson, 2007). While pockets of efficient firms using state-of-art technologies may exist, they fail to attract the large share of productive resources that efficiency would dictate, due to credit market imperfections. Therefore, a country with an initial severe misallocation has the opportunity to grow fast for some time if the engine of reallocation is ignited. The mechanism is similar to that of models of transition from agriculture to industry (see Lewis (1954) and more discussion below): efficient firms can count on a highly elastic supply of

factors attracted from the less productive firms. Thus, the transition is an investment-driven reallocation process during which returns to capital do not fall, since the supply of labor from the declining less productive firms limits wage growth. The reallocation itself sustains high aggregate TFP growth.

More formally, we construct a model where firms are heterogenous in productivity and their access to financial markets. High-productivity firms are operated by agents with entrepreneurial skills who are financially constrained and must rely on retained earnings to finance their investments. Low-productivity firms survive due to better access to financial markets. Thus, the growth of the high-productivity sector is limited by the extent of entrepreneurial savings. If such saving flow is sufficiently strong, the high-productivity sector outgrows the low-productivity sector, and attracts an increasing employment share. During a successful transition, wages grow less than GDP, and the low wage growth sustains the return to capital.

During the transition, the dynamic equilibrium has "AK" features: within each sector, the rate of return to capital is constant due to labor mobility and to the financial integration of one of the two sectors. Due to a composition effect, the aggregate rate of return on capital is actually increasing. Moreover, the country accumulates a foreign surplus. While investments in the expanding sector are financed by the retained earnings of entrepreneurs, wage earners deposit their savings with intermediaries who can invest them in loans to domestic firms and in foreign bonds. As the financially-integrated domestic sector declines, a growing share of the intermediated funds must be invested abroad, causing a growing foreign surplus. After the transition, the economy behaves like a standard neoclassical model where further capital accumulation is subject to decreasing returns.

Reallocation within the manufacturing sector – the driving force in our model – has been shown to be a source of first-order productivity growth in China. In an influential paper, Hsieh and Klenow (2007) provide a methodology to estimate the effect of resource misallocation across firms on aggregate TFP.¹ Applying their methodology to China, they conclude that reallocation accounted for an annual 1.4 percentage points increase in aggregate TFP during 1998-2005.² Thus, resource reallocation across firms seems to have contributed significantly to the recent economic performance of China.

Our theory has a number of auxiliary predictions consistent with the evidence of China's

¹Hsieh and Klenow (2007) show that in a frictionless economy a measure of TFP-revenue, defined as standard TFP multiplied by the relative price of the good produced, should be equalized across all firms. Thus, a larger variance of TFP-revenue indicates a more pronounced resource misallocation. See Acemoglu and Zilibotti (2001, p. 578) for a similar efficiency measure.

²Recent papers estimate the annual TFP growth in the manufacturing sector to be in the range between 1.4%-3% (Wang and Yao 2001, Young 2003, Islam *et al.*, 2006). Thus, reallocation may account for a large share of total TFP growth.

transition. We state here the main points, and defer a more detailed discussion of the evidence to section 2.

1. The theory predicts raising inequality within urban areas. This is due to wages growing less than entrepreneurial rents during the transition. Moreover, inequality should be higher in regions with a high density of entrepreneurial activity. We find both prediction to be consistent with the evidence for China.
2. The theory predicts that savings determine investments in regions with a high intensity of entrepreneurial firms, while investments should be unrelated to savings in regions dominated by financially-integrated firms.³ Consistent with this prediction, we find the time-series correlation between investments and savings to be significantly higher in Chinese provinces with a high employment share in private firms.
3. In the benchmark model, TFP is the only dimension of technological heterogeneity across firms. We extend the theory to a two-sector model where firms can specialize in the production of more or less capital intensive goods. This extension bears the prediction that financially constrained firms with high TFP will specialize in labor-intensive activities (even though they have no technological comparative advantage). Thus, the transition proceeds in stages: first low-productivity firms retreat to capital-intensive industries, and then they gradually vanish. This is consistent with the dynamics of sectoral reallocation in China, where young high-productivity private firms have entered extensively in labor-intensive sectors, while old state-owned firms continue to dominate capital-intensive industries.

The theory is related to the seminal work of Kuznets (1957, 1966 and 1973) and Chenery and Syrquin (1975) who emphasize different features of economic transitions. In the same vein, Lewis (1954) constructs a model of reallocation from agriculture to industry where the supply of labor in manufacturing is "unlimited" due to structural overemployment in agriculture. While his mechanism has some similarity with ours, productivity increases in his model rely on some form of hidden unemployment in the traditional sector. Lewis' theory captures aspects of the reallocation between rural and urban areas in China, while our focus is on the reallocation within the industrial sector and on the accumulation of foreign reserves. Other papers focusing

³Our model has a mixture of closed- and open-economy features. In a closed-economy environment, savings and investments are perfectly correlated, whereas in open-economy models they are unrelated. A region with a large share of entrepreneurial firms behaves as a closed economy in that savings determine investments.

on the transition from agriculture to industry include Fei and Ranis (1961 and 1964), Takayama (1965), Laitner (1990) and Matsuyama (1992).

Our paper is also related to Ventura (1997), who shows that in economies engaging in external trade capital accumulation is not subject to diminishing returns, since resources are moved from labor-intensive to capital-intensive sectors. Due to international trade, the excess production of capital goods is exported rather than lead to falling prices, thus returns to capital do not fall. Ventura's model does not imply any initial inefficiency, and a different (testable) implication of the two mechanisms is that in our model TFP growth is associated – at the industry level – with the speed of reallocation across firms with different initial TFP. In addition, his model has no implications about trade imbalances.

Matsuyama (2004, 2005) show that financial frictions may induce trading economies to specialize in industries where they do not have a technological comparative advantage. In our model, by a similar mechanism, less efficient firms can survive and even outgrow more productive firms. Moreover, one of our extensions has the feature that financial constraints generate comparative advantage and specialization of the more productive firms in labor-intensive industries in spite of the lack of any technological comparative advantage. Other models of transition and non-balanced growth include Acemoglu and Zilibotti (1997), Kongsamut, Rebelo and Xie (2001), and Acemoglu and Guerrieri (2006). Matsuyama (2007) provides a survey of the literature on economic transition.

A few recent papers address the question of why China is accumulating a large foreign surplus. Most papers emphasize the high saving rate in China. Kuijs (2005) shows that household, enterprise and government saving rates in China are 11.8, 8.6 and 7.9 percentage points higher than those in US, respectively. Demography, the lack of social security and an imperfect financial sector are among the factors proposed as explanations for high savings in China (e.g. Kraay, 2000). However, it remains unclear why domestic savings are not just invested domestically given the high rate of return to capital in China. Mendoza, Quadrini and Rios-Rull (2007) argue that this may be due to differences in financial development inducing savers in emerging economies to seek insurance in safe US bonds (see also Caballero, Farhi and Gourinchas, 2006). Dooley et al. (2004) propose a strategic "political" motive: the Chinese government would influence wages, interest rates and international financial transactions so as to foster employment and export-led growth.

The paper is organized as follows. Section 2 describes some empirical evidence for China since 1992 that motivate our analysis. Section 3 describes the benchmark model and characterizes equilibrium. Section 4 discusses the effect of financial development. Section 5 presents two

extensions focusing, respectively, on regional shocks to savings and specialization of different firms in labor- or capital-intensive production. Section 6 concludes. An appendix contains some technical results.

2 The transition of China: empirical evidence

After thirty years of central planning, China introduced its first economic reforms in December 1978. The early reforms reduced land collectivization introducing the principle of household responsibility in agriculture, and increased the role of local governments and communities. Subsequently, the government established some Special Economic Zones where legal conditions were designed to attract foreign investments. During the 1980s, China became a mixed economy, with some elements of planning and others of market economy. Its economic growth was high but volatile. The end of the decade was shaken by economic slowdown and political unrest, which raised concerns about the sustainability of reforms.

A new stage of the reform process was launched in 1992, inaugurated by Deng Xiaoping's "southern tour", during which the old leader spoke up in favor of an acceleration of reforms. Under Jiang Zemin's leadership, China moved towards a full-fledged market economy. The role of the state in allocating resources decreased, and many unprofitable enterprises were shut down. The economic performance remained strong, and became more stable. Figure 1 shows the evolution of GDP per capita in China relative to the United States since 1970. It is clear that convergence picked up in 1979 and accelerated since the early 1990s.

FIGURE 1 HERE

The focus of this paper is on the post-1992 Chinese transition, characterized by sustained growth, high return to capital, changes in income distribution and a pronounced resource reallocation within the manufacturing sector. In the rest of the section we document these changes.

FIGURE 2 HERE

The average investment-GDP ratio was high stable throughout the 1990s (with an average of 34% in the period 1993-2002) and increased thereafter, reaching 52% in 2006 (source: China Statistical Yearbook). The rate of return to capital was sustained at a high level. Figure 2 reports the average rate of return on capital and the total profits per unit of capital in secondary industries (manufacturing, construction and mining) as from the estimates of Bai, Hsieh and Qian (2006, Table 1) and from official statistics, respectively. The aggregate return to capital decreased from 28% in 1993 to 17.5% in 2001, but increased thereafter, reaching 21% in 2005. Bai, Hsieh and Qian (2006, Figure 11) also report that the rate of return on capital in the secondary industries was close to 30% and increasing over time, in line with the evidence on rising profit rates in secondary industries in Figure 2. These high corporate returns have not been matched by the return on financial assets available to individual savers: the average real rate of return on bank deposits, the main financial investment of Chinese households, has been close to zero during the same period.⁴ Wage growth has been lower than growth in output per capita in recent years. The average real annual growth of wages in the urban manufacturing sector was 7.5% from 1992 to 2004, substantially below the average growth rate in real GDP per capita during the same period, 8.9%.⁵ Similarly, the labor share of aggregate output fell from 50% in 1992 to 41% (see Bai, Hsieh and Qian 2006, Table 1). The falling labor share has contributed to rising inequality even across urban households (see Benjamin *et al.* 2005).

FIGURE 3 HERE

The reallocation within the manufacturing sector is a focal point of our paper. Figure 3 shows the private employment share in manufacturing, mining and construction, including both DPE and foreign-owned enterprises.⁶ In 1994, private enterprises accounted for about 10% of total employment. By 2006, their share went up to 80%. DPE (which account for the lion share of private employment) and SOE differ in two important aspects: productivity and access to financial markets. SOE are on average less productive and have better access

⁴More precisely, the average one-year real deposit rate from 1992 to 2006 is -1.5%. Nominal deposit rates are calculated at the end of each year. Real deposit rates are obtained by subtracting the GDP deflator from nominal deposit rates. Data source: China Yearbook of Statistics, various issues.

⁵We report the average annual real wage growth of urban manufacturing staff and workers. Data source: Banister (2007, Table 10), based on China Labor Statistical Yearbook 2005.

⁶The disaggregation of manufacturing employment into DPE and foreign-owned enterprises is not available. When considering data on economy-wide employment, the employment share of DPE is about five times as large as that of foreign firms in 2005, according to official statistics.

to external credit than DPE. This makes ownership structure a natural proxy for the different types of firms in our theory. Figure 4 shows a measure of profitability, i.e., the ratio between total profits ("operation profits plus subsidies plus investment returns") and value of fixed assets net of depreciation. The gap between DPE and SOE is about 9 percentage points per year. A similar gap is reported by Islam et al. (2006). An important concern with these official Chinese statistics is that the ownership classification is based on the ownership at the time of initial registration. However, many firms have subsequently been privatized. This problem is overcome by a recent study of Dollar and Wei (2007) using data from a survey of a stratified sample of 12400 firms, classified according to their current ownership. They find that the average return to capital was twice as high in private firms than in fully state-owned SOE (see Table 6 p. 23). Similarly, Hsieh and Klenow (2007) estimate the TFP gap (adjusted by relative prices) between DPE and SOE to be 42%.⁷

FIGURE 4 HERE

FIGURE 5 HERE

A centerpiece of our analysis is financial market imperfections. In an international comparative study of the Chinese financial system, Allen, Qian and Qian (2005) find that China scores low in terms of creditor rights, investors protection, accounting standards, non-performing loans and corruption.⁸ As a result of financial imperfections, Chinese firms rely heavily on corporate savings to finance investments and running costs. Moreover, there is evidence that credit markets discriminate against private firms. One reason for this might be that the main Chinese banks are also state owned: Boyreau-Debray and Wei (2005) document that state-owned banks tend to offer a preferential treatment and easier credit to SOE. As a result, SOE can finance a larger share of their of investments by external financing, in particular bank loans and government transfers. Figure 5 shows that SOE finance more than 30% through bank loans vs. less than 10% for DPE. Similarly, Dollar and Wei (2007, Table 3.1, p.21) show

⁷Perhaps surprisingly, all studies document that collectively owned firms have a very high productivity. Dollar and Wei (2007) conjecture that this may be due to an underevaluation of their physical assets.

⁸Interestingly, some reforms of the financial system have been undertaken, including a plan to turn the four major state-owned commercial banks into joint-stock companies. This effort involves inviting foreign investors to advise about how to improve the managerial efficiency of banks (Kwan 2006). In section 4 we discuss the role of financial development during the economic transition.

that private firms have less access to bank financing and rely more on retained earnings and family/friends networks to finance investments.

