Growing like China*

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Abstract

China has been growing at a high rate and has at the same time accumulated a staggering foreign surplus. We constructs a theory that explain these seemingly puzzling observations, while being consistent with salient features of the Chinese growth experience since 1992: high output growth, sustained returns on capital investments, extensive reallocation within the manufacturing sector, falling labor share and accumulation of a large foreign surplus. The theory makes only minimal deviations from a neoclassical growth model. Its building blocks are financial imperfections and reallocation among firms with heterogeneous productivity. Some firms use more productive technologies than others, but low-productivity firms survive because of better access to credit markets. Due to the financial imperfections, high-productivity firms – which are run by entrepreneurs – must be financed out of internal 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. We test some auxiliary implications of the theory and find robust empirical support.

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

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1 Introduction

Over the last thirty years, China has undergone a spectacular economic transformation. The transformation has involved not only fast economic growth and sustained capital accumulation, but also major shifts in the sectoral composition of output, urbanization, and a growing importance of markets and entrepreneurial skills. Reallocation of both labor and capital across manufacturing firms has been a key source of productivity growth. The rate of return on investments has remained well above 20%, higher than in most industrialized and developing economies. If investment rates have been high, saving rates have been even higher: in the last fifteen years, China has seen a growing net foreign surplus. Its foreign reserves swelled from 21 billion USD in 1992 (5% of its GDP) to 1700 billion USD in March 2008 (43% of its GDP), see Figure 1.

FIGURE 1 HERE

The joint observation of high growth and high return on capital, on the one hand, combined with a growing foreign surplus, on the other hand, is puzzling. A closed-economy neoclassical growth model would predict that the high investment rate should lead to a substantial fall in the return to capital. An open-economy model would predict a large net capital inflow rather than an outflow, owing to the high domestic return on capital. In this paper, we propose a theory of economic transition that resolves this puzzle while being consistent with the main stylized facts of the Chinese experience. The focal points of the theory are financial frictions and firms' reallocation. In our theory, both the sustained return on capital and the foreign surplus arise from the reallocation of capital and labor from less productive externally-financed firms to entrepreneurial firms that are more productive, but have less access to external financing. As financially integrated firms shrink, 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.

Our paper is part of a recent literature arguing that low aggregate total factor productivity (TFP) – especially in developing countries – is the result of micro-level resource misallocation (see Parente, Rogerson and Wright, 2000, Caselli and Coleman 2002, Banerjee and Duflo 2005, Hsieh and Klenow, 2007, Restuccia and Rogerson, 2008, and Gancia and Zilibotti, 2009). While pockets of efficient firms using state-of-art technologies may exist, these firms fail to attract the large share of productive resources that efficiency would dictate, due to financial frictions and other imperfections. Most existing literature emphasizes the effects of resource misallocation on average productivity. In contrast, our paper argues that when a country starts from a situation of severe inefficiency, but manages to ignite the engine of reallocation, it has the potential to grow fast over a prolonged transition. 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.

To analyze such transition, we construct a model where firms are heterogeneous in productivity and access to financial markets. High-productivity firms are operated by agents with entrepreneurial skills who are financially constrained and who must rely on retained earnings to finance their investments. Low-productivity firms can survive due to their better access to credit markets, since the growth potential of high-productivity firms is limited by the extent of entrepreneurial savings. If the saving flow is sufficiently large, high-productivity firms outgrow low-productivity ones, progressively driving them out of the market. 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 actually increases. Moreover, the economy 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 demand for funds from financially-integrated domestic firms declines, a growing share of the intermediated funds must be invested abroad, building a growing foreign surplus. This prediction is consistent with the observation that the difference between deposits and domestic bank loans has been growing substantially, tracking China's accumulation of foreign reserves (see again Figure 1). After the transition, the economy behaves as in a standard neoclassical model where 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) estimate that reallocation across manufacturing firms with different productivity accounts for an annual 1.4 percentage points increase in aggregate TFP during 1998-2005. Thus, reallocation may account for a large share of total TFP growth.[1]

Our theory bears a number of auxiliary predictions that are consistent with the evidence of China's transition. We state here the main implications, and defer a more detailed discussion of the evidence to section 2.

1. The theory predicts that savings determine investments in regions with a high intensity of entrepreneurial firms, while investments are unrelated to savings in regions dominated by financially-integrated firms. 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 entrepreneurial firms.

2. In the benchmark model, all firms produce the same good and differ only in TFP. 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 observed 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.

3. The theory predicts rising inequality within urban areas, as wages grow less than entrepreneurial rents during the transition. Moreover, inequality should be higher in regions with a high density of entrepreneurial activity. We find both predictions to be consistent with the evidence for China.

The theory is related to the seminal work of Kuznets (1966) and Chenery and Syrquin (1975) who study sources of productivity growth during 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 is similar in some respects 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

[1] Recent 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).

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 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 growing production of capital goods is exported, thus preventing the returns to capital from falling. Ventura's model does not assume any initial inefficiency, nor does it imply that TFP should grow within each industry – a key implication of our theory. In addition, his model has no implications regarding 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 ones. Moreover, our two-sector extension also predicts that financial constraints generate specialization in spite of the lack of any technological comparative advantage. Matsuyama (2007) provides a survey of the literature on economic transition.

Gourinchas and Jeanne (2007) note – as we do in this paper – that the observation that capital tend to flow out of fast-growing economies with high marginal product of capital is inconsistent with the neoclassical growth model. They show, using a panel of 69 developing countries, that this pattern is not a unique feature of China. In particular, developing countries with fast TFP growth tend to have both large capital outflows and large investment rates, while the opposite is true for slow-growing countries. They label this finding as the "allocation puzzle".

A few recent papers address the more specific question of why China is accumulating a large foreign surplus. Most papers emphasize the country's high saving rate. Kuijs (2005) shows that household and enterprise saving rates in China are, respectively, 11.8 and 8.6 percentage points higher than those in the US, respectively. Demography, the lack of social security and an imperfect financial sector are among the factors proposed as explanations for this (e.g. Kraay, 2000). However, it remains unclear why domestic savings are not invested domestically given the high rate of return to capital in China. Mendoza, Quadrini and Rios-Rull (2007) argue that this may be explained by differences in financial development inducing savers in emerging economies to seek insurance in safe US bonds (see also Caballero, Farhi and Gourinchas, 2006). Dooley, Folkerts-Landau and Garber (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 motivates 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 on specialization of different firms in labor- or capital-intensive production. Section 6 concludes. Proofs and other technical material are contained in an appendix

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, increased the role of local governments and communities, and experimented with market reforms in a few selected special economic zones. During the 1980s, China was a mixed economy, with some elements of planning and others of market economy, and with a high but volatile growth.

After a period of economic and political instability, a new stage of the reform process began in 1992, inaugurated by Deng Xiaoping's "southern tour" during which the leader spoke in favor of an acceleration of reforms (see Zhao 1993). Since then, China has moved towards a fully-fledged market economy. Thereafter, the role of the state in allocating resources has decreased, and many unprofitable enterprises were shut down. The focus of this paper is on the post-1992 Chinese transition, a period characterized by a fast and stable growth, and by a pronounced resource reallocation within the manufacturing sector. In spite of very high investment rates (37% on average), the rate of return to capital has not fallen over time, especially in the manufacturing sector. If the aggregate return to capital fell slightly (from 28% in 1993 to 21% in 2005), the rate of return on capital in manufacturing has been increasing over time since the early 1990s and climbed close to 35% in 2003 (see Bai, Hsieh and Qian (2006), Figure 11). 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, was close to zero during the same period.[2] Wage growth has been lower than

[2] More 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.

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% (see Banister (2007), Table 10, based on China Labor Statistical Yearbook (2005)). Similarly, the labor share of aggregate output fell from 50% in 1992 to 41% in 2005 (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.* 2008).

FIGURE 2 HERE

The reallocation of investments and workers within the manufacturing sector is a focal point of our paper. Figure 2 shows the private employment share in manufacturing, mining and construction, including both domestic private enterprises (DPE henceforth) and foreign-owned enterprises.[3] In 1994, private enterprises accounted for about 10% of total employment. By 2006, their share rose up to 80%. DPE (which account for the lion's 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 to external credit than do DPE. This makes ownership structure a natural proxy for the different types of firms in our theory. Figure 3 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, similar to that reported by Islam, Dai and Sakamoto (2006).[4] Similarly, Hsieh and Klenow (2007) estimate the TFP gap (adjusted by relative prices) between DPE and SOE to be 42%.

FIGURE 3 HERE

FIGURE 4 HERE

[3] The 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.

[4] A concern with the official data is that the ownership classification is based on ownership at the time of initial registration. However, many firms subsequently have been privatized. This problem is addressed by Dollar and Wei (2007) who use survey data on 12400 firms, classified according to their *current* ownership. They find the average return to capital to be twice as high in private firms than in fully state-owned enterprises (see Table 6 p. 23). Interestingly, collectively owned firms also have a much higher productivity than SOE.

Financial and contractual imperfections are central in our analysis. In a cross-country comparative study, Allen, Qian and Qian (2005) find that China scores low in terms of creditor rights, investor protection, accounting standards, non-performing loans and corruption.[5] In an environment of such financial imperfections, Chinese firms rely heavily on retained earnings to finance investments and running costs. Moreover, there is evidence that credit markets discriminate against private firms. One reason might be that the main Chinese banks are also state owned: Boyreau-Debray and Wei (2005) document that state-owned banks tend to offer easier credit to SOE. As a result, SOE can finance a larger share of their investments through external financing. Figure 4 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 that private firms have less access to bank financing and rely more on retained earnings and family and/or friends to finance investments. One should also note that, despite the rapid growth of the Chinese stock market in recent years, equity continues to be a significant source of financing only for SOEs and large semi-privatized SOEs. For instance, Gregory and Tenev (2001) document that at the end of 1999, private firms accounted for only 1 percent of the companies listed on the Shanghai and Shenzhen stock exchanges. The same study reports the results of a survey of private firms in different Chinese provinces (including Beijing) conducted in 1999 by the World Bank, showing that about 80 percent of them regarded the lack of access to external finance as a most serious constraint.[6] Similar conclusions are reached by Laurenceson (2002) arguing that the importance of stock markets has been insignificant relative to the aggregate amount of savings in China, and practically irrelevant for non-SOEs.

Another sign that DPE are more financially constrained is that both capital-output and capital-labor ratios are substantially lower in DPE than in SOE. In 2006 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

[5] Interestingly, 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 consulting foreign advisors to improve the managerial efficiency of banks (Kwan 2006). In section 4 we discuss the role of financial development during the economic transition.

[6] "*(These private firms...) relied heavily on self-financing for both start-up and expansion. More than 90 percent of their initial capital came from the principal owners, the start-up teams, and their families... In the case of post-start-up investments, the sample firms continued to depend overwhelmingly on internal sources, with at least 62 percent of their financing coming from the principal owners or out of retained earnings. Among external funding sources, informal channels, credit unions, and commercial banks were about equally represented. Outside equity, including public equity, and public debt markets played an insignificant role.*" (Gregory and Tenev, 2001, p.1)

than in DPE, although part of this difference can be attributed to the higher average educational attainment of SOE workers. This gap arises from both an intensive and an extensive margin. First, SOE are more capital intensive within each industry, as shown in Figure A1 in the appendix. Panels 1 and 2 show, respectively, the capital-output and capital-labor ratio by ownership structure within three-digit manufacturing industries.

Second, DPE have taken over labor-intensive industries, while the share of SOE remains high in capital-intensive industries. To document the retreat of SOE from labor-intensive industries, we classify three-digit manufacturing industries by the capital-labor ratio in US industries in 1996 (we do not classify them according to capital-labor rations in China in order to avoid an endogeneity problem).[7] We then match the industries listed by the China Industrial Economy Statistical Yearbook (CIESY 2002, 2003 and 2004) to the SIC codes.[8] This leaves a total of 27 industries. Figure 5 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%.

FIGURE 5 HERE

The economic transition of China has been accompanied by increasing inequality – even within the urban sector. For instance, the Gini coefficient of income grew from 0.36 in 1992 to 0.47 in 2004. Our theory suggests that this development may be due in part to the slow growth of wages relative to entrepreneurial income. The pattern of income inequality across regions can offer some insight. We classify Chinese provinces by the percentage of employees in DPE over total employees in all industrial enterprises. Figure 6 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 it does not prove any causal relationship, this correlation is nevertheless interesting.

[7] The U.S. data are from NBER-CES Manufacturing Industry Database, available at http://www.nber.org/nberces.

[8] Among 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 6 HERE

3 Theory

In this section we develop a theory of economic transition that is consistent with the facts documented in the previous section. A key prediction – also consistent with the evidence from China – is that during the transition the economy experiences a growing foreign surplus.

