China: An Institutional View of an Unusual Macroeconomy

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Abstract

China presents several macroeconomic patterns that appear inconsistent with standard stylized facts about economic development and hence inconsistent with the standard neoclassical growth model. We show that Chinese macroeconomic patterns instead appear consistent with an environment where state control of factor markets can promote aggressive output goals. We consider the micro-institutional features that can sustain this behavior, emphasizing the hukou system and state control over capital allocation, and present a simple model built on these features. The model can explain several puzzling facts about the Chinese economy, including its unusually low labor share and unusually high saving and investment rates. Interestingly, the model also shows that free-market reforms can initially take the economy further from global macroeconomic norms.

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1 Introduction

Since 1978, China has recorded one of the fastest GDP growth rates ever known and has now become the second largest economy in the world. This economic success has led to substantial interest in China's development model, both as a potential guide for other countries and as an increasing force shaping the world economy. At the same time, many observers question whether China's growth can be sustained and whether the Chinese economic system is converging towards a free-market, capitalist model.

In this paper, we first document that China is currently an outlier on several core macroeconomic dimensions. These dimensions include an unusually low labor share of income coupled with unusually high investment and savings rates. These features, which are unusual compared to both global norms and the antecedent experience of other rapidly-growing Asian economies, create tension with the traditional macroeconomic growth model, where markets are competitive and factor shares approximately constant. Given this tension, we then consider an alternative model where China seeks to increase output through state control of factor markets, which are not fully competitive.

Building from a micro-institutional description of labor market policy (the hukou system) and investment policy (the five-year plans and incentive systems used to promote them), we build a simple model of the Chinese macroeconomy. The model shows how the state can depress the labor share of income and create unusually high domestic savings and investment rates, in successful pursuit of its output goals. We further discuss, qualitatively, how this Chinese development model can allow trade surpluses as well as implications for Chinese growth in the years ahead. In sum, this paper presents a perspective where China's extraordinary macroeconomic features hinge partly on state institutions that deviate sharply from a competitive-market environment.

Our paper adds to a growing literature on China that emphasizes how various distortions can affect macroeconomic outcomes, in particular, elevating savings and investment. In Song, Storesletten, and Zilibotti (2011), the key distortion is a still-large state enterprise sector with low efficiency and a state-owned banking system that channels all loans to the state enterprises. The financial market distortion incentivizes more efficient private firms to save and invest large amounts. Wei and Zhang (2011) alternatively focus on China's

one-child policy which has had the unintended consequence of causing very high gender imbalance in the young population. As the sex ratio rises, Chinese parents with a son raise their savings in a competitive manner in order to improve their son's relative attractiveness for marriage. They find that this mechanism can potentially account for about half of the rise in the household savings rate during 1990-2007. The main innovation of our paper is to show how labor-market distortions, in conjunction with financial-market distortions, can lead to elevated national savings and investment rates. Our paper draws on a microeconomic literature that finds that, because of the hukou registration system, migrant workers operate in a separate labor market from formally registered workers and are paid significantly less, even after controlling for many observable characteristics [Lu and Song (2006), Park and Wang (2010), Lee (2012)].

Section 2 of the paper considers China's macroeconomic aggregates, showing their unusual features and then argues that these features appear at odds with the traditional growth model. Section 3 introduces a perspective in which China harnesses state control of factor markets to meet aggressive output goals, and grounds these ideas in micro-institutional features of the Chinese system. Section 4 presents a formal model. Section 5 summarizes the findings and discusses further extensions.

2 China: An Unusual Macroeconomy

Chinese macroeconomic behavior appears unusual on several dimensions. We document here macroeconomic facts about the Chinese economy and then highlight their tension with a traditional growth model.

2.1 Stylized Facts

In tandem with its high GDP growth rate, China features an unusually low labor share of income coupled with elevated saving rates, investment rates, and capital-output ratios. These features are unusual not only in comparison to the world distribution, but also in comparison to earlier East Asian industrializers.

2.1.1 Labor Share

Figure 1A presents labor share estimates for China together with a broad sample of 54 countries analyzed by Bernanke and Gurkaynak (2002).[1] In the cross-country sample, the mean labor share is 0.66, with 72% of the countries showing estimates in the 0.60-0.80 range. Related evidence from long time series in the United States and United Kingdom shows labor shares remain within a 0.60-0.75 range over the 1935-1985 period (Gollin 2002).

By contrast, the Chinese labor share appears unusually low (Bai, Hsieh, Qian 2006; Lardy 2012). Kraay (2012) considers China's labor share based on four different sources: provincial data on employee compensation, flow of funds data, input-output tables, and household surveys. As shown in Figure 1B, all four sources agree that the Chinese labor share was approximately .51 in 1993, putting China in the bottom 10% of the world sample. By 2007, the average labor share from these four sources was .43, giving China the lowest observed labor share seen in the data. Note that Figure 1B also suggests that the Chinese labor share has declined with time, although this finding is less consistent across sources.[2]

While imputing labor shares can be challenging, especially in countries with poor data quality and/or large informal sectors, available data suggests that China has an unusually low labor share by international standards, and, if anything, now appears to be an extreme outlier by most measures.

