Growing (with Capital Controls) Like China*

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Abstract

This paper explores the effects of capital controls and policies regulating interest rates and the exchange rate in a model of economic transition applied to China. We build on Song et al. (2011) who construct a growth model consistent with salient features of the recent Chinese growth experience: high output growth, sustained returns on capital investment, extensive reallocation within the manufacturing sector, sluggish wage growth, and accumulation of a large trade surplus. The salient features of the theory are asymmetric financial imperfections and heterogeneous productivity across private and state-owned firms. Capital controls and regulation of banks' deposit rates stifles competition in the banking sector and mitigates the lending to productive private firms. Removing this regulation would accelerate the growth in productivity and output. A temporarily undervalued exchange rate reduces real wages and consumption, stimulating investments in the high-productivity entrepreneurial sector. This fosters productivity growth and a trade surplus. A high interest rate limits the disadvantage of financially constrained firms, reduces wages and increases the speed of transition from low- to high-productivity firms.

JEL Codes. F31, F41, F43, G21, O16, O53, P23.

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1 Introduction

Economic theory predicts that capital should flow towards countries, regions and firms where it commands the highest returns. Yet, this prediction is contradicted by the data: Gourinchas and Jeanne (2013) document that, within non-OECD economies, capital inflows are negatively correlated with productivity and output growth: on average, capital does not to flow into the countries that offer the best investment opportunities. This observation has been labeled as the "allocation puzzle". Due to its size and due to the large current account surpluses run over the last 15 years, China is a center piece of this puzzle. In spite of the high return to real investment, China has been a large capital exporter, amassing reserves amounting to almost 4 trillion US Dollars in the end of first quarter of 2014.[1]

In Song *et al.* (2011), henceforth SSZ, we document that a version of the allocation puzzle holds true within China. Regions and firms where capital commands the highest returns fail to attract financial resources. For instance, the gap between savings and investment is positively correlated with productivity at the provincial level. We then propose a structural explanation for this pattern, and the associated accumulation of foreign reserves. The predictions of our theory are consistent with a set of salient stylized facts of China since 1992: high output growth, sustained returns on capital investments, an extensive reallocation within the manufacturing sector, and sluggish wage growth.

The building blocks of the model in SSZ are asymmetric financial imperfections and differences in productivity across firms. More specifically, we construct a competitive economy populated by two sets of firms. The former have access to more productive technologies, but are subject to tighter financial constraints. In a frictionless environment, the less productive firms would be driven out by competition. However, these can survive, due to their better access to credit markets. The credit market imperfections constrain the growth of the more productive firms, whose investments must be financed largely from retained earnings. Thus, the demise of the less productive sector is not instantaneous, but happens gradually. During the transition, the high-productivity

[1] Caselli and Feyrer (2007) argue that a properly measured return to capital is approximately equalized across a sample of countries which excludes China. Their main point is that one should correct for differences in the relative price of capital when calculating its rate of return. Bai *et al.* (2007) estimate of the rate of return on capital for China including such an adjustment, and find that China has a significantly higher rate of return on capital than most countries. See Bai *et al.* (2007), p.65.

firms outgrow the low-productivity firms and attract an increasing employment share. The downsizing of the low-productivity firms implies that a growing share of domestic savings be invested in foreign assets, generating a trade surplus.

SSZ assumes, for simplicity, a laissez-faire environment: the government plays no active role in setting the exchange rate, interest rate, etc. In reality, the Chinese government uses a variety of policy instruments that affect prices and resource allocation. For instance, capital controls, interest rate regulations and reserve requirements have been pervasive (see, e.g., Obstfeld and Rogoff 2005). In addition, while China has been a very open economy to trade flows and to inward foreign direct investments, cross-border portfolio flows have been subject to tight regulations. Chinese private investors cannot trade in foreign assets, nor can foreign investors access Chinese financial markets. The RMB is today only convertible for trade transactions. There are exemptions, as we document below, but these are still limited. The gross cross-border flow of assets is still moderate, relative to China's GDP. China is in this sense similar the other large emerging economies (Gourinchas and Rey 2013).

In this paper, we study how capital controls and regulations of the financial system affect key measures of economic performance, such as wage growth, productivity growth, and trade surplus. To this end, we extend the SSZ model to incorporate explicitly a range of financial market regulations: controls of deposit and lending rates, restrictions over cross-border financial investments, interest rate and exchange rate policies. We also evaluate the welfare effects of such policies.

The model economy is a non-monetary small "semi-open economy" where consumers demand two goods, one produced by domestic firms and one produced abroad. As in SSZ there are pervasive frictions in the domestic economy: the more productive firms are credit constrained, whereas the less productive firms have access to external (bank) financing. Due to capital controls, domestic savers, firms, and banks cannot access the international credit market. Nor are foreign agents allowed to hold any domestic assets. Only the government (e.g., through the central bank) can hold positive or negative debt positions versus the rest of the world, matching trade flow imbalances. In this sense the economy is semi-open, as in previous work by Jeanne (2012), and Bacchetta *et al.* (2013 and 2014).

We use this model to study the effect of a number of policies influencing financial markets. First, the government fixes the relative price at which domestic goods are traded for foreign goods (i.e., the real exchange rate). This policy is implemented by a restriction on the market access for foreign exporters. We label this as the (real) *exchange*

rate policy (ERP). The main focus here is on the case of a temporarily undervalued exchange rate, which is relevant for the debate about China. Namely, the government makes foreign goods artificially more expensive relative to home goods. Second, the government sets the interest rate on domestic government bonds, and issues domestic bonds so as to meet the demand at that rate. We label this as the *interest rate policy* (IRP). Third, the government regulates the spread between the deposit and lending rates offered by domestic banks. This is implemented by imposing a ceiling on the interest rates banks can offer to depositors. We label this as the *deposit rate policy* (DRP). This regulation influences competition in the banking sector. Since banks are not allowed to compete in offering better conditions to borrowers and lenders, the competition among banks is muted, creating an incumbency advantage. Since in China incumbent banks are state owned, and are, as we document in SSZ, biased against financing private enterprises, this barrier to entry has potentially important implications for the efficiency of the banking sector and, ultimately, aggregate productivity. As we discuss below, the government is currently deregulating the banking industry. We use our theory to explore what the effect of this regulation will be. Finally, we consider the effect of full financial deregulation: removing all restrictions on cross-border flows, interest rates and exchange rates.

Consider, first, the ERP. An undervalued exchange rate decreases the demand for foreign goods, and reduces real wages. Since the ERP is assumed to be temporary, this generates in addition an intertemporal substitution in consumption, fostering savings at the expenses of consumption, a mechanism similar to that emphasized by Dornbusch (1983).[2] Thus, an undervalued exchange rate increases the savings gap, resulting in a trade surplus and accumulation of foreign reserves. Interestingly, this policy also affects the speed of transition, since it increases the savings and investments of private entrepreneurs. Thus, the theory predicts that an undervalued exchange rate would, as often argued in the policy debate, decrease consumption and generate a trade surplus, even in the absence of any nominal rigidities. Over time, the exchange rate policy helps the entrepreneurs grow faster, thereby accelerating TFP and economic growth. This trade-off between static losses and dynamic gains of the exchange rate policy are reminiscent of that emphasized by the mercantilist export-led-growth view (see, e.g., Korinek and Servén 2010, and Rodrik 2009). However, these authors emphasize the role

[2]He argues that if the relative price of the domestic consumption basket is changing over time, this is equivalent to a change in the effective real domestic interest rate. For instance, a temporarily undervalued exchange rate corresponds to an increase in the domestic interest rate, which in turn leads consumers to save more today to raise future relative to current consumption.

of dynamic externalities in manufacturing (as in Lucas 1988) or, more specifically, in the export sector. While this complementary mechanism might be important in reality, our mechanism does not hinge on any such externality.

Consider, next, the IRP. In a standard model, a low interest rate has an expansionary effect by lowering the borrowing cost for investing firms. In our model the real interest rate has an additional general equilibrium effect (that is absent in the case of the ERP): it distorts the allocation of resources between private and state-owned firms. Namely, when the banks' lending rate is low, financially unconstrained state-owned firms increase their capital-labor ratio. This increases the equilibrium wage rate. In turn, high wages reduce the profitability of financially constrained firms, slowing down capital accumulation in the entrepreneurial sector, and, hence, hampering the transition from low-productivity to high-productivity firms. Therefore, a low interest rate has on the one hand an expansionary effect (through both higher wages increasing aggregate consumption, and higher investments of financially integrated firms). On the other hand, it reduces productivity growth and hampers reallocation, reducing economic growth. One should also note that a high interest rate increases the trade surplus. This is per se not surprising, although the channel in our theory is different from standard ones.

Both the ERP and IRP have non-trivial distributional effects. On the one hand, an undervalued exchange rate hurts the early generations of both workers and entrepreneurs, due to the distortion of consumption. On the other hand, the future generations gain from this policy, due to larger investments triggering the earlier onset of fast wage growth. Interestingly, due to the mechanism of the transition model, a larger number of workers' generations are hurt by the policy – i.e., there are more persistent negative effects for wage earners than for entrepreneurs. Moving to the IRP, on the one hand a high interest rate hurts early generations of workers through low wages, though it benefits future generations of workers (possibly, far in time) by speeding up transition.

Finally, consider the DRP. This is an especially topical policy: until July 2013, Chinese banks could compete neither in the loan market (by offering lower interest rate to borrowers) nor in the deposit market (by offering higher interest rate to depositors). Ceilings on deposit rates are still in place as we write, although the People's Bank of China (PBOC) has recently announced its intention to lift them, too. We focus on the effect of removing the ceilings on deposit rates. We find two main results. First, if there is no heterogeneity between incumbent and potential new banks, then the deposit rate deregulation has no effect over and above increasing the rate of return earned by depositors. In this case, the deregulation would increase consumption of the old and

reduce the trade surplus slightly, without any effect on productivity. Deregulation has a more far-reaching effect if the increasing competition in the banking industry triggers the entry of new banks that are less entrenched with state-owned enterprises, and hence are more prone to lend to the most productive private firms. In this case, deregulation will ultimately increase the access to external financing for high-productivity firms owned by private entrepreneurs. This speeds up reallocation and productivity growth and reduces the trade surplus.

The article is structured as follows: In section 2, we describe the main aspects of the Chinese policies (capital controls, interest rate controls, etc.) over the last two decades. In section 3 we present the model. In sections 4 and 5 we perform the policy experiments. Section 5 studies the effect of reforming the financial market system. Section 6 concludes.

2 Facts

In this section, we present two sets of empirical facts. We first document the dynamics of foreign reserves, exchange rates, capital controls, and capital flows. We then describe how monetary policy has been conducted over the last two decades. The aim is to provide a set of stylized facts that will be the basis of the theoretical discussion in the subsequent sections of the paper.

2.1 Foreign Reserves and Exchange Rates

China transformed its dual-track exchange rate system to a semi-pegged regime in 1994. Panel A of Figure 1 plots the dynamics of nominal and real exchange rates between RMB and USD, along with the real effective exchange rate (REER) published by the IMF. The initial values are normalized to 100. A lower exchange rate corresponds to RMB appreciation. After an initial sharp appreciation, mainly caused by high inflation in China between 1994 and 1996, the subsequent period is characterized by a period of real depreciation of the exchange rate between 1998 and 2005, followed by a period of real appreciation thereafter. Since the nominal exchange rate versus the USD remained fixed between 1996 and 2005, the real depreciation was driven by China inflation being low relative to its trading partners. Since 2005, the central bank of China has allowed an appreciation of the nominal exchange rate, resulting in a significant real appreciation. Note that the dynamics of the REER are very similar to those of the real exchange rate *vis-à-vis* the USD.

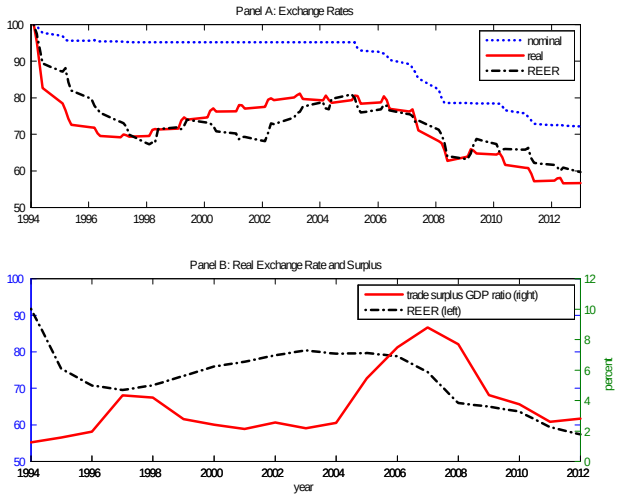

Figure 1: The dotted and solid lines in Panel A plot quarterly nominal and real exchange rates between RMB and USD, respectively. The dashed line is the real effective exchange rate. We use inflation rates in China and the US to compute real exchange rates. The initial rates are normalized to 100. The dashed and solid lines in Panel B plot annual real effective exchange rate and surplus GDP ratio (%), respectively.

Panel B of Figure 1 plots the dynamics of trade surplus (as a share of GDP) vs. the REER. The trade surplus dynamics appears to be negatively correlated with that of the real exchange rate until the global financial crisis. In particular, the trade surplus grew strongly during the periods 1994-1997 and 2004-2008, during which time the REER appreciated. Instead, the trade surplus fell over the 1998-2004 period, when China's REER depreciated.[3] Although this time-series correlation cannot be given a causal interpretation, it is suggestive of the fact that changes in trade surplus do not coincide with the depreciation of the RMB, but rather the opposite, counter to the view that the currency undervaluation is a major cause of the trade surplus.

Since 1997, China has run large trade surpluses. This has given rise to an exceptional accumulation of foreign reserves, defined as foreign bonds and currency held by the Chinese central bank. Figure 2 shows the evolution of the foreign reserves-to-GDP ratio (solid blue line), the net international investment position relative to GDP (black dashed line), and the difference between deposit and loans in the domestic Chinese banks, also

[3]During the financial crisis this relationship appears to have been broken – after 2008 we have seen a fall in the trade suplus during a time of a minor appreciation. However, it is hardly surprising to see a lower trade surplus during the financial crisis since this period was characterized by a dramatic fall in global trade, combined with extraordinary fiscal stimulus by the Chinese government.