3.1 Environment

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 heterogeneous 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*), whose skills are transmitted from parents to children.[9] The population grows at the exogenous rate ν, hence, $N_{t+1} = (1+\nu) N_t$. The rate ν captures demographic trends, including migration from rural to urban areas, assumed to be exogenous, for simplicity.[10]

There are two types of firms, both requiring one manager, capital and labor as inputs. *Financially integrated* (F) firms are owned by intermediaries (see below) and operate as standard neoclassical firms. *Entrepreneurial* (E) firms are owned by old entrepreneurs who are residual claimants on the profits and who hire their own children as managers. Each firm can choose between two modes of production (similar to Acemoglu *et al.*, 2007). Either the firm delegates decision authority to its manager, or it retains direct control on strategic decisions. There is a trade-off. On the one hand, delegation leads to higher total factor productivity (TFP) – e.g., the manager takes decisions based on superior information. More formally, a firm retaining control has a TFP equal to A while the TFP of a firm that delegates authority is χA where $\chi > 1$. On the other

[9] Lower case will denote per-capita or firm-level variables. Upper case will denote aggregate variables.

[10] 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.

hand, delegation raises an agency problem: unless monitored, the manager can steal the output, and never be caught (as in Acemoglu, Aghion and Zilibotti, 2006). The key assumption is that family-run E firms are better at monitoring their managers (indeed, the ability to monitor is the defining skill of an entrepreneur), and these can only divert a share $\psi < 1$ of output. F firms, on the other hand, are weak at corporate governance, and cannot effectively monitor their managers: under delegation, all output would be stolen.[11]

Given these assumptions, F firms will always choose a centralized organization. Moreover, under a condition that will be spelled out below, E firms prefer delegation. Thus, the technology of F firms is described by the following production function

$$y_{Ft} = k_{Ft}^{\alpha} \left(A_t n_{Ft} \right)^{1-\alpha},$$

while the technology of E firms is represented by

$$y_{Et} = k_{Et}^{\alpha} \left(\chi A_t n_{Et} \right)^{1-\alpha}.$$

In both cases, k and n denote the capital and labor input, respectively, and capital is assumed to depreciate fully after one period. In the case of centralized organization (F firms) the input of the manager is equivalent to that of a regular worker and is included into n_F. A_t is a TFP parameter that evolves according to

$$A_{t+1} = (1+z) A_t.$$

Consider, next, the savings decisions of the household sector. Young workers earn a wage, w, and deposit their savings with a set of competitive intermediaries (*banks*) paying a gross interest 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 in E firms earn a managerial compensation, m_t. Like the workers, they save a fraction $\beta / (1+\beta)$ of their earnings, and invest it either in bank deposits or in their family business.

Banks collect savings from households and invest in domestic capital and foreign bonds yielding a gross return R. Domestic investments can be channelled either to F firms or to old entrepreneurs who invest in their own business. However, contractual imperfections plague the relationship between banks and entrepreneurs. Output and

[11] The assumption that the manager can steal the output unless he is monitored is a catch-all for a variety of moral hazard issues. Similar results would obtain if we assumed that there is a conflict of objectives between managers and owners as in Aghion and Tirole (1997).

profits are partially non-verifiable, and entrepreneurs can only pledge a share η of the second-period net profits.[12] In the benchmark model, we will make the simplifying assumption that $\eta = 0$, i.e., there is no lending from banks to private entrepreneurs. This extreme assumption will be generalized to $\eta > 0$ in section 4.1.

In a competitive equilibrium where banks invest in both foreign bonds and domestic capital, the rate of return on domestic firms – absent other frictions – must equal the rate of return on foreign bonds, and both rates must equal the rate of return on deposits.[13] More formally, $R^d = R^l = R$ where R^l is the return on capital investment in domestic firms. Moreover, profit maximization implies that R^l equals the marginal product of capital in the F sector, and that wages equal the marginal product of labor,

$$w_t = (1-\alpha)\left(\frac{\alpha}{R^l}\right)^{\frac{\alpha}{1-\alpha}} A_t. \tag{1}$$

Next, consider E firms. The value of a firm owned by an old entrepreneur who has invested k_{Et} is the solution to the following program:

$$\Xi_t\left(k_{Et}\right) = \max_{m_t, n_{Et}} \left\{\left(k_{Et}\right)^{\alpha}\left(\chi A_t n_{Et}\right)^{1-\alpha} - m_t - w_t n_{Et}\right\} \tag{2}$$

subject to the incentive constraint that $m_t \geq \psi\left(k_{Et}\right)^{\alpha}\left(A_{Et} n_{Et}\right)^{1-\alpha}$, where m_t is the payment to the manager, and arbitrage in the labor market implies that the wage is as in (1).[14] The optimal contract implies that the incentive constraint is binding:

$$m_t = \psi\left(k_{Et}\right)^{\alpha}\left(\chi A_t n_{Et}\right)^{1-\alpha}. \tag{3}$$

Taking the First Order Condition with respect to n_E and substituting in the equilibrium wage given by (1) yields

$$n_{Et} = \left(\left(1-\psi\right)\chi\right)^{\frac{1}{\alpha}}\left(\frac{\alpha}{R^l}\right)^{-\frac{1}{1-\alpha}} \frac{k_{Et}}{\chi A_t}, \tag{4}$$

which in turn implies, together with (2) and (3), that the value of the firm is

$$\Xi_t\left(k_{Et}\right) = \left(1-\psi\right)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} R^l k_{Et} \equiv \rho_E k_{Et}. \tag{5}$$

[12] The assumption that output is not verifiable rules out the possibility that financially integrated firms hire old entrepreneurs. If the entrepreneurs could commit to repay, all firms would be run by private entrepreneurs.

[13] In section 4 we assume that banks are subject to iceberg costs when turning savings into domestic investments. In that case, $R^l > R$.

[14] The managerial compensation must also exceed the workers' wage rate ($m_t > w_t$). We assume that this participation constraint is never binding in equilibrium.

In constrast, F firms are not subject to any incentive constraint since their managers make no discretionary decisions. Thus, the managers' participation constraint is binding and they earn the same wage as ordinary workers.

We introduce the following assumption:

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

Assumption 1 ensures that $\rho_E > R^l$, so that (i) E firms prefer delegation to centralization and (ii) young entrepreneurs find it optimal to invest in the family business. If this assumption were not satisfied, there would be no E firms in equilibrium. Thus, Assumption 1 is key to trigger economic transition.

Before discussing the equilibrium dynamics, we review the main assumptions of this section.

3.2 Discussion

The theory describes a general growth model characterized by heterogeneous firms that differ in productivity and access to credit markets. In the application to China, the natural empirical counterparts of E firms and F firms are state-owned and private enterprises, respectively. In our model, we do not emphasize the public ownership of less productive firms. However, we focus on two salient features that are related to the ownership structure. First, due to their internal bureaucratic structure, SOE are weak in corporate governance, and grant less autonomy and incentives to their management. This feature is well documented. For instance, Liu and Otsuka (2004) documents that profit-linked managerial compensation schemes are very rare in a sample of SOE, and in contrast are ten to twenty times more prevalent in a sample of Township and Village Enterprises. The rigidity of the SOE structure is emphasized by Chang and Wong (2004). Second, thanks to connections to state-owned banks they enjoy better access to borrowing (see the motivating evidence discussed above). In describing F firms as competitive, we abstract from other institutional features, such as market power or distortions in the objectives pursued by firms and their managers, that may be important in Chinese SOE. We do so partly for tractability. We note, however, that SOE in China have been subject to an increased competitive pressure that has led many of them to be closed or privatized and forced to restructure. Therefore, we believe the abstraction of competitive profit-maximizing firms to be fruitful in order to focus on the two distortions discussed above. Likewise, again for simplicity, we model the labor market as competitive and frictionless. While the Chinese labor market is characterized by important frictions (for example, barriers to geographical mobility) we do not think that including such frictions would change any of the qualitative predictions of the theory, although it would affect the speed of reallocation.

The assumption that private firms are less financially integrated is also well rooted in the empirical evidence discussed in section 2, showing that Chinese private firms rely heavily on self-financing, and receive only limited funding from banks and insignificant equity funding. The assumption that monitoring is easier within flexible organizations – and most notably in family firms – seems natural. In the model, we do not emphasize inter-family altruistic links: parents transmit genetically entrepreneurial skills to their children, but also must provide them with incentives to avoid opportunistic behavior. Alternatively, we could have focused on parental altruism and assumed that incentive problems are altogether absent in family firms. In such an alternative model, parents would leave voluntary bequests to their children, who in turn would invest in the family firm. In the technical appendix we develop a model with warm-glow bequests, and show that the main implications of the theory are robust. One advantage of the specification chosen in the previous section is that it does not hinge on family ties. For instance, we could dispense of the assumption that young managers and old entrepreneurs in E firms are members of the same family, and assume instead that entrepreneurial skills – i.e., the ability to monitor – can be learned through the experience of working as a manager with delegated authority. The results would be identical to those of our model. Therefore, the model captures general features of private credit-constrained firms beyond the convenient abstraction of the family firm.

The feature that is essential for our mechanism to work is that financial and contractual frictions must obstruct the flow of capital towards high-productivity entrepreneurial firms. If the entrepreneurs could borrow external funds without impediments, the transition would occur instantaneously and only the more efficient E firms would survive in equilibrium. As we will see, the fact that entrepreneurs must rely – partially or totally – on their own savings generates a smooth transition.

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 showing that E firms choose in equilibrium a lower capital-output ratio than do F firms. To this aim, denote by $\kappa_J \equiv k_J/(A_J n_J)$ the capital per effective unit of labor. We drop time subscripts when this causes no confusion. As discussed above, in a competitive equilibrium, the borrowing rate, R^l, pins down the marginal product of capital in the F sector. Thus, $R^l = \alpha\kappa_F^{\alpha-1}$, implying

$$\kappa_F = \left(\frac{\alpha}{R^l}\right)^{\frac{1}{1-\alpha}}. \tag{6}$$

Since κ_F is constant, the equilibrium wage in (1) 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. Equation (4) then implies immediately that

$$\kappa_E = \kappa_F \left(\left(1-\psi\right)\chi\right)^{-\frac{1}{\alpha}}, \tag{7}$$

where $\kappa_E < \kappa_F$ as long as Assumption 1 holds. The following Lemma is then easily established.

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

Intuitively, financially constrained firms have a comparative disadvantage in using capital – manifested in the higher return on capital – and therefore choose a lower capital-labor ratio.

Consider, next, the transitional dynamics of capital and labor. The key properties of the model that determine the equilibrium dynamics are that (i) K_{Et} and A_t are predetermined (whereas K_{Ft} is not a state variable, and is determined so as to equate the return on investments in the F sector to the international bond rate), (ii) capital per effective unit of labor, κ_E and κ_F, are constant in each sector, and (iii) entrepreneurial saving at t (hence, K_{Et+1}) is linear in K_{Et}. These three properties imply that employment, capital and output in the entrepreneurial sector grow at a constant rate during transition, as is stated formally in the following Lemma.

Lemma 2 *During transition, given K_{Et} and A_t, the equilibrium dynamics of capital and employment in the entrepreneurial sector are given by:*

$$\frac{K_{Et+1}}{K_{Et}} = \frac{\beta}{1+\beta}\psi\left(\left(1-\psi\right)\chi\right)^{\frac{1-\alpha}{\alpha}}\frac{R^l}{\alpha} \equiv 1+\gamma_{K_E}, \tag{8}$$

and $N_{Et+1}/N_{Et} = \left(1+\gamma_{K_E}\right)/\left(1+z\right) \equiv 1+\nu_E$. The employment share of the entrepreneurial sector grows over time if and only if $\nu_E > \nu$, or, equivalently

$$\chi > \frac{1}{1-\psi}\left(\frac{1+\beta}{\beta}\frac{\left(1+z\right)\left(1+\nu\right)}{\psi}\frac{\alpha}{R^l}\right)^{\frac{\alpha}{1-\alpha}}. \tag{A2}$$

The fact that young entrepreneurs earn a constant share of E-firms' profits is a key driving force of the transition. To illustrate this point, suppose that $z = 0$. In this case the workers' wage remains constant during the transition. However, the managerial rents, m_t, still grow in proportion to the output of the E sector. The 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 avoid a falling return to investments. If young entrepreneurs were to earn no rents and to receive the workers' wage, investments in the E sector would not grow over time. As one can see from (8), 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) fall.

Note that both Assumption 1 and condition A2 require the TFP gap, χ, to be large. Hence, generically, only one of them will be binding. Interestingly, the theory can predict 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 continue to be positive (i.e., Assumption 1 continues to hold) but the employment share of the E sector shrinks (i.e., condition A2 ceases to be satisfied).

The equilibrium dynamics of capital, employment and output of the F sector are characterized residually by the condition that $K_{Ft} = \kappa_F A_t (N_t - N_{Et})$, namely the F sector hires all workers not employed in the E sector, and K_F adjusts so as to attain the optimal capital-labor ratio. Standard algebra shows that, as long as the employment share in the E sector increases, the growth rate K_F declines over time.[15] Capital accumulation in the F sector is hump-shaped during the transition. Initially, when employment in the E sector is small, K_F grows at a positive rate. However, as the transition proceeds, its growth rate declines and eventually turns negative.

