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Introduction

Motivating Facts:

- Over the last 30 years, China has undergone a spectacular economic transformation involving not only fast economic growth and sustained capital accumulation, but also major shifts in the sectoral composition of output, increased urbanization and a growing importance of markets and entrepreneurial skills.
- Reallocation of labor and capital across manufacturing firms has been a key source of productivity growth. The rate of return on investment has remained well above 20 percent, higher than in most industrialized and developing economies.
- If investment rates have been high, saving rates have been even higher: in the last 15 years, China has experienced a growing net foreign surplus: its foreign reserves swelled from 21 billion USD in 1992 (5 percent of its annual GDP) to 2,130 billion USD in June 2009 (46 percent of its GDP).

The combination of high growth and high return to capital, on the one hand, and a growing foreign surplus, on the other hand, is puzzling. A closed-economy neoclassical model predicts that the high investment rate would lead to a fall in the return to capital. An open-economy model predicts a large net capital inflow rather than an outflow, owing to the high domestic return to capital.

The focal points of the theory are financial frictions and reallocation of resources across firms. In our theory, both the sustained return to 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, the combination of high growth and high investment is consistent with the accumulation of a foreign surplus.

Relevant Literature:

*This note is writte during my M.phil. study at the University of Oxford.

- Low aggregate total factor productivity - especially in developing countries - is a result of micro-level resource misallocation (see Stephen L. Parente, Richard Rogerson, and Randall Wright 2000; Francesco Caselli and Wilbur J. Coleman II 2001; Abhijit Banerjee and Esther Duflo 2005; Diego Restuccia and Rogerson 2008; Gino Gancia and Fabrizio Zilibotti 2009; and Chang-Tai Hsieh and Peter J. Klenow 2009).
- 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, since efficient firms can count on a highly elastic supply of factors attracted from the less productive firms.
- Reallocation within the manufacturing sector - the driving force in our model - has been shown to be an important source of productivity growth in China. In an influential paper, Hsieh and Klenow (2009) estimate that reallocation across manufacturing firms with different productivity accounted for an annual two percentage point increase in aggregate TFP during 1998-2005. Loren Brandt, Johannes Van Biesebroeck, and Yifan Zhang (2009) estimate that up to two-thirds of the aggregate TFP growth in Chinese manufacturing was due to productivity differences between entering and exiting firms during 1998-2005.
- The theory is related to the seminal contribution of Arthur W. Lewis (1954), who constructs a model of reallocation from agriculture to industry where the supply of labor in manufacturing is unlimited due to structural overemployment in agriculture. Our paper is also related to Jaume Ventura (1997), who shows that in economies engaging in external trade, capital accumulation is not subject to diminishing returns because resources are moved from labor-intensive to capital-intensive sectors.
- Kiminori Matsuyama (2004, 2005) shows that financial frictions may induce trading economies to specialize in industries in which they do not have a technological comparative advantage. See also the work of Pol Antràs and Ricardo J. Caballero (2009).
- Pierre-Olivier Gourinchas and Olivier Jeanne (2009) document that it is common to observe capital outflow from fast-growing developing economies with high marginal product of capital. As in the case of China, 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 the "allocation puzzle."

1. The Transition of China: Empirical Evidence

1.1. Political Events and Macroeconomic Trends

The focus of this paper is on the post-1992 Chinese transition, a period characterized by fast and stable growth and by a pronounced resource reallocation within the manufacturing sector.

Some Summary Statistics

- In spite of very high investment rates (39 percent on average), the rate of return to capital has

remained stable: while the aggregate return to capital has fallen slightly (from 28 percent in 1993 to 21 percent in 2005), the rate of return to capital in manufacturing has been increasing since the early 1990s and climbed close to 35 percent in 2003, according to Figure 11 in Chong-En Bai, Hsieh, and Yingyi Qian (2006).

- 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.
- Wage growth has been lower than growth in output per capita in recent years. Similarly, the labor share of aggregate output fell gradually from 59 percent in 1998 to 47 percent in 2007 (Bai and Zhenjie Qian 2009, Table 4).3 The falling labor share has contributed to rising inequality even across urban households (Dwayne Benjamin, Brandt, John Giles, and Sangui Wang 2008).

1.2. Reallocation in Manufacturing

Figure 2 plots alternative measures of the evolution of the employment share of private enterprises.