2.1.2 Saving Rate

Figure 2A shows the China's domestic saving rate compared to a world sample of 175 countries. Saving rates for each country are taken from the World Development Indicators and averaged over the 2000-2010 period. Figure 2B presents the same data, but excludes oil exporters (where fuels account for at least 75% of exports).

China's saving rate, averaging 46.4%, appears unusually high, exceeding saving rates in 94% of other countries. Leaving out oil exporters, China's average saving rate exceeds

[1] The Bernanke and Gurkaynak estimates are measured in the 1980-1995 period and consider labor shares making adjustments for self-employment income, building on Gollin (2002). Bernanke and Gurkaynak construct as many as three different estimates for each country; plotted points are means across the available estimates for each country. Chinese labor shares, which are not included in Bernanke and Gurkaynak, are averages across four methods analyzed by Kraay (2012), discussed in the text. Income per-capita (PPP) is taken from the Penn World Tables.

[2] Flow of funds data suggests the Chinese labor share in 2007 remains at approximately .51, while the other three sources put labor share around .40. Lardy (2012) discusses some challenges with the provincial aggregation in comparison to a flow-of-funds approach. Kraay (2012) considers these measures in addition to the input-output and household survey approaches.

all but two other countries, which are both small and rich – Luxembourg and Singapore. Figures 2A and 2B further show that China's savings rate is especially high given its income level. In a regression of average savings on log income per-capita and the share of fuels in exports, which predict saving rates with an R^2 of 0.6, China's saving rate appears 32 percentage points higher than expected.

Figure 2C presents China's domestic saving rate over time, comparing it to the earlier industrializers, South Korea, Japan, and Singapore. As in these other Asian economies, growth in income per-capita is associated with rising saving rates. Strikingly, however, when comparing saving rates at similar levels of per-capita income, China's saving rate far outpaces those in the other countries, exceeding Korea's savings rate by approximately 10 percentage points and Singapore's by approximately 20 percentage points. Thus China appears unusual not only in its absolute level of savings (now over 50%), but it appears especially unusual given its level of economic development, even in comparison to the history of other rapid-growth cases in Asia.

2.1.3 Consumption Rate

Unusually high saving rates are, not surprisingly, mirrored with unusually low consumption rates. Figure 3A presents China's household consumption rate compared to the world sample. Averaging over the 2000-2010 period, China's consumption rate is 38.8%, which is unusually low and consistent with the unusually low labor share of income.[3] Comparing China to other Asian economies, Figure 3B shows that China's consumption appears 20-40 percentage points lower at comparable states of development.

2.1.4 Investment Rate

Figure 4A shows China's average investment rate over 2000-2010, compared to a world sample. As with savings, consumption, and the labor share, China appears to be an outlier. With an average investment rate of 39.8%, China in the first decade of this century outpaced all other countries save two – Bhutan and Equatorial Guinea. Figure 4B shows the evolution of China's investment rate compared to other Asian Miracles. In each case, economic development has been associated with high and rising investment rates. However,

[3] Those rare countries with even lower consumption rates than China, as with the saving rate analysis, are typically oil exporters.

as with the saving rate, China's investment rate at a given level of per-capita income sharply exceeds the historical precedent in these other high growth countries. In sum, China appears unusual in its high rate of investment (now over 45%) both compared to the world sample and to antecedent and remarkable growth experiences of other Asian countries.

Finally, unusually high investment rates imply that China's capital-output ratio will also appear unusually high. Using the perpetual inventory method, capital-output ratios can be calculated under various assumptions about capital depreciation rates and the initial capital stock. Generally, China's capital-output ratio will be elevated conditional on its level of development, with an upward shift compared to other Asian economies similar to that seen in Figure 4B.

2.2 The Standard Model

To see the challenges these facts impose on standard theory, consider that neoclassical growth theory often builds on two core assumptions. First, factors are paid their marginal products. Second, the aggregate production function can be approximated as Cobb-Douglas, $Y = K^{\alpha}(AL)^{1-\alpha}$. The first assumption corresponds to a setting where firms maximize profits and are price takers (markets are competitive), and the program becomes

$$\max_{K,L} K^{\alpha}(AL)^{1-\alpha} - RK - wL \tag{1}$$

where R is the rental price of capital and w is the wage.