Finally, standard algebra shows that GDP per worker is given by

$$\frac{Y_t}{N_t} = \frac{Y_{Ft} + Y_{Et}}{N_t} = \kappa_F^{\alpha} \left(1 + \frac{\psi}{1-\psi} \frac{N_{Et}}{N_t}\right) A_t. \tag{9}$$

[15] More formally,

$$\frac{K_{Ft+1}}{K_{Ft}} = \frac{A_{Ft+1}}{A_{Ft}} \frac{N_{Ft+1}}{N_{Ft}} = (1+z)(1+\nu) \frac{1 - \frac{N_{E0}}{N_0}\left(\frac{1+\nu_E}{1+\nu}\right)^{t+1}}{1 - \frac{N_{E0}}{N_0}\left(\frac{1+\nu_E}{1+\nu}\right)^{t}} \equiv 1 + \gamma_{K_F t}.$$

where $\frac{d}{dt}\left(1 + \gamma_{K_F,t}\right) = (1+z)\frac{N_{E0}}{N_0}\left(\frac{1+\nu_E}{1+\nu}\right)^t \left(\ln \frac{1+\nu_E}{1+\nu}\right) \frac{\nu - \nu_E}{\left(1 - \left(\frac{1+\nu_E}{1+\nu}\right)^t\right)^2} < 0$ as long as N_E/N grows.

The growth rate of GDP per worker accelerates during transition as long as condition (A2) is satisfied, reflecting the resource reallocation towards more efficient firms. Under the same condition, the average rate of return on capital in the economy increases during the transition, even though the rates of return on capital in E firms and F firms are constant. Intuitively, this reflects the increasing share of the capital stock yielding the high return ρ_E.[16]

Figure 7 illustrates the transitional dynamics of employment, wage, output and average rate of return in our economy when Assumption 1 and condition A2 hold. In the figure, the transition ends in period T, when all workers are employed in the E sector. During the transition, the employment share of the E sector, the average rate of return and output per effective units of labor grow, whereas wages per effective units remain constant.

FIGURE 7 HERE

3.4 Foreign Balance, Savings, and Investments

In this section, we derive the implications of the model for foreign balance, saving and investment rate. We start from the foreign balance, which is the main focal point of our theory. Consider the banks' balance sheet:

$$K_{Ft} + B_t = \frac{\beta}{1+\beta} w_{t-1} N_{t-1}. \tag{10}$$

The left-hand side are the banks' assets (i.e., F-sector investments, K_{Ft}, plus foreign bonds, B_t), while the right-hand side describes their liabilities (deposits). The analysis of the previous section leads to the following Lemma.

Lemma 3 *The country's foreign balance is given by*

$$B_t = \left(\frac{\beta}{1+\beta} \frac{(1-\alpha)\,\kappa_F^{\alpha-1}}{(1+z)\,(1+\nu)} - 1 + \frac{N_{Et}}{N_t} \right) \kappa_F A_t N_t. \tag{11}$$

[16] More formally, the average rate of return is

$$\rho_t = \frac{\rho_E K_{E,t} + \rho_F K_{F,t}}{K_{E,t} + K_{F,t}} = \frac{R^l}{1 - \left(1 - \chi\left((1-\psi)\,\chi\right)^{-\frac{1}{\alpha}}\right) \frac{N_{Et}}{N_t}},$$

which is increasing as long as N_{Et}/N_t increases.

As long as the employment share of the E sector (N_{Et}/N_t) increases during the transition, the country's foreign asset position increases, at least, for sufficiently large t.[17] When the transition is completed (say, at time T), all workers are employed in E firms ($N_{ET}/N_T = 1$), and the net foreign position becomes $B_T = (\beta/(1+\beta))(1-\alpha)\kappa_F^{\alpha}A_T N_T > 0$.

The intuition for the growing foreign surplus despite rapid economic growth is that as employment is reallocated towards the more productive E firms, investment in the financial integrated sector shrinks. Hence, the demand for domestic borrowing falls and banks must shift their portfolio towards foreign bonds. Although there is a potentially increasing demand of borrowing from the E sector, this cannot be satisfied due to the financial frictions. Interestingly, the growth rate of the foreign surplus can exceed that of GDP, resulting in a growing B_t/Y_t ratio.[18]

Figure 8 illustrates the evolution of the foreign balance-GDP ratio during transition through a simulated example.

FIGURE 8 HERE

During the transition, the gross saving rate, S_t/Y_t (where $S_t = (\beta/(1+\beta))(w_t N_t + \mu m_t)$), is increasing, whereas the gross investment rate, I_t/Y_t (where $I_t = K_{Et+1} + K_{Ft+1}$), is decreasing. Both forces contribute to the growing foreign trade surplus during the transition. Consider, first, why the saving rate grows. Workers employed in the F sector earn a constant share, $1-\alpha$, of output in that sector, and save a fraction $\beta/(1+\beta)$ of this. In contrast, workers employed in the E sector save a fraction $(\beta/(1+\beta))(1-\alpha)(1-\psi)$ of output in that sector. In addition, young entrepreneurs save a share $(\beta/(1+\beta))\psi$. Thus, the saving rate of the E-sector equals $(\beta/(1+\beta))(1-\alpha+\alpha\psi)$ which exceeds the corresponding rate in the F sector. Since the E sector expands over time, the average national saving rate is increasing, due to a composition effect. Next, consider investments.

[17] When t is small, so that N_{Et}/N_t is small, the right-hand side term in parenthesis can be negative. Thus, initially B_t may fall. However, $B_t/(A_t N_t)$ is non-decreasing.

[18] B_t/Y_t grows during transition as long as ψ is not too large. More formally,

$$\frac{B_t}{Y_t} = \frac{\frac{\beta}{1+\beta}\frac{(1-\alpha)\kappa_F^{\alpha-1}}{(1+z)(1+\nu)} - 1 + \frac{N_{Et}}{N_t}}{1 + \frac{\psi}{1-\psi}\frac{N_{Et}}{N_t}}\kappa_F^{1-\alpha}$$

which is increasing with N_{Et}/N_t provided that $\psi < \left(\frac{1+\beta}{\beta}\frac{(1+z)(1+\nu)}{1-\alpha}\frac{\alpha}{R^l}\right)$. The set of parameters satisfying this condition together with assumption 1 and condition (A2) is non-empty.

Recall that investments at t equal capital at t+1, and consider for simplicity the case of $z = \nu = 0$. Then, every worker who is shifted from the F to the E sector works with less capital. Therefore, the total domestic investment falls during the transition. Even with positive technical change and population growth, the investment rate would fall over time. It is important to note that the prediction of a growing foreign surplus does not hinge on a falling investment rate. In the next section, we show that augmenting our model with improvements in the financial sector can yield both increasing investment rates and a growing foreign surplus during transition.

The following proposition summarizes the main results so far.

Proposition 1 *Suppose Assumption 1 holds. During a transition, the equilibrium employment in the two sectors is given by* $N_{Et} = K_{Et}/\left(A_t\kappa_F\left(1-\psi\right)^{-\frac{1}{\alpha}}\chi^{-\frac{1-\alpha}{\alpha}}\right)$ *and* $N_{Ft} = N_t - N_{Et}$*, where* κ_F *is given by (6), and* K_{Et} *and* A_t *are predetermined at t. The rate of return to capital is constant over time in both sectors, and higher in the E than in the F sector:* $\rho_F = R^l$ *and* $\rho_E = \left(1-\psi\right)^{\frac{1}{\alpha}}\chi^{\frac{1-\alpha}{\alpha}}R^l$*. The capital and employment growth of the E sector are given by (8). If condition A2 holds, then the employment share of the E sector grows over time. The stock of foreign assets, given by (11), is growing.*

3.5 Post-transition Equilibrium

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

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

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 rate of return on capital will decrease. Figures 7 and 8 illustrate the post-transition dynamics of the main variables.

3.6 Discussion

The theory fits some salient qualitative features of the recent Chinese growth experience discussed in section 2. First, in spite of the high investments and growth of industrial production the *corporate* rate of return does not fall. Second, E firms – similarly to DPE in China – have a higher TFP and less access to external financing. This induces a lower capital intensity in E firms than in F firms (Lemma 1) – again in line with the empirical evidence. Moreover the rate of return on capital is higher in E firms than in F firms, as in the data DPE are more profitable than SOE. Third, 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. Fourth, such reallocation leads to an external imbalance – as in the data the economy runs a sustained trade surplus. Finally, the model predicts a growing inequality between wages and entrepreneurial earnings.

The most problematic prediction is that of a falling investment rate during the transition. As explained above, the mechanism behind this prediction is very different from that of a 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 our 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). One simple mechanism delivering capital deepening is a reduction of financial frictions during the transition. We turn to financial development in the next section.

4 Financial development

There have been some 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.[19] This has brought an increase in the efficiency of the banking system, witnessed for instance by a sharp reduction in the ratio of non-performing loans.[20] To incorporate financial development into the theory,

[19] Before 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.

[20] In 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

we introduce intermediation costs and let them vary over time. In particular, banks incur an *iceberg cost,* ξ, by which for every unit of domestic investment made at $t-1$, ξ_t units get lost in real costs such as operational costs, red tape, etc. Thus, ξ is an inverse measure of efficiency. The equilibrium rate of return in F firms then becomes

$$R_t^l = \frac{R}{1-\xi_t}. \tag{12}$$

Recall that a larger R^l reduces capital intensity in the F sector (see equation (6)). Since $\kappa_E = \kappa_F \left((1-\psi)\chi \right)^{-\frac{1}{\alpha}}$, a high 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. Consequently, if ξ falls sufficiently fast over time, it can offset the tendency of the investment rate to fall (and of the average rate of return 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, rates of return, and capital-output ratio observed in China.

We provide a numerical example to illustrate the possibility that, under financial development, the investment rate increases and the average rate of return on capital falls during the transition, while the implication of a growing foreign surplus remains. To this end, we introduce financial development in the form of a reduction in the iceberg cost ξ_t such that the (annualized) rate of return in F firms (R^l) falls gradually from 10% to 6.5% between the start and the endpoint of the transition, assuming one period to be 30 years. We set $\alpha = 0.5$ to match the initial labor share and set the annualized population growth rate to 1%. The growth rate of productivity is 5% per year.[21] In addition, we set $\beta = 1$, $\psi = 0.4$, and $\chi = 3.7$. This corresponds to an economy where the aggregate saving rate is initially 25% and goes up to 35% at the end of the transition. Moreover, the annualized rate of return to E firms falls from 11% to 7.5%, staying always 1% above that of F firms.[22]

after 2000 is reported to have fallen drastically compared with older loans (see Ouanes, 2006).

[21] In our simple model there is no scope for improvements in the quality of the labor force, which has been an important driving force of growth in China. Thus, z captures both technical progress and human capital accumulation. The value of z is not essential, and qualitatively and quantitatively similar transitions as in Figure 9 can be obtained from a large range of values for z.

[22] The simplifying assumption that all agents have the same discount factor imposes strong constraints on the set of admissible parameters. Conceptually, the growth of B/Y and I/Y are governed by two different forces: low initial B/Y (and subsequently growing B/Y) require that the workers' saving rate be not too high. Instead, a growing I/Y requires that the financial development (i.e., the fall in

FIGURE 9 HERE

Figure 9 plots the outcomes of this economy (dotted line) compared to outcomes in the absence of financial development (solid line), where the only difference is the exogenous evolution of iceberg costs reflected in the rate of return to F firms, plotted in Panel 1. To facilitate comparison, both economies start out with the same initial entrepreneurial capital. Transition to full employment in the E sector is completed at time T_2 (T_1) in the economy with (without) financial development. A lower cost of capital implies that F firms increase their capital intensity which, in turn, implies that the wage per efficiency units is increasing with financial development instead of being stagnant as in the case without financial development (see equation (1) and Panel 2 of Figure 9). An increasing wage implies capital deepening also in the E sector, even though E firms cannot borrow. Intuitively, the transition takes longer when there is financial development because an increasing share of the entrepreneurial savings must be devoted to increase capital intensity and, hence, labor productivity in the E sector. Consequently, the capital-output ratio increases in both sectors, implying that the rate of return falls in both sectors. This, in turn, implies a an increasing aggregate capital-output ratio (from 0.86 to 1.01 during the transition), and a falling average rate of return (Panel 3). The increased capital deepening also ensure a higher growth rate of aggregate output in the first phase of the transition (Panel 4). Due to the increased capital intensity in both sectors, the investment rate actually increases during the transition in this numerical example (Panel 5). Increased investment mitigates the foreign surplus accumulation. However, the key prediction of a growing foreign surplus is maintained in this example (Panel 6).[23]

R_t^l) be sufficiently large. However, a low R_t^l would violate condition A2 and terminate the transition prematurely unless χ is sufficiently high or the entrepreneurs have sufficiently high saving rates to sustain the growth of the E sector. Hence, the need for large χ and ψ hinge on the stark assumption of equal discount factors.