1.3. Productivity and Credit Frictions

Domestic private enterprises (DPE) and state-owned enterprises (SOE) doffer 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 of total profits to fixed assets net of depreciation. Based on this measure, the gap between DPE and SOE is about 9 percentage points per year, similar to that reported by Nazrul Islam, Erbiao Dai, and Hiroshi Sakamoto (2006). A concern with the official data is that the ownership classification is based on ownership at the time of initial registration. However, many firms have subsequently been privatized. This problem is addressed by David Dollar and Shang-Jin Wei (2007), who use survey data on 12,400 firms, classified according to their current ownership. They find the average return to capital to be twice as high in private firms as in fully state-owned enterprises (Dollar and Wei 2007, Table 6). Interestingly, collectively owned firms also have a much higher productivity than SOE.

Large productivity differences also emerge from TFP accounting: Brandt, Hsieh, and Xiaodong Zhu (2008, Table 17.3) estimate an average TFP gap between DPE and SOE of 1.8 during 1998-2004, while Brandt and Zhu (2010) estimate a gap of 2.3 in 2004. Using a different methodology, Hsieh and Klenow (2009) estimate a "revenue-TFP gap" of 1.42.

Financial and contractual imperfections are also well documented. In this environment, Chinese firms must rely heavily on retained earnings to finance investments and operational costs. Financial repression is far from uniform: private firms are subject to strong discrimination in credit markets. The Chinese banks - mostly state owned - tend to offer easier credit to SOE (Genevieve Boyreau-

Debray and Wei 2005). As a result, SOE can finance a larger share of their investments through external financing.

Another sign that DPE are financially repressed is that bother capital-output and capital-labor ratios are substantially lower in DPE than in SOE. In 2006, the average capital-output ratio was 1.75 in SOE and 0.67 in DPE (China Statistical yearbook (CSY) 2007). In the same year, capital per worker was almost five times larger in SOE than in DPE, although part of this difference reflects 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 even within three-digit manufacturing industries, both in terms of capital per worker and in terms of the capital-output ratio. Second, DPE have taken over labor-intensive industries, while the share of SOE remains high in capital-intensive industries.

1.4. Income Inequality

Our theory suggests that the increase in income inequality 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.

1.5. Foreign Surplus and Productivity Growth

2. The Benchmark Model

2.1. Preferences, Technology, and Markets

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 utility function

$$U_t = \frac{(c_{1t})^{1-\frac{1}{\theta}} - 1}{1-\frac{1}{\theta}} + \beta \frac{(c_{2t+1})^{1-\frac{1}{\theta}} - 1}{1-\frac{1}{\theta}}, \tag{1}$$

where θ is the intertemporal elasticity of substitution in consumption c_t. We focus on the case when agents' savings are nondecreasing in the rate of return, i.e., when $\theta \geq 1$.

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) which are transmitted from parents to children. 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. For simplicity ν is assumed to be exogenous.

There are two types of firms, both requiring capital and labor as well as one manager. Financially integrated (F) firms are owned by intermediaries and operate as standard neoclassical firms. En-

trepreneurial (E) firms are owned by old entrepreneurs. The entrepreneurs are residual claimants on the profits and hire their children as managers (cf. Caselli and Nicola Gennaioli 2006).

The key assumption is that, due to financial and contractual imperfections, only some firms (F firms) have access to the deep pockets of banks, which are perfectly integrated in international financial markets. Other firms (E firms) are owned by agents who have superior skills and can run more productive technologies. However, there are frictions restricting the flow of funds from the agents with a deep pocket to those with superior skills. As a result, the latter end up being credit constrained. This, in turn, allows less productive firms to survive in equilibrium.

Different micro-foundations would be consistent with heterogeneous productivity across firms to exist in equilibrium. Here, we present one such example: following Daron Acemoglu et al. (2007), we assume that each firm can choose between two modes of production: either the firm delegated decision authority to its manager, or it retains direct control of strategic decisions. There is a trade-off. On the one hand, delegation leads to higher total factor productivity (TFP) - e.g., the manager makes decisions based on superior information. Thus, a firm delegating authority can attain $\chi > 1$ extra efficiency units per worker compared with a firm retaining centralized authority. On the other hand, delegation raises an agency problem: the manager can divert a positive share of the firm's output for his own use. Such opportunistic behavior can only be deterred by paying managers a compensation that is at least as large as the funds they could steal. The key assumption is that entrepreneurs are better at monitoring their managers, so that E firm managers can steal only a share $\psi < 1$ of output. In contrast, F firms are weak at corporate governance and cannot effectively monitor their managers: under delegation, all output would be stolen. Thus, F firms will always choose a centralized organization, while E firms opt for delegation, given a condition that will be spelled out below. Of course, less productive firms could not survive unless they had the benefit of having better access to external funds. Such advantage is due to entrepreneurs being subject to credit constraints, as explained below.