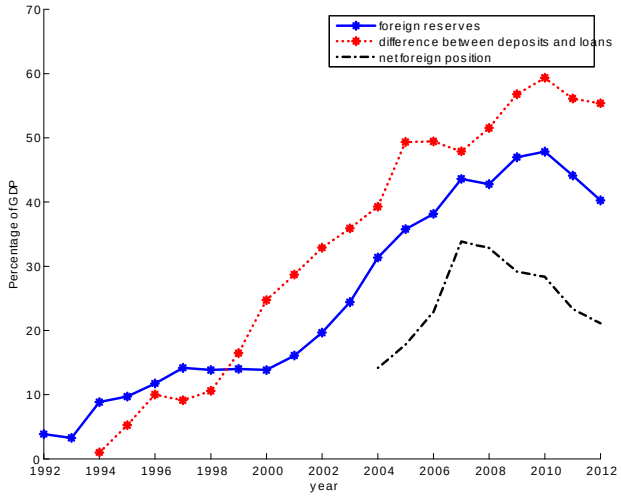

Figure 2: This figure plots foreign reserves (solid line), difference between bank deposits and loans (dotted line) and net foreign assets (dashed line), all in percentage of GDP.

measured as a percentage of GDP (dotted red line).[4] The key observation is that the accumulation of foreign reserves reflects a growing domestic savings gap.

2.2 Capital Controls

Capital flows to and from China are subject to pervasive controls. Indeed, while RMB has been fully convertible for current account transactions since 1996, the Chinese government has retained strong controls on the capital accounts. Controls are mainly exercised by restricting international portfolio investments, though there are also some restrictions on direct investment.[5] Consequently, portfolio investment flows in and out of China are rather small. This can be seen in Table 1 and 2. Table 1 reports China's annual inward and outward investment flows since 2005. The total inward portfolio investment, for instance, is merely 16 percent of the total inward direct investment. Table 2 compares China's direct and portfolio investment positions with those of the

[4]Figure 2 is an updated version of Figure 1 in SSZ, where the data end in 2007. Two observations are worth commenting. First, China's foreign reserves continue to grow, rising from 1.9 trillion USD in 2007 to 3.2 trillion USD by the end of 2011. Unlike the pattern before 2007 when foreign reserves tended to outgrow GDP, foregin reserves and GDP have almost the same growth rate, leaving the foreign reserves GDP ratio roughly unchanged (43 and 44 percent for 2007 and 2011, respectively). Second, foreign reserves and the difference between bank deposits and loans continue to move in tandem, attesting to a key prediction of SSZ that China's surplus is essentially driven by the declining demand for funds from financially integrated domestic firms.

[5]For instance, foreign direct investment in the service sector is more heavily regulated than in manufacturing. See Table 1 in Shu et al. (2008) for more detailed description on capital controls in China.

group of countries with the highest degree of capital account liberalization. Foreign direct investment into China (inward direct investments) as a share of China's GDP is 25 percent, which is not far from the average level in the countries with open capital accounts (i.e., 33 percent). However, Table 2 shows that the inward and outward portfolio positions and China's direct investments abroad (outward direct investments) are an order of magnitude smaller than their counterpart figures in countries with open capital accounts.

One way to assess how effective the capital controls are in practice, is to evaluate if there are deviations from covered interest rate parity (CIP henceforth). Namely, that the difference between the forward rate and the spot rate of two currencies is equal to the nominal interest rate difference. A deviation from this hypothesis implies that there are arbitrage opportunities, unless there are capital controls preventing such arbitraging. Naturally, CIP holds in economies with developed financial markets and open capital accounts. However, Cappiello and Ferrucci (2008) and Shu et al. (2008) find that in the case of China, there were significant deviations from CIP between 1999 and 2007. This suggests that capital controls have been effectively blocking portfolio flows. In summary, capital controls appear to be highly asymmetric in China, with limited barriers to direct investments but tight controls on portfolio investments.

Table 1: Inward and Outward Direct and Portfolio Investments (billion USD)

	Inward Investment		Outward Investment	
	Direct	Portfolio	Direct	Portfolio
2005	103	20	12	25
2006	143	44	26	148
2007	89	26	25	19
2008	212	21	70	-32
2009	399	22	60	-10
2010	255	34	71	14
2011	337	25	108	-53
2012	253	88	78	36

Source: State Administration of Foreign Exchange (www.safe.gov.cn).

Table 2: International Investment Positions (% of GDP)

	Direct		Portfolio	
	Assets	Liabilities	Assets	Liabilities
China 2010	5.3	25.1	4.4	3.8
Class-D Countries, averaged over 1995-2009	36.3	32.6	51.8	54.2

Source: He et al. (2012). Class-D countries refer to the countries with the highest degree of capital account liberalization.

A partial liberalization has taken place over the past decade. For instance, until 2002 foreign investors were prohibited to trade RMB-denominated financial assets in China. Since then, the Chinese Securities Regulatory Committee has allowed "qualified foreign institutional investors" (QFIIs) to buy Chinese stocks and bonds. By the end of 2012, 206 QFIIs have been approved, with an investment quota of 41 billion USD in total.[6] The number of QFIIs increased by more than half in 2012, jumping from 134 to 206, indicating an acceleration in the process of liberalizing capital controls. This can also be seen from Table 1, which shows that inward portfolio investment more than doubled between 2011 and 2012. Although non-bank Chinese residents and institutions are still prohibited from buying foreign securities directly, the restriction has been gradually lifted by allowing "qualified domestic institutional investors" (QDIIs) to invest in foreign capital markets since 2006. Despite an initial boom (Table 1 shows that outward portfolio investment saw a six-fold increase between 2005 and 2006), outward portfolio investments have remains small thereafter.[7]

China is currently considering removing the tight regulation of cross-border portfolio investments, i.e., opening its capital account. The People's Bank of China (PBOC), with the endorsement of China's State Council, is committed to achieve some limited capital account opening by 2015, and a complete liberalization by 2020. This would include the full convertibility of the RMB. The milestones of the process remain largely unknown. It is likely that the first measures will include further extensions of the existing "qualified investor programs". Aside from the details of its implementation, this reform has far reaching implications. First, it will enable China to improve the management of its immense wealth, currently invested mainly in foreign government bonds, by letting domestic investor hold portfolios of foreign assets. Second, foreign investors will be able to purchase equity and corporate bonds issued by Chinese companies. This may open new financing opportunities for Chinese real investors, freeing them from the yoke of the large state-owned Chinese banks.

2.3 Interest Rate Policies

The People's Bank of China (PBOC henceforth) has been China's central bank since 1983. According to Law of the People's Republic of China on PBOC enacted in 1995, "the aim of monetary policies is to maintain the stability of the value of currency and

[6]Data source: Chinese Securities Regulatory Committee (http://www.cbrc.gov.cn). See also http://www.reuters.com/article/2013/04/09/china-investment-qfii-idUSL3N0CI10A20130409

[7]See Yao and Wang (2012) for more details.

thereby promote economic growth" (Article 3). Although PBOC has never been explicit about its monetary policy framework, it is widely believed that the growth rates of reserve money, M2 and bank credit are PBOC's main targets (e.g., OECD, 2010). The main monetary policy instruments include retail interest rates regulation, reserve requirements adjustment and open market operations. Less transparent administrative forces such as "window guidance" on bank lending are also adopted.[8]

Retail interest rates are heavily regulated, though some of the restrictions have been relaxed since the late 1990s. The central bank imposes an upper bound on deposit rates and a lower bound on lending rates. The ceiling for the deposit rate used to be the benchmark rate itself. In 2012 this bound was relaxed to 10 percent above the benchmark rate. Similarly, the floor of lending rate is 10 percent below its benchmark rate, with an exception for the mortgage rate allowed to be 30% below the benchmark rate.[9] The ceiling on deposit rate appears to be binding. The actual average lending rates are above the floor (Porter and Xu, 2009), though the difference is not big.[10]

The tight regulation of interest rates on deposits and loans have stifled the competition in the banking industry since potential competitors were not allowed to compete in offering better conditions to borrowers and lenders. This has preserved the market power of the four major banks. Moreover, the capital controls and the financial restrictions make it is difficult for banks to obtain other sources of financing than bank deposits. The ceiling on deposit rates is therefore a key policy constraint that prevents private banks from acquiring larger market shares. The situation is currently changing, and the new Chinese government led by Li Keqiang views interest rate liberalization as a priority. In July 2013, the PBOC scrapped the floor on lending rates, allowing banks to compete in offering cheap loans to attract the best projects. Then, in August 2013, the PBOC announced the imminent liberalization of the interest rates on deposits.

Figure 3 plots the nominal and real one-year benchmark deposit rate (dashed lines) and lending rate (dotted lines) dictated by the government. We also include the three-month US T bill rate as a measure of the world interest rate (solid lines). The first

[8]Window guidance, a practice used by e.g. the Bank of Japan to control credit, refers to a policy through which the central bank can persuade financial institutions to follow its guidelines. In China, PBoC uses window guidance to adjust quantitatively new bank loans. The effectiveness of window guidance is primarily based on the fact that China's Communist Party controls personnel decisions on top leaders of all state-owned commercial banks. See Geiger (2006) for a more detailed description of window guidance in China.

[9]The average one-year loan rate from 1994 through 2012 is 7.0 percent. The average floor of the one-year loan rate is, thus, 70 base points below the average benchmark rate.

[10]For instance, the share of loans with lending rates more than 30% above benchmark rates is less than 20% in most periods (He and Wang, 2012).

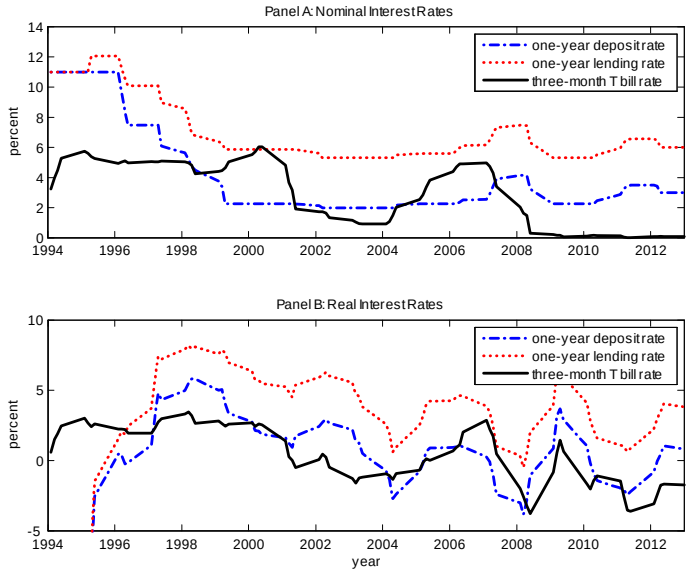

Figure 3: Panel A of this figure plots the one-year benchmark deposit rate (dashed line) and lending rate (dotted line), and the three-month T bill rate (solid line). Panel B plots the corresponding real interest rates, measured by the difference between nominal interest rate and inflation rate.

observation is that China's real deposit and lending rates move closely with the real world interest rate, with a correlation coefficient of 0.89 from 1998 through 2012. More importantly, the real deposit rate in China is on average slightly higher than its US counterpart in most periods since 1998. The average real deposit rate is 0.91% from 1998 through 2012, while the average US real interest rate is virtually equal to zero (-0.01%). The real interest rate gap has been widening recently, reaching an average of 1.88 percentage points in 2011 and 2012.[11]

In addition to regulating banks' interest rates, PBOC has been adjusting the reserve requirements. Until 2006, the Required Reserve ratio was essentially flat at 7 percent, and was gradually increased to 20 percent by 2012. The timing of the changes in the reserve requirement seems to coincide with the timing of the changes in the nominal deposit rate (Panel A of Figure 4).

As we pointed out in SSZ, China's bank deposits have, since 1994, been outgrowing bank loans. The aggregate deposits minus the aggregate bank lending has more or less tracked the growth in the central bank's foreign reserves (see Figure 2). The reserve

[11] This is in line with PBoC's claim that it has been implementing "prudent" monetary policies since 2009. See the lecture that Xiaochuan Zhou, the governor of PBoC, prepared for the Per Jacobsson Foundation. http://topics.caixin.com/zxc/

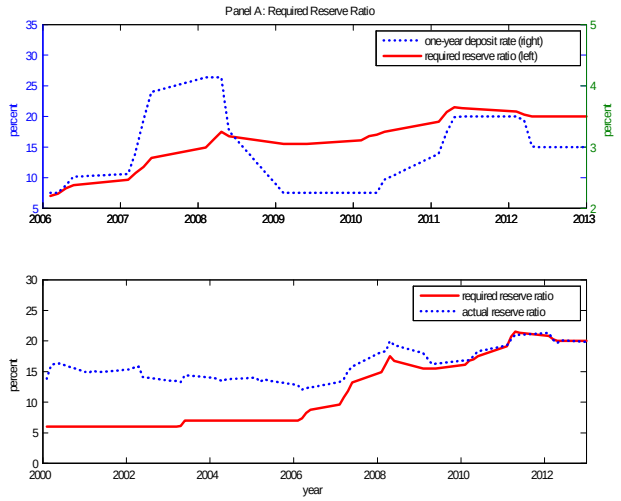

Figure 4: Panel A of this figure plots the required reserve ratio for large financial institutions (solid line and left axis) and one-year deposit rate (dotted line and right axis). The solid and dotted lines in Panel B plot the required reserves ratios for large financial institutions and actual reserve ratios of all financial institutions, respectively.

requirement might have been binding for some individual banks during this period. However, the actual reserves kept by banks have, on average, been substantially larger than the required reserve ratio (Panel B of Figure 4). However, by the end of 2007, the required reserve ratio seems to have caught up with the actual reserves held by banks. For example, in 2008 the average reserves were just 2.6 percentage points above the required reserve ratio.[12]

Sterilization through open market operations has been an important component of China's monetary policy. As both the current account and the capital account have had large surpluses, the PBOC has purchased substantial amounts of foreign currencies while pegging to the dollar, running up the foreign reserves. Starting from 2003,the PBOC has also been issuing substantial amounts of central bank bills (CBB). The motivation has been "sterilization", the idea being that when banks and households invest in bonds with long duration, this tends to reduce the holdings of more liquid assets and, hence to reduce M2.[13] Figure 5 shows that the magnitude of the issuance of CBB between 2004

[12]PBoC started to require different reserve ratios for large and small- to median-sized financial institutions in October 2008. We cannot disentangle actual reserve ratios for the two sets of financial institutions.