Alternatively, if we were to assume, realistically, that entrepreneurs have a higher saving rate than workers, the model could, for low values of ψ and χ, generate even larger increases in I/Y and B/Y during the transition than in the economy displayed in Figure 9. This is the case if, for example, $\psi = 0.2$, $\chi = 1.8$, and the workers' annualized discount factor to 0.943, maintaining $\beta = 1$ for the entrepreneurs. See the technical appendix for details.

[23] When expressed as a fraction of GDP, net foreign assets increase from 43% to 77%. In contrast, in the data the foreign asset-GDP ratio of China increased from 5% to over 43% between 1992 and 2008. As discussed above, it is difficult to match the low initial ratio if we maintain a common discount rate. However, it is easy to replicate quantitatively the empirical observation if we assume that workers have a lower discount factor, equal to an annualized 0.96% rate.

4.1 Bank Lending to the Entrepreneurial Sector

A limitation of the analysis so far is that financial development affects directly only financially unconstrained F firms. Capital deepening also occurs in the E sector, but this is due to a general equilibrium effect through wages. In this section, we generalize the model by allowing E firms to finance part of their investments through bank loans. The possibility to partially 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 $\rho_E > R^l$.

We assume that entrepreneurs can borrow, but can only pledge a share $\eta > 0$ of the second-period net profits. The fraction $1 - \eta$ is not verifiable. The principal-agent problem, (2), is unchanged, and both $\Xi_t (k_{Et})$ and ρ_E continue to be defined by (5). 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

$$R^l l^E \leq \eta \rho_E \left(s^E + l^E \right), \tag{13}$$

where $R^l = R / (1 - \xi)$ 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:

$$\frac{l^E}{l^E + s^E} = \frac{\eta \rho_E}{R^l}. \tag{14}$$

The entrepreneur's investment problem can be expressed as $\max_{l^E, s^E} \log \left(m - s^E \right) + \beta \log \left(\rho_E \left(l^E + s^E \right) - R^l l^E \right)$, subject to (14). Using the constraint to substitute away l^E, the program simplifies to

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

The 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:

$$k_{Et+1} = l_t^E + s_t^E = \frac{\beta}{1 + \beta} \frac{\psi \left((1 - \psi) \chi \right)^{\frac{1-\alpha}{\alpha}}}{1 - \eta (1 - \psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}}} \frac{R}{(1 - \xi) \alpha} k_{Et}$$

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

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 (14) is invariant to ξ.

3. As long as 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 determined by the condition

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

   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 thus can revert the growth in the foreign surplus.

5 Extensions and Empirical Analysis

In this section we extend the model and derive some auxiliary testable implications of the theory. We consider two extensions. The first introduces region-specific shocks to saving rates. A key feature of our model is that investments in E firms are determined by entrepreneurial savings, whereas F-sector investments are detached from domestic savings. Whenever E firms have a large (small) share of employment, we expect fluctuations in local savings to be highly (little) correlated with fluctuations in investments – since entrepreneurial savings is a large (small) share of local savings in this case. We test this prediction by looking at the properties of the time-series correlation between savings and investments across regions with different shares of employment in E firms. The second extension introduces multiple industries with different capital intensities (i.e., different α's). This generates endogenous specialization of E and F firms in more or less capital-intensive industries, yielding testable predications about the timing of expansion of private firms across industries.

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.[24] The entrepreneurial capital stock can therefore differ across the two regions. This feature can be motivated by differences in local institutions affecting the profitability of entrepreneurial activity. To make the comparison stark, suppose that Assumption 1 holds in region A, but not in region B. Hence, all agents in region B invest their savings in bank deposits.

Our main focus is on the cross-region correlation between savings and investments. To this aim, we assume saving rates to be subject to region-specific shocks, captured by i.i.d. stochastic fluctuations in the discount factors β_{rt}, where $r \in \{A, B\}$. Under this assumption, the theory predicts a positive time-series correlation between savings and investments in region A, and no correlation in region B. The reason is that in region A entrepreneurial investments are constrained by entrepreneurial savings. In contrast, in region B investments are independent of local savings, like in an open-economy growth model. The same argument generalize to economies with many regions: the time-series correlation between investments and savings should be increasing with the employment share of the E sector.[25]

We test this implication using a dataset covering all Chinese provinces for which official data have been published by the National Bureau of Statistics since 2001. This yields a panel of 31 provinces with observations from 2001 to 2006.[26] The share of the E

[24] The 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.

[25] The assumption that regions differ in the profitability of entrepreneurial activity is made for simplicity. The same results would obtain if we assumed that cross-regional differences in the share of E firms are driven by different histories of realizations of β's.

[26] A list of these regions and summary statistics is available upon request. The employment statistics for 2001, 2002, 2003 and 2005 are from China Industrial Economy Statistical Yearbook (various issues). The China Statistical Yearbook (2007) provides data for 2006. Annual data for investment, saving and GDP are all from China Statistical Yearbook (2002 to 2007).

sector is measured by the ratio of employment in domestic private industrial enterprises to total industrial employment in a province. Regional investment is total investment in fixed assets in each province, and regional saving is provincial GDP minus private and government consumption expenditures. Both investments and savings are expressed as ratios of provincial GDP.

TABLE 1 HERE

We first split the sample into terciles according to the employment shares of DPE in 2001. Then, we estimate the regression

$$(I/Y)_{rt} = a_t + a_r + b \cdot (S/Y)_{rt} + u_{rt}, \tag{15}$$

within each tercile, where where I/Y is the investment rate, S/Y is the savings rate, and a_r and a_t are province and year dummies, respectively. The theory predicts that the estimated coefficient b should be lowest in the bottom tercile, and highest in the top tercile. This prediction is borne out in the data. Consider Table 1. We report three specifications, where the first does not include time dummies, the second is the specification (15), 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 tercile, and insignificant for the third tercile. Moreover, the coefficient b declines monotonically from the lower to the higher tercile, in accordance with our theory.[27]

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

$$(I/Y)_{rt} = a_r + a_t + b_1 \cdot EMPL_{rt}^{PRIV} + b_2 \cdot (S/Y)_{rt} + b_3 \cdot \left((S/Y)_{rt} \times EMPL_{rt}^{PRIV}\right) + \varepsilon_{rt},$$

[27] We also calculated the time-series correlation between savings and investment rates individually for each region:

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

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).

where $EMPL_{rt}^{PRIV}$ is the share of employment in the private sector.[28] 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 (b_3 is positive and significant even when time dummies are omitted).

TABLE 2 HERE

5.2 Capital- and Labor-Intensive Industries

An important feature of the Chinese transition 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). The retreat from labor-intensive industries has further widened the gap between the capital-output ratio of SOEs and that of private firms since the mid 1990s (see 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.[29] Our theory provides an alternative explanation based on financial frictions. To this end we extend our model to a two-sector environment. For simplicity, we assume $\nu = \xi = 0$.

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

$$Y_t = \left(\varphi \left(Y_t^k\right)^{\frac{\sigma-1}{\sigma}} + \left(Y_t^l\right)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}. \tag{16}$$

The superscripts k and l stand for capital- and labor-intensive intermediate goods, respectively, and $\varphi > 0$ is a parameter. Both goods can be produced either by E or F firms, with the following technologies:

$$y_J^l = \left(A_J^l\right)^{1-\alpha} \left(k_J^l\right)^{\alpha} \left(n_J^l\right)^{1-\alpha}, \tag{17}$$

[28] Interestingly, the regional growth rate is positively correlated with $EMPL_{rt}^{PRIV}$ even after controlling for the investment rate. This is consistent with the prediction of our theory that sectoral reallocation accelerates during the transition, see Figure 7. Results are available upon request.

[29] The 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 competitive internationally like *keiretsu* in Japan or *chaebol* in Korea. Movshuk (2004) provides a case study on the iron and steel industry.

and

$$y_J^k = \left(A_J^k\right)^{1-\alpha} k_J^k, \tag{18}$$

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. We assume the same TFP gap between E and F firms 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. Assumption 1 and condition A2 are assumed to hold.

We set the final good to be the *numeràire*. Profit maximization of final producers subject to (16) yields:

$$\frac{Y^k}{Y^l} = \left(\varphi \frac{P^l}{P^k}\right)^{\sigma}. \tag{19}$$

The standard price aggregation holds:

$$\left(\varphi^{\sigma} \left(P^k\right)^{1-\sigma} + \left(P^l\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}} = 1. \tag{20}$$

When F firms are active in the production of the labor-intensive good, they behave as in the benchmark model of section 3. In particular, the following analogues of equations (1) and (6) hold:

$$w_t = P_t^l \left(1-\alpha\right) A_{Ft}^l \left(\kappa_{Ft}^l\right)^{\alpha}, \tag{21}$$

$$\kappa_{Ft}^l = \left(\frac{P_t^l \alpha}{R}\right)^{\frac{1}{1-\alpha}}. \tag{22}$$

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

$$P_t^k \left(A_{Ft}^k\right)^{1-\alpha} = R. \tag{23}$$

Given these equilibrium conditions, we can determine the return for E firms to invest in each industry. The following Lemma characterize the patterns of specialization of F and E firms. Recall that K_{Et} is predetermined by the entrepreneurial savings.

Lemma 4 *(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 $K_{Ft}^k \geq 0$.*

Lemma 4 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 produced only by F firms. This is consistent with the retreat of Chinese SOE from labor-intensive industries. Due to this specialization in the capital-intensive industry, the average capital-output ratio in F firms increases during the transition, consistent again with the Chinese evidence. Eventually, F firms 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 do both foreign bonds and 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 disappearance of F firms. Eventually, no F firms are left even in the capital-intensive industry.

- Stage 4: The economy enters the post-transition equilibrium of section 3.5.

Table 3 summarizes the main features of each of the four stages of the transition. The complete characterization of the equilibrium can be found in the technical appendix.

Table 3

	stage 1		stage 2		stage 3		stage 4	
industry	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

In this paper, we have constructed a neoclassical model augmented with financial and contractual imperfections that affect asymmetrically different firms in the economy. The theory is consistent with a number of key facts about the recent Chinese experience, most notably sustained high returns on investments in spite of high capital accumulation, large productivity differences across firms, reallocation from low-productivity to high-productivity firms (as documented by Hsieh and Klenow 2007) and the accumulation of a large foreign surplus. A number of simplifications that have been made for the sake of tractability will be relaxed in future research. In particular, the two-period overlapping generations model with logarithmic preferences does not speak to the high levels of savings and investments in China. Theories of entrepreneurial savings with financial constraints such as Quadrini (1999) and Di Nardi and Targetti (2006) could add additional insights to reinforce and complement the mechanism of this paper. Also, by assuming an exogenous rate of TFP growth, we have abstracted from investments in technology adoption which is an important driver of China's performance. Finally, while this paper has emphasized qualitative insights, the analysis can be extended to a multiperiod environment amenable to quantitative evaluation.

In spite of these limitations, we believe our theory offers a useful tool for understanding one of the major puzzles of the recent growth experience: how is it that China grows at such a stellar rate while taking an increasing asset position on the rest of the world? Some commentators have tried to explain this puzzle by attributing it to government manipulation of the exchange rate that hold the value of the Chinese currency artificially low. While it is difficult to falsify theories that rely on such non-economic mechanisms, in this paper we have provided a number of empirical observations that corroborate the mechanism of our theory.

References

Acemoglu, Daron, Philippe Aghion and Fabrizio Zilibotti (2006), 'Distance to Frontier, Selection, and Economic Growth', *Journal of the European Economic Association* **4**(1), 37-74.

Acemoglu, Daron, Philippe Aghion, Claire Lelarge, John Van Reenen and Fabrizio Zilibotti (2007), 'Technology, Information and the Decentralization of the Firm', *Quarterly Journal of Economics*, 2007, **122**(4), 1759-1799.

Aghion, Philippe and Jean Tirole (1997), 'Real and Formal Authority in Organizations', *Journal of Political Economy* **105**(1), 1-29.

Allen, Franklin, Jun Qian and Meijun Qian (2005), 'Law, Finance, and Economic Growth in China', *Journal of Financial Economics* **77**(1), 57 – 116.

Bai, Chong-En, Chang-Tai Hsieh and Yingyi Qian (2006), 'The Return to Capital in China', *Brooking Papers on Economic Activity* **2,** 61–101.

Banerjee, Abhijit and Esther Duflo, (2005), 'Growth Theory through the Lens of Development Economics' in H. Chenery and T.N. Srinivasan, eds. *Handbook of Development Economics,* Elsevier, Vol. 1a, 473-552.

Banister, Judith (2007), 'Manufacturing in China Today: Employment and Labor Compensation', *Economics Program Working Paper Series EPWP 0701, The Conference Board.*

Benjamin, Dwayne, Loren Brandt, John Giles and Sangui Wang (2008), 'Income Inequality during China's Economic Transition,' in L. Brandt and T. Rawski, eds., *China's Great Economic Transformation,* Cambridge University Press, 729–775.