Another symptom that DPE are more financially constrained is their low capital intensity. Both capital-output and capital-labor ratios are substantially lower in DPE than in SOE. In 2006, for instance, the average capital-output ratio in SOE was 1.75 vs. 0.67 in DPE (source: China Statistics Yearbook 2007). In the same year, the capital per worker was almost five times larger in SOE than in DPE, although part of this difference can be attributed to the higher average educational attainment of SOE workers. This gap has two sources. First SOE are more capital intensive within each industry, as shown in Figure 6. Panel 6.1 shows the capital-output ratio by ownership structure within three digit manufacturing industries. Panel 6.2 shows the corresponding capital-labor ratio. Both graphs show that SOE use more capital intensive technology, which is in line with the view that DPE are more financially constrained.

FIGURE 6 HERE

Second, DPE have expanded more in more labor-intensive industries, while the share of SOE remains high in capital-intensive industries. Thus, the Chinese transition seems to be characterized by a progressive retreat of SOE from labor-intensive industries. This specialization contributes to explain the lower aggregate capital-output ratio of DPE. To document this pattern, we classify 3-digit manufacturing industries by the capital-labor ratio in US industries in 1996 (we do not classify them according to capital-labor ratios in China in order to avoid an endogeneity problem).⁹ We then match the industries listed by the China Industrial Economy Statistical Yearbook (CIESY 2002, 2003 and 2004) to the SIC codes.¹⁰ This leaves a total of 27 industries. Figure 7 plots the SOE share of total employment across industries of different capital-intensity (average between 2001 and 2003). Clearly, SOE are significantly more represented in industries that are more capital intensive in the US. For instance, the SOE employment share in the ten most capital-intensive industries is 57%, while in the ten least capital-intensive industries it is 26%.

⁹The U.S. data are from NBER-CES Manufacturing Industry Database, available at <http://www.nber.org/nberces>.

¹⁰Among 31 industries in CIESY, 18 of them fit industries at the SIC 2-digit level, and 9 can be matched to industries at the SIC 3-digit level. There is no match between CIESY and the SIC for the remaining 4 industries. Details are available upon request.

FIGURE 7 HERE

Our theory predicts, in accordance with the evidence above, that financially integrated firms have a higher capital-output and capital-labor ratio than high-productivity financially constrained firms (Lemma 1). Moreover, in an extension in section 5.2 we allow firms to specialize in the production of more or less capital-intensive goods. The main prediction there is that during the transition financially constrained firms will first expand in the labor-intensive and only later enter the capital-intensive industries (see Lemma 3). Thus, our theory is consistent with the evidence that in the middle of the transition SOE are present in capital-intensive industries but retreat from labor-intensive industries.

One of the main concerns of the economic transition of China – which was already mentioned above – has been the increasing inequality. For instance the Gini coefficient for income was about 0.47 in 2004, up from 0.36 in 1992. A natural question is whether the privatization of the economy has contributed to the rising inequality. This is what our theory would predict, due to the sluggish wage growth and rapid growth of entrepreneurial rents. The pattern of income inequality across regions can offer some insight. We classify Chinese provinces by the extent of penetration of private firms measured by the percentage of employees in DPE over total employees in all industrial enterprises. Figure 8 shows a high positive correlation between the Gini coefficient at the provincial level in 2006 and the employment share of DPE: provinces with more private firms have a substantially higher income dispersion. Although this does not prove any causal relationship, this correlation is nevertheless interesting.

FIGURE 8 HERE

3 Theory

3.1 Household Sector and Banks

The model economy is populated by overlapping generations of two-period lived agents who work in the first period and live off savings in the second period. Preferences are parameterized by the following time-separable logarithmic utility function

$$U_t = \log(c_{1t}) + \beta \log(c_{2t+1}),$$

where β is the discount factor. Agents have heterogenous skills. Each cohort consists of a measure N_t of agents with no entrepreneurial skills (*workers*), and a measure μN_t of agents with entrepreneurial skills (*entrepreneurs*).¹¹ The population grows at the exogenous rate ν , hence, $N_{t+1} = (1 + \nu) N_t$.¹²

Young workers earn a wage, w , and deposit their savings with intermediaries (*banks*) that pay a deposit rate, R^d . They choose savings so as to maximize utility subject to an intertemporal budget constraint, $c_{1t}^w + c_{2t+1}^w/R^d = w_t$. This yields the optimal saving, $s_t^w = \beta/(1 + \beta) w_t$. Young entrepreneurs run private firms and earn an entrepreneurial compensation, m_t . Like the workers, they can deposit their savings with banks but can, in addition, invest in their own business.

There exists a set of competitive intermediaries, called *banks*. They collect savings from households and hold portfolios consisting of loans to domestic enterprises and foreign bonds paying a gross return R . Competition implies that $R^d = R$. In this section, we assume financial intermediation to be costless, thus the borrowing rate for domestic firm is $R^l = R$. In section 4 we augment the model with intermediation costs and study financial development.

3.2 Production Sector

There are two productive sectors, labeled as the E (*entrepreneurial*) sector and the F (*financially integrated*) sector. These sectors produce identical goods, but differ in technology and access to capital markets. Firms in the E sector need to be operated by entrepreneurs and have a higher TFP, reflecting higher knowledge or organizational capital. However, they are subject to financial constraints. In particular, entrepreneurs have limited access to bank loans, and must finance most of their investments out of personal savings. The F sector needs no entrepreneurs, has a lower TFP but can borrow from banks.¹³ This advantage in the credit market keeps F firms alive in spite of their lower efficiency. In this section, we make the extreme assumption that entrepreneurs cannot borrow at all from banks. In an extension, we relax this assumption, and allow entrepreneurs to obtain bank loans. However, entrepreneurs can only pledge a fraction of their revenue as repayment, and thus can only finance a fraction

¹¹Lower case will denote per-capita or firm-level variables. Upper case will denote aggregate variables.

¹²The rate ν captures demographic trends, including migration from rural to urban areas (assumed to be exogenous, for simplicity). Since 1990 the average annual population growth rate in China has been 0.7% and the annual growth of the urban-rural population ratio has been about 3.3% per year.

¹³In the application to China, we think of F firms as state-owned firms and E firms as private firms. While in the model banks are assumed to behave competitively - which is for simplicity - the Chinese banking sector is largely state owned. This has been argued to be a source of preferential treatment towards state-owned firms (see, e.g., Boyreau-Debray and Wei, 2005). This is one motivation for why in the model banks lend to F firms and not to E firms.

of their investments through external funds.

In each sector, technology is described by a Cobb-Douglas production function with constant returns to scale. More formally,

$$y_{Jt} = (A_{Jt})^{1-\alpha} k_{Jt}^\alpha (n_{Jt})^{1-\alpha},$$

for $J \in \{E, F\}$, where n denotes labor, k is capital and

$$A_{Jt+1} = (1+z) A_{Jt},$$

where $(A_{Jt})^{1-\alpha}$ denotes TFP.¹⁴ TFP is assumed to be higher in the E-sector, but to grow at the same rate, z , in both sectors. We denote by $\chi \equiv A_{Et}/A_{Ft} > 1$ the TFP gap. Capital depreciates fully after one period. We denote by ρ_J the rate of return to capital in sector J , and by $\kappa_J \equiv k_J/(A_J n_J)$ the capital per effective unit of labor. We drop time subscripts when this is no source of confusion.

The F sector finances its investments through bank loans. In a competitive equilibrium, the borrowing rate, R^l , pins down the marginal product of capital in the F sector. Thus, $\rho_F = \alpha \kappa_F^{\alpha-1} = R^l$, implying

$$\kappa_F = \left(\frac{\alpha}{R^l} \right)^{\frac{1}{1-\alpha}}. \quad (1)$$

Profit maximization implies that wages equal the marginal product of labor,

$$w_t = (1-\alpha) \kappa_F^\alpha A_{Ft} = (1-\alpha) \left(\frac{\alpha}{R^l} \right)^{\frac{\alpha}{1-\alpha}} A_{Ft}. \quad (2)$$

Since κ_F is constant, the wage grows at the rate of technical change, z , as long as employment in the F sector is positive. This is a standard feature of neoclassical open-economy growth models.

In the E sector, each firm is owned by an old entrepreneur and run by a young entrepreneur (*manager*). Managers earn rents, due to a moral hazard problem. In particular, we assume that managers can steal a share ψ of the output, and never be caught (as in Aghion, Acemoglu and Zilibotti, 2006). The incentive constraint requires, then, that $m \geq \psi y_E$, where m denotes the managerial compensation. The optimal contract between the old entrepreneur and the

¹⁴Raising A_J to the power $1-\alpha$ simplifies the notation without entailing any loss of generality.

manager solves the following principal-agent problem:¹⁵

$$\begin{aligned} \Xi_t(k_{Et}) &= \max_{n_{Et}, m_t} \left\{ k_{Et}^\alpha (A_{Et} n_{Et})^{1-\alpha} - w_t n_{Et} - m_t \right\} \\ &\text{s.t.} \\ m_t &\geq \psi k_{Et}^\alpha (A_{Et} n_{Et})^{1-\alpha} \\ m_t &\geq w_t \end{aligned} \quad (3)$$

We assume that the participation constraint is not binding in equilibrium ($m_t > w_t$), thus the managerial compensation is pinned down by the incentive constraint:¹⁶

$$m_t = \psi k_{Et}^\alpha (A_{Et} n_{Et})^{1-\alpha}. \quad (4)$$

The optimal employment choice satisfies the following first order condition:

$$n_{Et} = \frac{k_{Et}}{A_{Et}} \left(\frac{(1-\psi)(1-\alpha)A_{Et}}{w_t} \right)^{\frac{1}{\alpha}}. \quad (5)$$

Using (2) to substitute in the equilibrium wage, and rearranging terms, yields

$$n_{Et} = ((1-\psi)\chi)^{\frac{1}{\alpha}} \left(\frac{\alpha}{R^l} \right)^{-\frac{1}{1-\alpha}} \frac{k_{Et}}{A_{Et}}, \quad (6)$$

which in turn implies, together with (3) and (4), that

$$\Xi_t(k_{Et}) = (1-\psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} R^l k_{Et} \equiv \rho_E k_{Et} \quad (7)$$

Young entrepreneurs can deposit savings in banks or invest in their own business. The following assumption ensures $\rho_E > R^d$, i.e., that the internal rate of return on entrepreneurial investment exceeds the deposit rate.

Assumption 1 $\chi > \underline{\chi} \equiv \left(\frac{1}{1-\psi} \right)^{\frac{1}{1-\alpha}}$.

Assumption 1 implies that entrepreneurs invest their savings entirely in their own business. Note that $\chi > 1$ does not ensure that Assumption 1 hold. For χ larger but close to one the entrepreneurial sector, albeit more productive, would attract no investments. This is due to the agency cost. Note also that $\partial \underline{\chi} / \partial \psi > 0$ and $\partial \underline{\chi} / \partial \alpha > 0$. Intuitively, the larger the managerial

¹⁵The equilibrium measure of young entrepreneurs is indeterminate, due to the assumption of constant-return technology. Without loss of generality, we assume that all agents with entrepreneurial skills actually find employment as entrepreneurs. This would be the unique equilibrium if we assumed epsilon-decreasing returns, due to a limited span of managerial activity. An alternative interpretation giving the same results is that E firms are run by entrepreneurial dynasties where parents employ all their children in the family business. Under this interpretation, managerial rents would be replaced by warm-glow bequests.

¹⁶An appendix provides the formal parameter condition for the participation constraint never to bind.

rent (ψ), the larger χ must be to make entrepreneurial investments profitable. Moreover, the larger the capital share of output, α , the larger the wedge caused by agency costs, and, hence, the larger χ must be. We return to this point in section 5.2.

The following Lemma follows from Assumption 1.

Lemma 1 *Let $\chi > \underline{\chi}$. Then, E firms have a lower capital-output ratio and a lower capital-labor ratio than F firms.*

Proof. Equation (6) implies that

$$\kappa_E = \kappa_F ((1 - \psi) \chi)^{-\frac{1}{\alpha}}, \quad (8)$$

where κ_F is given by (1), and Assumption 1 implies that $\kappa_E < \kappa_F$. Hence, $\frac{k_E}{y_E} = \kappa_E^{1-\alpha} > \kappa_F^{1-\alpha} = \frac{k_F}{y_F}$. Moreover,

$$\frac{k_F/n_F}{k_E/n_E} = \frac{\kappa_F/A_F}{\kappa_E/A_E} = \left(\frac{\chi}{\underline{\chi}}\right)^{\frac{1-\alpha}{\alpha}} > 1$$

where the inequality again follows from Assumption 1. ■

3.3 Equilibrium during transition

In this section, we characterize the equilibrium dynamics during a transition in which there is positive employment in both sectors. We start by characterizing the labor allocation, conditional on the state variables K_{Et} and A_{Et} . Due to constant-return-to-scale, aggregation holds and we can replace individual-firm variables (lower case) by aggregate variables (upper case). From the definition of κ_J and Cobb-Douglas technology, employment and output in the two sectors are given by

$$N_{Et} = \frac{K_{Et}}{A_{Et}\kappa_E}, \quad N_{Ft} = N_t - \frac{K_{Et}}{A_{Et}\kappa_E}, \quad (9)$$

where κ_E is given by (8).