[13]This policy is, in some sense, the opposite of the policies of "quantitative easing" and "operation twist" that the U.S. Federal Reserve has been pursuing over the last years. The Federal Reserve's stated motivation for this policy has been twofold. First, by purchasing long bonds from the public, the public is forced to hold assets with shorter duration, and this has an expansionary effect. Second, by reducing

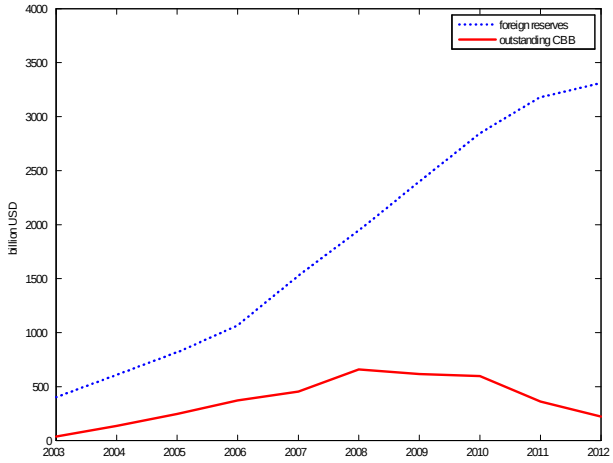

Figure 5: This figure plots foreign reserves (dotted line) and outstanding central bank bills (solid line).

and 2008 is about 40 percent of the increase in foreign reserves during the period. As a result, reserve money grew in tandem with M2 and nominal GDP, at an annual rate slightly below 20 percent.[14]

PBOC started to reduce CBB after 2008. One reason for the scaling back of this policy might be that PBOC decided to rely more on reserve requirements and tightened the requirements in 2007. Once these requirements started to bind for most banks, the PBOC could pursue a contractive policy by continuing to increase the reserve requirements, without the need to purchase CBB. An alternative theory for why PBOC reduced the issuance of CBB could be that this policy was not very effective. For example, some recent work (He and Wang, 2012) suggests that the interest rates in the interbank money market respond sensitively to deposit rate and required reserve ratio, while their responses to open market operations are less dramatic. Although the retail interest rates have been heavily regulated, the wholesale interest rates in the interbank money market are determined by market clearing.

2.4 Summarizing the facts

We now summarize the main facts for exchange rate policy, monetary policies, capital controls, and trade surpluses. In the subsequent section we will lay out a theory that

the supply of bonds with long duration, the long interest rateswill fall, which in turn will stimulate firms' borrowing.

[14]The annualized growth for reserve money, M2 and nominal GDP from 2003 through 2008 is 19.6, 18.3 and 16.5 percent, respectively. Data: www.pbc.gov.cn.

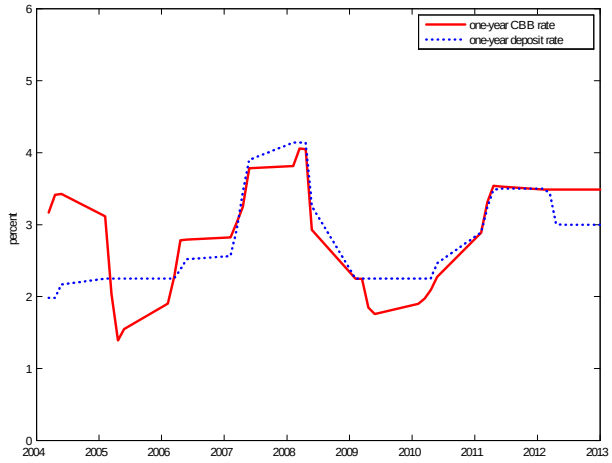

Figure 6: This figure plots the one-year central bank bill interest rate (solid line) and the one-year deposit rate (dotted line).

will allow us to analyze the effects of these policies and the interaction between them.

1. The trade surpluses of China have been growing when China's real exchange rate has been appreciating, and the trade surpluses have been falling when the exchange rate has depreciated. Consequently, trade surpluses have been large when the Chinese currency has been strong and small when the currency has been weak, except, perhaps, during the financial crisis when trade surpluses have fallen.

2. China has pervasive capital controls on portfolio investment: Chinese households are prevented from holding foreign assets and foreigners are prevented from purchasing Chinese assets. There are less controls on direct investments.

3. China has regulated the interest rates offered by banks, imposing a floor on lending rates and a ceiling on deposit rates. This has stifled competition in the banking industry. The government has recently liberalized these policies.

4. Bank of China has been keeping the domestic real interest rates above the US interest rates most of the time since 1997.

3 The Benchmark Model

In this section, we develop a theory of economic transition in China. The purpose is to study the implications for welfare and economic outcomes of the policies discussed in the

previous sections. The model extends the framework of SSZ to a setting with multiple goods and an explicit role for government policy.

3.1 Preferences, Technology and Markets

Preferences and Population: 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. Agents consume two goods, a domestically produced good (c) and a foreign produced good (c^*).

Preferences are parameterized by the following time-separable utility function:

$$\begin{aligned} U_t &= \frac{1}{1-1/\gamma}\left(\left(c_{1,t}\right)^{\frac{\varepsilon-1}{\varepsilon}}+\left(c^*_{1,t}\right)^{\frac{\varepsilon-1}{\varepsilon}}\right)^{\frac{\varepsilon}{\varepsilon-1}(1-1/\gamma)} \\ &\quad +\beta\frac{1}{1-1/\gamma}\left(\left(c_{2,t+1}\right)^{\frac{\varepsilon-1}{\varepsilon}}+\left(c^*_{2,t+1}\right)^{\frac{\varepsilon-1}{\varepsilon}}\right)^{\frac{\varepsilon}{\varepsilon-1}(1-1/\gamma)} \end{aligned} \tag{1}$$

where β is the discount factor, γ is the intertemporal elasticity of substitution (IES) of consumption, and ε is the (Armington) elasticity of substitution between home and foreign good. We assume that $\gamma \geq 1$, implying that agents' savings are non-decreasing in the rate of return.

Agents have heterogeneous skills. Each cohort consists of a measure one of agents with no entrepreneurial skills (*workers*), and a measure μ of agents with entrepreneurial skills (*entrepreneurs*).

Technology: There are two types of firms, both requiring capital and labor. *Financially integrated* (F) firms operate as standard neoclassical firms. *Entrepreneurial* (E) firms are owned by old entrepreneurs who are residual claimants on the profits and hire young skilled workers as managers. The key assumptions are that E firms are more productive than F firms but, due to asymmetric financial imperfections, they are barred from borrowing from banks. This is an extreme version of the more general model in SSZ where entrepreneurs can borrow up to an endogenous limit.[15] There, we also provide a microfounded explanation based on Acemoglu *et al.* (2007) that rationalizes this form of asymmetric credit constraints and productivity differences across firms.

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

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

[15] In section 5 we relax this assumption by allowing new banks to lend to entrepreneurs up to some limit.

where y is domestic output and k and n denote capital and labor, respectively. Capital depreciates fully after one period. The technology parameter A grows at an exogenous rate z; $A_{t+1} = (1+z)\,A_t$.

"Exchange rate policy": The model economy is part of a world comprising a continuum of small open economies with identical preferences, half of them producing the "domestic" good y and the other half producing the "foreign" good y^*. Since all countries are small, none can affect, individually, the world price. The world market relative price of home vs. foreign good is assumed to be unity. Although the government of our model economy cannot affect world prices, it can distort the price at which the two goods are traded domestically. The distortion is implemented by a market access restriction for foreign exporters. More precisely, we denote by e the government-set relative price ("exchange rate") at which traders can exchange domestic goods for foreign goods. We focus on $e \geq 1$ capturing the notion of an "undervalued" exchange rate, which is the case debated in the Chinese case. $e > 1$ implies that the government makes foreign goods artificially more expensive than in the laissez-faire equilibrium. Since the relative price of foreign goods exceeds the international price, the local good market does not clear. In particular, foreign producers strictly prefer to sell their good in our domestic economy than in the international market. To enforce its policy, the government must then impose some rationing and require that foreign traders must hold licences specifying the quantity each of them can trade with domestic producers.[16] We view these market access restrictions as a modeling expedient to capture the notion that the government exercises monopoly power in the foreign currency market.[17]

"Capital controls": There are four assets in the economy: domestic deposits (i.e., claims to next-period domestic goods issued by domestic banks), domestic government

[16] In principle, the government could cash-in rents by auctioning licences to foreign producers. We assume that the government foregoes this opportunity and issues licenses for free.

[17] If the model were extended to allow a search friction in the market for goods, it would be possible to provide an alternative microfoundation for the assumption that the government can distort the relative price of home goods and foreign goods, without rents being present and having the government impose rations and forego rents.

To see this, assume, following Bai, Ríos-Rull and Storesletten (2013), that producers can post prices for their goods and that consumers can search is several markets. They direct their search effort to the markets that yield the highest expected utility – they prefer low prices and a low search effort to find the goods. Assume that the government forces foreign producers to post their goods at a price e relative to the price posted by domestic producers. The Chinese market therefore becomes profitable for foreign producers and many of them pay an entry cost to compete in China. This makes the market tightness – foreign goods available for sale per domestic consumer – very high and, hence, the probability of achieving a sale very low. In equilibrium, both domestic and foreign producers break even and foreign goods are traded at a relative price e. The inefficiency induced by the distorted price is that consumers search too little for the foreign goods.

bonds (i.e., claims to next-period domestic goods issued by the government), foreign bonds (i.e., claims to next-period foreign goods issued by foreign agents), and domestic corporate loans (i.e., claims to next-period domestic goods issued by domestic firms). We assume that the government imposes capital controls: domestic agents (with the exception of the government itself) can only hold domestic assets and foreigners cannot hold any domestic assets. The government sets the interest rate on domestic government bonds, and issues domestic bonds so as to meet the demand at such a rate. We refer to this policy as a IRP. The government has access to lump-sum taxes and transfers to cover possible gains or losses on ERP and IRP. The government period budget constraint is

$$b_{t+1} + e_t b^f_{t+1} = R_t b_t + e_t R_w b^f_t - \tau_t,$$

where τ_t denotes the lump sum tax levied on the young workers and R_t and R_w denote, respectively, the rate of return on domestic and foreign bonds. The left-hand side is the total government debt expressed as the sum of debt in domestic (b) and foreign (b^f) goods. Negative debt means a positive asset position. We assume that the government honours its debt and that it cannot run a Ponzi scheme. Note that the government itself abides by the market restriction policy: namely, the government does not convert foreign goods or assets into domestic goods at the international price, but does so at the exchange rate e.

Savings: Young workers earn a wage w_t and deposit their savings s_{t+1} with domestic banks paying a gross interest rate R^d_{t+1}. They choose savings so as to maximize utility, (1), subject to the two budget constraints,

$$s_{t+1} + c_{1t} + e_t c^*_{1t} = w_t - \tau_t \quad (2)$$

$$c_{2,t+1} + e_{t+1} c^*_{2,t+1} = R^d_{t+1} s_{t+1}. \quad (3)$$

We assume that household can only hold deposits in their portfolio.

Young skilled agents employed as managers in E firms earn a compensation, m_t. Their savings can be invested either in domestic bank deposits or in physical capital (that becomes productive in the following period) installed in their own business. For simplicity, we assume that young managers neither pay taxes nor receive subsidies.

Banks: Banks collect deposits from workers and invest in corporate loans and government bonds. Issuing loans to firms is subject to two sets of frictions:

1. The issuance of loans to firms is subject to an *intermediation cost*, capturing operational costs, red tape, etc. We model this as an iceberg cost ξ per period.

2. Entrepreneurs are constrained in their ability to obtain bank loans. In SSZ we assume that the output of E firms is non-verifiable, and that entrepreneurs can only pledge to repay a share η of the second-period net profits. In most of the analysis in this paper we make the simplifying assumptions that entrepreneurs cannot raise any external financing at all ($\eta = 0$). This is relaxed in Section 5.

An arbitrage condition implies that the rate of return on government bonds equals the lending rate to firms net of the intermediation cost. More formally, $R^l = \frac{R}{1-\xi}$, where R^l is the interest rate on loans. Moreover, in a competitive equilibrium, the rate of return on banks' assets must equal the deposit rate, $R^d = R$.[18]

Since banks are pure intermediaries with no equity, their balance sheet yields:

$$b_{t+1} + K^F_{t+1} = s_{t+1}.$$

The left hand side are the net bank assets: government bonds and loans to F firms. The right hand side are the liabilities, i.e., deposits. Note that the corporate loans issued at t are equivalent to the aggregate investments in F firms, which in turn equal K^F_{t+1}, due to the assumption of full capital depreciation.

F firms: Profit maximization implies that R^l_t equals the marginal product of capital in F firms. Let $\kappa_F \equiv K_F / (AN_F)$ denote capital per effective unit of labor. Then,

$$\kappa_{Ft} = \left((1-\xi) \frac{\alpha}{R_t} \right)^{\frac{1}{1-\alpha}}. \tag{4}$$

The wage, then, equals the value of the marginal product of labor:

$$w_t = (1-\alpha) (\kappa_{Ft})^{\alpha} A_t. \tag{5}$$

Note that the wage is expressed in units of local goods. Since households consume a basket of domestic and foreign goods, an exchange rate depreciation does not affect w but still reduces the real wage in terms of the composite consumption good.