Boyreau-Debray, Genevieve and Shang-Jin Wei (2005), 'Pitfalls of a State-Dominated Financial System: The Case of China', *NBER Working Paper 11214.*

Caballero, Ricardo J., Emmanuel Farhi, Pierre-Olivier Gourinchas (2006)'An Equilibrium Model of "Global Imbalances" and Low Interest Rates', *NBER Working Paper 11996.*

Caselli, Francesco and Wilbur John Coleman II (2002), 'The U.S. Technology Frontier', *American Economic Review* **92**(2), 148-152.

Chang, Eric C. and Sonia M. L. Wong (2004), 'Political Control and Performance in China's Listed Firms, *Journal of Comparative Economics* **32**, 617-636.

Chenery, Hollis Burnley and Moises Syrquin (1975), 'Patterns of Development, 1950-1970', *Oxford University Press for the World Bank.*

Dekle, Robert and Guillaume Vandenbroucke (2006), 'A Quantitative Analysis of China's Structural Transformation', *IEPR Working Paper No. 06.51.*

De Nardi, Mariacristina and Marco Cagetti (2006), 'Entrepreneurship, Frictions, and Wealth', *Journal of Political Economy* **114**(5), 835-870.

Dollar, David and Shang-Jin Wei (2007), 'Das (Wasted) Kapital: Firm Ownership and Investment Efficiency in China', *NBER Working Paper 13103.*

Dooley, Michael, David Folkerts-Landau and Peter Garber (2004), 'Direct Investment, Rising Real Wages and the Absorption of Excess Labor in the Periphery', *NBER Working Paper 10626.*

Fei, John C. H. and Gustav Ranis (1961), 'A Theory of Economic Development', *American Economic Review* **51**(4), 533-565.

Fei, John C. H. and Gustav Ranis (1964), 'Capital-Labor Ratios in Theory and in History: Reply', *American Economic Review* **54**(6), 1063-1069.

Gancia, Gino and Fabrizio Zilibotti (2001), 'Technological Change and the Wealth of Nations', *Annual Economic Review*, **1**, forthcoming.

Gourinchas, Pierre-Olivier and Olivier Jeanne (2007), 'Capital Flows to Developing Countries: The Allocation Puzzle', *NBER Working Paper 13602.*

Gregory, Neil and Stoyan Tenev (2001), 'The Financing of Private Enterprise in China', *Finance and Development - Quarterly Magazine of the IMF*, **38**(1).

Hsieh, Chang-Tai and Peter J. Klenow (2007), 'Misallocation and Manufacturing TFP in China and India', *NBER Working Paper 13290.*

Islam, Nazrul, Erbiao Dai and Hiroshi Sakamoto (2006), 'Role of TFP in China's Growth', *Asian Economic Journal* **20**(2), 127–159.

Kraay, Aart (2000), 'Household Saving in China', *World Bank Economic Review*, **14**(9), 545-70.

Kuijs, Louis (2005), 'Investment and Saving in China', *World Bank Policy Research Working Paper 3633.*

Kuznets, Simon (1966), *Modern Economic Growth: Rate, Structure and Spread*, Yale University Press, New Haven.

Kwan, Chi Hung (2006), 'Participation of Foreign Investors in China's State-Owned Commercial Banks - A win-win game', China in Transition - Research Institute of Economy Trade and Industry http://www.rieti.go.jp/en/china/06021501.html

Laitner, John (2000), 'Structural Change and Economic Growth', *Review of Economic Studies* **67**(3), 545–561.

Laurenceson, James (2002), 'The Impact of Stock Markets on China's Economic Development: Some Preliminary Assessments', Discussion Paper no. 302, University of Queensland.

Lewis, Arthur (1954), 'Economic Development with Unlimited Supplies of Labor', *Manchester School of Economic and Social Studies* **22**(2), 139-91.

Liu, Deqiang and Keijiro Otsuka (2004), 'A Comparison of Management Incentives, Abilities, and Efficiency between SOEs and TVEs: The Case of the Iron and Steel Industry in China', *Economic Development and Cultural Change* **52**(4), 759-80.

Matsuyama, Kiminori (1992), 'A Simple Model of Sectoral Adjustment', *The Review of Economic Studies* **59**(2), 375-387.

Matsuyama, Kiminori (2004), 'Financial Market Globalization, Symmetry-Breaking and Endogenous Inequality of Nations', *Econometrica* **72**(3), 853-884.

Matsuyama, Kiminori (2005), 'Credit Market Imperfections and Patterns of International Trade and Capital Flows', *Journal of the European Economic Association* **3**(2-3), 714-723.

Matsuyama, Kiminori (2007), 'Ricardian Trade Theory' in L. Blume and S. Durlauf, eds. *The New Palgrave Dictionary of Economics,* 2nd Edition, Macmillan, Vol. 7, 183-190.

Mendoza, Enrique G, Vincenzo Quadrini and Jose-Victor Rios-Rull (2007), 'Financial Integration, Financial Deepness and Global Imbalances', *NBER Working Paper 12909.*

Movshuk, Oleksandr (2004), 'Restructuring, Productivity and Technical Efficiency in China's Iron and Steel Industry, 1988–2000' *Journal of Asian Economics*, **15**(1), 135-51.

Ouanes, Abdessatar (2006), 'Progress in China's Banking Sector Reform: Has Bank Behavior Changed? *IMF Working Paper 06/71.*

Parente, Stephen, Richard Rogerson and Randall Wright (2000), 'Homework in Development Economics: Household Production and the Wealth of Nations', *The Journal of Political Economy* **108**(4), 680-687.

Quadrini, Vincenzo (1999), 'The Importance of Entrepreneurship for Wealth Concentration and Mobility', *Review of Income and Wealth,* **45**(1), 1-19.

Restuccia, Diego and Richard Rogerson (2008), 'Policy Distortions and Aggregate Productivity with Heterogeneous Plants', *Review of Economic Dynamics,* **11**(4), 707-20.

Takayama, Akira (1965), 'On a Two-Sector Model of Economic Growth with Technological Progress – A Comparative Statics Analysis', *The Review of Economic Studies* **32**(3), 251-262.

Ventura, Jaume (1997), 'Growth and Interdependence', *The Quarterly Journal of Economics* **112**(1), 57-84.

Wang, Yan and Yudong Yao (2001), 'Sources of China's Economic Growth, 1952-99: Incorporating Human Capital Accumulation', *World Bank Policy Research Working Paper 2650.*

Young, Alwyn (2003), 'Gold into Base Metals: Productivity Growth in the People's Republic of China during the Reform Period', *Journal of Political Economy* **111**(6), 1220 – 1261.

Zhao, Suisheng (1993), 'Deng Xiaoping's Southern Tour: Elite Politics in Post-Tiananmen China', *Asian Survey* **8**(33), 739–756.

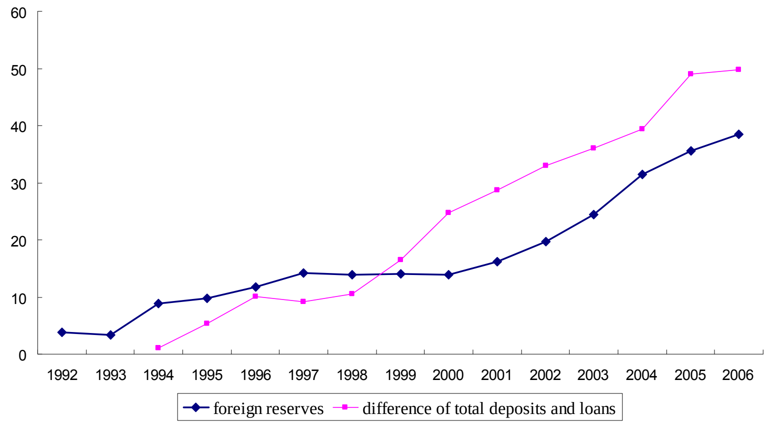

Figure 1: Foreign Reserves and Differences between Domestic Deposits and Loans (percentages of GDP). Data source: Chinese Statistical Yearbook various issues.

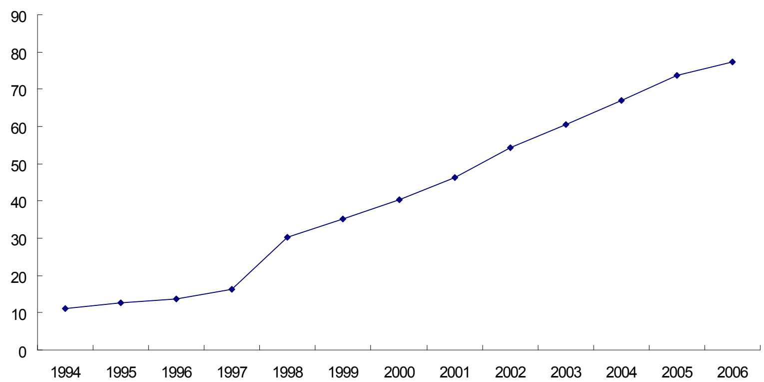

Figure 2: Private employment share in manufacturing (percentage). Private employment includes both non-state-owned domestic and foreign-owned enterprises. Data source: Chinese Statistical Yearbook, various issues.

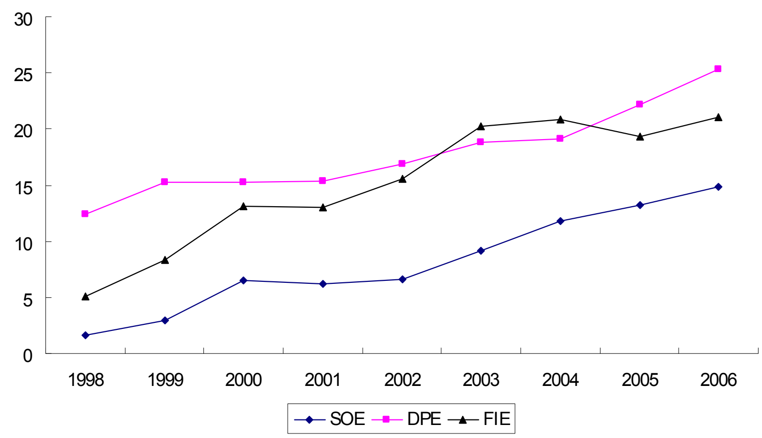

Figure 3: Total Profits over Net Value of Fixed Assets for Industrial Enterprises in state-owned (SOE), domestic private (DPE) and foreign-investment (FIE) enterprises. Data Source: China Statistical Yearbook 2006 and 2007.

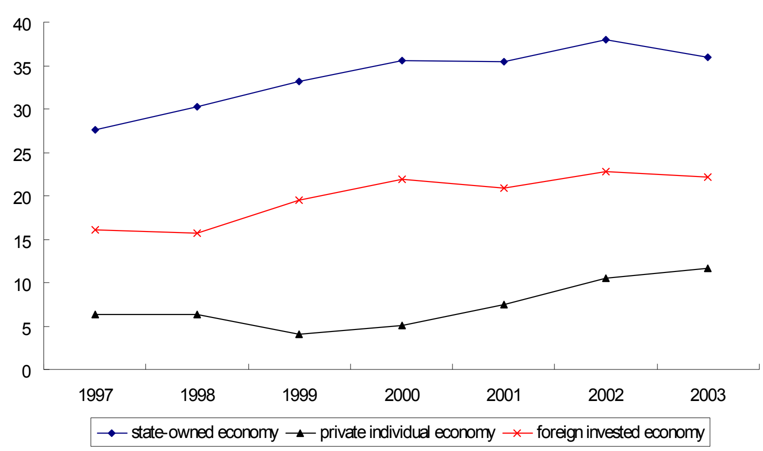

Figure 4: Share of investment financed by bank loans and government budgets (percentage). Date source: China Statistical Yearbook 1998 to 2001 and 2003, China Economy & Trade Statistical Yearbook 2002 and 2004.

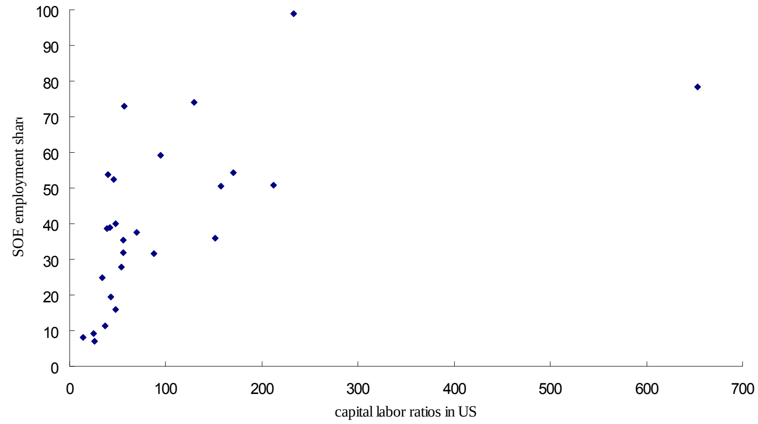

Figure 5: SOE Employment Shares across Industries (percentage) Note: SOE employment shares are the average ratio of state-owned industrial enterprise employees to total industrial enterprise employees over 2001 and 2003. Data source: China Industrial Economy Statistical Yearbook (2002, 2003, 2004). We use US capital labor ratios in 1996, from NBER-CES Manufacturing Industry Database.