Given logarithmic preferences, the savings of each young entrepreneur is given by $s_t^E = k_{t+1}^E = \frac{\beta}{1+\beta} m_t$. Using (4), and aggregating over all entrepreneurs yields:

$$K_{Et+1} = \frac{\beta}{1+\beta} \psi \kappa_E^\alpha A_{Et} N_{Et}. \quad (10)$$

Dividing both sides of (10) by K_{Et} , and substituting κ_E by its equilibrium expression, we obtain the accumulation rate and the employment growth rate in the E-sector:

$$\frac{K_{Et+1}}{K_{Et}} = \frac{\beta}{1+\beta} \psi ((1 - \psi) \chi)^{\frac{1-\alpha}{\alpha}} \frac{R^l}{\alpha} \equiv 1 + \gamma_{K_E}, \quad (11)$$

$$\frac{N_{Et+1}}{N_{Et}} = 1 + \nu_E \equiv \frac{1 + \gamma_{K_E}}{1 + z}, \quad (12)$$

where the latter follows from κ_E being constant.

Managerial rents being a constant share of E-firms profits is a key driving force of the transition in our theory (similar to Acemoglu, Aghion and Zilibotti (1996)). To illustrate this point, suppose that $z = 0$. In this case the workers' wage rate would be constant during the transition, while the managerial rent would grow with output in E firms. The resulting growing earning inequality between workers and entrepreneurs is key for the transition to occur, since (i) the investments of E firms are financed by entrepreneurial savings, and (ii) constant wages sustain the return to investments. If young managers earned no rent and were paid the market wage, investments in the E sector could not grow over time, inhibiting the transition. As one can see from (11), the growth rate is hump-shaped in ψ . If entrepreneurial rents are small (low ψ), young entrepreneurs are poor, and there are low investments. However, if ψ is too large, the profitability and growth of E-sector firms (ρ_E) falls.

Let $\tilde{N}_{Et} \equiv N_{Et}/N_t$ denote the employment share of the E sector. Then, equation (12) implies that $\tilde{N}_{Et} = \tilde{N}_{E0} ((1 + \nu_E) / (1 + \nu))^t$, where $\tilde{N}_{E,0} = K_{E0} / (A_{E0} N_0 \kappa_E)$ is an initial condition. Whether the employment share of the E sector grows or declines depends ultimately on whether entrepreneurial savings are sufficiently large to sustain $\nu_E > \nu$. The following assumption is necessary and sufficient to ensure this.

Assumption 2 $\chi > \frac{1}{1-\psi} \left(\frac{1+\beta}{\beta} \frac{(1+z)(1+\nu)}{\psi} \frac{\alpha}{R^l} \right)^{\frac{\alpha}{1-\alpha}}$.

Note that both Assumptions 1 and 2 require the TFP gap to be large. Hence, generically, only one of them will bind. Interestingly, the theory does not rule out the possibility of failed take-offs. For instance, suppose that the saving rate, $\beta / (1 + \beta)$, unexpectedly falls. Then, it is possible that investments in the E sector continues to be positive (i.e., Assumption 1 continues to hold) but the employment share of the E sector shrinks (i.e., Assumption 2 ceases to hold).

Next, we characterize the equilibrium dynamics of the F sector. Recall that $K_{F,t}$ is not a state variable due to the open-economy assumption. Since κ_F is constant, the capital dynamics are determined by the employment dynamics, i.e.,

$$\frac{K_{F,t+1}}{K_{F,t}} = \frac{A_{F,t+1}}{A_{F,t}} \frac{N_{F,t+1}}{N_{F,t}} = (1 + z) (1 + \nu) \frac{1 - \tilde{N}_{E0} \left(\frac{1+\nu_E}{1+\nu} \right)^{t+1}}{1 - \tilde{N}_{E0} \left(\frac{1+\nu_E}{1+\nu} \right)^t} \equiv 1 + \gamma_{K_{F,t}}.$$

Standard algebra shows that, as long as $\nu_E > \nu$, γ_{K_F} declines over time.¹⁷ Capital accumulation

¹⁷More formally, $\frac{d}{dt} (1 + \gamma_{K_{F,t}}) = (1 + z) (1 + \nu) \tilde{N}_{E,0} \left(\frac{1+\nu_E}{1+\nu} \right)^t \left(\ln \frac{1+\nu_E}{1+\nu} \right) \frac{\nu_E - \nu}{(1+\nu)(A_{F,t} x^t - 1)^2} < 0$.

in the F sector is hump-shaped during the transition. Initially, when employment in the E sector is small, γ_{K_F} is positive. However, as the transition proceeds, γ_{K_F} falls and eventually turns negative.

3.4 Foreign balance

To study the external balance, consider the banks' balance sheet:

$$K_{Ft} + B_t = \frac{\beta}{1 + \beta} w_{t-1} N_{t-1}. \quad (13)$$

The left-hand side are the banks' assets (i.e., loans to the F sector, K_{Ft} , and bonds that return in period t, B_t), while the right-hand side captures their liabilities (deposits). The analysis of the previous section leads to the following Lemma.

Lemma 2 *The country's foreign surplus is given by*

$$B_t = \left(\frac{\beta}{1 + \beta} \frac{(1 - \alpha) \kappa_F^{\alpha-1}}{(1 + z)(1 + \nu)} - 1 + \tilde{N}_{E0} \left(\frac{1 + \nu_E}{1 + \nu} \right)^t \right) \kappa_F A_{Ft} N_t \quad (14)$$

Proof. Using the fact that κ_E and κ_F are constant, and the expression of N_F given in (9), we can rewrite (13) - after dividing all terms by $A_{Ft} N_t$ - as:

$$\begin{aligned} \frac{B_t}{A_{Ft} N_t} &= \frac{\beta}{1 + \beta} \frac{w_{t-1} N_{t-1}}{A_{Ft} N_t} - \frac{K_{Ft}}{A_{Ft} N_t} \\ &= \frac{N_{t-1}}{N_t} \frac{\beta}{1 + \beta} \frac{w_{t-1}}{A_{Ft}} - \kappa_F \frac{N_{Ft}}{N_t} \\ &= \frac{N_{t-1}}{N_t} \frac{\beta}{1 + \beta} (1 - \alpha) \kappa_F^\alpha \frac{A_{Ft-1}}{A_{Ft}} - \kappa_F (1 - \tilde{N}_{Et}) \\ &= \left(\frac{\beta}{1 + \beta} \frac{(1 - \alpha) \kappa_F^\alpha}{(1 + z)(1 + \nu)} - \kappa_F \right) + \kappa_F \tilde{N}_{Et}. \end{aligned}$$

which leads to expression (14) in the Lemma. ■

As long as the employment share of the E sector increases during the transition (i.e., as long as $\nu_E > \nu$), the country's foreign asset position increases, at least, for sufficiently large t.¹⁸ When the transition is completed (say, at time T), $\tilde{N}_{E0} ((1 + \nu_E) / (1 + \nu))^T = 1$, and the net foreign position becomes

$$B_T = \frac{\beta}{1 + \beta} (1 - \alpha) \kappa_F^\alpha A_{FT} N_T > 0.$$

The following proposition summarizes the main results so far.

¹⁸When t is small, so that \tilde{N}_{Et} is small, the right-hand side term in parenthesis can be negative. Thus, initially B_t may fall. However, $B_t / A_{Ft} N_t$ is non decreasing.

Proposition 1 *Suppose Assumption 1 holds. During a transition (i.e., as long as $N_{Et} > 0$ and $N_{Ft} > 0$), the equilibrium employment in the two sectors is given by (9). The rate of return to capital is constant over time in both sector, and higher in the E than in the F sector: $\rho_F = R^l$ and $\rho_E = (1 - \psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} R^l$. The capital and employment growth of the E sector are given by (11) and (12), respectively. If Assumption 2 holds, then (11)-(12) imply a growing employment share of the E sector. The stock of net foreign assets, described by (14), is growing.*

3.5 GDP, Investment rate and Return on Capital

In this section, we derive implications for the aggregate dynamics. During the transition, GDP is given by

$$Y_t = Y_{Et} + Y_{Ft} = \kappa_F^\alpha \left(\frac{\psi}{1-\psi} \frac{N_{Et}}{N_t} + 1 \right) A_{Ft} N_t, \quad (15)$$

where

$$Y_{Et} = \kappa_E^{\alpha-1} K_{Et}, \text{ and } Y_{Ft} = \kappa_F^\alpha (A_{Ft} N_{Ft}). \quad (16)$$

Hence, the growth rate of Y is

$$\frac{Y_{t+1}}{Y_t} = \frac{1 + \frac{\psi}{1-\psi} \tilde{N}_{E,0} \left(\frac{1+\nu_E}{1+\nu} \right)^{t+1}}{1 + \frac{\psi}{1-\psi} \tilde{N}_{E,0} \left(\frac{1+\nu_E}{1+\nu} \right)^t} (1 + \nu) (1 + z) \equiv 1 + \gamma_{Y,t}.$$

where $1 + \gamma_{Y,t} \in [(1 + \nu) (1 + z), (1 + \nu_E) (1 + z)]$. As long as $\nu_E > \nu$, $\gamma_{Y,t}$ increases during the transition. The growth acceleration reflects the resource reallocation towards more efficient firms. The aggregate investment net of depreciation is given by:

$$\begin{aligned} I_t^{net} &= K_{Et+1} - K_{Et} + K_{Ft+1} - K_{Ft} \\ &= \left(\frac{\alpha}{R^l} \right)^{\frac{1}{1-\alpha}} \left(z - \left(\frac{\beta}{1+\beta} \psi ((1-\psi)\chi)^{\frac{1-\alpha}{\alpha}} \frac{R^l}{\alpha} - 1 \right) \left(1 - \chi ((1-\psi)\chi)^{-\frac{1}{\alpha}} \right) \tilde{N}_{Et} \right) A_{Ft} N_t \end{aligned}$$

Thus, using (15), and simplifying terms, we can express the investment-output ratio as

$$\frac{I_t^{net}}{Y_t} = \frac{z - \left(\frac{\beta}{1+\beta} \psi ((1-\psi)\chi)^{\frac{1-\alpha}{\alpha}} \frac{R^l}{\alpha} - 1 \right) \left(1 - \chi ((1-\psi)\chi)^{-\frac{1}{\alpha}} \right) \tilde{N}_{Et} \frac{\alpha}{R^l}}{1 + \frac{\psi}{1-\psi} \tilde{N}_{Et}} \quad (17)$$

The net investment rate can be positive or negative, depending on the rate of technical change, z . Zero long-run growth would imply negative investment rates during the transition, but net investment is positive as long as technical progress is sufficiently high. However, the investment rate declines unambiguously during the transition.¹⁹

¹⁹Note that $\frac{\beta}{1+\beta} \psi ((1-\psi)\chi)^{\frac{1-\alpha}{\alpha}} \frac{R^l}{\alpha} > 1$ and $\chi ((1-\psi)\chi)^{-\frac{1}{\alpha}} < 1$ by Assumption 2 and 1, respectively. To

Consider, next, the average rate of return on capital. This is given by:

$$\rho_t = \frac{\rho_E K_{E,t} + \rho_F K_{F,t}}{K_{E,t} + K_{F,t}} = \frac{R^l}{1 - \left(1 - \chi \left((1 - \psi) \chi\right)^{-\frac{1}{\alpha}}\right) \tilde{N}_{Et}}. \quad (18)$$

Since the denominator is falling in \tilde{N}_{Et} , the rate of return on capital is increasing during the transition. Intuitively, ρ_t must be increasing since an increasing share of the capital has the high return ρ_E .

Proposition 2 *Suppose Assumptions 1 and 2 hold. During a transition (i.e., as long as $N_{Et} > 0$ and $N_{Ft} > 0$), the aggregate GDP grows at an increasing rate, the investment rate falls, and the average return on capital increases.*

3.6 Post-transition Equilibrium

Once the transition is complete at period T , $N_{Et} = N_0 (1 + \nu)^t$ for $t > T$. All workers are employed in E firms, the aggregate capital stock is given by $K_{Et+1} = \beta / (1 + \beta) \psi m_t$, which implies standard neoclassical dynamics of capital per efficiency units;

$$\kappa_{Et+1} = \frac{\beta}{1 + \beta} \frac{\psi}{(1 + z)(1 + \nu)} (\kappa_{Et})^\alpha.$$

Thus, there is capital deepening over time until the capital per efficiency unit converges. Consequently, wage growth will increase and output and net foreign surplus will increase until the capital deepening is completed. However, the investment rate and the rate of return on capital will decrease. The details are in an appendix.

3.7 Discussion

The model analyzed so far fits some salient qualitative features of the recent Chinese growth experience discussed in section 2. First, the high growth rate of industrial production and sustained private investments does not cause the *corporate* rate of return to fall. This is consistent with the observation of a sustained return to investments in China. E firms – similarly to DPE in China – have a higher TFP and less access to external financing. This induces them to choose a lower capital-labor and capital-output ratio than F firms (Lemma 1) – again in line with the empirical evidence. Moreover the rate of return on capital is higher in

see that the investment rate is decreasing, note that the derivative of the I/Y ratio is given by

$$\frac{d}{d\tilde{N}_{Et}} \left(\frac{I_t^{net}}{Y_t} \right) = -\frac{\alpha(1-\xi)}{R} \frac{z \frac{\psi}{1-\psi} + \left(\frac{\beta}{1+\beta} \psi \left((1-\psi) \chi \right)^{\frac{1-\alpha}{\alpha}} \frac{R}{\alpha(1-\xi)} - 1 \right) \left(1 - \chi \left((1-\psi) \chi \right)^{-\frac{1}{\alpha}} \right)}{\left(1 + \frac{\psi}{1-\psi} \tilde{N}_{Et} \right)^2} < 0.$$

E firms than in F firms, as in the data DPE are more profitable than SOE. The transition is characterized by factor reallocation from financially integrated firms to entrepreneurial firms – similar to the reallocation from SOE to DPE in the data. This leads to an external imbalance – as in the data the economy runs a sustained trade surplus. Finally, the model features growing inequality between wages and entrepreneurial earnings.