E firms: Following SSZ, we assume that E firms must hire a manager and pay him a compensation $m \geq \psi y$ in order to satisfy an incentive-compatibility constraints.[19] The incentive constraint is important, since in its absence managers would be paid the

[18] In section 5, we consider the case in which the interest rate on deposits, R^d, is set by government regulation with the assumption that $R^d \leq R$.

[19] The managerial compensation must also exceed the workers' wage rate ($m_t > w_t$). We restrict attention to parameters and initial conditions such that the participation constraint is never binding in equilibrium.

workers' wage, and the equilibrium would feature no capital accumulation in E firms and no transition from SOE to DPE. A more detailed motivation of the incentive constraint is contained in SSZ.

The value of a firm owned by an old entrepreneur with capital k_{Et} is given by the solution to the following problem:

$$\Xi_t(k_{Et}) = \max_{m_t, n_{Et}} \left\{ (k_{Et})^{\alpha} (\chi A_t n_{Et})^{1-\alpha} - m_t - w_t n_{Et} \right\}. \tag{6}$$

The problem is subject to the incentive-compatibility constraint discussed above. This is binding in equilibrium:

$$m_t = \psi (k_{Et})^{\alpha} (\chi A_t n_{Et})^{1-\alpha}. \tag{7}$$

Moreover, an arbitrage condition in the labor market implies that the wage, w_t, is as in (5). The optimal contract implies that the incentive constraint is binding:

Taking the first-order condition with respect to n_E and substituting in the equilibrium wage yields the employment choice of the firm:

$$n_{Et} = ((1-\psi)\chi)^{\frac{1}{\alpha}} \left((1-\xi) \frac{\alpha}{R_t} \right)^{-\frac{1}{1-\alpha}} \frac{k_{Et}}{\chi A_t}. \tag{8}$$

The capital per effective unit of labor in E firms, denoted $\kappa_{E,t}$, is then given by

$$\kappa_{E,t} \equiv \frac{K_{E,t}}{A_t N_{E,t}} = \kappa_{F,t} \cdot ((1-\psi)\chi)^{-\frac{1}{\alpha}} \tag{9}$$

Plugging (7) and (8) into (6) yields the value of the firm:

$$\Xi_t(k_{Et}) = (1-\psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} \frac{R_t}{1-\xi} k_{Et} \equiv \rho_t k_{Et}, \tag{10}$$

where ρ is the rate of return to capital in E firms. In order to ensure that $\rho_t > \frac{R_t}{1-\xi}$, so that entrepreneurs are credit constrained (i.e., if they were allowed to borrow at the going rate, they would like to do so) we make the following assumption.

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

3.2 Savings and investments decisions

In this section, we analyze the savings decisions of workers and entrepreneurs.

3.2.1 Workers

Workers maximize utility, (1), subject to a lifetime budget constraint,

$$w_t - \tau_t = c_{1,t} + e_t c^*_{1,t} + \frac{c_{2,t+1} + e_{t+1} c^*_{2,t+1}}{R^d_{t+1}}. \tag{11}$$

The First Order Conditions of this problem yield:

$$\begin{aligned} c_{1,t} &= \lambda_t^{-\gamma} \left(1 + e_t^{1-\varepsilon}\right)^{\frac{\gamma-\varepsilon}{\varepsilon-1}}, \\ c_{2,t+1} &= \left(\frac{\lambda_t}{\beta R^d_{t+1}}\right)^{-\gamma} \left(1 + e_{t+1}^{1-\varepsilon}\right)^{\frac{\gamma-\varepsilon}{\varepsilon-1}}, \\ c^*_{1,t} &= c_{1,t} \cdot e_t^{-\varepsilon}, \\ c^*_{2,t+1} &= c_{2,t+1} e_{t+1}^{-\varepsilon} \end{aligned}$$

where λ_t is a Lagrangian multiplier. Hence, the Euler equation for the consumption of the domestic good yields,

$$\frac{c_{2,t+1}}{c_{1,t}} = \left(\beta R^d_{t+1}\right)^{\gamma} \left(\frac{1 + e_{t+1}^{1-\varepsilon}}{1 + e_t^{1-\varepsilon}}\right)^{\frac{\gamma-\varepsilon}{\varepsilon-1}}$$

Note that the Euler equation depends on the time evolution of the exchange rate. In particular, if $e_{t+1} = e_t$, the level of e does not matter. Consider, next, a declining sequence of e: $e_t > e_{t+1}$. To fix ideas, suppose $\beta R^d_{t+1} = 1$. In this case, the consumption growth of the domestic good is positive (negative) if $\gamma > \varepsilon$ ($\gamma < \varepsilon$). The reason for the ambiguity in consumption growth is that, on the one hand, the consumption basket is overall more expensive in period t than in period t+1. Thus, the IES of consumption calls for a positive consumption growth in both the domestic and the foreign good. On the other hand, in period t the foreign good has a higher relative price than in period t+1. This calls for a negative consumption growth of the domestic good (i.e., in period t, the consumer substitutes the expensive foreign good with the cheaper domestic good). Which of the two forces dominates depends on the comparison between ε (the Armington elasticity) and γ (the IES of consumption).

Substituting in the expressions above into the budget constraints, (11), yields the expression of the consumption of the domestic good in period t for the young:

$$c_{1,t} = \frac{w_t - \tau_t}{\left(1 + \beta^{\gamma} \left(R^d_{t+1}\right)^{\gamma-1} \left(\frac{1+e_{t+1}^{1-\varepsilon}}{1+e_t^{1-\varepsilon}}\right)^{\frac{\gamma-1}{\varepsilon-1}}\right)\left(1 + e_t^{1-\varepsilon}\right)}$$

The private savings of the workers are, then, given by

$$\begin{aligned} s_{t+1} &= w_t - \tau_t - c_{1,t} - e_t c^*_{1,t} \\ &= \left(1 - \frac{1}{1 + \beta^\gamma \left(R^d_{t+1}\right)^{\gamma-1} \left(\frac{1+e_{t+1}^{1-\varepsilon}}{1+e_t^{1-\varepsilon}}\right)^{\frac{\gamma-1}{\varepsilon-1}}} \right) (w_t - \tau_t). \end{aligned}$$

As long as $\gamma \geq 1$, the savings of the young workers at t increase in R^d_{t+1} and in e_{t+1}/e_t. However, if $e_{t+1} = e_t$, then savings do not depend on the exchange rate.

3.2.2 Entrepreneurs

The entrepreneurs' saving decision is similar. However, the entrepreneurs earn a managerial compensation (m_t) instead of a wage net of taxes ($w_t - \tau_t$), and have access to an asset that yields a higher return ($\rho_t = (1-\psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} \frac{R_t}{1-\xi} > R^d_t$), since they can invest in their own business. Thus, their lifetime budget constraint can be expressed as:

$$m_t = \hat{c}_{1,t} + e_t \hat{c}^*_{1,t} + \frac{\hat{c}_{2,t+1} + e_{t+1}\hat{c}^*_{2,t+1}}{\rho_{t+1}}, \tag{12}$$

where hats refer to entrepreneurial variables. Operating as above, the optimal first-period consumption yields:

$$\hat{c}_{1,t} = \frac{m_t}{\left(\beta^\gamma \rho_{t+1}^{\gamma-1} \left(\frac{1+e_{t+1}^{1-\varepsilon}}{1+e_t^{1-\varepsilon}}\right)^{\frac{\gamma-1}{\varepsilon-1}} + 1\right)\left(1 + e_t^{1-\varepsilon}\right)},$$

and the aggregate entrepreneurial savings are given by:

$$\begin{aligned} \hat{s}_{t+1} &= \left(m_t - \hat{c}_{1,t} - e_t \hat{c}^*_{1,t}\right)\mu \\ &= \left(1 - \frac{1}{1 + \beta^\gamma \rho_{t+1}^{\gamma-1} \left(\frac{1+e_{t+1}^{1-\varepsilon}}{1+e_t^{1-\varepsilon}}\right)^{\frac{\gamma-1}{\varepsilon-1}}} \right) \mu m_t. \end{aligned}$$

Note that $\hat{s}_{t+1}$ is increasing in R_{t+1} (since ρ_{t+1} is increasing in R_{t+1}), and in e_{t+1}/e_t.

3.2.3 Foreign position

Let ω_t denote the net position of the government at t expressed in units of domestic good. In particular, ω_t is the difference between the purchase of foreign bonds ($-e_t b^f_{t+1}$), entitling the government to foreign goods at $t+1$, and the issuance of domestic debt

$(-b_{t+1})$, committing the government to deliver domestic goods at $t+1$. More formally, $\omega_t = -\left(e_t b^f_{t+1} + b_{t+1}\right)$. Hence,[20]

$$\omega_t = -R_t b_t - e_t R_w b^f_t + \tau_t. \tag{13}$$

Since we assumed that all bonds have a one-period maturity, and that the government neither consumes nor invests, the period budget constraint implies that the government net position must equal the difference between the tax revenue at t and the interest payments on domestic and foreign bonds.

Alternatively, the government's foreign position can be decomposed as follows:

$$\underbrace{-e_t b^f_{t+1}}_{\text{trade surplus}} = \underbrace{(s_{t+1} - K_{F,t+1})}_{\text{saving gap households \& firms}} + \underbrace{\underbrace{R_w\left(-e_t b^f_t - b_t\right)}_{\text{interests on net govt. wealth}} - \underbrace{(R_t - R_w)\, b_t}_{\text{IRP losses}} + \underbrace{\tau_t}_{\text{taxes}}}_{\text{net government savings}}.$$

In words, the trade surplus is the sum of the saving gap of the private sector (households' savings minus domestic firms' investments) plus the net government savings (recall that, for simplicity, we have assumed that there are no government investments). The latter can be decomposed into the time t tax revenue, the return on government wealth evaluated at the world interest rate, and the losses associated with the IRP. In particular, assuming $b_t > 0$, there are losses (gains) whenever the government sets the interest rate on government debt higher (lower) than the world interest rate.

If the government engages in no active ERP or IRP, then, $e_{t+1} = e_t = 1$, $R_t = R_w$, and $\tau_t = 0$. Moreover, $b^f_t = b_t$ since the government would simply enforce the legal obligation that private domestic agents cannot hold foreign assets, by exchanging one-to-one foreign assets for government bonds. The equation above then simplifies to

$$-b^f_{t+1} = s_{t+1} - K_{F,t+1},$$

which is the case studied by SSZ. As emphasized there, s increases over time due to the productivity growth, whereas K_F falls due to the declining employment and investments in the F sector during the transition.

[20] In the case in which the government imposes a deposit rate $R^d < R$ banks make profits that are transferred to the government. These profits should be added to the right on side of equation (13) and of the ensuing expressions below.

3.3 Post-transition convergence.

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

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

This law of motion converges to a unique steady state. Along the convergence path, there is capital deepening over time. Consequently, wage growth increases after the transition is completed. Thereafter, wages, output increase towards a steady state. In the post-transition economy all investments are self-financed by the managers/entrepreneurs of the E firms, while the workers' savings feed a large trade surplus. We recall that this extreme form of financial constraint is maintained for simplicity here. In SSZ we assume that even E firm have a partial access to external financing, i.e., banks finance part of the investment process even in the post-transition economy.

Figure 7 shows a simulated transition path for the E firm employment share, wages per effective unit of labor (w_t/A_t), total output and trade surplus under the assumption of laissez-faire policies. Namely, the government sets in all periods the interest rate equal to the world interest rate and the exchange rate equal to one.

4 Exchange Rate and Interest Rate Policy

In this section we consider the effects of specific ERP and IRP. Consider an economy that starts in period zero. From period one and onwards the economy is as described above (we label this as the *transition period* to emphasize the takeover of the E sector and the decline of the F sector). In period zero, (i.e., the *pre-reform period*) the economy has a simpler structure: Agents are endowed with some income earned in pre-reform activities. There is no pre-installed capital, and firms can invest in capital that becomes productive in period one. A measure μ of young agents have entrepreneurial skills, and contemplate becoming entrepreneurs in period one. Their endowment is denoted by m_0. The other young agents have no entrepreneurial skills and just consume and save for retirement out of their endowment, w_0. Old agents have an endowment w_0^{OLD} that is entirely consumed. The government has neither assets nor liabilities, and taxes are zero.

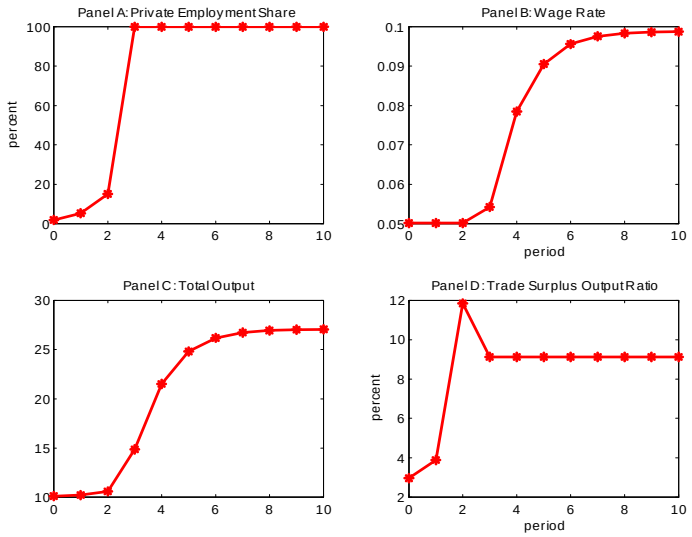

Figure 7: This figure plots the dynamics of E-firm employment share (Panel A), wage rate (Panel B), total output (Panel C) and surplus output ratio (Panel D).