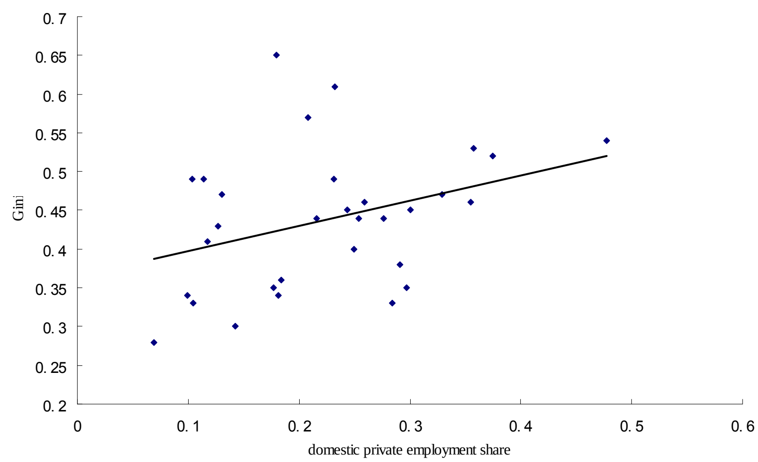

Figure 6: Gini coefficient *vs.*domestic private industrial employment shares across provinces in 2006. Data source: Chinese Statistical Yearbook 2007. Provincial Gini is from Report to the Seventeenth National Congress of the Communist Party of China.

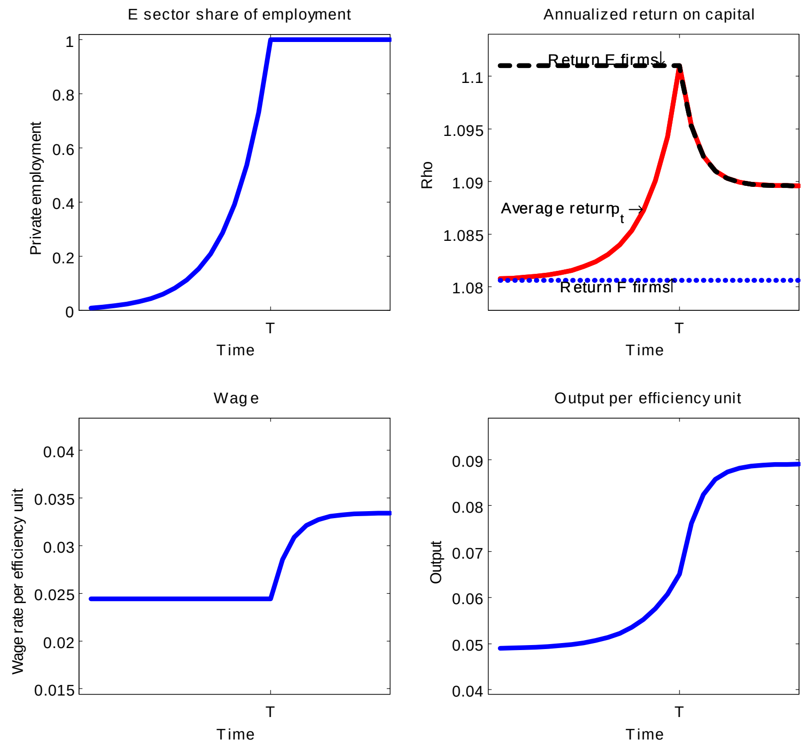

Figure 7: Transition and post-transition dynamics.

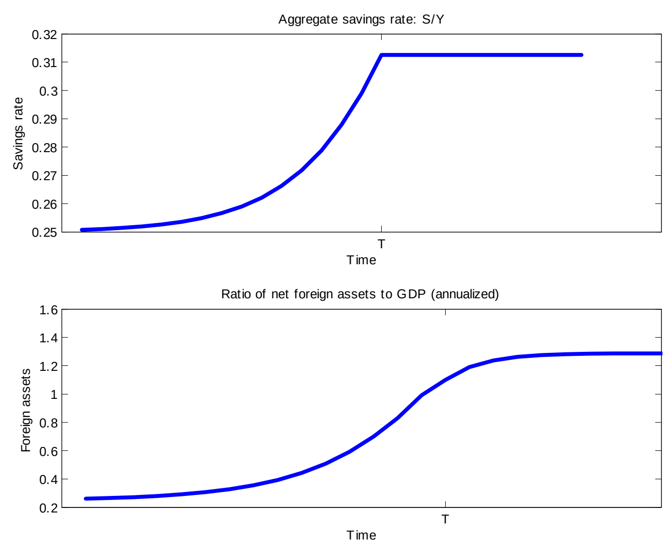

Figure 8: Saving rate and balance of payment surplus.

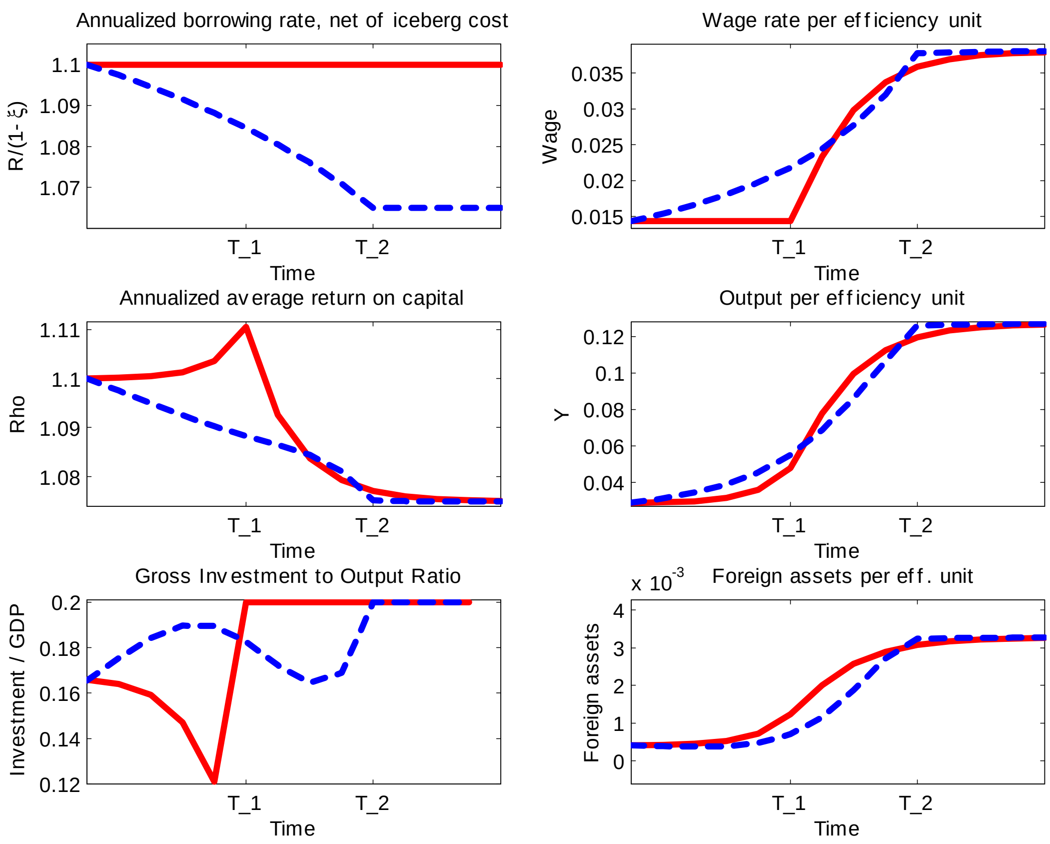

Figure 9: Transition with financial development.

Table 1. Panel Regression by Tercile

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

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	-0.0101
	(0.2613)	(0.2408)
$SAVINGS*EMPL^{PRIV}$	1.2342*	3.6284***
	(0.6898)	(0.8697)
SAVINGS	0.3827*	0.5013***
	(0.2047)	(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.

7 Appendix: Not for publication

7.1 Capital-output and capital-labor ratio by ownership structure.

Figure A1 reports capital-output and capital-labor ratios by ownership structure within three-digit manufacturing industries.

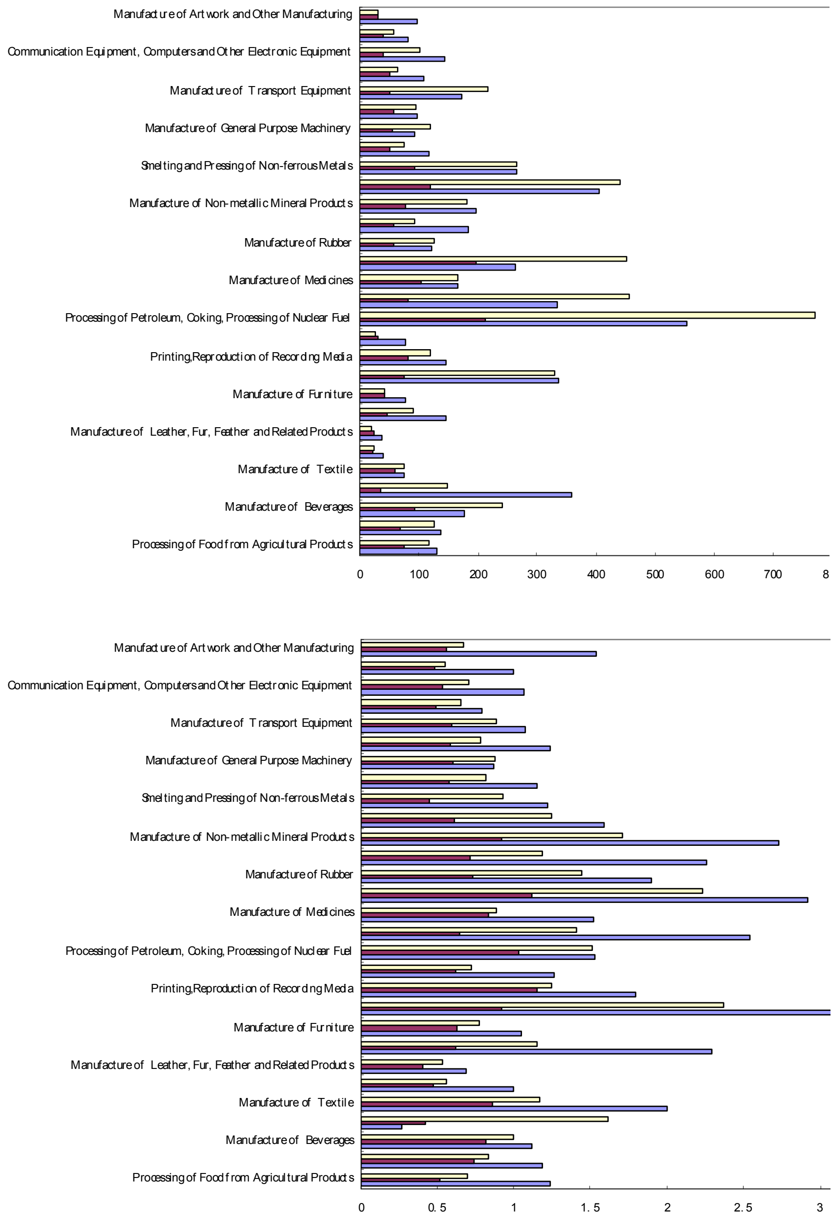

Figure A1: Capital-Labor Ratios (upper panel, thousand yuans per worker) and Capital-Output Ratios by Ownership and Sector in Manufacturing in 2006 (yellow=FIE, red=DPE, blue=SOE).

7.2 Proofs of Lemmas

Proof of Lemma 1. That the capital-output ratio is higher in F firms follows immediately from the fact that $\kappa_E < \kappa_F$ (shown in the text), since $k_E/y_E = \kappa_E^{1-\alpha} < \kappa_F^{1-\alpha} = k_F/y_F$. Similarly, that the capital-labor ratio is higher in F firms follows from observing that

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

where the inequality again follows from Assumption 1. ■

Proof of Lemma 2. Due to constant-return-to-scale, aggregation holds, thus we can replace individual-firm variables (lower case) by aggregate variables (upper case). Since $\kappa_E \equiv K_{Et}/(\chi A_t N_{Et})$ is constant and $N_{Ft} = N_t - N_{Et}$, then

$$N_{Et} = \frac{K_{Et}}{\chi A_t \kappa_E}, \;\; N_{Ft} = N_t - \frac{K_{Et}}{\chi A_t \kappa_E}, \tag{24}$$

where κ_E is given by (7).

The saving of each young entrepreneur is given by $s_t^E = k_{t+1}^E = (\beta/(1+\beta))\, m_t$. Using (3), and aggregating over all entrepreneurs yields:

$$K_{Et+1} = \frac{\beta}{1+\beta}\psi\kappa_E^\alpha \chi A_t N_{Et}. \tag{25}$$

Dividing both sides of (25) by K_{Et}, and substituting κ_E by its equilibrium expression, we obtain (8). That $N_{Et+1}/N_{Et} = (K_{Et+1}/K_{Et})/(1+z)$ follows from (24).