In this environment, the capital and labor shares of income are constants. If labor is paid its marginal product, then the labor share of income is $wL/Y = 1 - \alpha$. This model is "standard" for several reasons, but most importantly for our purposes because, as reviewed above, estimates of labor shares typically remain within narrow bounds. This tendency constitutes one of the major stylized facts of macroeconomics.[4]

Given that China does not satisfy this macroeconomic regularity, one is left with three possible conclusions: (i) the Chinese data are not correctly measured; (ii) China's production function diverges substantially from the norm, and/or (iii) not all factors are paid their

[4] A Cobb-Douglas production function, following Uzawa's steady-state growth theorem, also has the empirically appealing feature of allowing capital-augmenting technical progress in tandem with non-trending interest rates, both of which appear important features of economic growth. Nonetheless, the Cobb-Douglas description is still open to debate. Theoretically, constant labor shares can be consistent with non-unit elasticity of substitution between capital and labor, if capital- and labor-augmenting technical change proceed in the right way (see, e.g., Antras 2004). Relaxing the Cobb-Douglas assumption may be fruitful for understanding the Chinese economy, but this approach is not pursued in this paper.

marginal products. If one assumes that the data is sufficiently accurate to take the stylized facts above as broadly correct and that China's production function does not differ from the rest of the world, where Cobb-Douglas remains a reasonable stylization, then the last option remains. Namely, factor allocation in China departs from a competitive markets model.

This paper investigates this possibility.

3 China: An Alternative Approach

Our approach departs from the paradigm represented in (1) on two dimensions. Namely, we consider a case where (1) the state attempts to achieve high output (possibly subject to social stability considerations) and (2) factor markets are not fully competitive. The theory draws on explicit Chinese state policies, as discussed below.

At a broad level, we can connect this approach to the observed macroeconomic results along the following lines. Consider a program where China seeks to elevate output through capital accumulation, subject to constraints on the capital accumulation process. Namely, capital accumulation depends on investment, investment is limited by domestic savings (given China's capital controls), and domestic savings are in turn limited by factor payments to labor. In particular, consider two policy parameters. Let labor be paid a wage, $w(\theta)$, where θ is a policy parameter that creates distortions between wages and marginal products. Meanwhile, let China set an investment policy $I = \beta S$, where β is a policy parameter mapping savings into investment. Given national output, Y, and an average propensity to consume from household wage income, c, domestic savings are $S = Y - cw(\theta)L$. The investment rate is then

$$\frac{I}{Y} = \beta \left(1 - c\frac{w(\theta)L}{Y}\right)$$

This set-up thus provides a straightforward approach for linking an unusually low labor share, unusually high domestic saving rate, and unusually high investment rate. In particular, labor market policy (θ) elevates the domestic saving rate, and capital market policy (β) directs these savings toward domestic investment, working in tandem to meet China's output objectives.

We thus have a candidate approach for understanding some unusual features of the Chinese macroeconomy. The next section discusses how the Chinese economy can implement

this broad development approach, considering explicit state policies that can translate such a centralized output objective into the actions of decentralized firms.

3.1 The Chinese System

We ground our theoretical approach in prominent institutional features of the Chinese political and economic system. In particular, we start with the labor market, emphasizing how the hukou system influences the wages of migrant workers. We then consider explicit state objectives, as emphasized in a succession of five-year plans, that work to direct available savings into investment.

3.1.1 Labor Markets

China has long engaged in policies concerning population controls, including both population growth (the one child policy) and population allocations across areas (the hukou system). Demographic goals are explicit parts of state policy, encoded in successions of China's five year plans. For example, the Eleventh Five Year Plan (2006-2011) set the urbanization rate to grow from 43% to 47% and targeted an increase in urban employment by 45 million jobs.

China's hukou system, which has controlled internal migration within China since 1958, has long created a rural-urban divide among the workforce. A hukou, which is a residence permit, historically defines where people can live and work. Modeled on a similar system in the Soviet Union, the hukou system initially featured outright prohibitions on migration from rural to urban areas, largely as a means of political and social control. After the beginning of economic reform in 1978 there was a growing demand for urban labor. The government began to partially relax the restrictions on rural-urban migration to allow a gradual flow of migrant workers, who were not entitled to the full benefits of urban residents. Local governments employed numerous mechanisms to control the flow of migrant labor, including (1) quotas on the number of migrants that employers can hire, (2) fees levied on firms employing migrants (which have been estimated to reach 44% of the average monthly wage), and (3) recruitment fees paid to government agencies (Knight et al. 1999). More generally, local governments control access to land, financing, and licensing for firms, including construction and labor-intensive manufacturing firms, where migrants are often employed, which can further control the number of jobs available to migrants.

A body of literature on the hukou system documents substantial wage discrimination, where migrants earn far less than registered urban workers, even given similar observable worker characteristics (e.g. Meng and Zhang 2001, Lu and Song 2006, Park and Wang 2010, Lee 2012). For example, Park and Wang (2010), taking data for ten Chinese cities in 2005, show that migrant workers' hourly wages average 45% of registered urban workers.[5] Lu and Song (2006), studying 2003 data from Tianjin, find that migrants earn 51% of the urban-registered wage. Controlling for age, schooling, job tenure, and gender among other characteristics, the urban-registered workers still enjoy a 38% wage premium. Lee (2012) finds similar compensation premia when adjusting compensation for non-wage benefits, controlling for many observables and looking across five Chinese cities in 2005. These findings are also broadly consistent with the recorded difference in average monthly wages between migrants and urban-registered workers reported by China's National Bureau of Statistics, as shown in Figure 5.