The technology of F and E firms are described, respectively, by the following production functions:

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

where y is output and k and n denote capital and labor, respectively. Capital depreciates fully after one period. In the case of F firms, the input of the manager is equivalent to that of a regular worker and is indeed in n_F. The technology parameter A grows at an exogenous rate z; $A_{t+1} = (1+z)A_t$.

We now analyze agents' savings. Young workers earn a wage w and deposit their savings with a set of competitive intermediaries (banks) paying a gross interest rate R^d. These workers choose savings so as to maximize utility, (1), subject to an intertemporal budget constraint,

$$c_{1t}^W + \frac{c_{2t}^W}{R^d} = w_t.$$

This yields the optimal savings

$$s_t^W = \zeta^W w_t,$$

where $\zeta^W \equiv \frac{1}{1+\beta^{-\theta}R^{1-\theta}}$. Young entrepreneurs in E firms earn a managerial compensation, m_t. Their savings can be invested either in bank deposits or in their family business.

Banks collect savings from workers and invest in loans to domestic firms and foreign bonds. The bonds yield a gross return R. Contractual imperfections plague the relationship between banks and entrepreneurs. The output of E firms is non-verifiable, and entrepreneurs can only pledge to repay a share of η of the second-period net profits. In a competitive equilibrium, the rate of return on domestic loans must equal the rate of return on foreign bonds, which in turn must equal the deposit rate. However, lending to firms is subject to an iceberg cost ξ, which captures operational costs, red tape, etc. Thus, ξ is an inverse measure of the efficiency of intermediation. In equilibrium, $R^d = R$ and $R^l = R/(1-\xi)$, where R^l is the lending rate to domestic firms.

For F firms, profit maximization implies that R^l equals the marginal product of capital and that wages equal the marginal product of labor:

$$w_t = (1-\alpha)\left(\frac{\alpha}{R^l}\right)^{\frac{\alpha}{1-\alpha}} A_t. \tag{2}$$

Consider now the value of an E firm, owned by an old entrepreneur with capital k_{Et}. This value is the solution to the following problem:

$$\Xi_t(k_{Et}) = \max_{m_t, n_{Et}} \left\{ (k_{Et})^{\alpha} \left(\chi A_t n_{Et}\right)^{1-\alpha} - m_t - w_t n_{Et} \right\} \tag{3}$$

subject to the incentive constraint that $m_t \geq \psi (k_{Et})^{\alpha} (\chi A_t n_{Et})^{1-\alpha}$ where m_t is, again, the payment to the manager, and arbitrage in the labor market implies that the wage is as in (2). The optimal contract implies that the incentive constraint is binding:

$$m_t = \psi \left(k_{Et}\right)^{\alpha} \left(\chi A_t n_{Et}\right)^{1-\alpha}. \tag{4}$$

Taking the first-order condition with respect to n_E and substituting in the equilibrium wage given by (2) yields that

$$n_{Et} = ((1-\psi)\chi)^{\frac{1}{\alpha}} \left(\frac{R^l}{\alpha}\right)^{\frac{1}{1-\alpha}} \frac{k_{Et}}{\chi A_t} \tag{5}$$

Plugging (4) and (5) into (3) yields the value of the firm:

$$\Xi_t(k_{Et}) = (1-\psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} R^l k_{Et} \equiv \rho_E k_{Et}, \tag{6}$$

where ρ_E is the E firm rate of return to capital. In order to ensure that $\rho_E > R^l$, we make the following assumption.

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

Given this assumption, (i) E firms prefer delegation to centralization and (ii) young entrepreneurs find it optimal to invest in the family business. If Assumption 1 were not satisfied, there would be no E firms in equilibrium. Thus, a sufficiently large productivity difference is necessary to trigger economic transition.