However, some predictions do not match accurately the empirical evidence. In our model, the rate of return on capital actually grows over the transition. In the data, there is some evidence of a falling aggregate return on capital during the period 1992-2000 – although it has increased again thereafter. In manufacturing, the rate of return has in fact increased, according again to Bai et al. (2006, Figure 11). More problematic, however, the theory predicts a fall in the investment rate, albeit for very different reasons from the standard neoclassical growth model. There, the investment rate falls due to capital deepening and decreasing returns. In contrast, in our model, the investment rate falls due to a composition effect: financially constrained firms - which have a lower capital-output ratio - expand, while financially unconstrained firms contract. However, in the data there is no evidence of a falling investment rate: Bai, Hsieh and Qiang (2006) document that the aggregate investment-GDP ratio has been U-shaped since 1992, with a trough in 1997. In 2006, the investment rate was a staggering 52%!

One way to reconcile the theory with the data is to introduce a mechanism generating capital deepening within each sector. This would be consistent with the evidence that both private and state-owned firms in China have increased their capital-output ratio over time (whereas capital-output ratios are constant within each sector in our model). A simple mechanism that delivers capital deepening is an improvement of financial intermediation during the transition. We turn to financial development in the next section.

4 Financial development

There is some evidence of attempts to improve the Chinese financial system during recent years. For instance, the lending market has been deregulated allowing for both more competition and more flexibility in pricing of loans.²⁰ This has resulted in an increase in efficiency of the bank

²⁰Before 1996, banks had to lend at the official lending rate. In 1996, a reform allowed them to set the rate between 0.9 and 1.1 times the official rate. The upper limit gradually increased to 1.3 times for small and medium enterprises in the late 1990s and was eventually removed completely in 2004 (see Ouanes, 2006). The increase in competition is also witnessed by the loan share of the four major state-owned banks falling from 61% in 1999 to 53% in 2004 and by the growing equity market.

system, witnessed for instance, by a sharp reduction in the ratio of non-performing loans.²¹ To incorporate financial development into the theory, we introduce intermediation costs and let them vary over time. In particular, loans to domestic firms are subject to an *iceberg cost*, ξ , by which for every unit of domestic bank loans made at $t-1$, ξ_t units get lost in real costs including monitoring, red tape, etc.. Thus, ξ is an inverse measure of the efficiency of the banking system. The borrowing rate of domestic firms becomes then

$$R_t^l = \frac{R}{1 - \xi_t}. \quad (19)$$

Recall that a larger R^l reduces capital intensity in the F sector. Since κ_E is proportional to κ_F , R^l also reduces capital intensity in the E sector. Consider financial development in the form of a reduction of the iceberg cost. *Ceteris paribus*, the fall in ξ leads to a reduction in R_t^l , which in turn implies an increase in wages and in the capital intensity of both sectors. Equations (17) and (18) show that the fall in R^l induces an increase in the investment rate and a decrease in the return of capital, respectively. Thus, if ξ falls sufficiently fast over time, it can offset the tendency of the investment rate to fall (and of ρ_t to increase) during the transition. In conclusion, a version of our model augmented with the plausible assumption that the efficiency of the financial system increases over time can be consistent with the non-decreasing investment rate and capital-output ratio observed in China.

We provide a numerical example [TO BE COMPLETED] to illustrate the possibility that, for empirically plausible parameter values, I/Y increases and the average rate of return on capital falls during the transition. In fact, in this example the investment rate is U-shaped which arguably has been the pattern of investment rate in China since 1992. Equally important, the numerical example continues to feature a foreign net surplus.

We assume one period to be 30 years. We consider an improvement of the banking system such that the annual lending rate for domestic firms falls from 10% to 8% between the start and the endpoint of the transition. We view this is a sizable, but not unreasonable improvement. The growth rate of productivity is set to 5% per year. This is on the upper end of the range of estimates of TFP growth. But we should note that in our simple model there is no scope for improvements in the quality of the labor force that are instead an important driving force of growth in China. Thus, z should capture both technical progress and human capital accumulation. We set $\alpha = 0.5$ to match the labor share. Moreover, we assume $\chi = 2.15$ and $\psi = 0.3$. Note that χ is set so that Assumptions 1-2 are satisfied.

²¹In state-owned banks, the non-performing loan ratio has fallen from 26% in 2002 to 10% in 2005. Although part of this improvement can be attributed to a government bailout, this ratio for new loans after 2000 is reported to have fallen drastically compared with older loans (see Ouanes, 2006).

TO BE COMPLETED...

4.1 Bank Lending to the Entrepreneurial Sector

A limitation of the analysis so far is that the direct effect on lending of financial development only operates on financially unconstrained F firms. Capital deepening also occurs in the E sector, but this is due to a general equilibrium effect through wages. Entrepreneurs continue to be excluded from lending, hence they are not affected by efficiency improvements in the bank sector. In this section, we generalize the model by introducing explicit microfoundations to the credit constraint faced by entrepreneurs. This generalization allows E firms to finance part of their investments through bank loans. The possibility to leverage investments grants entrepreneurs a higher return on their savings – they borrow at the rate R^l and earn a rate of return equal to ρ_E .

We assume that young entrepreneurs can borrow, but can only pledge a share η of the second-period net profits. The fraction $1 - \eta$ is not verifiable. The principal-agent problem, (3), is unchanged, and both $\Xi_t(k_{Et})$ and ρ_E continue to be defined by (7). However, the firm size is, now,

$$k_{Et+1} = s_t^E + l_t^E,$$

where s^E is the saving of the entrepreneur, and l^E is the bank loan. The incentive-compatibility constraint of the entrepreneur implies that

$$R^l l^E \leq \eta \rho_E (s^E + l^E), \quad (20)$$

where, recall, $R^l = R/(1 - \xi)$ denotes the borrowing rate. Note that a reduction in ξ will now lower the borrowing cost for both sectors. In equilibrium, the incentive-compatibility constraint binds. Thus, the share of E-sector investments financed through bank loans is:

$$\frac{l^E}{l^E + s^E} = \frac{\eta \rho_E}{R^l}. \quad (21)$$

Note that, if due to financial development ξ were to decrease, the share of external financing would increase over time.

The optimal investment of an entrepreneur can be expressed as:

$$\max_{l^E, s^E} \log(m - s^E) + \beta \log(\rho_E (l^E + s^E) - R^l l^E),$$

subject to (21). Using the constraint to substitute away l^E , the program simplifies to

$$\max_{s^E} \log(m - s^E) + \beta \log\left(\frac{(1 - \eta) \rho_E R^l}{R^l - \eta \rho_E} s^E\right).$$

The entrepreneurs' saving decision is not affected by the availability of bank loans, due to standard properties of the logarithmic utility. However, the E-sector will grow faster, as bank financing now works as an accelerator. Savings and external financing determine capital accumulation in the E sector:

$$\begin{aligned} k_{Et+1} &= l_t^E + s_t^E = \frac{\beta}{1 + \beta} \frac{R^l}{R^l - \eta \rho_E} m_t \\ &= \frac{\beta}{1 + \beta} \frac{\psi ((1 - \psi) \chi)^{\frac{1-\alpha}{\alpha}}}{1 - \eta (1 - \psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}}} \frac{R}{(1 - \xi) \alpha} k_{Et} \end{aligned}$$

where we have substituted R^l , m and ρ_E by their equilibrium expressions. A number of insights are noteworthy:

1. Financial development in the form of an increase in η , i.e., better credit market access for entrepreneurs unambiguously speeds up transition. However, it affects neither the capital intensity (κ_E) nor the wage rate during the transition. The reason is that the economy-wide wage rate is not affected by η as long as F firms remain in operation.
2. Financial development in the form of a reduction of ξ , i.e., lower iceberg intermediation cost in *both* sectors unambiguously slows down transition. Moreover, it increases the capital intensity (κ_E) and the wage rate. This result depends on the logarithmic specification. In particular, a lower ξ increases the rate of return on entrepreneurial investments, but this does not affect their savings. In addition, the share of bank loans is independent of ξ . This can be seen by noting that both R^l and ρ_E depend on ξ but their ratio does not. Hence, the right-hand side of equation (21) is invariant to ξ .
3. To the extent to which financial development takes the form of a simultaneous increase in η and reduction in ξ , the model predicts capital deepening within each sector, and an ambiguous effect on the speed of transition.
4. The foreign asset position is now determined by the condition

$$K_{Ft} + \eta \rho_E K_{Et} + B_t = \frac{\beta}{1 + \beta} w_{t-1} N_{t-1}.$$

Now, the effect of growth on the foreign asset position is ambiguous: for low η , the economy still accumulates a foreign surplus, while the opposite can occur if η is large. Financial development in the form of an increase in η can thus revert the growing net foreign surplus.

5 Extensions

In this section we extend the model to derive some auxiliary testable implications of the theory. We consider two extensions. The first analyzes the consequences of heterogeneity in saving rates and entrepreneurial returns across regions. This allows us to study the pattern of correlation between savings and investments across Chinese provinces characterized by different penetration of private firms. The second introduces multiple sectors with heterogeneous technologies. This generates endogenous specialization of E and F firms in more or less capital-intensive goods, yielding testable predications about the timing of expansion of private firms across sectors.

5.1 Savings and investments across regions

In this section we extend the theory to a two-region economy, region A and region B. We assume that E firms are located in the region where the respective entrepreneurs live, whereas there is no restriction on capital mobility in the F sector.²² We assume the employment share of E firms to differ across the two regions. This can be motivated by a variety of alternative assumptions. For instance, local conditions – e.g., different legal enforcement, technology – can cause differences in the profitability of entrepreneurial activity. To make the comparison stark, suppose that Assumption 1 holds in region A, whereas it is not met in region B where all agents invest their savings in bank deposits.

Our main focus is on the correlation between savings and investments at the regional level. To this aim, we assume region-specific shocks to saving rates, captured by iid stochastic fluctuations in the discount factors β_{rt} , where $r \in \{A, B\}$. This simple extension predicts that the time-series correlation between savings and investments should be positive in region A, while it should be zero in region B. The reason is that in region A entrepreneurial investments are constrained by entrepreneurial savings. In contrast, in region B investments are detached from local savings (as in an open-economy growth model). More generally, in an economy with many regions, the correlation between investments and savings should increase with the employment share of the E sector.²³

We test this implication using a dataset covering all Chinese provinces for which official data are published by the National Bureau of Statistics (NBS). This yields a panel of 31 provinces

²²The extent of labor mobility does not affect the main result in this section, but only the speed of transition in each region and in the economy as a whole. If labor is perfectly mobile, for instance, one region will eventually become empty.

²³The assumption that regions differ in the profitability of entrepreneurial activity is for simplicity. We could alternatively think that differences in the share of entrepreneurial firms are simply the result of different histories of realizations of β 's. The implications would be identical.

with observations from 2001 to 2006.²⁴ The regional size of the E sector is proxied by the ratio of the number of employees of domestic private industrial enterprises to total industrial employment in a province. NBS reports "main indicators" of domestic private enterprises by provinces since 2001. The employment data for 2001, 2002, 2003 and 2005 are from China Industrial Economy Statistical Yearbook (various issues). The China Statistical Yearbook (2007) provide data for 2006. Regional investment is total investment in fixed assets in each province and regional saving is defined as provincial GDP minus private and government consumption expenditures. Both investments and savings are expressed as ratios of provincial GDP. Annual data for investment, saving and GDP are all from China Statistical Yearbook (2002 to 2007).

TABLE 1 HERE

We first divide the sample in terciles according to private employment shares in 2001. Then, we estimate within each tercile the following regression

$$(I/Y)_{rt} = a_r + b \cdot (S/Y)_{rt} + u_{rt}, \quad (22)$$

where a_r and a_t are province and year dummies, respectively. Our theory predicts that the estimated coefficient b should be lowest in the bottom tercile, and highest in the top tercile. This prediction is born out in the data. Consider Table 1. We report three specifications, where the first is the basic specification in (22), the second includes time dummies, and the third controls, in addition, for GDP per capita. In all cases, the estimates of b are positive and highly significant for the first and second, and negative and insignificant for the third tercile. Moreover, the coefficient b declines monotonically from the lower to the higher tercile, in accordance with our theory.²⁵

²⁴See the appendix for a list of these regions and summary statistics (TO BE ADDED).

²⁵We also calculated the time-series correlation between savings and investment rates individually for each country:

$$CORR_r(S, INV) = \frac{1}{5} \frac{\sum_{t=2001}^{2006} ((INV_{rt} - \overline{INV}_r) (S_{rt} - \overline{S}_r))}{\sqrt{\sum_{t=2001}^{2006} (INV_{rt} - \overline{INV}_r)^2} \sqrt{\sum_{t=2001}^{2006} (S_{rt} - \overline{S}_r)^2}}$$

where \overline{S}_r and \overline{INV}_r are the average savings and investments in region r between 2001 and 2006. Then, we calculated the average of the correlation coefficient within each tercile. This average correlation is 0.74 in the top tercile (s.d. 0.31), 0.68 in the second tercile (s.d. 0.39) and 0.52 in the lowest tercile (s.d. 0.43).