Equilibrium unemployment search models provide a natural way to investigate the implications of the hukou system. With the hukou system and its supporting policies providing limited urban vacancies for rural hukou workers, rural hukou workers can be viewed as the "unemployed" - a surplus labor supply for the scarce urban vacancies. Consequently, migrants' wages can fall below their marginal product and towards their outside option - the rural wage. With migrant wages below their urban marginal products, the labor share of income falls. This feature in turn provides large domestic savings, via firms' operating surplus, which can support very high investment rates.

3.1.2 Capital Markets

The second piece of our analysis governs the use of elevated savings in the economy to meet output goals. China's five-year plans, at a high level, also provide guidance for state objectives, giving explicit output targets. Noting that national GDP growth has consistently met these targets over the last several decades suggests that these targets are implemented through effective micro-institutional measures.

In China's one-party system, centralized goals can be decentralized to local leaders through promotion incentives, where the Communist Party selects officials at all levels to

[5] Moreover, urban-registered workers are found to receive pension and health benefits in over 55% of cases, while migrants receives these additional benefits in less than 7% of cases.

serve a five-year term. Local leaders make decisions over "a substantial amount of resources, such as land, firms, financial resources, energy, raw materials, and others" (Xu 2011) while promotion incentives for local officials hinge on their success at bringing economic growth. As described in Vogel (2011, pp. 699-700): "[Deng] established a system in which governing teams, selected by the next higher level, were given considerable independence as long as they managed to bring rapid growth... In Deng's era and in the decades after Deng, those judgments were based overwhelmingly on how much the team contributed to China's overall economic growth." This combination of decentralized decision-making and centralized promotion opportunities provide a means for centralized state growth objectives to be decentralized to local officials (Edin 2003, Xu 2011).

To meet output goals, major institutional foundations include (1) state ownership of all land; and (2) a repressed financial system. Only the state could alienate land out of agriculture into industrial and commercial use, which was necessary as urbanization proceeded. The repressed financial system included ceilings on deposit interest rates, which have frequently been negative in real terms; dominance by four big state-owned commercial banks; underdevelopment of stock and bond markets; and a closed capital account. The state's unusual power in land and capital markets meant that local governments could rapidly develop infrastructure (e.g., roads, ports, and power). Local government also had levers to encourage industrial firms to invest by providing access to land, reliable infrastructure, and low-cost financing.

Ultimately, one can model the decentralization of investment decisions in various ways. Most simply, elevated output can be achieved indirectly by the state setting very low interest rates, elevating investment demand to make use of the domestic savings. Here, managers of firms may still seek to maximize profits, but they effectively act to meet output targets given their subsidized borrowing costs. This approach may be especially consonant with China's centralized control of the financial system (see also Song et al. 2011). Alternatively, with promotion incentives based on meeting output targets, the managers of firms might be viewed as seeking to achieve output goals directly, recycling the enterprise's retained earnings into further capital accumulation. In this view, the incentive system decentralizes output goals to the firm manager level. This approach may be especially consonant with public investments and state-owned enterprises. Both approaches, which are not mutually

exclusive, achieve similar outcomes - the deployment of savings into domestic investment. For simplicity, we will take the former approach in the model below, decentralizing output-goals through control of capital markets.

4 The Model

We use an equilibrium search model in the style of Pissarides (2000) to characterize the labor market. We focus on migrant labor – rural-registered workers seeking higher-paying jobs in cities, who are engaged in a search process. The central mechanism emphasizes that urban vacancies for rural-registered workers are scarce so that migrant workers have weak bargaining power over wages when offered jobs. Vacancies are scarce because the hukou system limits the employment of rural workers in cities, keeping would-be migrants in oversupply. Effectively, urban firms have a collective form of monopsony power over migrants, even though there are many urban firms who themselves are not collusive.

4.1 Workers

Consider three types of workers, indexed $j \in \{u, a, m\}$, where u denotes urban workers with urban resident permits, a denotes rural workers with rural resident permits, and m denotes migrant workers, who have rural resident permits but work in cities.

Let there be L workers in China, where

$$L_m + L_u + L_a = L$$

and $s_j = L_j/L$ denotes the share of workers of each type. We let population grow at rate n, and treat the number of urban (L_u) and rural ($L_a + L_m$) registrations as policy parameters, which also grow at rate n. Thus, we take the total population L and registered-urban population $L_u < L$ as exogenous features.