The government announces a sequence of policies, $\{e_t, R_{t+1}, \tau_{t+1}\}_{t=0}^{\infty}$ subject to an intertemporal budget constraint. Note that, since agents only live for two periods, the results would be equivalent if policies were announced, sequentially, one period in advance. We consider a class of fiscal policies such that the net government position is constant in the long run. Moreover, we assume that the government pursues a laissez-faire policy from period $t = 1$ and onwards: for $t \geq 1$, $e_t = 1$, $R_{t+1} = R_w$, and τ_t is constant at the level that balances the long run government budget. The focus of our analysis is then on the ERP and IRP set in period zero. The assumption that the activist policy ($e_0 \neq 1$ and $R_1 \neq R_w$) only lasts for one period is for simplicity. It is straightforward, but more cumbersome to extend the activist policy beyond period zero.[21]

Consider the intertemporal budget constraint of the government. Since the tax (or subsidy) is assumed to keep government wealth constant from period one and onwards ($\omega_t = \tilde{\omega}$), then, for all $t \geq 1$ we have

$$\tau_t = \tau = -\left(R_w - 1\right)\tilde{\omega},$$

[21] The ERP is related to the analysis of Bacchetta *et al.* (2014). Based on a different model, they consider an economy with capital controls and derive the optimal exchange rate policy. They find that it is optimal to have an initial real depreciation of the currency followed by an appreciation in the long run. In our paper, we do not attempt to characterize the optimal policy, but focus on the trade off in welfare across different social groups (workers vs. entrepreneurs) and cohorts.

where, recall, $\omega_t = -\left(e_t b_{t+1}^f + b_{t+1}\right)$.

Consider the initial period, when, recall $b_0 = b_0^f = \tau_0 = 0$. Thus, the period budget constraint yields:

$$\begin{aligned} b_1 + e_0 b_1^f &= 0 \\ &\Rightarrow \quad b_1^f = -\frac{b_1}{e_0}, \end{aligned}$$

where b_1 is determined by the domestic saving gap. Next, consider the period budget constraint in period one, imposing that $e_1 = 1$, and $\tau_1 = \tau$:

$$\begin{aligned} b_2 + b_2^f &= R_1 b_1 + R_w b_1^f - \tau \\ &\Rightarrow \quad b_2^f = \left(\frac{R_1}{R_w} - \frac{1}{e_0}\right) b_1 - b_2, \end{aligned}$$

where we have used the facts that $\tau = (R_w - 1)\left(b_2 + b_2^f\right)$, $\tilde{\omega} = -\left(e_1 b_2^f + b_2\right)$, and $b_1^f = -\frac{b_1}{e_0}$. Note, again, that b_2 is determined by the domestic saving gap. The same holds true for the following periods, thus, for $t \geq 2$ we have:

$$b_t^f = \left(\frac{R_1}{R_w} - \frac{1}{e_0}\right) b_1 - b_t$$

Note that the government net position *vis-a-vis* the rest of the world equals to $\tilde{\omega} + b_t$, where $-\tilde{\omega} = \left(\frac{R_1}{R_w} - \frac{1}{e_0}\right) b_1$ is the loss incurred to run the ERP and IRP in the first period, and b_t is the saving gap of the country. Recall that by assumption the government wealth does not grow after period two. Alternatively, we could have assumed that $\tau_t = 0$ for some periods, in which case the government net position would change over time.

Next, we move to calculate b_1. This is determined by the domestic saving gap:

$$\begin{aligned} b_1 &= s_1 N_0 - K_{F,1} \\ &= w_0 N_0 \left(1 - \frac{1}{1 + \beta^\gamma R_1^{\gamma-1} \left(\frac{2}{1+e_0^{1-\varepsilon}}\right)^{\frac{\gamma-1}{\varepsilon-1}}}\right) - K_{F,1}. \end{aligned}$$

Finally, we must determine domestic investments, $K_{F,1}$ and $K_{E,1}$. Consider, first, the E sector, where investments are determined by the entrepreneurs' savings:

$$K_{E,1} = \hat{s}_1 = M_0 \left(1 - \frac{1}{1 + \beta^\gamma \rho_1^{\gamma-1} \left(\frac{2}{1+e_0^{1-\varepsilon}}\right)^{\frac{\gamma-1}{\varepsilon-1}}}\right)$$

where

$$\rho_1 = (1-\psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} \frac{R_1}{1-\xi}.$$

Since $\gamma > 1$, $K_{E,1}$ is increasing in ρ_1, which is in turn increasing in R_1. Thus, $K_{E,1}$ is increasing in R_1. Moreover, $K_{E,1}$ is increasing in e_0.

Next, consider the F sector. Following SSZ yields:

$$\begin{aligned} K_{F,1} &= \kappa_{F,1} A_1 \left(N_1 - N_{E,1}\right) \\ &= A_1 \left(\frac{R_1}{(1-\xi)\,\alpha}\right)^{-\frac{1}{1-\alpha}} N_1 - (1-\psi)^{\frac{1}{\alpha}} \chi^{\frac{1-\alpha}{\alpha}} \underbrace{\left(1 - \frac{1}{1+\beta^{\gamma}\rho_1^{\gamma-1}\left(\frac{2}{1+e_0^{1-\varepsilon}}\right)^{\frac{\gamma-1}{\varepsilon-1}}}\right)}_{K_{E1}} \mu m_0 \end{aligned}$$

The equality stems from the definition of κ_F and the fact that employment in the F sector is the residual that clears the labor market after the E firms have decided their employment. It uses the equilibrium expressions of $\kappa_{F,1}$ given in (4), that of ρ_1 given in (10), and the fact that, from (9), $N_{E,1} = \rho_1 \frac{\kappa_{F,1}^{-\alpha}}{\alpha} \frac{K_{E,1}}{A_1}$. Note that:

1. $K_{F,1}$ is decreasing in R_1 via two channels: first, because an increase in the interest rate decreases $\kappa_{F,1}$, and second because it increases the investment rate of entrepreneurs (assuming that $\gamma > 1$), thereby reducing $N_{F,1}$;

2. $K_{F,1}$ is decreasing in e_0 because a temporarily undervalued exchange rate increases the savings of entrepreneurs (assuming that $\gamma > 1$), thereby speeding up the transition.

4.1 Calibration

In this section, we calibrate the model in order to construct a benchmark for the quantitative analysis in the following sections. The usual *caveat* applies to quantitative predictions derived from two-period models.[22] Nevertheless, a numerical based on realistic parameters is interesting both to illustrate the properties of the model and to give a sense of how the model predictions hinge on the different parameters.

Our calibration follows Song *et al.* (2014). On the technology side, we set $\alpha = 0.5$ so that the capital share of output is 0.5 (Bai *et al.*, 2006) in the initial stage of the

[22]The two-period model can be generalized to a multi-period OLG model as in Song *et al.* (2011) and Song *et al.* (2014), where one period is one year. Such an extension is beyond the scope of this paper.

transition. The remaining parameters are calibrated so as to match some empirical moments (see Song *et al.* 2014 for a more detailed discussion). In particular, ψ and χ are chose to be such that the model is consistent with the capital-output ratio in E firms being equal to half of the corresponding ratio in F firms for manufacturing industries, and the rate of return on capital is 9% larger in E firms than in F firms.[23] The implied parameter values are $\psi = 0.27$ and $\chi = 2.73$. With this parameter the TFP of an E firm is 1.65 times larger than the TFP of an F firm, in line with the estimates of Hsieh and Klenow (2009). On the demand side, β is calibrated to 0.97^{30} so as to generate a 25% household saving rate (in the absence of activist policies), which matches the average urban household saving rate in 2000-2010. This gives also a plausible annual trade surplus equal to 3% of GDP in the initial period, which is slightly below the average of 4% in 2000-2012 (note that in some policy experiments the initial trade surplus will be higher than this). Finally, we set the IES to $\gamma = 2$, also in accordance with Song *et al.* (2014). The assumption that $\gamma \geq 1$ is consistent with the prediction that agents increase their life-cycle savings when they face a higher rate of return on wealth. Setting $\gamma = 2$ is in line with the recent empirical study of Gruber (2013), based on cross-sectional heterogeneity in the after-tax interest rate.[24]

Finally, we must calibrate the Armington elasticity, ε, a parameter that has no counterpart in our earlier studies. We set $\varepsilon = 2$, consistent with the recent studies of Feenstra *et al.* (2014). Previous estimates range between a lower bound of unity, based on macro data (e.g., Heathcote and Perri 2002) and much higher values in micro studies (e.g., Broda and Weinstein 2006, and Romalis 2007). Based on these studies, Acemoglu *et al.* (2012) calibrate (a version of) the Armington elasticity to 3.3.

We assume an annualized world interest rate of 2.5%, i.e., $R_w = (1.025)^{30}$. In times of no activist policies, the interest rate on government bonds is set equal to 3.5%, i.e., $R = (1.035)^{30}$ – recall that R pins down both the deposit rate and the lending rate to

[23] Song et al. (2011) document that manufacturing, domestic private enterprises (DPE) have on average a ratio of profits per unit of book-value capital 9% larger than that of SOEs during the period 1998-2007. A similar difference in rate of return on capital is reported by Islam, Dai, and Sakamoto (2006).

[24] There is no consensus in the literature on the magnitude of the IES of consumption. Earlier studies based on macro data estimate the IES to be significantly smaller than unity (Campbell and Mankiw 1989, Hall 1988). Cooley and Presott (1995) argue for an IES of unity. However, recent studies estimate the IES to be larger than unity (see Attanasio and Vissing-Jørgensen 2003; Gruber 2013; Mulligan 2002). Based on these studies, Angeletos (2007) argues for calibrating the IES of consumption above unity even in high-frequency dynastic models. In our two-period model, one period is 30 years. It seems plausible that high-frequency fluctuations in consumption be more painful to a household than low-frequence fluctuations because people can adapt their habits when changes occur more gradually.

SOEs. We set the iceberg cost $\xi = 0.58$ which implies an annualized 5.5% return to capital in SOE.[25] Again, in times of no activist policies we set $e_t = 1$.

We consider the following activist policies:

1. Interest rate policy: we set a higher initial interest rate on government bonds, $R_1 = 1.035^{30}$). As robustness, we consider alternative policies where $R_1 = 1.03^{30}$ and $R_1 = 1.045^{30}$, respectively.

2. Exchange rate policy: we consider a one-period undervaluation of 27% (so, $e_0 = 1.27$ and $e_t = 1$ for $t > 0$), in the ball park of estimates from studies advocating the thesis that the exchange rate of the RMB has been strongly undervalued in the first decade of the XXth Century (see, e.g., Goldstein and Lardi 2009). As robustness, we consider undervaluations of 5% and 40%.

4.2 Effect of ERP and IRP on trade surplus

We start by deriving the implications of the activist policies (ERP and IRP) on the savings gap and on the trade surplus. First, we obtain analytical results. Then, we derive quantitative results based on the calibration described above.

Consider, first, the trade surplus:

$$\begin{aligned} b_1 &= s_1 N_0 - K_{F,1} \\ &= w_0 N_0 \left(1 - \frac{1}{1 + \beta^\gamma R_1^{\gamma-1} \left(\frac{2}{1+e_0^{1-\varepsilon}} \right)^{\frac{\gamma-1}{\varepsilon-1}}} \right) - K_{F,1}. \end{aligned}$$

Both a larger R_1 and a larger e_0 increase s_1 and decreases $K_{F,1}$. Thus, activist policies involving $e_0 > e_1$ and $R_1 > R_w$ increase unambiguously the savings gap. Next, recall that the expression of the trade surplus in period one yields: $-e_0 b_1^f = b_1$. Thus, the trade surplus expressed in units of domestic good is increasing in R_1 and in e_0.

We can then calculate how the trade surplus evolves over time after the first period ($t \geq 1$):

$$\underbrace{-b_{t+1}^f}_{\text{trade surplus}} = \underbrace{(s_{t+1} - K_{F,t+1})}_{\text{domestic saving gap}} + \underbrace{\tilde{\omega}}_{\text{net govt wealth}}$$

[25] In Song *et al.* (2011) and Song *et al.* (2014), we assume a declining ξ to capture some exogenous financial development. Here, for simplicity, we assume a constant ξ, since its dynamics does not affect dimensions we emphasize in this paper. Moreover, the value of ξ in our previous papers focusing on multiperiod economy is not comparable with that in this paper, due to the different assumptions about depreciation.

An increase in the saving gap translates one-to-one into an increase in the government surplus. In addition, the trade surplus depends on the losses the government runs on its activist policies in the first period. As discussed above such losses are equal to $-\tilde{\omega} = \left(\frac{R_1}{R_w} - \frac{1}{e_0}\right) b_1$. Thus a higher R_1 or a higher e_0 increase the losses of the government, as long as b_1 is positive. So, after the first period, the activist policies have an ambiguous effect on the trade surplus: a larger R_1 and a larger e_0 increase the domestic saving gap, but reduce the net government wealth. In the long run, the effect on the domestic saving gap vanishes, and the only remaining effect of the policies is that the government is poorer, implying a lower trade surplus.

Consider, next the quantitative effects. Figure 8 shows simulated trade surplus trajectories corresponding to the two baseline activist policies ($R_1 = 1.035^{30}$ and $e_0 = 1.27$) compared to the trajectories under the laissez faire policy ($R_1 = 1.025^{30}$ and $e_0 = 1$) in the calibrated economy. Panel (a) shows the effect of the IRP. Initially, the IRP increases the trade surplus (as a share of GDP) from 3% to 6.4%. This is due to two forces. On the one hand, since $\gamma > 1$, intertemporal substitution reduces consumption when agents face a higher deposit rate. On the other hand, a higher interest rate makes borrowing more expensive for F firms, thereby reducing externally financed investments (note that the investment of E firms increase, but this is irrelevant for the trade surplus, since it is financed entirely through the savings of entrepreneurs). The gap shrinks in period 1 and is reverted from period 2 and onwards, reflecting, as explained above, that the government is poorer and must levy a tax. Panel (b) shows the effect of the ERP. The effect is qualitatively similar to that of the IRP, but quantitatively smaller. The trade surplus (as a share of GDP) increases from 3% to 4.1% in the first period, then the economy runs a slightly lower surplus than in the laissez-faire benchmark. Recall that this effect hinges on the assumption that $\gamma > 1$, i.e., agents' savings increase when the price of consumption goods decrease over time.