Next, we consider the entire sample (i.e., we do not split by terciles) and run the following regression:

$$INV_{rt} = a_r + a_t + b_1 \cdot EMPL_{rt}^{PRIV} + b_2 \cdot S_{rt} + b_3 \cdot (S_{rt} \times EMPL_{rt}^{PRIV}) + \varepsilon_{rt},$$

where INV_{rt} is the investment rate, S_{rt} is the savings rate, $EMPL_{rt}^{PRIV}$ is the share of employment in the private sector, and a_r and a_t are regional and time dummies, respectively. Our theory predicts a positive interaction coefficient, b_3 , namely the effect of savings on investments should increase with the share of private firms. The results are shown in Table 2. Column 1 shows that the interaction coefficient is positive and statistically significant at the 10% level. When we control for GDP per capita in the initial period, the interaction coefficient triples and becomes significant at the 1% level (omitting time dummies change the size of the estimated b_3 but this remains positive and significant).

TABLE 2 HERE

Our theory also predicts that regions with a high private employment share should have a higher growth rate even after controlling for the investment rate. Using the same data as above, we regress the annual growth rate of GDP at the province level on the share of domestic private enterprise employment in the industrial sector, controlling for the investment rate, and time and province dummies. We find a significant positive correlation, in accordance with the theory. Results are available upon request.

5.2 Capital- and Labor-Intensive Industries

An interesting observation about the transition of the Chinese economy is that the share of SOEs has declined dramatically in labor-intensive industries while it is still high in capital-intensive industries (see Section 2). SOEs have been traditionally more capital-intensive, as argued above. However, the increasing retreat from labor-intensive industries has widened the gap between the capital-output ratio of SOEs and that of private firms since the mid 1990s (e.g. Dekle and Vandenbroucke, 2006). Previous studies have attributed this phenomenon to a strategic policy of retaining state control over large SOE and privatizing small SOE in the late 1990s.²⁶ Our theory provides an alternative explanation based on financial frictions. To this

²⁶The so-called policy of "grasping the large and releasing the small ones" meant to abandon control of small SOE and support only a few large SOE in so-called "national crucial industries". The stated objective of this policy would be to help large SOE be internationally competitive as *keiretsu* in Japan or *chaebol* in Korea. Movshuk (2004) provides a case study on the iron and steel industry.

end we extend our model to a two-sector environment. We assume $\nu = \xi = 0$, for simplicity.

The final good, Y_t , is assumed to be a CES aggregate of two intermediate goods:

$$Y_t = \left(\varphi \left(Y_t^k \right)^{\frac{\sigma-1}{\sigma}} + \left(Y_t^l \right)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}. \quad (23)$$

The superscripts k and l stand for capital- and labor-intensive intermediate goods, respectively. $\varphi \in (0, 1)$ is a parameter describing the intensity of the demand for capital-intensive goods. Intermediate goods can be produced either in the E or in the F sector, with the following technologies:

$$y_J^l = \left(A_J^l \right)^{1-\alpha} \left(k_J^l \right)^\alpha \left(n_J^l \right)^{1-\alpha}, \quad (24)$$

and

$$y_J^k = \left(A_J^k \right)^{1-\alpha} k_J^k, \quad (25)$$

where $J \in \{E, F\}$. The production technology for the labor-intensive good is identical to that of the benchmark model. The assumption that the capital-intensive good is produced without labor is for convenience (in the appendix we generalize the model to the case in which both industries use both factors and show that the results are robust). We assume the TFP gap between E and F firms to be the same in the two industries. More formally, $\chi \equiv A_{Et}^k/A_{Ft}^k = A_{Et}^l/A_{Ft}^l$. Note that we raise both A_J^k and A_J^l to the power of $1 - \alpha$ to ensure that the technological advantage of E firms is the same in both sectors. Both final- and intermediate-good production takes place under perfect competition. We maintain throughout Assumptions 1 and 2.

We set the final good to be the *numéraire*. Profit maximization of final producers subject to (23) yields:

$$\frac{Y^k}{Y^l} = \left(\varphi \frac{P^l}{P^k} \right)^\sigma. \quad (26)$$

The standard price aggregation holds:

$$\left(\varphi^\sigma \left(P^k \right)^{1-\sigma} + \left(P^l \right)^{1-\sigma} \right)^{\frac{1}{1-\sigma}} = 1. \quad (27)$$

When F firms are active in the production of the labor-intensive good, they behave as in section 3.2. In particular, the following analogues of equations (1) and (2) hold:

$$\kappa_{Ft}^l = \left(\frac{P_t^l \alpha}{R} \right)^{\frac{1}{1-\alpha}}, \quad (28)$$

$$w_t = P_t^l (1 - \alpha) A_{Ft}^l \left(\kappa_{Ft}^l \right)^\alpha. \quad (29)$$

In addition, when F firms are active in the production of the capital-intensive good, perfect competition pins down its price level:

$$P_t^k \left(A_{Ft}^k \right)^{1-\alpha} = R. \quad (30)$$

Given these equilibrium conditions, we can determine the return for E firms to invest in the capital- and in the labor-intensive industries, respectively. We prove the following key Lemma (recall that K_{Et} is predetermined by the entrepreneurial savings).

Lemma 3 (i) If, at time t , $K_{Ft}^l > 0$ and $K_{Ft}^k > 0$, then $\rho_{Et}^l > \rho_{Et}^k$, implying that $K_{Et}^l = K_{Et}$ and $K_{Et}^k = 0$. (ii) If, at time t , $K_{Et}^l > 0$ and $K_{Et}^k > 0$, then $R \geq \rho_{Ft}^k > \rho_{Ft}^l$, implying that $K_{Ft}^l = 0$ and $K_{Ft}^k \geq 0$.

Proof. Part (i). We start by proving that $\rho_E^l = (1 - \psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} R$. To this aim, observe that, since (assuming as in section 3.2 that the incentive constraint is binding) $m_t = \psi P_t^l y_{Et}^l$, then

$$\Xi_t^l \left(k_{Et}^l \right) = \max_{n_{Et}} \left\{ (1 - \psi) P_t^l \left(k_{Et}^l \right)^\alpha \left(A_{Et} n_{Et} \right)^{1-\alpha} - w_t n_{Et} \right\}$$

The first order condition yields:

$$n_{Et} = \frac{k_{Et}^l}{A_{Et}^l} \left(\frac{(1 - \psi) (1 - \alpha) P_t^l A_{Et}^l}{w_t} \right)^{\frac{1}{\alpha}}$$

Then, plugging (29) into the first order condition yields

$$n_{Et} = \left((1 - \psi) \chi \right)^{\frac{1}{\alpha}} \left(\frac{P_t^l \alpha}{R} \right)^{-\frac{1}{1-\alpha}} \frac{k_{Et}^l}{A_{Et}^l} \quad (31)$$

Finally, plugging the optimal n_{Et} into the profit function, and simplifying term, yields the value of a E firm in the labor intensive sector:

$$\begin{aligned} \Xi_t \left(k_{Et}^l \right) &= (1 - \psi) k_{Et}^l \left(\left((1 - \psi) \chi \right)^{\frac{1}{\alpha}} \right)^{1-\alpha} \left(\frac{\alpha}{R} \right)^{-1} - (1 - \alpha) \chi^{-1} \left((1 - \psi) \chi \right)^{\frac{1}{\alpha}} \left(\frac{\alpha}{R} \right)^{-1} k_{Et}^l \\ &= (1 - \psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} R k_{Et}^l \equiv \rho_E^l k_{Et}^l, \end{aligned}$$

where ρ_E^l is identical to ρ_E in the one-sector model of section 3 (see equation (7)). This the rate of return for E firms when F firms are active in the labor-intensive industry.

Next, we show that, when F firms are active in both industries, the return to investment in the capital-intensive sector for E firms, ρ_E^k , is lower than ρ_E^l . When F firms are active in the capital-intensive industry, the value of a E firm in the labor-intensive sector is

$$\begin{aligned} \Xi_t^k \left(k_{Et}^k \right) &= (1 - \psi) P_t^k \left(A_{Et}^k \right)^{1-\alpha} k_{Et}^k \\ &= (1 - \psi) \chi^{1-\alpha} R k_{Et}^k \equiv \rho_E^k k_{Et}^k \end{aligned}$$

where we have used equation (30) to eliminate P_t^k . Finally, Assumption 1 ensures that $\rho_E^l > \rho_E^k$ (since $(1 - \psi)^{\frac{1}{1-\alpha}} \chi > 1 \Leftrightarrow (1 - \psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} > (1 - \psi) \chi^{1-\alpha}$). Thus, E firms will not invest in the capital-intensive sector. This completes the proof of part (i) of the Lemma.

Part (ii). We prove the argument by constructing a contradiction. Suppose that, when $K_{Et}^l > 0$ and $K_{Et}^k > 0$, $K_{Ft}^l > 0$. Then, $\rho_E^l = (1 - \psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} R$ as shown in the first part of the proof, see (32). Moreover, $\rho_E^l = \rho_E^k = (1 - \psi) \chi^{1-\alpha} R$, since otherwise E firms would not invest in both industries. Solving for P_t^k yields

$$P_t^k = (1 - \psi)^{\frac{1-\alpha}{\alpha}} \chi^{\frac{1}{\alpha}} \frac{R}{(A_{Ft}^k)^{1-\alpha}} > \frac{R}{(A_{Ft}^k)^{1-\alpha}}$$

where the inequality follows from Assumption 1, and $P_t^k = R / (A_{Ft}^k)^{1-\alpha}$ is the condition that guarantees that F firms make zero profits in the capital-intensive industries. Thus, the inequality establishes that F firms would be making positive profits in the capital-intensive sector, which is impossible in a competitive equilibrium. Thus, $K_{Ft}^l = 0$ when E firms are active in both sectors. This concludes the proof of part (ii) of the Lemma. ■

Lemma 3 leads to the complete characterization of the dynamic equilibrium. There are four distinct stages of the transition:

- Stage 1: Only F firms invest in the capital-intensive sector, while both E and F firms invest in the labor-intensive sector. The employment share of F firms declines as entrepreneurial investments increase. Consequently, the employment share of the F sector is decreasing over time in the labor-intensive industry. However, capital-intensive goods are only produced by F firms. This is consistent with the observation that Chinese SOE have retreated from labor-intensive industries but have remained predominant in capital-intensive industries. Due to this specialization in the capital-intensive industry, the average capital-output ratio in F firms increases during the transition. This is consistent with the observation of a growing capital-output ratio gap between SOE and private firms in China. Eventually, F firms will abandon completely the labor-intensive activity.
- Stage 2: All workers are employed by E firms. Entrepreneurs continue to invest their savings in the labor-intensive sector since these investments yield a higher return than either foreign bonds or alternative investments in the capital-intensive industry. However, the rate of return falls over time, as employment cannot grow, and investment leads to capital deepening. Consequently, wages grow. Eventually, the incentive to accumulate capital in the labor-intensive industry comes to a halt. If $\chi^{1-\alpha} > \alpha(1 + \beta) / (\beta\psi R)$, entrepreneurs turn to the capital-intensive industry and the economy enters stage 3. If

$\chi^{1-\alpha} < \alpha(1 + \beta) / (\beta\psi R)$, economic transition stops and the capital-intensive industry remains dominated by F firms, in spite of their lower productivity.

- Stage 3: The investment of E firms in the capital-intensive industry causes the progressive retreat of F firms. Eventually, F firms will have disappeared
- Stage 4: the economy enters the post-transition equilibrium of section 3.6.

Table 3 summarizes the main features of each of the four stages of the transition. The complete characterization of the equilibrium is deferred to Appendix 7.2.

industry	stage 1		stage 2		stage 3		stage 4	
	E	F	E	F	E	F	E	F
labor-intensive	Yes	Yes	Yes	No	Yes	No	Yes	No
capital-intensive	No	Yes	No	Yes	Yes	Yes	Yes	No

6 Conclusions

TO BE WRITTEN

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7 Appendix

7.1 Post-Transition Equilibrium

The aggregate allocations are then given by

$$\begin{aligned}
\frac{I_t^{net}}{Y_t} &= \frac{K_{Et+1} - K_{Et}}{Y_t} = \frac{\beta}{1 + \beta} \psi - (\kappa_{E,t})^{1-\alpha} \\
w_t &= A_{Et} (1 - \alpha) (1 - \psi) (\kappa_{E,t})^\alpha \\
\rho_t &= \rho_{E,t} = \alpha (1 - \psi) (\kappa_{E,t})^{\alpha-1} \\
Y_t &= A_{Et} N_t (\kappa_{E,t})^\alpha \\
\frac{B_{t+1}}{A_{Ft} N_t} &= \frac{\beta}{1 + \beta} w_t \frac{N_t}{A_{Ft} N_t} = \frac{\beta}{1 + \beta} \chi (1 - \alpha) (1 - \psi) (\kappa_{Et})^\alpha
\end{aligned}$$

Then capital in the E-sector evolves according to (10) and eventually converges to a steady state. If $(1 - \psi) \alpha (1 + \beta) (1 + z) (1 + \nu) / (\beta \psi R) > 1$, then $\lim_{t \rightarrow \infty} \rho_E > R$, and entrepreneurs never invest in bonds. Else, entrepreneurs will eventually place part of their savings in bank deposits.

7.2 Two-sector model

The characterization of the dynamics in the two-sector economy is unsurprising. There are four possible stages in the economy, characterized by whether the E (F) sector is active in the labor-intensive (capital-intensive) industry. The algebra is however complicated by the changes over time in the relative prices due to the improvement of technology in the capital-intensive industry.²⁷ To simplify the analysis, we restrict attention to the case of no exogenous technical change, i.e., $z = 0$. In this case, $A_{Et} = A_E$ and $A_{Ft} = A_F$. The equilibrium during the first stage is summarized by the following proposition.