Let wages be denoted w_j and let workers consume a fraction c of their wage income, which is their only income source.[6] For simplicity, rural workers earn a competitive wage, w_a, when staying in the rural sector, while urban (registered) workers earn a competitive wage, w_u, in the urban sector. By contrast, migrant wages are determined through bargaining,

[6] That is, workers have no capital income. This stylization is broadly consistent with the observation that property and most enterprises remain owned by the state, while real interest rates on consumer deposits in China are typically near zero. Flow of funds data suggest for example that household income outside of labor compensation in 2008 amounted to only 2.4% of GDP (Lardy 2012).

where the share of migrant employment in urban firms is limited by policy as

$$L_m/L_u \leq \theta$$

This "hukou" policy parameter, θ, creates limited vacancies for rural workers in the city, which is the key to the wage behavior. It is taken as a simple way of modeling the various restrictions imposed on migrant employment.

4.2 Matching

Migrant job vacancies are filled when firms and migrant workers meet. If vacancies are scarce, then migrant workers find it hard to match. This scarcity worsens the outside option of the migrant worker, and their wage paid falls as a result.

For simplicity, let employment be forever – there is no job destruction.[7] The "unemployed" are the mass of rural workers, L_a. The mass of urban vacancies for rural workers is V. Let the matching function be $M(L_a, V)$, which is constant returns to scale and has the following natural properties. First, $M(0, x) = M(x, 0) = 0$, so that matches are impossible in the absence of vacancies or job-seekers. Second, $M_1 > 0$ and $M_2 > 0$, so that increasing the number of vacancies or job-seekers increases the rate of matching. Third, $\lim_{x\to\infty} M(x, 1) = \infty$ and $\lim_{y\to\infty} M(1, y) = \infty$, so that vacancies are filled immediately when there are infinitely many job-seekers per position and job-seekers find work immediately when there are infinitely many vacancies per worker.

Define the ratio of vacancies to rural workers as $z = V/L_a$. The rate at which rural workers find urban jobs is

$$b(z) = \frac{M(L_a, V)}{L_a} = M(1, z)$$

and the rate at which vacancies are filled is

$$d(z) = \frac{M(L_a, V)}{V} = M(1/z, 1)$$

It follows that $b'(z) > 0$, $d'(z) < 0$, $b(0) = d(\infty) = 0$, and $b(\infty) = d(0) = \infty$.

4.3 Value Functions

As a baseline, we consider a balanced growth setting, where the rural and urban sectors have common productivity growth rates, g. The Bellman equations for the migrant workers and

[7] Job destruction could easily be introduced.

the firms that employ them are

$$\begin{aligned}
\tilde{r}V_m &= w_m && (2)\\
\tilde{r}V_a &= w_a + b\left(V_m - V_a\right) && (3)\\
\tilde{r}V_F &= v_m - w_m && (4)\\
\tilde{r}V_V &= d\left(V_F - V_V\right) && (5)
\end{aligned}$$

where V_m is the net present value of being employed as a migrant worker, V_a is the net present value of rural employment, V_F is a firm's net present value from filling a job with a migrant, and V_V is the net present value of a vacancy. The flow value v_m is the marginal value-added of a migrant worker for the urban firm. In equilibrium, this will be the same as the registered urban wage, w_u. Note that the "effective" discount rate is $\tilde{r} = r - g$, where the real discount rate is $r > g$ and taken as exogenous.

4.4 The Migrant Wage

The rural wage, w_a, and the value-added of the migrant worker, v_m, are known. They come from the production functions and optimization behavior in agricultural firms and urban firms, which we will consider below.

Using a standard (Nash Bargaining Solution) bargaining concept, we'll assume that the wage w_m is determined such that firm and worker have the same net gain against their outside option

$$V_m - V_a = V_F - V_V$$

From (2), (3), (4) and (5) we can determine the migrant wage as

$$w_m = (1-q)w_a + qv_m \tag{6}$$

where we define the migrant worker's "bargaining power" as

$$q = \frac{b + \tilde{r}}{b + d + 2\tilde{r}} \tag{7}$$

and note that $q \in [0, 1]$. The migrant's wage is thus a weighted average of the worker's outside option wage, w_a, and the migrant's value-added in urban work, v_m. The migrant's capacity to extract her additional value-added through urban work depends on whether

vacancies are more or less scarce compared to the rural population (via the b and d terms), which determines the migrant worker's relative bargaining power, q. Increasingly scarce vacancies ($z = V/L_a$ falls) mean that d rises and b falls. Thus lots of rural labor compared to urban vacancies will cause the wage to fall toward the outside option, the rural wage. This outcome is the main point of this labor market model. It follows naturally to the extent that Chinese policy successfully limits urban vacancies for rural workers.