Consider, next, the contract between banks and entrepreneurs. The E firm's capital stock comprises the savings of the younger entrepreneur and the bank loan, $k_{Et} = s^E_{t-1} + l^E_{t-1}$. The incentive-compatibility constraint of the entrepreneur implies that $R^l l^E \leq \eta\rho_E(s^E + l^E)$. This constraint is binding if and only if $\eta < R^l/\rho_E$, which we assume to be the case. Thus, the share of investments financed through bank loans is

$$\frac{l_E}{l_E + s_E} = \frac{\eta\rho_E}{R^l}. \tag{7}$$

The entrepreneur's investment problem can be expressed as the choices of l_E and s_E that maximize discounted utility, U, subject to $c_1 = m - s_E$, $c_2 = \rho_E(l_E + s_E) - R^l l_E$, and the incentive-compatibility constraint, (7). If we use (7) to substitute away l_E, the problem simplifies to

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

This implies that the optimal savings are $s_E = \zeta^E m$, where

$$\zeta^E \equiv \left(1 + \beta^{-\theta}\left(\frac{(1-\eta)\rho_E R^l}{R^l - \eta\rho_E}\right)^{1-\theta}\right)^{-1}.$$

2.2. Discussion of Assumptions

The theory describes a 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 and F firms are private and state-owned 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. Second, thanks to connections to state-owned banks, SOE enjoy better access to borrowing.

In assuming F firms to be "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. Also for simplicity, we model the labor market as competitive and frictionless. While the Chinese labor market is characterized by important frictions (e.g., 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 and wage growth.

The assumption that private firms are less financially integrated is also well rooted in the empirical evidence discussed before. THe assumption that monitoring is easier within flexible organizations - and most notably in family firms - seems natural. In the model, we do not emphasize interfamily altruistic links: parents transmit genetically entrepreneurial skills to their children but also must provide them incentives to avoid opportunistic behavior.

The essential feature of our model's reallocation mechanism is that financial and contractual

frictions 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 be active in equilibrium. The fact that the growth of E firms is constrained by the savings of entrepreneurs implies a gradual transition.

2.3. Equilibrium during Transition

In this section, we characterize the equilibrium dynamics during a transition in which there is positive employment in both E and F firms. We drop time subscripts when this causes no confusion. We start by showing that, due to the disadvantage in raising funds, E firms choose in equilibrium a lower capital-output ratio than do F firms. To see this, denote by $\kappa_J = k_J/(A_J n_J)$ the capital per effective unit of labor. As discussed above, in a competitive equilibrium, the lending rate R^l pins down the marginal product of capital of F firms. Thus,

$$\kappa_F = \left(\frac{\alpha}{R^l}\right)^{\frac{1}{1-\alpha}}. \tag{8}$$

Since κ_F is constant, the equilibrium wage in (2) grows at the rate of technical change, z, as in standard neoclassical open-economy growth models. Equation (5) then implies immediately that

$$\kappa_E = \kappa_F \left((1-\psi)\chi\right)^{-\frac{1}{\alpha}}. \tag{9}$$

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

Consider, next, the equilibrium dynamics. The key properties of the model are that (i) K_{Et} and A_t are state variables (whereas $K_F t$ is determined by equation (8) and is therefore not a state variable), (ii) capital per effective unit of labor for each type of firm, κ_E and κ_F, is constant for each type of firm, and (iii) entrepreneurial savings in period t (hence, K_{Et+1}) is linear in K_{Et}. These three properties imply that the employment, capital and output of E firms grow at a constant rate during transition.

Lemma 2. Given K_{Et} and A_t, the equilibrium dynamics of total capital and employment of E firms during transition are given by $K_{Et+1}/K_{Et} = 1+\gamma_{K_E}$ and $N_{Et+1}/N_{Et} = (1+\gamma_{K_E})(1+z) \equiv 1+\nu_E$, where

$$1+\gamma_{K_E} = \frac{R^l}{R^l - \eta\rho_E}\left(1+\beta^{-\theta}\left(\frac{(1-\eta)\rho_E R^l}{R^l-\eta\rho_E}\right)^{1-\theta}\right)^{-1}\frac{\psi}{1-\psi}\frac{\rho_E}{\alpha}, \tag{10}$$

and

$$\rho_E = (1-\psi)^{1/\alpha}\chi^{(1-\alpha)/\alpha}R^l \quad \text{and} \quad R^l = R/(1-\xi).$$

There exists $\hat{\chi} = \hat{\chi}(\beta,\chi,\psi,\eta,\alpha,\nu,z,R,\xi) < \infty$ such that the employment share of E firms N_E/N grows over time (i.e., $\nu_E > \nu$) if an only if $\chi > \hat{\chi}$. $\hat{\chi}$ is defined in the Appendix. Moreover, $\hat{\chi}$ is decreasing in β and in η and increasing in ν and in z. Thus, the employment share of E firms grows if, ceteris paribus, β or η are sufficiently large or if ν or z are sufficiently small.