Proposition 3 *Stage 1 is defined as*

$$\frac{K_{Et}}{A_E N} \leq ((1 - \psi) \chi)^{-\frac{1}{\alpha}} \left(\frac{P_t^l \alpha}{R} \right)^{\frac{1}{1-\alpha}},$$

where

$$P_t^l = \left(1 - \varphi^\sigma (P_t^k)^{1-\sigma} \right)^{\frac{1}{1-\sigma}}, \tag{33}$$

$$P_t^k = \frac{R}{(A_F)^{1-\alpha}}, \tag{34}$$

²⁷See (30) for example.

In the first stage, both of the E- and F-sector are active in the labor-intensive industry while only the F firms produce capital-intensive goods. Specifically, prices of labor- and capital-intensive goods are determined by (33) and (34). Labor, capital and output in the labor- and capital-intensive industries are such that

$$N_{Ft}^l = N - N_{Et}^l, \quad N_{Et}^l = ((1 - \psi)\chi)^{\frac{1}{\alpha}} \left(\frac{P_t^l \alpha}{R}\right)^{-\frac{1}{1-\alpha}} \frac{K_{Et}^l}{A_E}, \quad (35)$$

$$K_{Ft}^l = \left(\frac{P_t^l \alpha}{R}\right)^{\frac{1}{1-\alpha}} A_F N, \quad K_{Et}^l = K_{Et}, \quad Y_t^l = \left(\frac{P_t^l \alpha}{R}\right)^{-1} \psi (\chi(1 - \psi))^{\frac{1-\alpha}{\alpha}} K_{Et}^l + \left(\frac{P_t^l \alpha}{R}\right)^{\frac{\alpha}{1-\alpha}} A_F N, \quad (36)$$

$$Y_t^k = \left(\varphi P_t^l / P_t^k\right)^\sigma Y_t^l, \quad K_{Ft}^k = \frac{Y_t^k}{(A_F)^{1-\alpha}}, \quad K_{Et}^k = 0, \quad (37)$$

respectively. Moreover, capital in the E-sector evolves according to

$$\frac{K_{Et+1}}{A_E N} = \frac{\beta \psi}{1 + \beta} P_t^l \left(\frac{K_{Et}}{A_E N}\right)^\alpha, \quad (38)$$

and the aggregate output is equal to

$$Y_t = \left(P_t^l\right)^\sigma Y_t^l, \quad (39)$$

Proof. (Appendix) It is straightforward from Lemma 3 that $K_{Et}^k = 0$. (33) follows immediately from (27), whereas (34) follows from the zero-profit condition for F firms in the capital-intensive industry. The first part of (36) comes from (28). The first part of (37) follows from (26). Using the condition that final-good firms make zero profits together with (26) and (27) leads to

$$\begin{aligned} Y_t &= P_t^l Y_t^l + P_t^k Y_t^k \\ &= \left(1 + \varphi^\sigma \left(\frac{P_t^k}{P_t^l}\right)^{1-\sigma}\right) P_t^l Y_t^l = \left(P_t^l\right)^\sigma Y_t^l, \end{aligned}$$

which establishes (39). To derive (36), observe that

$$\begin{aligned} Y_t^l &= \left(\kappa_F^l\right)^\alpha \left(\frac{\psi}{1 - \psi} \frac{N_{Et}^l}{N} + 1\right) A_F N \\ &= \left(\frac{P_t^l \alpha}{R}\right)^{\frac{\alpha}{1-\alpha}} \left(\psi \chi^{\frac{1}{\alpha}} (1 - \psi)^{\frac{1-\alpha}{\alpha}} \left(\frac{P_t^l \alpha}{R}\right)^{-\frac{1}{1-\alpha}} \frac{K_{Et}^l}{A_E} + N\right) A_F^l \\ &= \frac{R}{P_t^l \alpha} \left(\psi \chi^{\frac{1}{\alpha}} (1 - \psi)^{\frac{1-\alpha}{\alpha}} \frac{K_{Et}^l}{A_E} + N \left(\frac{P_t^l \alpha}{R}\right)^{\frac{1}{1-\alpha}}\right) A_F \\ &= \left(\frac{P_t^l \alpha}{R}\right)^{-1} \psi (\chi(1 - \psi))^{\frac{1-\alpha}{\alpha}} K_{Et}^l + \left(\frac{P_t^l \alpha}{R}\right)^{\frac{\alpha}{1-\alpha}} A_F N. \end{aligned}$$

Finally, (35) follows immediately from (31). The rest is immediate. ■

Proposition 4 *Stage 2 is defined as*

$$((1 - \psi)\chi)^{-\frac{1}{\alpha}} \left(\frac{P_t^l \alpha}{R} \right)^{\frac{1}{1-\alpha}} < \frac{K_{Et}}{A_E N} \leq \frac{1}{\chi} \left(\frac{P_t^l \alpha}{R} \right)^{\frac{1}{1-\alpha}}.$$

In the second stage, the F-sector vanishes in the labor-intensive industry. Specifically, prices of labor- and capital-intensive goods are determined by (33) and (34). $N_{Ft}^l = 0$, $N_{Et}^l = N$, capital and output in the labor-intensive industries are such that

$$K_{Ft}^l = 0, K_{Et}^l = K_{Et}, Y_t^l = \left(K_{Et}^l \right)^{\frac{\alpha}{1-\alpha}} A_E N,$$

capital and output in the capital-intensive industry is identical to (37) in Stage 1. Moreover, capital in the E-sector also evolves according to (38) as in Stage 1.

Proof. $K_{Ft}^l = 0$ is straightforward. It is then easy to check

$$\rho_{Et}^l \geq \rho_{Et}^k$$

in the second stage. ■

Corollary 1 *If*

$$\chi^{1-\alpha} < \frac{\alpha(1+\beta)}{\beta\psi R}, \quad (40)$$

then there are only two stages in the economy (firms in the E-sector never produce capital-intensive goods).

Proof. Define $\tilde{P}^l \equiv \left(1 - \varphi^\sigma \left(\frac{R}{(A_F)^{1-\alpha}} \right)^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$ as the constant price of labor-intensive goods in Stage 2. The law of motion (38) implies an upperbound of capital stock during the second stage of transition:

$$\frac{K_{Et}}{A_E N} \leq \left(\frac{\beta\psi\tilde{P}^l}{1+\beta} \right)^{\frac{1}{1-\alpha}}.$$

This gives the lowerbound of the rate of return:

$$\rho_{Et}^l > \tilde{P}^l \alpha (1 - \psi) \left(\frac{\beta\psi\tilde{P}^l}{1+\beta} \right)^{-1} = \frac{\alpha(1-\psi)(1+\beta)}{\beta\psi}.$$

Recall that $\rho_{Et}^k = (1 - \psi)\chi^{1-\alpha}R$. Therefore, $\rho_{Et}^l > \rho_{Et}^k$ always holds under the assumption of (40). ■

Proposition 5 Stage 3 is defined as

$$\frac{1}{\chi} \left(\frac{P_t^l \alpha}{R} \right)^{\frac{1}{1-\alpha}} < \frac{K_{Et}}{A_E N} \leq \frac{1}{\chi} \left(\frac{P_t^l \alpha}{R} \right)^{\frac{1}{1-\alpha}} + \frac{1}{\chi} \left(\frac{P_t^l \alpha}{R} \right)^\alpha \left(\frac{\varphi P_t^l}{P_t^k} \right)^\sigma A_E^\alpha N.$$

In the third stage, the E firms start to produce capital-intensive goods. Specifically, prices of labor- and capital-intensive goods are determined by (33) and (34). $N_{Ft}^l = 0$, $N_{Et}^l = N$, capital and output in the labor- and capital-intensive industries are such that

$$K_{Ft}^l = 0, K_{Et}^l = \frac{1}{\chi} \left(\frac{P_t^l \alpha}{R} \right)^{\frac{1}{1-\alpha}} A_E N, Y_t^l = \left(K_{Et}^l \right)^{\frac{\alpha}{1-\alpha}} A_E N, \quad (41)$$

$$Y_t^k = \left(\varphi P_t^l / P_t^k \right)^\sigma Y_t^l, K_{Ft}^k = \frac{Y_t^k - A_E^{1-\alpha} K_{Et}^k}{A_F^{1-\alpha}}, K_{Et}^k = K_{Et} - K_{Et}^l, \quad (42)$$

respectively. Moreover, capital in the E -sector evolves according to

$$\frac{K_{Et+1}}{A_E N} = \frac{\beta \psi}{1 + \beta} \left(P_t^l \left(\frac{K_{Et}^l}{A_E N} \right)^\alpha + P_t^k A_E^{1-\alpha} \left(\frac{K_{Et}}{A_E N} - \frac{K_{Et}^l}{A_E N} \right) \right). \quad (43)$$

Proof. $K_{Ft}^l = 0$ is straightforward. $K_{Et}^k > 0$ implies equalized rates of return across two industries.

$$\rho_{Et}^k = \rho_{Et}^l \Rightarrow (1 - \psi) \chi^{1-\alpha} R = P_t^l (1 - \psi) \alpha \left(K_{Et}^l \right)^{\alpha-1} \Rightarrow$$

$$K_{Et}^l = \frac{1}{\chi} \left(\frac{P_t^l \alpha}{R} \right)^{\frac{1}{1-\alpha}} A_{Et} N.$$

Given total capital K_{Et} in the E -sector, $K_{Et} - K_{Et}^l$ will be allocated to the capital-intensive industry. Finally, entrepreneurs' total income is equal to $\psi \left(P_t^l \left(K_{Et}^l \right)^\alpha \left(A_E N \right)^{1-\alpha} + P_t^k A_E^{1-\alpha} K_{Et}^k \right)$, which gives the law of motion of capital (43). ■

Proposition 6 Stage 4 is defined as

$$\frac{K_{Et}}{A_E N} > \frac{1}{\chi} \left(\frac{P_t^l \alpha}{R} \right)^{\frac{1}{1-\alpha}} + \frac{1}{\chi} \left(\frac{P_t^l \alpha}{R} \right)^\alpha \left(\frac{\varphi P_t^l}{P_t^k} \right)^\sigma A_E^\alpha N.$$

In the fourth stage, economic transition is complete in the sense that the F -sector vanishes even in the capital-intensive industry. Specifically, prices of labor- and capital-intensive goods are determined by (33) and (44).

$$P_t^k = \frac{R}{(1 - \psi) A_E^{1-\alpha}}. \quad (44)$$

$N_{Ft}^l = 0$, $N_{Et}^l = N$, capital and output in the labor- and capital-intensive industries are identical to (41) and (42), except that $K_{Ft}^k = 0$. The law of motion of capital in the E -sector also follows (43) in the third stage.

The proof is straightforward and therefore omitted.

Table 1. Panel Regression by Tercile

Specification (1): controls are provincial dummies			
Terciles	b	Obs.	Ad. R ²
1	0.9966*** (0.1056)	66	0.8574
2	0.7358*** (0.1332)	60	0.9160
3	0.2534 (0.3279)	60	0.5275
Specification (2): controls are provincial and year dummies			
Terciles	b	Obs.	Ad. R ²
1	0.6447*** (0.1684)	66	0.8647
2	0.5313*** (0.1217)	60	0.9195
3	0.0049 (0.3156)	60	0.6371
Specification (3): controls are provincial and year dummies, and GDP per capita			
Terciles	b	Obs.	Ad. R ²
1	0.5387*** (0.1516)	66	0.8871
2	0.5329*** (0.1237)	60	0.9179
3	-0.0032 (0.2981)	60	0.6719