Figure **??** shows how sensitive the results are to variations in the activist policies. In Panel A we show two alternative IRPs ($R_1 = 1.03^{30}$ and $R_1 = 1.045^{30}$). As expected, the larger the IRP the larger the effects. Remarkably, even an increase of half a percentage point in the annualized interest rate relative to laissez-faire would increase the initial trade surplus by 1.6 percentage points. In Panel B we show two alternative ERPs ($e_0 = 1.05$ and $e_0 = 1.4$). Again, the larger the ERP the larger the effects. Remarkably, as small undervaluation corresponding to the lower end of the empirical estimates has hardly any effect. A dubiously realistic 40% overvaluation has only a marginal incremental effect relative to the 27% benchmark.

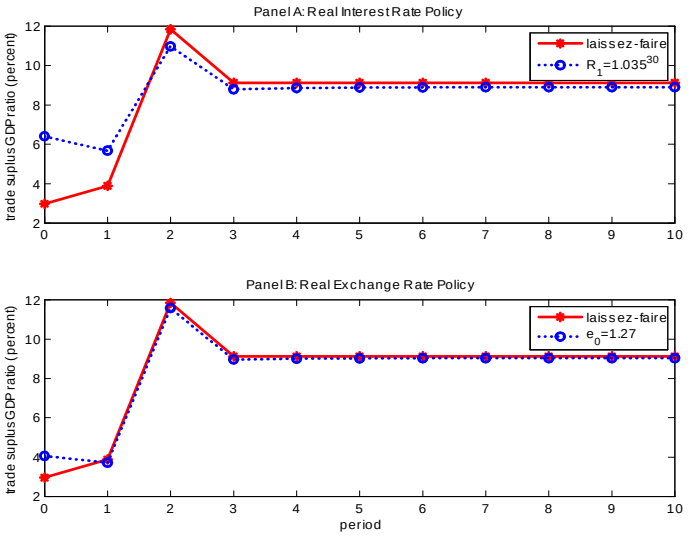

Figure 8: The solid lines in both panels plot the trade surplus as a share of GDP in the laissez-faire economy ($R = R_w = 1.025^{30}$ and $e_0 = 1$). The dotted lines in panels A and B are the corresponding figures under the IRP ($R_1 = 1.035^{30}$) and ERP ($e_0 = 1.27$), respectively.

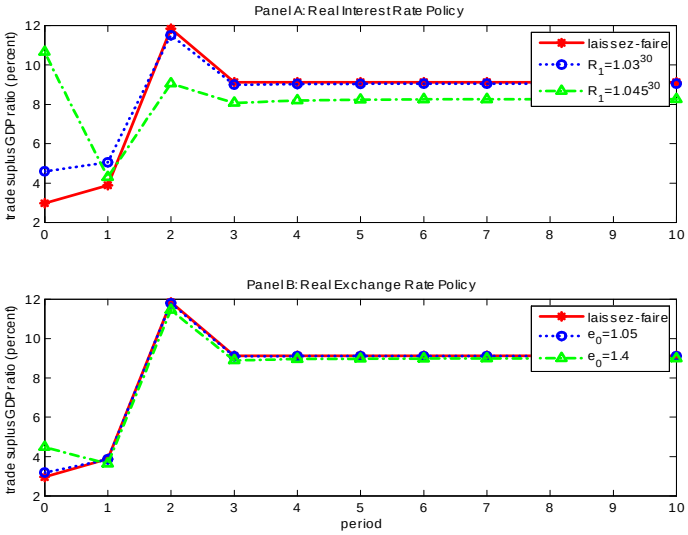

Figure 9: The solid lines in both panels plot the trade surplus as a share of GDP in the laissez-faire economy ($R = R_w = 1.025^{30}$ and $e_0 = 1$). The dotted and dashed lines in panel A are the corresponding figures under the IRPs $R_1 = 1.03^{30}$ and $R_1 = 1.045^{30}$, respectively. The dotted and dashed lines in panel B are the corresponding figures under the ERPs $e_0 = 1.05$ and $e_0 = 1.4$, respectively.

Our model shows that saving rate and trade surplus are affected by the real exchange rate dynamics but independent of its *level*. In other words, the ERP affects trade surplus only if the real exchange rate varies over time. Intuitively, the anticipation of future appreciation (depreciation) would increase the returns of holding domestic assets, resulting in a higher (lower) saving rate and, hence, a bigger (smaller) surplus. The prediction of our theory that a larger trade surplus is associated with expectations of an appreciation of the real exchange rate is broadly in line with the apparent positive correlation between real appreciation and trade surpluses (see Panel B of Figure 1).

As explained above, the effect of an expected real appreciation on the trade surplus works through the savings rate (consumers delay purchasing expensive import goods). Figure 10 plots the dynamics of the aggregate saving rate and real effective exchange rate. As we documented in Section 2, the RMB experienced a real depreciation over the 1998-2005 period and a real appreciation thereafter. Our model predicts that, if $\gamma > 1$ and consumers have perfect foresight about the exchange rate movements, then the exchange rate dynamics should tend to lower the saving rate before 2004 and increase it thereafter, especially during 2005-2008, when the appreciation was particularly strong. As it turns out, the aggregate savings rate did fall between 1998 and 2000 and it did rise sharply between 2005 and 2009. This is in line with the effect of the exchange rate mechanism of our theory. However, counter to the predictions of our model, the savings rate also rose sharply – almost eight percentage points – during the period 2000-2005. This suggests that other factors from which we abstract here, such as the housing market reform (see, e.g., Chamon and Prasad 2010), have been at play.

4.3 Effect of ERP and IRP on real wages

Consider, next, the effects of the activist policies on real wages. For simplicity, we restrict attention to the baseline activist policies (results about sensitivity analysis are available upon request). The equilibrium expression of w_t in equation (5) is increasing in R_t and independent of e_t. However, one should bear in mind that w_t is expressed in terms of units of the domestic good, and is not the real wage in terms of the consumption basket. Since households consume both domestic and foreign goods, the real wage is affected by changes in the relative prices. Given our isoelastic preferences, such the consumers' price level is given by

$$P_t = \left(1 + e_t^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}.$$

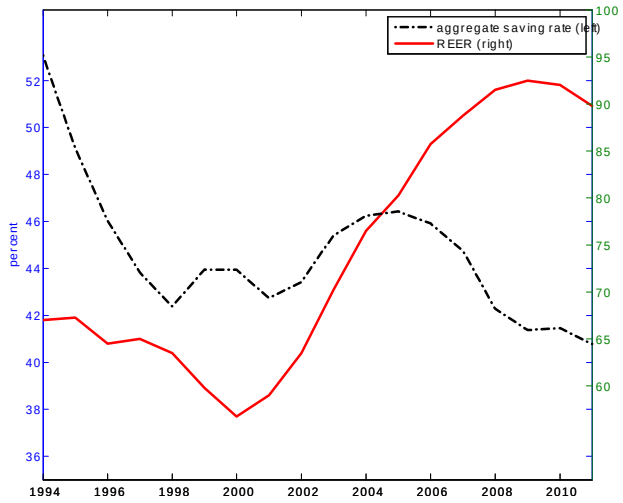

Figure 10: The solid and dashed lines are the aggregate saving rates (%), the left axis, and the annual real effective exchange rate, the right axis, respectively. The annual real effective exchange rates are the average of the normalized quarterly real effective exchange rates in Figure 1.

Since the price level is increasing in e_t, the real wage is decreasing in e_t.[26]

Figure 11 compares the real wage trajectories corresponding to alternative activist policies ($R_1 = 1.035^{30}$ and $e_0 = 1.27$, respectively) with those under the laissez faire policy. For convenience, we normalize wages by the level of technology A_t, i.e., we display the dynamics of $w_t/(P_t A_t)$ MMM A_t is constant over time. Under laissez faire, the normalized real wage is constant throughout the transition (i.e., until period 2). Thereafter, when E firms employ the whole labor force, wages grow due to capital deepening and converge to their steady state level, as explained in section 3.3.

Panel A shows the effect of the IRP. Wages in period 1 are lower than under laissez-faire, because a higher lending rate reduces the capital intensity and, hence, the wage rate paid by F firms. Once the activist policy is over, wages are the same as under laissez-faire. However, the transition is faster under the IRP, because the high cost of external financing speeds up the demise of F firms. In addition, higher profits increase the propensity to savings of entrepreneurs since $\gamma > 1$. The faster transition triggers an earlier onset of the neoclassical wage growth. Note that the activist IRP benefits the entrepreneurs during the transition and the future workers who enjoy higher wages. The

[26]For simplicity, we focus on activist policies in period zero only. In this case, setting $e_0 > 1$ reduces the real value of the endowment w_0. An activist ERP in later periods would imply a reduction in real wages as discussed in the text.

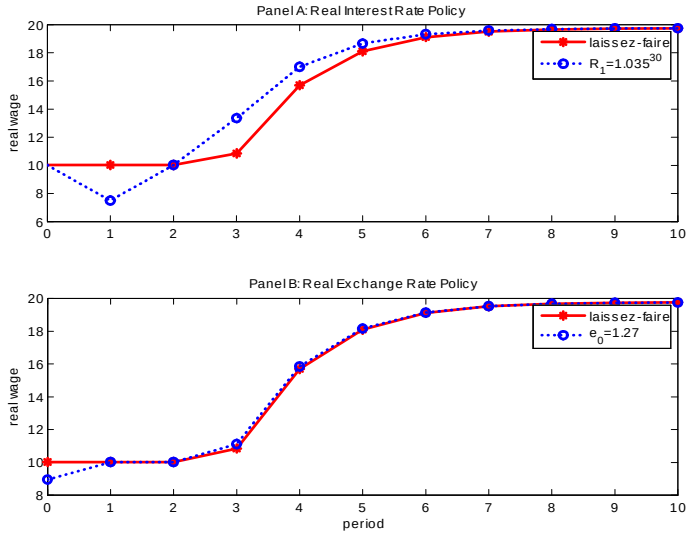

Figure 11: The solid lines in both panels plot the real wage in the laissez-faire economy ($R = R_w = 1.025^{30}$ and $e_0 = 1$). The dotted lines in panels A and B are the corresponding figures under the IRP ($R_1 = 1.035^{30}$) and ERP ($e_0 = 1.27$), respectively.

effects are quantitatively large: the benchmark IRP lowers wages by 25%.[27] Panel B shows the effect of the ERP. The policy reduces the real value of the initial endowment, causing a 10% reduction in the real wage. Thereafter, capital accumulates somewhat faster in the E sector speeding up the transition. Thus, wages are slightly above the laissez-faire analogue after period 2.

4.4 Effect of ERP and IRP on GDP

Consider, next, the effect of activist policies on GDP. A higher e_0 stimulates growth by increasing savings and capital accumulation in the E sector. A higher R_1 implies a lower capital labor ratio in F firms and a lower wage in period one. This per se reduces the output of F firms. At the same time, a higher level of R_1 speeds up (precisely by reducing wage costs) capital accumulation and growth of E firms. Since E firms are more productive, the composition effect causes an increase in the average TFP, and thus in GDP. Hence, the effect of increasing R_1 is ambiguous. More formally, let Y_t denote

[27] The quantitative effects are sensitive to the assumption of the two-period model, here. In a model where one period is one year and the annual depreciation rate were e.g. 8%, an increase in the lending rate from 5.5% to 6.5% would lower wages with 7%. In contrast, in our two-period model the corresponding interest rate policy, i.e., increasing the annualized interest rate from 5.5% to 6.5%, lowers wage by 25%. As mentioned above, the quantitative implications from a two-period model are subject to the usual *caveat*.

total GDP. Since the working population is constant and normalized to unity, then Y_t is also GDP per worker. Thus, for $t \geq 1$:

$$\begin{aligned} Y_t &= Y_{F,t} + Y_{E,t} = \kappa_{F,t}^{\alpha} \left(1 + \frac{\psi}{1-\psi} N_{E,t}\right) A_t \\ &= \left(\frac{R_t}{(1-\xi)\,\alpha}\right)^{-\frac{\alpha}{1-\alpha}} + \frac{\psi}{1-\psi} \left((1-\psi)\,\chi\right)^{\frac{1}{\alpha}} \frac{R_t}{(1-\xi)\,\alpha} \frac{K_{E,t}}{\chi A_t}. \end{aligned}$$

The first line follows from the fact that $Y_{F,t} = A_t \kappa_{F,t}^{\alpha}$ and $Y_{E,t} = \chi A_t \kappa_{E,t}^{\alpha}$, and from the definition of κ_F and κ_E. Then, using expression (9), and rearranging terms, one gets the right hand-side expression in the first line. The second equality follows from eliminating κ_F and N_E using (4) and (8).

Set $t = 1$. An increase in e_0 increases Y_t by increasing $K_{E,t}$. An increase in R_1 has instead an ambiguous net effect. As discussed above, it decreases $\kappa_{F,t}$ and increases $N_{E,t}$ (via its effects on wages and entrepreneurs' saving rates). The sign of the effect hinges on $K_{E,1}$. If the entrepreneurial sector is very small (small $K_{E,t}$), the activist policy decreases output initially, and increases it in future.

Figure 12 shows the quantitative effect of the baseline activist policies relative to laissez-faire. Panel A shows the effect of the IRP. Initially, the activist policy reduces output growth. The quantitative effect is large, and comparable to the effect on wages. However, after the first period the economy benefits from the faster capital accumulation in the E sector implying a faster convergence to the steady state. Panel B shows the effect of the ERP. In this case, the effect is very small and barely visible in the graph. Even a 40% undervaluation would yield similar results. This suggests that the manipulation of the exchange rate is not an important channel for growth.

4.5 Robustness

In this section, we perform some sensitivity analysis to variations in the preference elasticities γ and ε. We focus on these parameters since there is some uncertainty about their magnitudes in the empirical literature, as discussed above. We focus on the effects on the trade surplus.