The second part of the Lemma follows from the definitions of γ_{K_E} and ν_E, given (8). Standard algebra shows that condition (A2) is necessary and sufficient for $\nu_E > \nu$. ■

Proof of Lemma 3. Using equation (24), and recalling that κ_E and κ_F are constant, we can rewrite (10) as:

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

which proves the Lemma. ■

Proof of Lemma 4. 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 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 (21) and (22) into the first order condition yields

$$n_{Et} = ((1-\psi)\chi)^{\frac{1}{\alpha}} \left(\frac{P_t^l \alpha}{R}\right)^{-\frac{1}{1-\alpha}} \frac{k_{Et}^l}{A_{Et}^l} \tag{26}$$

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:

$$\begin{aligned}\Xi_t\left(k_{Et}^l\right) &= (1-\psi) k_{Et}^l \left(((1-\psi)\chi)^{\frac{1}{\alpha}}\right)^{1-\alpha} \left(\frac{\alpha}{R}\right)^{-1} - (1-\alpha)\chi^{-1} ((1-\psi)\chi)^{\frac{1}{\alpha}} \left(\frac{\alpha}{R}\right)^{-1} k_{Et}^l \\ &= (1-\psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} R k_{Et}^l \equiv \rho_E^l k_{Et}^l, \end{aligned} \tag{27}$$

where ρ_E^l is identical to ρ_E in the one-sector model of section 3 (see equation (5)). This is 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 (23) 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, (21) and (22) hold true, and $\rho_E^l = (1-\psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} R$ as shown in the first part of the proof, see (27). 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

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

where the inequality follows from Assumption 1, and $P_t^k = R/\left(A_{Ft}^k\right)^{1-\alpha}$ 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. ■

7.3 The Model with Altruism

In this section, we discuss an alternative version of the model in which all parents have a warm-glow bequest motive parameterized by the following function:

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

where a_{t+1} denotes the bequest. Agents choose consumption, savings and bequests to maximize utility subject to the constraint that

$$c_{1t} + \frac{c_{2t+1} + a_{t+1}}{\rho} = \omega_t + \frac{a_t}{1+\nu},$$

where $\rho = R^d$ and $\omega = w$ for workers, whereas $\rho = \rho^E$ and $\omega = m$ for entrepreneurs. Next, define $s_t \equiv \omega_t + a_t - c_{1t}$. The optimal savings and bequests are given by, respectively,

$$s_t = \frac{\beta+\lambda\beta}{1+\beta+\lambda\beta}\left(\omega_t + \frac{a_t}{1+\nu}\right), \tag{28}$$

$$a_{t+1} = \frac{\lambda}{1+\lambda}\rho s_t. \tag{29}$$

Combining these two equations yields the equilibrium law of motion for savings:

$$s_t = \frac{\beta+\lambda\beta}{1+\beta+\lambda\beta}\left(\omega_t + \frac{\lambda}{(1+\lambda)(1+\nu)}\rho s_{t-1}\right). \tag{30}$$

Consider, the entrepreneurs. We assume altruism to be sufficiently large to make the incentive constraint of the young entrepreneurs slack.[30] Thus, the constraint (3) can be

[30] We assume that parents can reduce one-to-one their bequests if the children steal the firm's profit. Thus, childrent have no incentive to misbehave.

ignored and the young entrepreneurs' income consists of pure bequests (more formally, $m_t = 0$). The value of an E firm solves then

$$\Xi_t \left(k_{Et}\right) \equiv \rho_E k_{Et} = \max_{n_{Et}} \left\{ \left(k_{Et}\right)^{\alpha} \left(\chi A_t n_{Et}\right)^{1-\alpha} - w_t n_{Et} \right\}.$$

Taking the First Order Condition and using (1) to substitute in the equilibrium wage, yields $n_{Et} = \chi^{\frac{1}{\alpha}} \left(\alpha/R^l\right)^{-\frac{1}{1-\alpha}} k_{Et}/\left(\chi A_t\right)$, which in turn implies that

$$\Xi_t \left(k_{Et}\right) = \chi^{\frac{1-\alpha}{\alpha}} R^l k_{Et} \equiv \rho_E k_{Et}. \tag{31}$$

As long as $\chi > 1$, $\rho_E > R^d$; implying that the rate of return to entrepreneurial investments exceeds the deposit rate. Thus, entrepreneurs invest their savings entirely in their own business. Moreover, it is immediate that Lemma 1 holds true. Then, using (28) and (29) for $\omega_t = 0$ and $\rho = \rho_E = \chi^{\frac{1-\alpha}{\alpha}} R^l$, we conclude that young entrepreneurs save and invest in their own business the amount

$$s_t^E = \frac{\beta + \lambda\beta}{1 + \beta + \lambda\beta} \frac{\lambda}{(1+\lambda)(1+\nu)} \chi^{\frac{1-\alpha}{\alpha}} R^l k_{Et}.$$

Aggregating over all entrepreneurs yields:

$$K_{Et+1} = \frac{\beta + \lambda\beta}{1 + \beta + \lambda\beta} \frac{\lambda}{(1+\lambda)(1+\nu)} \chi^{\frac{1-\alpha}{\alpha}} R^l K_{Et}. \tag{32}$$

The analysis of the transition is then as in the benchmark case.

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

$$K_{Ft} + B_t = S_{t-1}^W N_{t-1}. \tag{33}$$

where S^W denotes the total savings of the workers as given by Equation (30). Using the expression for the equilibrium wage, (1), one can rewrite the equilibrium law of motion of S^W, (30), as

$$s_t^W = \frac{\beta + \lambda\beta}{1 + \beta + \lambda\beta} \left((1-\alpha) \left(\frac{\alpha}{R^l}\right)^{\frac{\alpha}{1-\alpha}} + \frac{\lambda R}{(1+\lambda)(1+\nu)(1+z)} s_{t-1}^W \right). \tag{34}$$

where $s_t^W \equiv S_t^W / A_t$. As long as

$$\frac{\beta + \lambda\beta}{1 + \beta + \lambda\beta} \frac{\lambda R}{(1+\lambda)(1+\nu)(1+z)} < 1, \tag{35}$$

s_t^F is a converging sequence. Solving the difference equation in this case yields:

$$s_t^F = \frac{\beta + \lambda\beta}{1 + \beta + \lambda\beta} (1-\alpha) \left(\frac{\alpha}{R^l}\right)^{\frac{\alpha}{1-\alpha}} \frac{1 - (\mu R)^t}{1 - \mu R} + (\mu R)^t s_{-1}^F,$$

where s_{-1}^W denotes for the initial savings of the workers and $\mu \equiv \frac{\beta+\lambda\beta}{1+\beta+\lambda\beta}\frac{\lambda}{(1+\lambda)(1+\nu)(1+z)}$. Note that if s_{-1}^W is sufficiently low s_t^F is increasing along the transitional path.

Standard algebra leads then to an analogue of equation (11):

$$B_t = \left(\frac{s_{t-1}^W}{(1+z)(1+\nu)\kappa_F} - 1 + \frac{N_{Et}}{N_t} \right) \kappa_F A_t N_t.$$

As long as (i) the employment share of the E sector and (ii) the workers' savings, s^W, increase during the transition, the country's foreign asset position increases. Therefore, the main results of Lemma 3 and Proposition 1 carry over to the model with warm-glow bequests.

7.4 Post-Transition Equilibrium

The equilibrium wage, rate of return on capital, output and foreign balance are given by:

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

Then capital in the E-sector evolves according to (25) and eventually converges to a steady state. If $(1-\psi)\alpha(1+\beta)(1+z)(1+\nu)/(\beta\psi R) > 1$, then $\lim_{t\to\infty}\rho_E > R$, and entrepreneurs never invest in bonds. Otherwise, entrepreneurs will eventually place part of their savings in bank deposits.

7.5 Financial Development: Alternative Parameterization

In this section we describe an alternative parameterization of our economy where workers and entrepreneurs have different savings rates. The purpose of this experiment is to illustrate that with different savings rates the model can deliver large increases in foreign assets and domestic investment even with quite low values for ψ and χ. In particular, we set $\psi = 0.2$ and $\chi = 1.8$ and assume that workers have an (annualized) discount factor of 0.943, while maintaining $\beta = 1$ for entrepreneurs (where one period is set to thirty years, as above). The initial annual return in F firms is set to 12%, and financial development – modeled as a falling ξ_t – causes the annual return in F firms to fall gradually to 9.5% at the end of the transition. Finally, capital's share is set to $\alpha = 0.5$, the annual population growth rate is 1%, and the annual technical growth rate is 4%. Under these parameters the annualized return in E firms is always 0.5% larger than in F firms (so the annualized return in E firms start out at 12.5% and fall to 10% at the end of the transition). Moreover, Assumption A1 and condition A2 are satisfied.

The dynamics of the economy is displayed in figures A2 and A3. The investment rate grows (monotonically) by more than one third during the transition (Panel 5 of Figure A2).The initial stock of net foreign assets is zero and grows to 40% of GDP at the end of the transition (Figure A3 and Panel 5 of Figure A2).

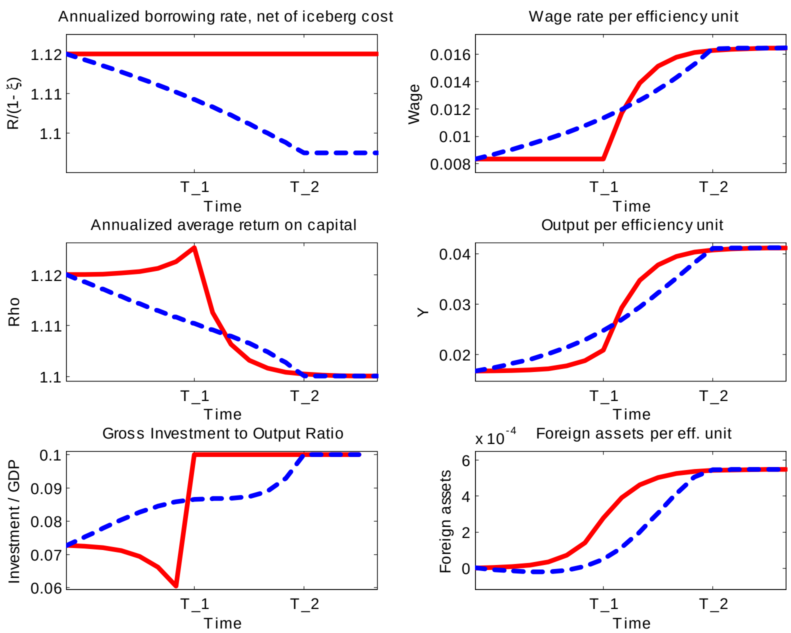

Figure A2

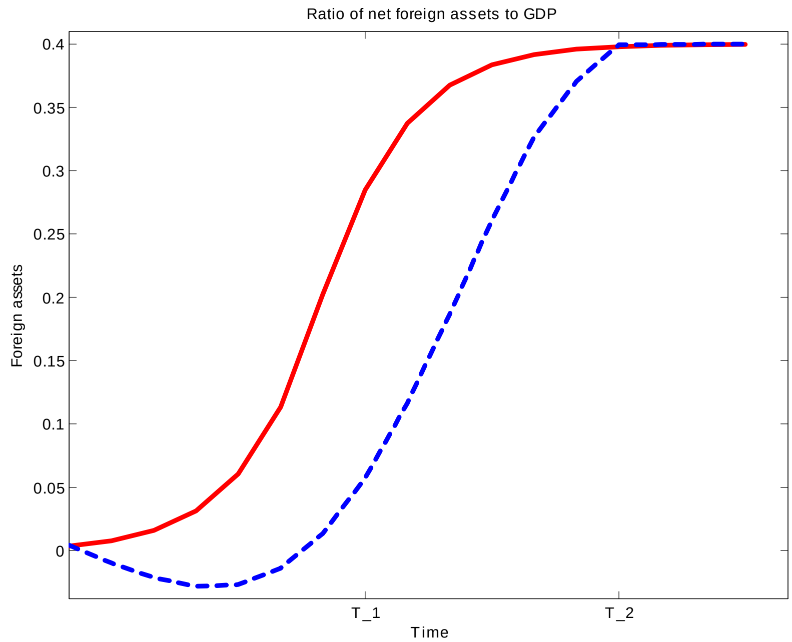

Figure A3

7.6 Equilibrium in Section 5.2

In this appendix, we provide a formal characterization of the equilibrium in the two-sector economy of Section 5.2. The equilibrium entails are four stages, described in the text. For notational convenience, we let $A^k_{Jt} = A^l_{Jt} = A_J$.