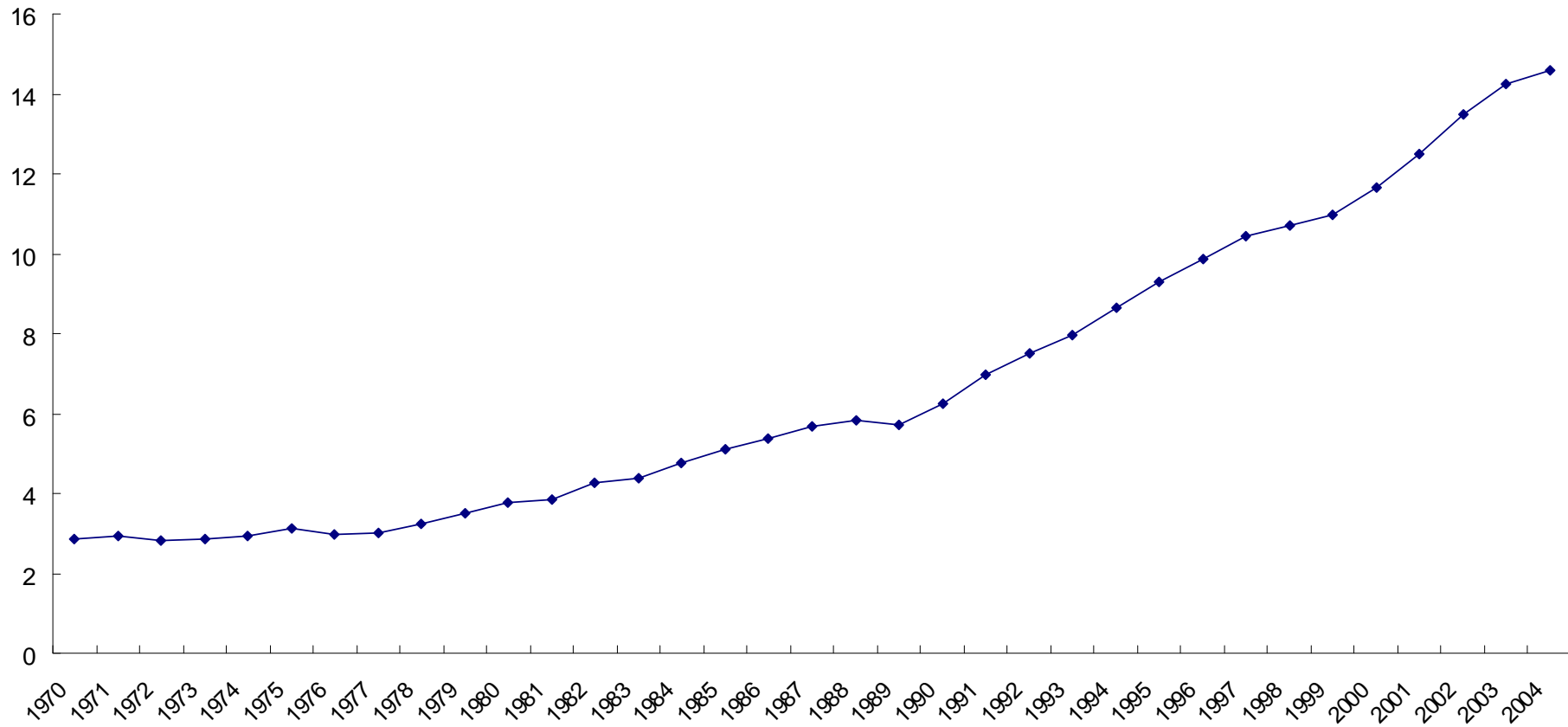
Notes: The dependent variable is the investment rate (INV) and the main regressor is the saving rate (SAVINGS). b is the estimated coefficient of SAVINGS from the fixed-effect regression. We add year dummies as additional controls in Specification (2). GDP per capita is introduced in Specification (3). Robust standard errors are in brackets. *** is significant at 1%.

Table 2 Investment, Saving and Private Employment

Dep. Variable	INV	
	(1)	(2)
EMPL ^{PRIV}	0.0347 (0.2613)	-0.0101 (0.2408)
SAVINGS*EMPL ^{PRIV}	1.2342* (0.6898)	3.6284*** (0.8697)
SAVINGS	0.3827* (0.2047)	0.5013*** (0.1723)
GDP Per Capita	-	-0.0124*** (0.0021)
Province Dummy	Yes	Yes
Year Dummy	Yes	Yes
Obs.	155	155
Ad. R ²	0.7731	0.8195

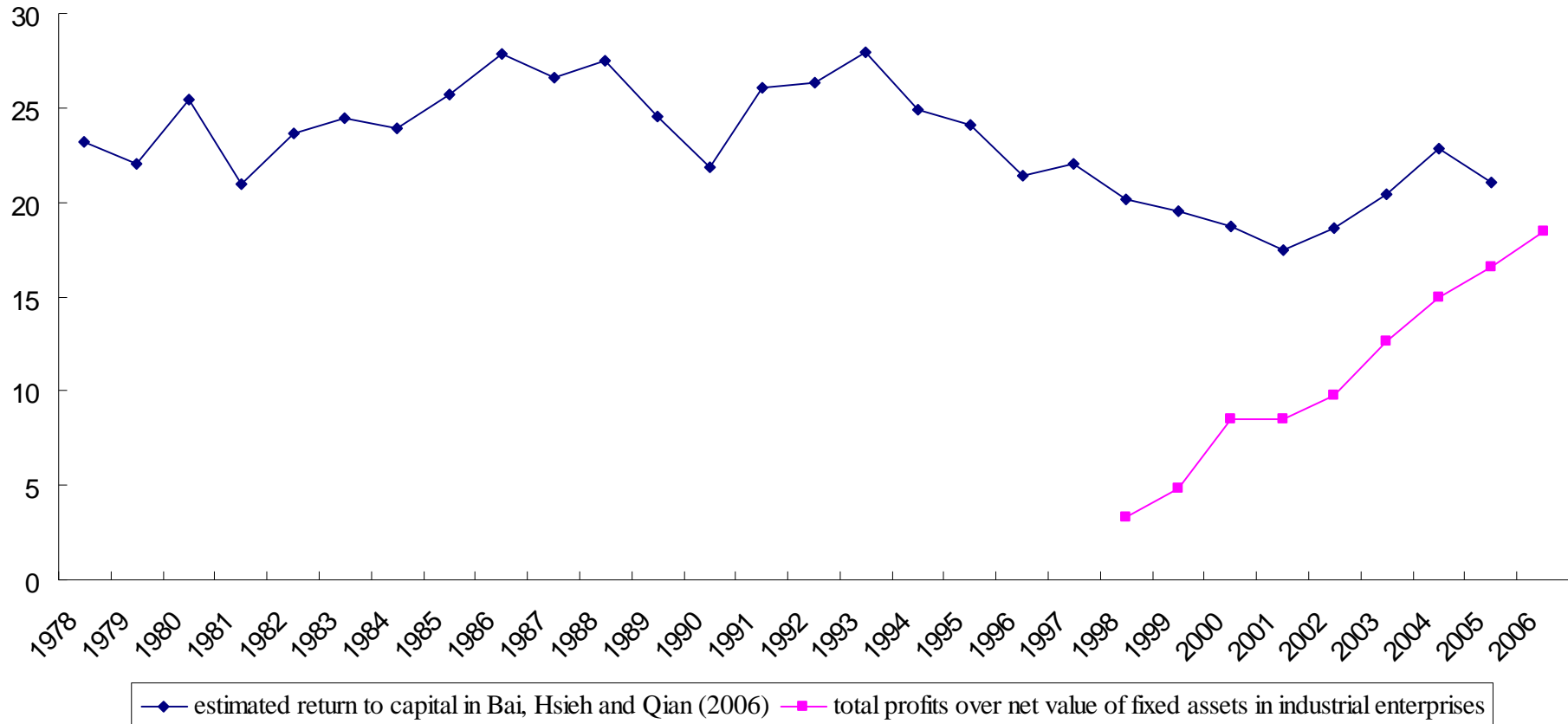
Notes: The dependent variable (INV) is the investment rate defined as the ratio of total investment in fixed assets to GDP. EMPL^{PRIV} is the employment share of domestic private industrial enterprises and the saving rate SAVINGS = (GDP-C-G)/GDP, where C and G are consumption and government consumption expenditures, respectively. The sample mean is subtracted to SAVINGS and EMPL^{PRIV}. Robust standard errors are in brackets. ***, ** and * is significant at 1%, 5% and 10%, respectively.

Figure 1 China Real GDP Per Capita as Percentage of US Real GDP Per Capita



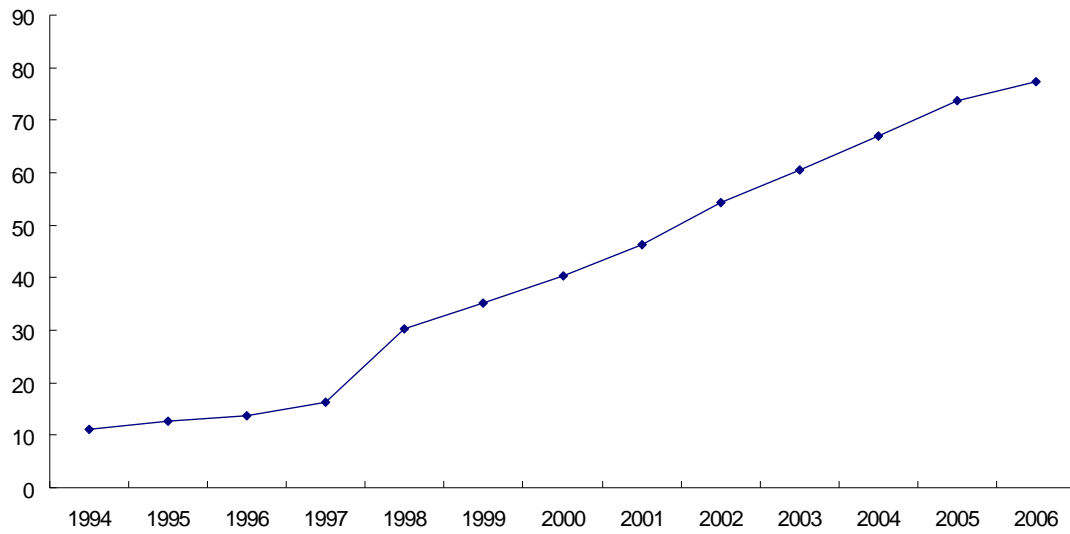
Data source: Penn World Table 6.2.

Figure 2 The Rate of Return to Capital



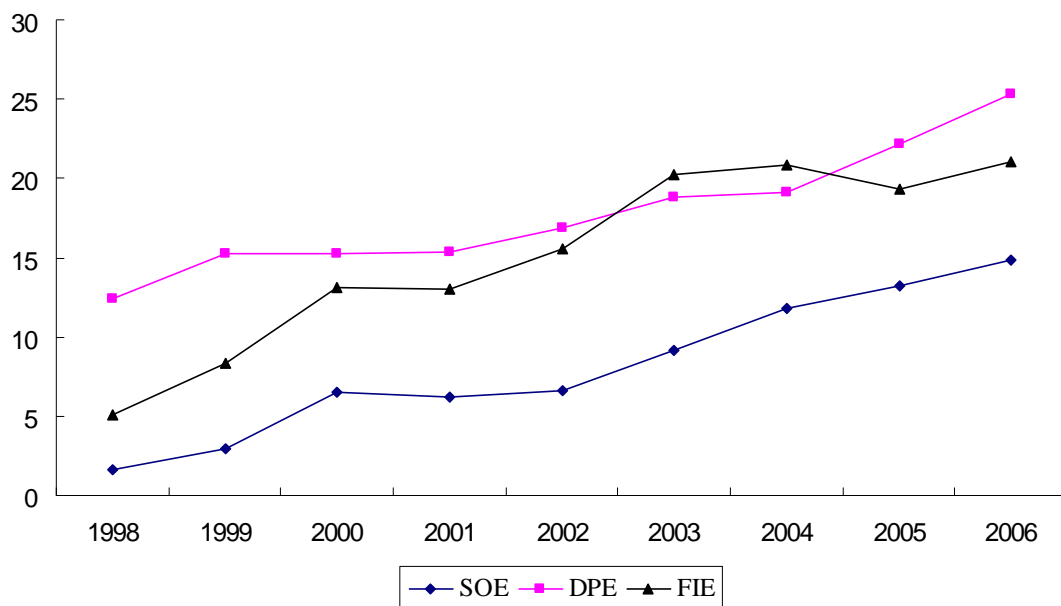
Data Source: Estimated rates of return to capital are from Bai, Hsieh and Qian (2006). Data on total profits and net value of fixed assets in industrial enterprises are from Chinese Statistical Yearbook (2007).

Figure 3 Percentage Share of Private Employment in Manufacturing



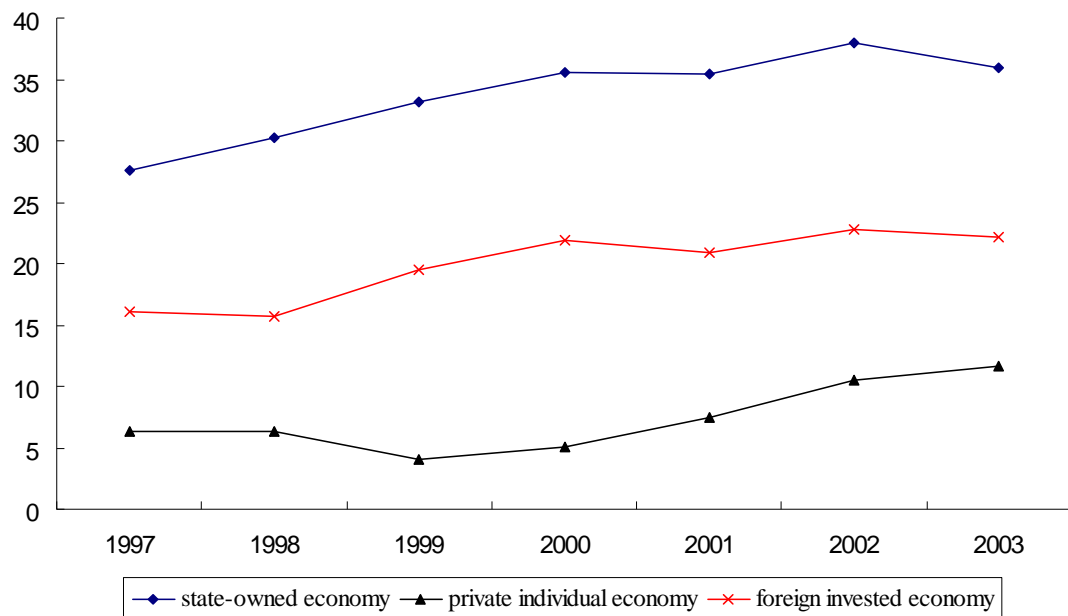
Note: Private employment is equal to total employees minus employees in state-owned and collectively-owned economy, which therefore includes employees in both domestic private and foreign invested economy. Data source: Chinese Statistical Yearbook various issues.