Consider, first, the intertemporal elasticity of substitution in consumption. As discussed above, the effect of the ERP hinges on $\gamma > 1$. Figure 13 shows the results under the alternative values $\gamma \in \{1.01, 2.5\}$. When $\gamma = 1.01$, agents are less willing to substitute consumption intertemporally, and thus save less. This has two main consequences for the IRP. First, the IRP has no effect on trade surplus in period zero. Second, the

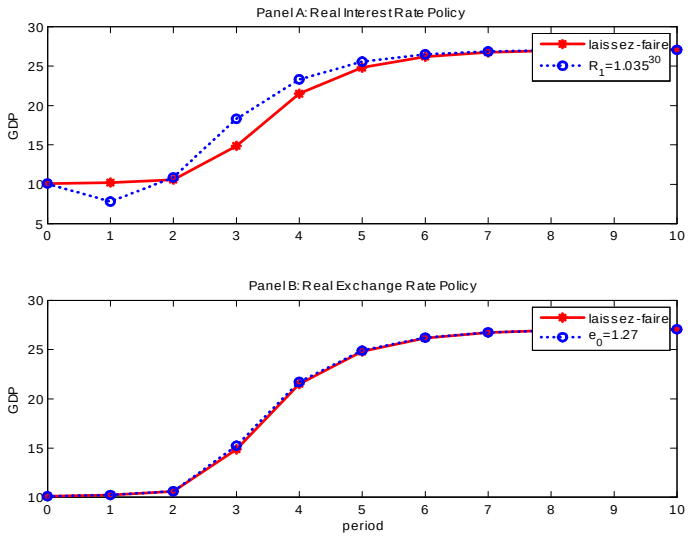

Figure 12: The solid lines in both panels plot the GDP in terms of world prices in the laissez-faire economy ($R = R_w = 1.025^{30}$ and $e_0 = 1$). The dotted lines in panels A and B are the corresponding figures under the IRP ($R_1 = 1.035^{30}$) and ERP ($e_0 = 1.27$), respectively.

transition is slower since managers save less and capital accumulation in E firms is more moderate. The ERP has no impact, and altogether very small effects, when $\gamma = 1$. In particular, a change in e_0 leaves savings unaffected due to the cancellation of an income and a substitution effect. The only effect of the policy is through the government budget constraint, and its sign is generally ambiguous. In the calibrated economy featuring a structural trade surplus, the EPR entails a cost for the government, since this purchases foreign bonds at unfavorable terms of trade. The government deficit causes a small decline in future trade surpluses. When $\gamma = 2.5$, the results are qualitatively similar, if quantitatively stronger, than in the baseline experiment with $\gamma = 2$ (see Figure 13).

Consider, next, the Armington elasticity ε. The IRP is not affected by the value of ε. To see why, note that in our model the propensity to consume equals $\left(1 + \beta^{\gamma} \left(R^d_{t+1}\right)^{\gamma-1} \left(\frac{1+e_{t+1}^{1-\varepsilon}}{1+e_t^{1-\varepsilon}}\right)^{\frac{\gamma-1}{\varepsilon-1}}\right)^{-1}$. When $e_t = e_{t+1}$ the Armington elasticity has no impact on consumption and savings. Thus, the effect of the IRP is invariant to ε, given that we assume $e_0 = 1$ in this policy experiment. However, the Armington elasticity does influence the effectiveness of the ERP. The effect of the ERP is decreasing in ε. To see why, note that when the Armington elasticity is high, agents are more willing to substitute domestic for foreign goods in response to a temporary undervaluation. Thus, a low Armington elasticity is equivalent to a larger effective temporary undervaluation. The quantitative effects across the

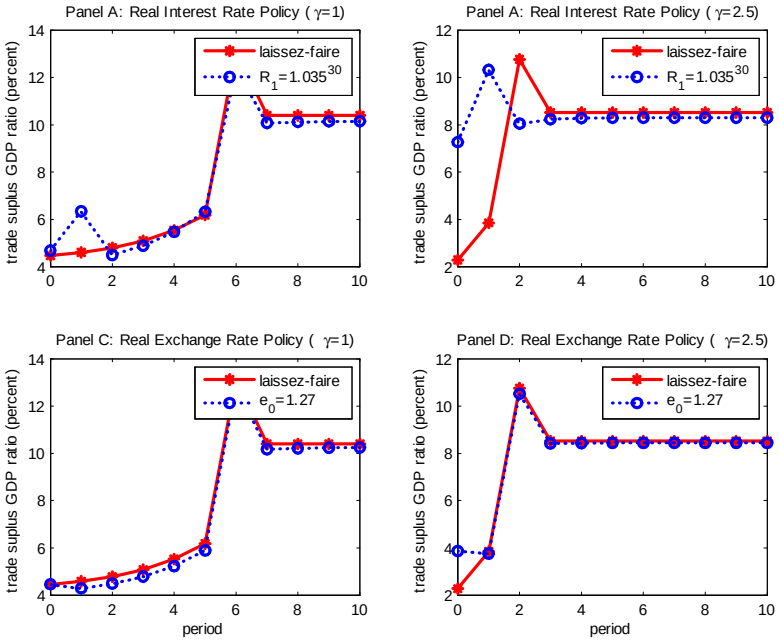

Figure 13: The solid lines in all panels plot the trade surplus as a share of GDP in the laissez-faire economy ($R = R_w = 1.025^{30}$ and $e_0 = 1$). The dotted lines in the upper (lower) panels are the trade surpluses under the IRP (ERP) $R_1 = 1.035^{30}$ ($e_0 = 1.27$). The left panels assume $\gamma = 1.001$. The right panels assume $\gamma = 2.5$.

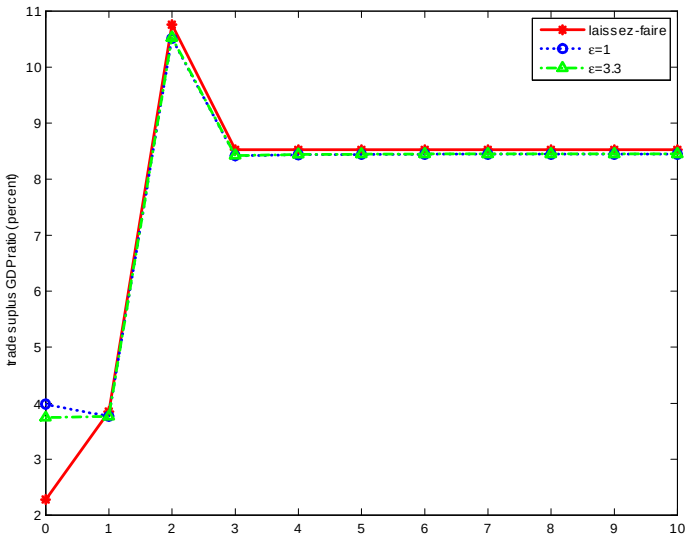

Figure 14: The solid line plots the trade surplus as a share of GDP in the laissez-faire economy ($R = R_w = 1.025^{30}$ and $e_0 = 1$). The dotted and dashed lines are the trade surpluses under the ERP for different values of ε. In particular, the dotted line corresponds to the case of $\varepsilon = 1$ while the dashed line corresponds to the case of $\varepsilon = 3.3$. The laissez-faire is invariant to ε.

range of empirically plausible estimates are tiny. Figure 14 shows the results under the alternative values $\varepsilon \in \{1, 3.3\}$. Lowering ε from 3.3 to 1 increases the first-period trade surplus from 4% to 4.1% under the ERP (note that the laissez-faire is independent of ε since $e_t = 1$ for all t).

4.6 Welfare effects of ERP and IRP

In this section we explore the welfare and distributional effects of the activist policies. We consider, on the one hand, how different policies affect workers relative to entrepreneurs within each cohort. On the other hand, we study the effects across generations. Welfare effects are evaluated in terms of equivalent variation, namely, the percentage increase in consumption under the laissez-faire policy needed to make the agent indifferent between the laissez-faire and the activist policy. Figure 15 shows the result for the calibrated economy, focusing on the baseline IRP ($R_1 = 1.035^{30}$) and ERP ($e_0 = 1.27$). The graphs show the welfare gains associated with the activist policy for each cohort. Each point along the x-axis represents the birth date of a particular cohort. Welfare effects are broken down by occupation (workers vs. managers/entrepreneurs).

Consider, next, the IRP. The initial generation perceives a small welfare gain due to

the high interest rates on savings, while their endowment is unaffected by assumption. The generation of workers born in period 1 suffers a large (30%) welfare loss from an increase in R_1, due to the lower wages (see Figure 11). For the same reason, managers and entrepreneurs of E firms benefit from an increase in R_1. All subsequent generations of managers gain, since they work in "larger" firms, earning a higher compensation when working as managers, and operate themselves larger firms as old entrepreneurs. In other terms, the effect of the larger capital accumulation in the first period triggered by the distortion has a permanent effect on the welfare of all subsequent generations of entrepreneurs (the effect only vanishes asymptotically). The welfare effect for the workers are more complex. The pre-tax wages of the worker are not affected until time 3, when the transition is over. However, all workers pay higher taxes to make up for the capital losses of the government. Thus, on the one hand, the earlier generations living through the economic transitions suffer a loss from the activist policies. On the other hand, the activist policy speeds up the transition, implying that the wage growth induced by capital deepening starts earlier.

Consider, next, the ERP. The first generation of both workers and entrepreneurs are worse off under the activist policy, because foreign goods are more expensive, and their consumption is distorted both intra- and intertemporally. The welfare effect is quantitatively large, amounting to 5.0% for managers 8.0% for workers. The subsequent generations of managers also gain, due to the larger capital accumulation in the first period (see the discussion for the IRP). For the workers, the effects are ambiguous, mirroring the discussion of the ERP.

Interestingly, while both the IRP not the ERP are growth-enhancing, neither benefits the workers until the end of the transition (period 3 in the calibrated economy). Thus, the activist policies cause persistent losses for the workers that extend over several generations.

5 Internal Financial Liberalization

In this section, we extend the model presented above to study the effect of regulations of the domestic banking sector, and of their removal, i.e., financial liberalization. To simplify the analysis, we assume that home and foreign goods are perfect substitutes, i.e., $\varepsilon \to \infty$, as in SSZ. Moreover, we assume that $e_t = 1$ and $R_t = R$, for all t. Generalizing the analysis along these dimensions is straightforward and yields no surprising additional implications.

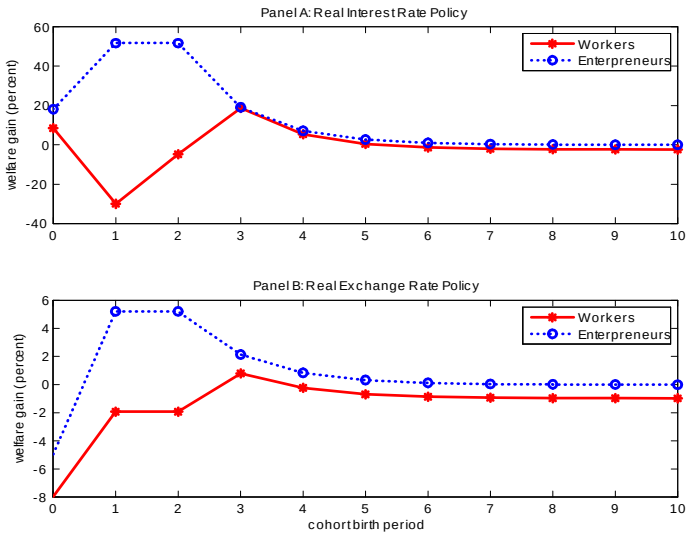

Figure 15: The figures display the welfare effects of activist policies. Welfare is measured as the percentage of lifetime consumption workers and managers/entrepreneurs are willing to give up to move from the laissez-faire policy ($R = R_w = 1.025^{30}$ and $e_0 = 1$) to the IRP ($R_1 = 1.035^{30}$, panel A) or the ERP ($e_0 = 1.27$, panel B). The x-axis represent the birth date of each cohort.

To capture more accurately the pre-reform scenario, we assume that the deposit rate is not determined by market forces, but by regulation. More precisely, the government sets a ceiling on the deposit rate, denoted by $R^d < R$. This implies, as discussed below, that the statutory maximum deposit rate is binding. Once a bank offers the maximum deposit rate R^d, there is nothing the bank can do to attract more deposits. Moreover, deposits are the only source of external funds for the banks – in particular, banks cannot issue bonds nor can they borrow from abroad, due to capital controls. Since banking activity cease to be a veil (banks, as we will se, make profits in equilibrium), it is useful for future reference to discuss explicitly the nature of competition between banks. In particular, we assume that there is a set of *incumbent banks* engaging in a two-stage Bertrand competition game. The total profits of the banking industry are transferred to the government.[28] For simplicity, throughout this section we restrict attention to equilibria featuring a positive trade surplus, i.e., such that banks hold government bonds in their portfolio.[29]

[28] This is for simplicity. We could alternatively assume that the profits accrue to a separate group, the bankers, or that they are rebated to consumers as lump sums. Since the major Chinese banks are state owned, it makes sense to consolidate their profits with those of the government.

[29] Otherwise, banks would like to borrow from the government or from the foreign sector. However, since capital controls forbid that, loans must equal deposits, as in the equilibrium of a neoclassical

The following assumption describes more formally competition between banks.

Assumption 2 *Competition in the banking industry is described by the following two-stage game: (stage i) banks compete (*à la *Bertrand) in offering firms lending contracts specifying a loan size and an interest rate; (stage ii) banks compete (*à la *Bertrand) in offering workers deposit contracts; (stage iii) if in stage ii all banks have raised sufficient funds to honor stage i contracts, contracts are enforced, otherwise no exchange take place, and the game restarts from stage i.*

The equilibrium characterization is simple. In the second stage, banks compete to attract depositors. Since they can earn the rate of return R on government bonds, absent regulation, competition would drive the deposit rate up to R. However, due to the ceiling on deposit rates, all banks will offer the maximum rate R^d. In the first stage, banks will choose a portfolio consisting of government bonds and loans to F firms, for which they charge an interest rate $R^l = R/(1-\xi)$.[30] Charging a lower rate wold be suboptimal, since it would yield a net return lower than government bonds. Finally, competition prevents banks from charging a higher rate of return on loans.