Equation (10) follows from the aggregation of the E firm investments, after recalling that $k_{Et+1} = s_t^E + \_t^E$, where $s_t^E = \zeta^E m_t$ (with m_t being determined by (4)), and λ_t^E is determined by (7). The constant growth rate of K hinges on the facts that the rate of return to capital in E firms is constant and that young entrepreneurs' earnings and savings are proportional to E firms' profits. To illustrate this point, suppose that $z = 0$. In this case, the workers' wage remains constant during the transition. However, the managerial compensation, m_t, still grows in proportion to the output of E firms. The growing earning inequality between workers and entrepreneurs is key for the transition to occur, since (i) the investment of E firms is financed by entrepreneurial savings, and (ii) constant wages avoid a falling return to investment. If young entrepreneurs earned no rents and just earned a workers' wage, entrepreneurial investments would not grow over time. Substituting the expression of ρ_E into (10) shows that the growth rate is hump-shaped in ψ. If entrepreneurial rents are low (small ψ), young entrepreneurs are poor, and there is low investment. However, if ψ is large, the profitability and growth of E firms (ρ_E) fall.

Note that both assumptions, that $\chi > \underline{\chi}$ and that $\chi > \hat{\chi}$, require the TFP gap, $\chi^{1-\alpha}$, to be large. Thus, generically, only one of them will be binding. Interestingly, the theory can predict failed takeoffs. For instance, suppose that initially both conditions were satisfied. Then, the saving rate ζ^E would fall, due to, e.g., a fall in β, so that $\hat{\chi}(\cdot, \beta) > \chi > \underline{\chi}$ after the shock. Then investment by E firms will continue to be positive, but their employment share would shrink over time.

The equilibrium dynamics of the set of F firms can be characterized residually from the condition that $K_{Ft} = \kappa_F A_t (N_t - N_{Et})$, namely, F firms hire all workers not employed by the E firms, and K_F adjusts to the optimal capital-labor ratio. Standard algebra shows that, as long as the employment share of E firms increases, the growth rate of K_F declines over time. The aggregate capital accumulation of F firms is hump-shaped during the transition. Initially, when the employment share of E firms is small, K_F grows at a positive rate (provided that either $\nu > 0$ or $z > 0$). However, as the transition proceeds, its growth rate declines and eventually turns negative.

Finally, GDP per worker is given by

$$\frac{Y_t}{N_t} = \frac{Y_{Ft} + Y_{Et}}{N_t} = \kappa_F^{\alpha} \left(1 + \frac{\psi}{1-\psi} \frac{N_{Et}}{N_t}\right) A_t. \tag{11}$$

The growth rate of GDP per worker accelerates during a transition as long as $\chi > \hat{\chi}$, reflecting the resource reallocation towards more efficient firms. Under the same condition, the average rate of return to capital in the economy increases during the transition, due to a composition effect, even though the rates of return to capital in E firms and F firms are constant. Intuitively, this reflects the increasing share of the capital stock of E firms that yields the high return ρ_E.

2.4. Foreign Surplus, Savings, and Investments

Consider the banks' balance sheet:

$$K_{Ft} + \frac{\eta \rho_E}{R^l} K_{Et} + B_t = \zeta^W w_{t-1} N_{t-1}. \tag{12}$$

The left-hand side of (12) consists of the banks' assets: loans to F firms, loans to E firms (as in equation (7)), and foreign bonds, B_t. The right-hand side of (12) captures their liabilities (deposits). The analysis of the previous section leads to the following Lemma:

Lemma 3. The country's foreign surplus is given by

$$B_t = \left(\zeta^W \frac{(1-\alpha)\kappa_F^{\alpha-1}}{(1+z)(1+\nu)} - 1 + (1-\eta)\frac{N_{Et}}{N_t} \right) \kappa_F A_t N_t \tag{13}$$

As long as the employment share of the E firms (N_{Et}/N_t) increases during the transition, the country's foreign surplus per efficiency, $B_t/(A_t N_t)$, increases. When the transition is completed (in period T, say) and all workers are employed by E firms ($N_{ET}/N_T = 1$), the net foreign surplus becomes

$$B_T = \left(\zeta^W \frac{(1-\alpha)\kappa_F^{\alpha-1}}{(1+z)(1+\nu)} - \eta \right) \kappa_F A_T N_T.$$

If E firms are sufficiently credit constrained (i.e., if η is low), then the transition necessarily ends with a positive net foreign position.