4.5 Production

We let the urban and rural sectors have Cobb-Douglas production functions, with decentralized firms seeking to maximize profits. In general, workers are employed within one of three types of firms: rural firms that employ rural-registered workers, urban firms that employ urban-registered workers, and urban firms that employ migrant workers. Firms solve the problem

$$\max_{K_j, L_j} K_j^{\alpha} \left(A_j L_j\right)^{1-\alpha} - w_j L_j - R K_j$$

where $j \in \{u, a, m\}$ denotes the type of worker and hence the type of firm. We imagine that $A_a < A_u$ and, for simplicity, $A_u = A_m$. In other words, urban production is more productive than rural production.[8]

All firms are price takers on capital, given its rental price. This implies that capital is employed such that $K_j = A_j \left(\frac{\alpha}{R}\right)^{\frac{1}{1-\alpha}} L_j$ in each sector. In practice, the state will set R to clear the savings market. With lots of savings, R can be set low, elevating capital intensity and output. In this manner, state control of the capital market acts to decentralize the state's output objective into firm-level profit maximizing decisions.

Migrant employment, the focus of the model, features bargaining over wages as already described. By contrast, we assume competitive labor markets among other types of workers (those who work where they are registered) and who are thus paid their marginal products.[9]

[8] The assumption that productivity in urban sector firms is similar for both urban-registered and migrant workers could be relaxed; we maintain this assumption to focus the model and emphasize the productivity advantage of urban over rural work.

Note also that we have also assumed perfectly elastic demand for rural and urban output. Alternatively, one could introduce CES preferences across the rural and urban products, allowing for downward sloping demand. Because this latter approach adds some complexity without substantively altering the main points of the model, we leave this approach aside. Results generalizing the demand side are available from the authors upon request.

[9] Equivalently, these firms can also be placed in a bargaining set-up, only in this case they are unconstrained in issuing vacancies, so that the the value of their vacancies is zero. Hence these firms have no

The migrant wage, as defined in (6), falls between the urban marginal product and the (lower) rural wage. Therefore, since $w_m < v_m$, the urban firm will hire as many rural-registered workers as possible, so that $L_m = \theta L_u$, and the total urban workforce is thus $(1+\theta) L_u$. Note also that the marginal product of workers in urban firms is $v_m = v_u = w_u$.

According to the population constraints, the allowable range for the hukou policy parameter, θ, is

$$\theta \in [0, \frac{1}{s_u} - 1]$$

and we will denote $\theta_{\max} = \frac{1}{s_u} - 1$, at which point all rural-registered workers would be employed in cities.

4.6 Macroeconomic Aggregates

In this section we define the main macroeconomic aggregates that result from the above policies and relate them back to the stylized facts of Section 2.

4.6.1 The Labor Share

Define the labor share of income as $\Lambda = \bar{w}L/Y$, where $\bar{w}$ is the mean wage paid in China. In the above model, the labor share in China falls due to migrants in the urban sector, and China's overall labor share is the GDP-weighted average of the urban and rural labor shares.[10] In particular, we have

$$\Lambda = (1-\alpha) - \frac{(w_u - w_m)\,\theta L_u}{Y} \tag{8}$$

so that China's labor share will decline (compared to its standard value of $1-\alpha$) through two forces: (i) the extent to which migrant workers are paid less than their marginal products, $w_u - w_m$; (ii) the mass of migrant workers, θL_u. These forces can be expressed in terms of the model's exogenous parameters as follows

Lemma 1 *China's labor share is* $\Lambda = (1-\alpha)\left[1 - \frac{\theta}{1+\theta}\frac{(1-q)\left(1-\frac{A_a}{A_u}\right)}{1+\frac{A_a}{A_u}\left(\frac{1}{(1+\theta)s_u}-1\right)}\right]$, *where* $q = \frac{\frac{n\theta s_u}{1-(1+\theta)s_u}+\tilde{r}}{\frac{n\theta s_u}{1-(1+\theta)s_u}\left(1+\frac{1}{z}\right)+2\tilde{r}}$ *and* $z = b^{-1}(\frac{n\theta s_u}{1-(1+\theta)s_u})$.

bargaining power against their workers, who therefore earn their marginal products. A bargaining approach can be set-up along the lines of (4) and (5) where the costless issuance of vacancies means that the value of vacancies goes to zero in equilibrium, which implies that the value of a filled job goes to zero for the firm, and hence the worker captures their full marginal product. For simplicity and focus of exposition, we simply assert that these firms pay marginal products.

[10] One could also consider extensions where the rural wage is not fully competitive, allowing the rural wage to also fall below the rural marginal product (e.g. through state control of rural enterprises). This decline in the rural wage would further reduce the migrant wage in cities, as migrants' outside option gets worse.

Proof: See appendix.

4.6.2 Saving, Investment, and Capital

The saving and investment rates follow as in Section 3. The saving rate is

$$\frac{S}{Y} = 1 - c\Lambda \tag{9}$$

where c is households' consumption rate from their labor payments. The saving rate can thus be expressed in terms of underlying parameters using the labor share expression in the Lemma, and the comparative statics properties of the savings rate are the opposite of those for the labor share.[11]

The aggregate investment rate in this model, following the capital market rule $I = \beta S$, then follows directly from above

$$\frac{I}{Y} = \beta\left(1 - c\Lambda\right) \tag{10}$$

where again the labor share is expressed in terms of underlying parameters using the Lemma.