Proposition 2 *Stage 1 is defined as*

$$\frac{K_{Et}}{A_E N} < ((1-\psi)\chi)^{-\frac{1}{\alpha}} \left(\frac{P^l_t \alpha}{R}\right)^{\frac{1}{1-\alpha}}, \tag{36}$$

where

$$P^l_t = \left(1 - \varphi^\sigma \left(P^k_t\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}}, \tag{37}$$

$$P^k_t = \frac{R}{A_F^{1-\alpha}}. \tag{38}$$

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 (37) and (38). Labor, capital and output in the labor- and capital-intensive industries are such that

$$N^l_{Ft} = N - N^l_{Et},\ N^l_{Et} = ((1-\psi)\chi)^{\frac{1}{\alpha}} \left(\frac{P^l_t \alpha}{R}\right)^{-\frac{1}{1-\alpha}} \frac{K^l_{Et}}{A_E}, \tag{39}$$

$$K_{Ft}^{l}=\left(\frac{P_{t}^{l}\alpha}{R}\right)^{\frac{1}{1-\alpha}}A_{F}N_{Ft}^{l},\ K_{Et}^{l}=K_{Et},\ Y_{t}^{l}=\left(\frac{P_{t}^{l}\alpha}{R}\right)^{-1}\psi\left(\chi\left(1-\psi\right)\right)^{\frac{1-\alpha}{\alpha}}K_{Et}^{l}+\left(\frac{P_{t}^{l}\alpha}{R}\right)^{\frac{\alpha}{1-\alpha}}A_{F}N, \tag{40}$$

$$Y_{t}^{k}=\left(\varphi P_{t}^{l}/P_{t}^{k}\right)^{\sigma}Y_{t}^{l},\ K_{Ft}^{k}=\frac{Y_{t}^{k}}{A_{F}^{1-\alpha}},\ K_{Et}^{k}=0, \tag{41}$$

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

$$\frac{K_{Et+1}}{A_{E}N}=\frac{\beta\psi}{1+\beta}P_{t}^{l}\left(\frac{K_{Et}}{A_{E}N}\right)^{\alpha}, \tag{42}$$

and the aggregate output is equal to

$$Y_{t}=\left(P_{t}^{l}\right)^{\sigma}Y_{t}^{l}, \tag{43}$$

Proof. When $K_{Ft}^{l}>0$ and $K_{Ft}^{k}>0$, it is straightforward from Lemma 4 that $K_{Et}^{k}=0$. (37) follows immediately from (20), whereas (38) follows from the zero-profit condition (22) for F firms in the capital-intensive industry. The first part of (40) comes from (22). The first part of (41) follows from (19). Using the condition that final-good firms make zero profits, together with, (19) and (20) 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 (43). (39) follows immediately from (26). To derive (40), observe that

$$\begin{aligned}
Y_{t}^{l} &= \left(\kappa_{F}^{l}\right)^{\alpha}\left(\frac{\psi}{1-\psi}\frac{N_{Et}}{N}+1\right)A_{F}N\\
&= \left(\frac{P_{t}^{l}\alpha}{R}\right)^{\frac{\alpha}{1-\alpha}}\left(\psi\chi^{\frac{1}{\alpha}}\left(1-\psi\right)^{\frac{1-\alpha}{\alpha}}\left(\frac{P_{t}^{l}\alpha}{R}\right)^{-\frac{1}{1-\alpha}}\frac{K_{Et}^{l}}{A_{E}}+N\right)A_{F}\\
&= \frac{R}{P_{t}^{l}\alpha}\left(\psi\chi^{\frac{1}{\alpha}}\left(1-\psi\right)^{\frac{1-\alpha}{\alpha}}\frac{K_{Et}^{l}}{A_{E}}+N\left(\frac{P_{t}^{l}\alpha}{R}\right)^{\frac{1}{1-\alpha}}\right)A_{F}\\
&= \left(\frac{P_{t}^{l}\alpha}{R}\right)^{-1}\psi\left(\chi\left(1-\psi\right)\right)^{\frac{1-\alpha}{\alpha}}K_{Et}^{l}+\left(\frac{P_{t}^{l}\alpha}{R}\right)^{\frac{\alpha}{1-\alpha}}A_{F}N.
\end{aligned}$$

Finally, (36) ensures that $K_{Ft}^{l}>0$, according to (26). The rest is immediate. ■

Proposition 3 *Stage 2 is defined as*

$$\left(\left(1-\psi\right)\chi\right)^{-\frac{1}{\alpha}}\left(\frac{P_{t}^{l}\alpha}{R}\right)^{\frac{1}{1-\alpha}}\leq\frac{K_{Et}}{A_{E}N}<\frac{1}{\chi}\left(\frac{P_{t}^{l}\alpha}{R}\right)^{\frac{1}{1-\alpha}}. \tag{44}$$

In the second stage, the F-sector vanishes in the labor-intensive industry. Specifically, prices of labor- and capital-intensive goods are determined by (37) and (38). $N_{Ft}^{l}=0$, $N_{Et}^{l}=N$, *capital and output in the labor-intensive industries are such that*

$$K_{Ft}^{l}=0,\ K_{Et}^{l}=K_{Et},\ Y_{t}^{l}=\left(K_{Et}^{l}\right)^{\alpha}\left(A_{E}N\right)^{1-\alpha},$$

capital and output in the capital-intensive industry is identical to (41) in Stage 1. Moreover, capital in the E-sector also evolves according to (42) as in Stage 1.

Proof. The first inequality of (44) implies that $K_{Ft}^{l}=0$. Now the wage rate is determined by the marginal product of labor in the E sector.

$$w_{t}=P_{t}^{l}\left(1-\alpha\right)\left(1-\psi\right)A_{E}\left(\frac{K_{Et}^{l}}{A_{E}N}\right)^{\alpha}.$$

It is then easy to show that

$$\rho_{Et}^{l}=P_{t}^{l}\alpha\left(1-\psi\right)\left(\frac{K_{Et}^{l}}{A_{E}N}\right)^{\alpha-1}.$$

Suppose that E firms are active in the capital-intensive industry. We have

$$\rho_{Et}^{k}=\left(1-\psi\right)\chi^{1-\alpha}R.$$

However, the second inequality of (44) implies that $\rho_{Et}^{l}>\rho_{Et}^{k}$. Therefore, $K_{Et}^{k}=0$ in the second stage. Finally, (44) is non-empty by Assumption 1. ■

Corollary 1 *If*

$$\chi^{1-\alpha}<\frac{\alpha\left(1+\beta\right)}{\beta\psi R},\tag{45}$$

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

Proof. Define $\tilde{P}^{l}\equiv\left(1-\varphi^{\sigma}\left(\frac{R}{\left(A_{F}\right)^{1-\alpha}}\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$ as the constant price of labor-intensive goods in Stage 2. The law of motion (42) implies a 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:

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

Recall that $\rho^k_{Et} = (1-\psi)\,\chi^{1-\alpha} R$. Therefore, $\rho^l_{Et} > \rho^k_{Et}$ always holds under the assumption of (45). ■

Proposition 4 *Stage 3 is defined as*

$$\frac{1}{\chi}\left(\frac{P^l_t \alpha}{R}\right)^{\frac{1}{1-\alpha}} \leq \frac{K_{Et}}{A_E N} < \frac{1}{\chi}\left(\frac{P^l_t \alpha}{R}\right)^{\frac{1}{1-\alpha}} + \frac{1}{A_E^{1-\alpha}}\left(\varphi \frac{P^l_t}{P^k_t}\right)^{\sigma}\left(\frac{1}{\chi}\left(\frac{P^l_t \alpha}{R}\right)^{\frac{1}{1-\alpha}}\right)^{\alpha}. \quad (46)$$

In the third stage, the E firms start to produce capital-intensive goods. Specifically, prices of labor- and capital-intensive goods are determined by (37) and (38). $N^l_{Ft} = 0$, $N^l_{Et} = N$, *capital and output in the labor- and capital-intensive industries are such that*

$$K^l_{Ft} = 0,\ K^l_{Et} = \frac{1}{\chi}\left(\frac{P^l_t \alpha}{R}\right)^{\frac{1}{1-\alpha}} A_E N,\ Y^l_t = \left(K^l_{Et}\right)^{\alpha} (A_E N)^{1-\alpha}, \quad (47)$$

$$Y^k_t = \left(\varphi P^l_t / P^k_t\right)^{\sigma} Y^l_t,\ K^k_{Ft} = \frac{Y^k_t - A_E^{1-\alpha} K^k_{Et}}{A_F^{1-\alpha}},\ K^k_{Et} = K_{Et} - K^l_{Et}, \quad (48)$$

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

$$\frac{K_{Et+1}}{A_E N} = \frac{\beta\psi}{1+\beta}\left(P^l_t\left(\frac{K^l_{Et}}{A_E N}\right)^{\alpha} + P^k_t A_E^{1-\alpha}\left(\frac{K_{Et}}{A_E N} - \frac{K^l_{Et}}{A_E N}\right)\right). \quad (49)$$

Proof. Lemma 4 implies that $K^l_{Ft} = 0$.[31] $K^k_{Et} > 0$ implies equalized rates of return across two industries.

$$\rho^k_{Et} = \rho^l_{Et} \Rightarrow (1-\psi)\,\chi^{1-\alpha} R = P^l_t (1-\psi)\,\alpha\left(\frac{K^l_{Et}}{A_E N}\right)^{\alpha-1} \Rightarrow$$

$$K^l_{Et} = \frac{1}{\chi}\left(\frac{P^l_t \alpha}{R}\right)^{\frac{1}{1-\alpha}} A_E N.$$

Given total capital K_{Et} in the E-sector, $K_{Et} - K^l_{Et}$ will be allocated to the capital-intensive industry. Enterpreneurs' total income is equal to $\psi\left(P^l_t\left(K^l_{Et}\right)^{\alpha}(A_E N)^{1-\alpha} + P^k_t A_E^{1-\alpha} K^k_{Et}\right)$, which gives the law of motion of capital (49). Finally, we need $Y^k_t > A_E^{1-\alpha} K^k_{Et}$ to ensure $K^k_{Ft} > 0$. This is given by the second inequality of (46). ■

Proposition 5 *Stage 4 is defined as*

$$\frac{K_{Et}}{A_E N} \geq \frac{1}{\chi}\left(\frac{P^l_t \alpha}{R}\right)^{\frac{1}{1-\alpha}} + \frac{1}{A_E^{1-\alpha}}\left(\varphi \frac{P^l_t}{P^k_t}\right)^{\sigma}\left(\frac{1}{\chi}\left(\frac{P^l_t \alpha}{R}\right)^{\frac{1}{1-\alpha}}\right)^{\alpha}.$$

[31] Alternatively, $K^l_{Ft} = 0$ can be ensured by the first inequality of (46).

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 (37) and (50).

$$P_t^k = \frac{R}{(1-\psi)\, A_E^{1-\alpha}}. \tag{50}$$

$N_{Ft}^l = 0$, $N_{Et}^l = N$, capital and output in the labor- and capital-intensive industries are identical to (47) and (48), except that $K_{Ft}^k = 0$. The law of motion of capital in the E-sector also follows (49) in the third stage.

The proof is immediate and is omitted.

Finally, we revisit the foreign balance. The balance sheets of the banks must take into account the investments of F firms in both industries:

$$K_{Ft+1}^k + K_{Ft+1}^l + B_t = \frac{\beta}{1+\beta} w_t N_t.$$

Proposition 6 *In the first stage, the country's asset position in the international bond market increases if*

$$\frac{\alpha\,(1-\psi)}{\psi} > \varphi^\sigma \left(P^l/P^k\right)^{\sigma-1}, \tag{51}$$

where P^l and P^k follow (37) and (38), respectively.

Proof. Using (21) and (22), standard algebra shows that:

$$\begin{aligned}
\frac{B_{t+1}}{A_F N} &= \frac{\beta}{1+\beta} w_t - \frac{K_{Ft+1}^l}{A_F N} - \frac{K_{Ft+1}^k}{A_F N} \\
&= \frac{\beta}{1+\beta} P^l (1-\alpha)\, A_F \left(\frac{P^l \alpha}{R}\right)^{\frac{\alpha}{1-\alpha}} \\
&\quad - \left(\frac{P^l \alpha}{R}\right)^{\frac{1}{1-\alpha}} \left(1 - \frac{\left((1-\psi)\,\chi\right)^{\frac{1}{\alpha}} \left(\frac{P^l \alpha}{R}\right)^{-\frac{1}{1-\alpha}} K_{Et+1}^l}{A_E N}\right) \\
&\quad - \frac{\left(\varphi P^l/P^k\right)^\sigma}{A_F^{1-\alpha}} \left(\left(\frac{P^l \alpha}{R}\right)^{-1} \psi \left(\chi\,(1-\psi)\right)^{\frac{1-\alpha}{\alpha}} \frac{K_{Et+1}^l}{A_F N} + \left(\frac{P^l \alpha}{R}\right)^{\frac{\alpha}{1-\alpha}}\right).
\end{aligned}$$

Since K_{Et+1}^l is increasing, B_{t+1} is an increasing sequence if (51) holds. ■

The main results of Proposition 1 therefore carry over to this extended model economy.