Figure 4 Total Profits over Net Value of Fixed Assets for Industrial Enterprises



Data Source: China Statistical Yearbook 2006 and 2007. SOE, DPE and FIE stand for state-owned, domestic private and foreign-invested enterprises, respectively.

Figure 5 Percentage Share of Investment Financed by Bank Loans and Government Budgets



Date source: China Statistical Yearbook 1998 to 2001 and 2003, China Economy & Trade Statistical Yearbook 2002 and 2004.

Figure 6.1 Capital Labor Ratios (thousand yuan per worker) by Ownership and Sector in Manufacturing in 2006

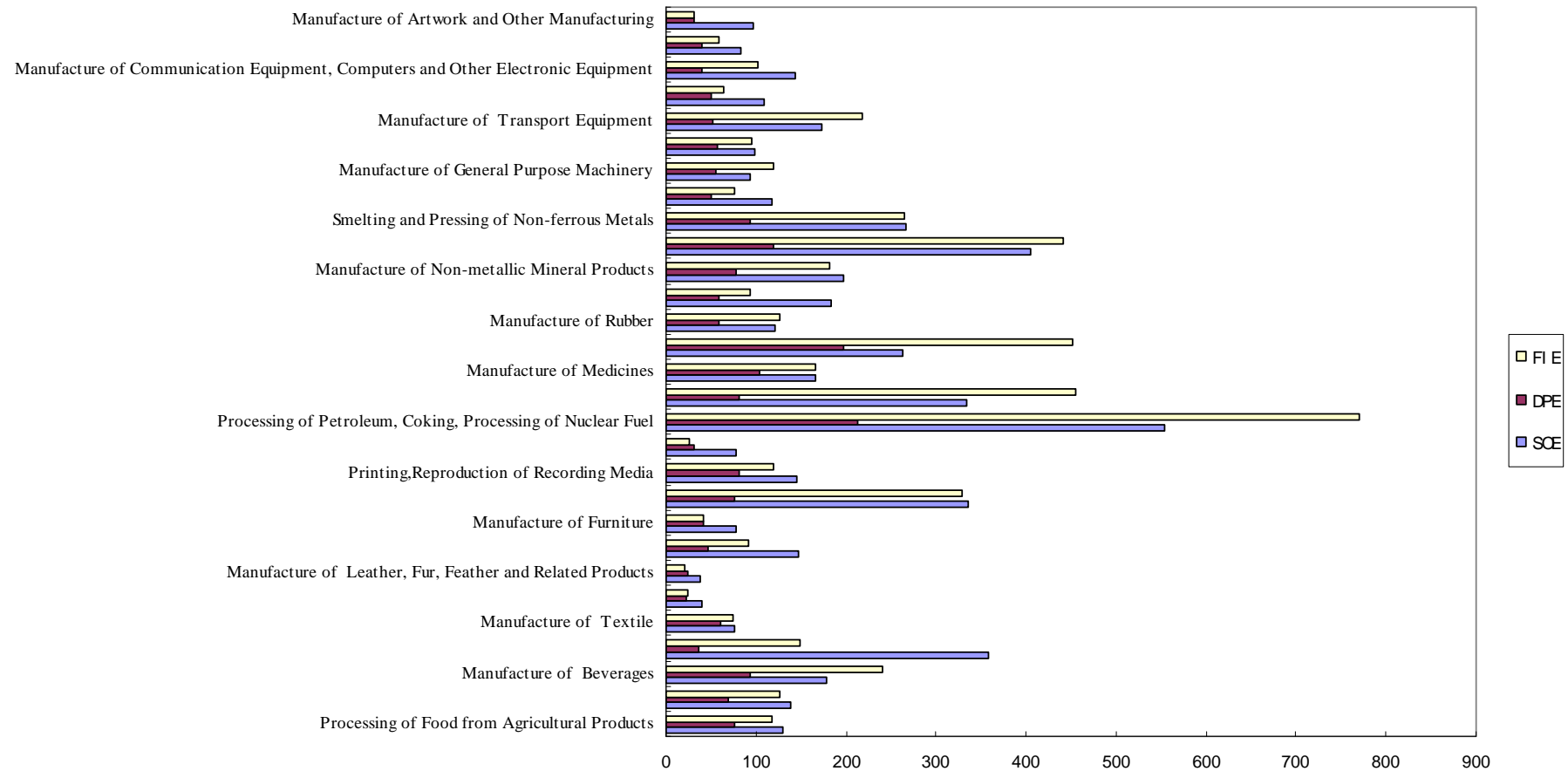
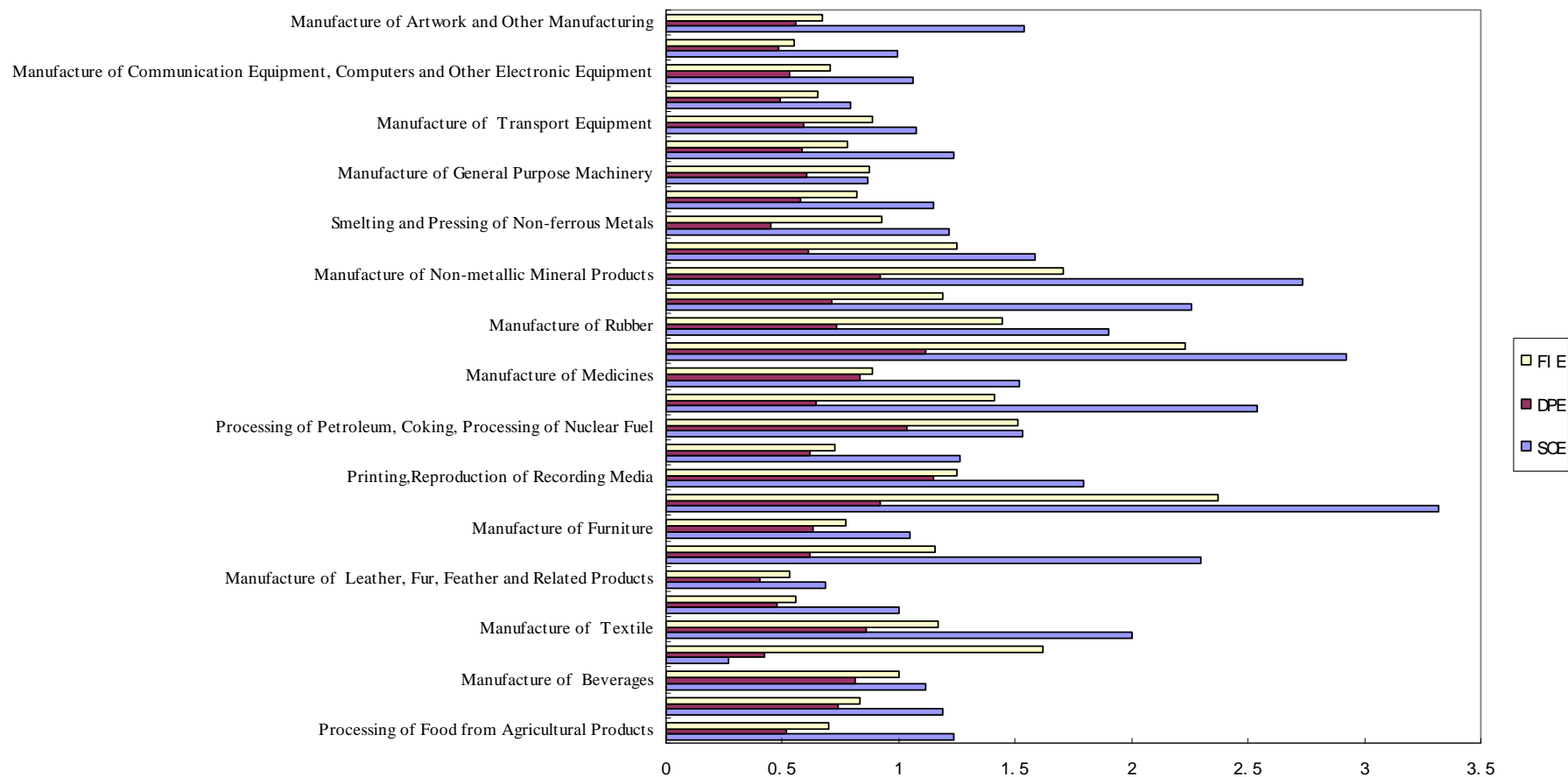
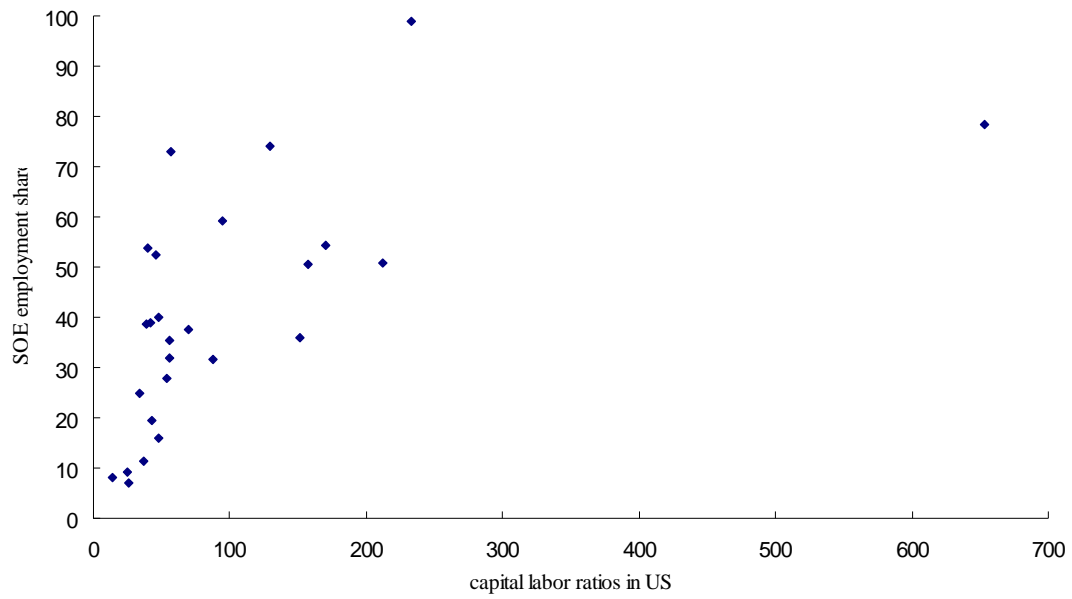


Figure 6.2 Capital Output Ratios by Ownership and Sector in Manufacturing in 2006



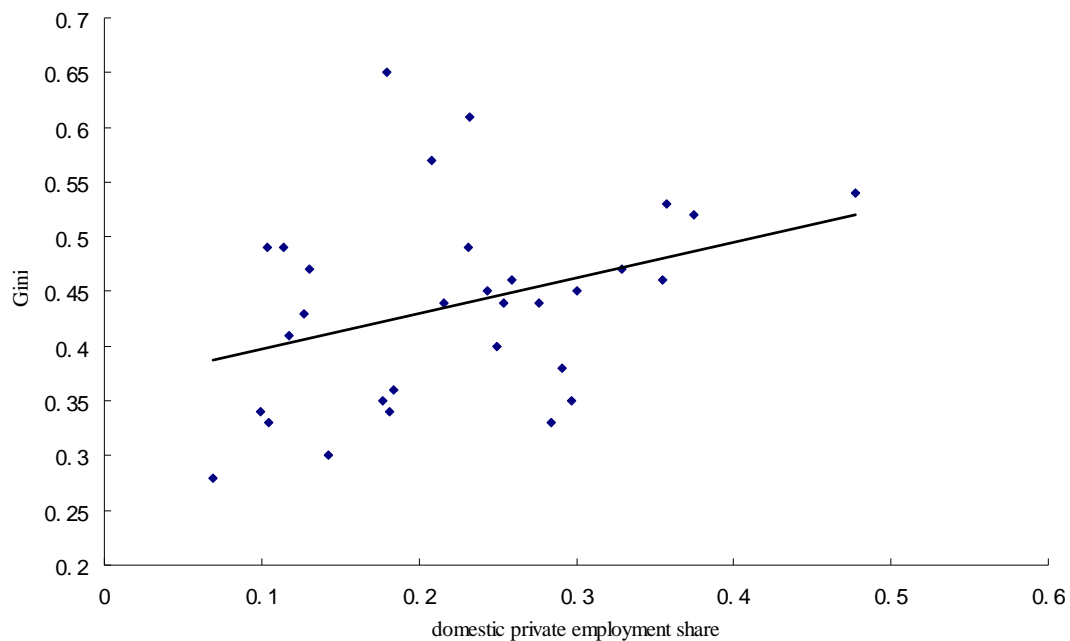
Note: We use net value of fixed assets as a proxy for capital. Data Source: Chinese Statistical Yearbook 2007.

Figure 7 SOE Employment Shares across Industries (percentage)



Note: SOE employment shares are the average ratio of state-owned industrial enterprise employees to total industrial enterprise employees over 2001 and 2003. Data source: China Industrial Economy Statistical Yearbook (2002, 2003, 2004). We use US capital labor ratios in 1996, from NBER-CES Manufacturing Industry Database.

Figure 8 Gini and Domestic Private Industrial Enterprise Employment Shares across Provinces in 2006



Note: Domestic private industrial enterprise employment share is equal to the percentage share of employees in domestic private industrial enterprises over total employees in all industrial enterprises. Data are from Chinese Statistical Yearbook 2007. Provincial Gini is from Report to the Seventeenth National Congress of the Communist Party of China.