The aggregate capital-stock, K, and market clearing rental price, R, are then determined based on the supply and demand for capital. Capital accumulates in both the urban and rural sectors as $\dot{K}_i = I_i - \delta K_i$ where i denotes the sector. The steady-state growth path of the capital stock is then $K = I/\left(g + n + \delta\right)$, which implies

$$\frac{K}{Y} = \frac{\beta}{g + n + \delta}\left(1 - c\Lambda\right)$$

On the demand side, firms are price-taking on capital in both rural and urban sectors and thus set $K_i = \left(\alpha/R\right) Y_i$, which implies that the total capital stock is $K = (\alpha/R)Y$. The rental price that clears the capital market is then

$$R = \left(g + n + \delta\right)\frac{\alpha}{\beta}\left(1 - c\Lambda\right)^{-1} \tag{11}$$

so that a lower labor share, leading to elevated savings, causes the Chinese state's capital market to clear at a lower rental price.

Finally, aggregate GDP in the model, summing across the output of urban and rural firms, is

$$Y = \left(\frac{\beta\left(1 - c\Lambda\right)}{g + n + \delta}\right)^{\frac{\alpha}{1-\alpha}}\left(A_u\left(1 + \theta\right)L_u + A_a L_a\right) \tag{12}$$

[11] Note that we leave the household saving rate as an exogenous parameter, to focus the model on the labor share aspect. The household saving rate, $1 - c$, which is also high in China, is an interesting and potentially complex subject in its own right. See, e.g., Wei and Zhang (2011) for analysis of the household saving rate in China.

4.7 Comparative Statics

We can now consider comparative statics on the steady-state macroeconomic aggregates. First, we consider a relative shock to the urban/rural productivity ratio.

Corollary 1 *The labor share is decreasing in A_u/A_a, while the saving rate and investment rate are increasing in A_u/A_a.*

Proof: See appendix.

Intuitively, widening the productivity gap between the urban and rural sector, other things equal, will increase the gap between the migrant's wage and their marginal product, which causes the labor share to fall. Hence, productivity-enhancing reform targeted at urban-areas will ultimately raise savings, investment, and capital stocks, while reform targeted at rural-areas can have the opposite effect.

Secondly, we consider the implications of relaxing the hukou policy, which has non-monotonic effects. There are two offsetting features. First, as the hukou policy is relaxed (θ rises), the bargaining power of migrant workers increases and their wage rises toward their marginal product. This "migrant-wage" mechanism is captured in the following Lemma, where we recall that $q \in [0,1]$ is the migrant's bargaining power and we define $\omega = w_m/w_u$ as the share of their marginal product that migrant workers capture.

Lemma 2 *$q'(\theta) \geq 0$, and $\{q(0), q(\theta_{\max})\} = \{0,1\}$. Moreover, $\omega'(\theta) \geq 0$, and $\{\omega(0), \omega(\theta_{\max})\} = \{w_a/w_u, 1\}$.*

Proof: See appendix.

This increase in the migrant's wage (toward their marginal product) causes the labor share of income to rise, other things equal.

On the other hand, as the hukou policy relaxes, more rural workers take up migrant work, causing a greater share of the labor force to be paid below their marginal product. This "migrant-quantity" effect causes the labor share to decline, other things equal. Interestingly, in the contest between the migrant-wage effect (the intensive margin) and the migrant-quantity effect (the extensive margin), relaxing the hukou policy – moving towards a freer labor market – can actually cause the labor-share to decline, moving further from the competitive market baseline. We encapsulate this non-monotonicity as follows.

Lemma 3 $\Lambda(0) = \Lambda(\theta_{\max}) = 1 - \alpha$, *but* $\Lambda(\theta) < 1 - \alpha$ *for all* $0 < \theta < \theta_{\max}$.

Thus the equilibrium labor share of income must initially decline when migration is first allowed but eventually rise. Following (9) and (10), the saving rate and investment rate are then non-monotonic in the hukou policy as well, but with the opposite sign, so that the saving and investment rates rise as migration is first allowed but eventually fall.

Proof: See Appendix.

The final result concerns aggregate GDP. Here again there is a non-monotonicity in the hukou policy, although for an additional reason. Namely, there is an allocative inefficiency when the hukou policy traps agricultural workers in the less-productive, rural sector. On this dimension, relaxing the hukou policy – allowing more rural workers to reallocate to the urban sector - would appear only to increase income per-capita, which suggests that income would be maximized with a fully relaxed hukou policy. However, the dynamics in the labor share mean that the saving rate and investment rate can be maximized away from a fully relaxed hukou policy. In the tension between these two forces, it turns out that maximal output is achieved somewhere between the hukou policy that minimizes the labor share and a fully free labor market. Defining $\hat{\theta}$ as a point such that $\Lambda'(\hat{\theta}) = 0$, this result is encapsulated formally as follows.