Consider the effect of deregulating the deposit rate. The deposit rate would then increase to R, and banks' profits would vanish. There would be no effect on the lending rate, implying no general equilibrium effect through wages. Households would enjoy a higher rate of return on their savings. Depending on the intertemporal elasticity of substitution for consumption, this might yield higher or lower savings. In the log case, there is no effect on the savings of the young. However, the higher rate of return increases unambiguously the consumption of the old. Thus, the only effect of the deregulation is a transfer from the government to the old consumers. Since the government neither consumes nor invests, while the old consume all their income, the deregulation reduces the trade surplus, at least as long as the saving rate does not increases too much in response to the higher deposit rate (the trade surplus falls unambiguously in the case of logarithmic utility). In summary, the deregulation of deposit rates has no effect on the production side of the economy. In particular, it has no effect on transition nor on economic growth. The only macroeconomic effect is a change (most likely, a decrease) in the aggregate saving rate and in the net foreign position of China.

closed-economy model. In this case, the interest rate on loans would be lower than R. We ignore this case since China has a very large foreign surplus.

[30] As discussd above, China had a floor on lending rates, which was removed in July 2013. For simplicity, we ignore such constraint, assuming that it is not binding.

The comparative statics above hinges on the assumption that the regulation does not affect entry in the banking industry. In the model above, incumbent (in China, state-owned) banks capture all deposits and make all loans. However, these banks are inefficient insofar as they do not lend to private firms. However, one might expect that more competition would trigger the entry of different types of banks that are more prone to lend to entrepreneurs. To explore this possibility, that we regard as highly realistic in the Chinese institutional context, we expand the model and allow competition between different types of banks. We distinguish between *incumbent banks* (behaving as described above) and *fringe banks*. The latter are prepared to lend to private firms, either due to a better monitoring technology, or due to a better governance that makes them less biased in favor of F firms. In China, this might capture the notion that fringe banks are private rather than state owned. However, fringe banks have a small disadvantage in collecting deposits: incumbents have a well-established network of branches and customers, which makes it costly for the fringe to attract depositors unless they offer them higher rates. In particular, we assume that savers would strictly prefer the deposits offered by incumbent banks at the rate R^d unless fringe banks offer at least $R^d + \delta$, where $\delta > 0$.

We model the lending behavior of fringe banks as follows. They can lend to F firms and purchase government bonds at the same terms as do incumbent banks. In addition, they can lend to E firms up subject to a moral hazard constraint. Following SSZ, we assume that entrepreneurs can pledge to repay a share η of the second-period net profits. The parameter η can be interpreted as a productivity parameter in the production function of fringe banks: the higher the banks' monitoring capability, the higher η, and the less tight the borrowing constraint faced by entrepreneurs. Alternatively, η can be thought of as an inverse measure of the capture of banks' policy from special interests. For instance, if banks are biased in favor of state-owned enterprises, this would be reflected in a smaller η, i.e., less lending to private firms. Incumbent banks are a particular case of fringe banks, with $\eta = \delta = 0$.

Assumption 3 *The bank industry comprises two types of banks: "incumbent" and "fringe" banks. The two types of banks differ in two dimensions:*

1. *Fringe banks have a disadvantage in attracting deposits. Let R^d denote the deposit rate offered by incumbent banks. Then, fringe banks can only attract deposits if they offer a deposit rate of at least $R^d + \delta$, where $\delta > 0$.*

2. *Fringe banks have an advantage at lending to private firms, parameterized by a*

larger η. Namely, entrepreneurs can pledge to repay a share $\eta > 0$ of the second-period net profits when they borrow from fringe banks, while $\eta = 0$ for incumbent banks.

Consider the optimal contract between fringe banks and entrepreneurs, when fringe banks are active. The E firm's capital stock comprises now not only the savings of young entrepreneurs, but also the loans from fringe banks: $k_{Et} = s^E_{t-1} + l^E_{t-1}$. The borrowing constraint of entrepreneurs yields: $R^l l^E \leq \eta\rho\left(s^E + l^E\right)$. This constraint is binding as long as $\eta < R^l/\rho$, which we assume to be the case. Thus, the share of private investments financed through bank loans is

$$\frac{l_E}{l_E + s_E} = \frac{\eta\rho}{R^l}. \tag{14}$$

The next proposition characterizes the equilibrium of the banking industry before and after the deregulation reform in an environment comprising both incumbent and fringe banks.

Proposition 1 *(i) In a "pre-reform" equilibrium (with regulation): Incumbent banks offer the ceiling deposit rate R^d and attract all savings from workers; they hold an asset portfolio comprising loans to F firms (with an interest rate of $R^l = R/(1-\xi)$) and government bonds, both yielding a rate of return net of intermediation costs of $R > R^d$. Fringe banks are not active.*
(ii) In a "post-reform" equilibrium (with no regulation): Incumbent banks offer the deposit rate R and attract a positive share of the savings from workers; they hold an asset portfolio comprising loans to F firms (with an interest rate of $R^l = R/(1-\xi)$) and government bonds, both yielding a rate of return net of intermediation costs of R. Fringe banks offer the deposit rate $R + \delta$ and attract a positive share of the savings from workers; they hold an asset portfolio comprising only loans to E firms with an interest rate of $R^{l,e} = (R+\delta)/(1-\xi)$.

Proof. Pre-reform. In the second stage, no bank can offer deposit rates higher than R^d. Suppose a deviant incumbent offers a deposit rate lower than R^d. Then, it will attract no customer. Fringe banks are unable to raise any funds: for any feasible deposit rate smaller or equal to R^d, consumers strictly prefer the deposits offered by incumbent banks. In the first stage, suppose a deviant incumbent bank offers a lending rate above $R/(1-\xi)$. Then, no firm will enter such a lending contract. A deviation below $R/(1-\xi)$ is also unprofitable, since the deviant bank could increase its profits by investing in bonds and earning a net rate R. Fringe banks cannot offer any contract as they are unable to raise funds in the second stage.

Post-reform. In the second stage, a deviant incumbent (fringe) offering a deposit rate lower than R ($R+\delta$) will attract no customer, whereas a deviant incumbent offering a deposit rate higher than R ($R+\delta$) will make losses. In the first stage, suppose a deviant incumbent (fringe) bank offers a lending rate above $R/(1-\xi)$ ($(R+\delta)/(1-\xi)$). A deviation of an incumbent bank below $R/(1-\xi)$ is also unprofitable, since the deviant bank could increase its profits by investing in bonds and earning a net rate R. A deviation of a fringe bank below $(R+\delta)/(1-\xi)$ is also unprofitable, since the deviant bank is then unable to raise funds for any interest rate below $R+\delta$. Finally, at the equilibrium deposit and lending rates both incumbent and fringe banks will be able to raise sufficient funds to honour the lending contracts, since, at the equilibrium interest rates, the aggregate demand of deposits exceed the aggregate demand of loans. ■

A stark result of the proposition is that the regulation of deposit rates stifles competition in the banking industry, at the expenses of the more productive E firms. In the post-reform competitive equilibrium, all banks' profits are driven to zero by competition. Incumbent banks set the deposit rate to R, and invest the resources collected in government bonds and loans to F firms. Fringe banks set the deposit rate to $R+\delta$ – the minimum rate required for them to attract customers – and lend exclusively to E firms, at an interest rate of $(R+\delta)/(1-\xi)$. In a deregulated economy, E firms still face less favorable lending conditions, but fare better than under regulation, since they can access external financing.

In this environment, the deregulation of deposit rates has large effects on productivity and growth. A simple extension of the analysis in SSZ shows that the growth rate of entrepreneurial capital, the key measure of the speed of economic transition, is given by:

$$\frac{K_{Et+1}}{K_{Et}} = 1 + g_{lib} = \frac{R^{l,e}}{R^{l,e} - \eta\rho}\left(1 + \beta^{-\gamma}\left(\frac{(1-\eta)\,\rho R^{l,e}}{R^{l,e} - \eta\rho}\right)^{1-\gamma}\right)^{-1} \frac{\psi}{1-\psi}\frac{\rho}{\alpha}, \tag{15}$$

where $\rho = (1-\psi)^{\frac{1}{\alpha}}\chi^{\frac{1-\alpha}{\alpha}}R/(1-\xi)$, and $R^{l,e} = (R+\delta)/(1-\xi)$ is rate at which entrepreneurs can borrow from fringe banks, as long as they are active. The key parameter is η, a measure of the access of E firms to external financing. K_{Et+1}/K_{Et} is increasing in η, and so are the growth rates of aggregate output and productivity. The pre-reform equilibrium is a particular case of (15) where $\eta = 0$, hence:

$$\frac{K_{Et+1}}{K_{Et}} = 1 + g_{reg} = \left(1 + \beta^{-\gamma}\rho^{1-\gamma}\right)^{-1} \frac{\psi}{1-\psi}\frac{\rho}{\alpha}, \tag{16}$$

which is the lower bound of the transition rate, given the other parameters.

The analysis so far has assumed that incumbent banks do not lend at all to entrepreneurs. From a descriptive standpoint, it is more realistic to assume that all banks lend to E firms, but that incumbent banks impose tighter borrowing constraints reflecting their bias against private firms. Formally, incumbent banks also lend to private firms, being subject to a tighter constraint, $\eta' < \eta$, than fringe firms. In this case, incumbent banks will lend to both F firms and E firms, whereas fringe banks will provide top-up financing to E firms, at higher lending rates.[31]

Corollary 1 *Suppose incumbent banks also lend to E firms, but entrepreneurs can only pledge a fraction $\eta' < \eta$ of their second-period profit when they borrow from incumbent firms. Then, (i) In a "pre-reform" equilibrium (with regulation): Incumbent banks offer the ceiling deposit rate R^d and attract all savings from workers; they hold an asset portfolio comprising loans to F firms and E firms (with an interest rate of $R^l = R/(1-\xi)$), and government bonds, all yielding a rate of return net of intermediation costs of $R > R^d$. Fringe banks are not active.*
(ii) In a "post-reform" equilibrium (with no regulation): Incumbent banks offer the deposit rate R and attract a positive share of the savings from workers; they hold an asset portfolio comprising loans to F firms and E firms (with an interest rate of $R^l = R/(1-\xi)$), and government bonds, all yielding a rate of return net of intermediation costs of R. Fringe banks offer the deposit rate $R+\delta$ and attract a positive share of the savings from workers; they hold an asset portfolio comprising only of top-up loans to E firms (i.e., loans in excess of the maximum financing that E firms can get from incumbent banks) with an interest rate of $R^{l,e} = (R+\delta)/(1-\xi)$.

The proof is a simple extension of the proof of Proposition 1 and is omitted. The corollary shows that the main insights of Proposition 1 are robust to less extreme assumptions.

In summary, liberalizing the deposit market is likely to speed up privatization, productivity, and growth. Before the liberalization, the entrepreneurial capital grows at the constant rate g_{reg}, which dictates the rate of growth of employment in E firms and the average growth rate of GDP. At the time of deregulation, the entrepreneurial capital jumps upwards and, subsequently, it continues to grow at a higher rate (g_{lib}) than before. The deregulation has no immediate effect on wages. However, since deregulation

[31] Note that we assume that all loans are observable. In addition, E-firms loans with incumbent banks have higher seniority. Thus, if an E-firm collateralizes a share η' of its future profit with an incumbent bank, it can only collateralize an additional share $\eta - \eta'$ when it turns to a fringe bank for a top up loan.

speeds up the transition, the time at which the transition ends (i.e., when all workers are employed in E firms) will occur earlier. Thus, the time when wage growth accelerates (time T in Figure 11) will come earlier.

So far, we have only considered the effects of a deregulation of interest rates on deposits. However, China is considering a more far-reaching reform that should lead to the full liberalization of cross-border investments. What would the effect of such a reform be? In our model, opening the capital account completely would have similar, and possibly stronger effects as those of an internal deregulation. In particular, foreign investors and intermediaries could introduce improvements equivalent to a further increase in η or, possibly a reduction in the intermediation costs ξ. This would be the case if foreign entities could bring additional expertise, or if they could trigger an increase in equity financing. A reduction in ξ would have additional effects. In particular, it would increase lending to both E firms and F firms. In turn, this would cause an increase in the capital-labor ratios of all firms and in wages.

6 Conclusions

In this paper we study the role of policy and financial reforms in an environment characterized by asymmetric financial frictions and active controls on international capital flows. We focus on exchange rate policy, interest rate policy, and the deregulation of interest rate controls. We show that these policies interact, and possibly strengthen, the structural transformation of China characterized by high productivity growth and the accumulation of a foreign assets analyzed in our previous work. We should emphasize that, contrary to a popular perception in the West, we do not argue that China's trade surplus originates from policy interventions alone. Our theory predicts that the imbalance is a natural outcome of the process of transformation under financial constraints. However, we show that activist exchange rate and monetary policy may have magnified some of the effects relative to the laissez faire. As far as the exchange rate policy is concerned, we document that the real exchange rate of China underwent a significant appreciation after 2006, following a period during which it was, arguably, undervalued. Our theory predicts that the initial undervaluation, followed by a later realignment, may have strengthened economic growth and contributed to the accumulation of foreign assets in the mid-2000's. As far as the real interest policy is concerned, we document that, although the real return on saving has been significantly lower in China than the stellar return on real investments, the Chinese real deposit rate and the rate of return

on domestic bonds have been on average 0.9% higher than the rate on US T-bills. If one takes this as an indication that the interest rate has been higher than the world rate, this policy has also contributed to economic growth and to the accumulation of foreign reserves. Both policies have increased savings and reduced consumption.

In the second part of the paper, we study the effect of a deregulation of deposit rates as a vehicle of increasing competition in the domestic banking sector. China has not yet made major reforms in this direction, but these are imminent, according to the recent announcements of the PBOC. The government has also launched a new free trade zone in the Shanghai area where offshore banking and capital transactions will be heavily deregulated. We show that as long as liberalization reduces the bias of the financial system against small and medium private enterprises, financial deregulation will promote growth and reduce the trade surplus. The prediction of the theory are in line with the empirical findings of Fan and Kalemli-Ozcan (2014) who study the effects of financial reforms on firm-level investments in a panel of Asian emerging economies. They find that financial reforms reduce savings and increase investments in private firms relative to state-owned firms, a pattern which conforms with the main mechanism of our theory. These findings make us confident in concluding that the financial reforms such as those currently under way may become a major engine of growth in future China.

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