Lemma 4 $Y'(\hat{\theta}) > 0$. $Y'(\theta_{\max}) < 0$ *if* $\frac{\tilde{r}}{n} > \frac{1-c(1-\alpha)}{\alpha c}$

Proof: See Appendix.

Overall, these results indicate that, other things equal, a restrictive hukou policy ($\theta < \theta_{\max}$) can reduce the labor share, expand the saving rate, and expand the investment rate, while also raising national output compared to competitive market norms where the hukou policy is fully relaxed. Thus, this institutional viewpoint may help provide a consistent interpretation for China's unusual macroeconomic aggregates. We next consider simple calibrations to further explore the magnitude of such effects and their non-monotonicities.

4.8 Calibration

Using National Bureau of Labor Statistics wage data (see Figure 5), the migrant wage in 2010 is approximately 55% of the urban-registered wage, while the rural wage is approximately 16% of the urban-registered wage.[12] Meanwhile, current estimates suggest that the migrant

[12] Wages are monthly. The data is available from http://www.stats.gov.cn/english/.

labor population is of similar magnitude to the urban-registered workforce, suggesting that the key parameter of the model, θ, is approximately 1. Lastly, as shown in Figure 6, which uses National Bureau of Statistics flow of funds data, the enterprise savings rate has risen by about 10 percentage points in the last decade, making these savings the primary driver of increased aggregate savings over that period, as seen in Figure 2C.

With these numbers in mind, we can turn to a specific calibration exercise. In particular, we consider specific relationships between the hukou policy, θ, and labor market outcomes by making assumptions about the matching function and about other exogenous parameters. Specifically, we take recent observables of the urban-registered population share and the population growth rate to choose $s_u = 0.25$ and $n = 0.005$. We further set the productivity growth rate, depreciation rate and effective discount rate as $g = 0.08$, $\delta = .06$, and $\tilde{r} = .08$. The urban-rural productivity ratio is set as $A_a/A_u = .16$, matching the current registered urban-rural wage ratio, and we set the capital elasticity of output at the standard value $\alpha = 1/3$. The marginal propensity to consume from household income is set at $c = 0.62$. Lastly, we let the matching function be $M(L_a, V) = \kappa L_a^{1/2} V^{1/2}$, where $\kappa = .01$. Then the relationships between the hukou policy parameter and economic outcomes are as summarized in Figure 7.

As is generally true by Lemma 3, the calibration shows the interesting result that the equilibrium labor share declines when the migration restrictions are initially relaxed (upper left panel). While a less restrictive migration policy is associated with higher wages for migrants (upper right panel), the increasing number of workers subjected to wages below their marginal products (lower left panel) depresses the labor share on net. This plot also shows migrant-urban wage differentials that are consistent with observed evidence (see, e.g., Figure 5) when $\theta \approx 1$, and the labor share can be seen to decline by substantial amounts through the hukou mechanism alone, broadly consistent with the magnitudes seen in Figure 1A or 1B. In particular, the labor share with $\theta \approx 1$ is found to be about 15 percentage points lower than would occur with fully competitive factor markets.[13]

Aggregate output, as shown in the model, reflects two mechanisms as the hukou policy relaxes. On the one hand, average labor productivity increases as workers are increasingly

[13] To the extent that the observed deviation in the labor share from international norms is thought to be larger than this calibration delivers, one simple extension would be to introduce wage supression in the urban and/or rural sector as well, given for example state control of property rights and state-owned enterprises, which disproportionately employ workers with hukou.

reallocated from lower-productivity rural jobs to higher-productivity urban jobs. Separately, saving (and hence capital accumulation) rises and then falls, following the labor share dynamics. The first force means that output peaks to the right of the minimum labor share, where the maximum saving rate occurs but reallocative productivity gains are not yet fully exploited (Lemma 4).

Figure 7 (lower right panel) plots the marginal percentage increases in equilibrium GDP due to a marginal relaxation of the hukou policy ($\frac{\partial \log Y}{\partial \theta}$). For this calibration, additional relaxations of the hukou policy are seen to be growth enhancing over a wide range of θ, yet the growth advantage declines at higher θ and eventually turns negative. These diminishing returns occur both because the percentage output gain from worker reallocation is declining the more the reallocation has already occurred, and because diminishing returns to capital increasingly mute the growth advantage of additional saving rate increases.[14] Thus liberalizing the hukou system pays its biggest growth dividends at first. Eventually, once the labor share rises and the saving rate plummets, further relaxation of the hukou policy causes equilibrium output to fall.

Overall, in moving away from the fully restrictive population registration system, the hukou policy turns from being a mechanism for political and social control into a mechanism that can also facilitate economic growth and hence the attainment of aggressive output objectives by the state. The calibration suggests that large changes in the labor share, saving rate, and output can follow from natural parameterizations.

5 Discussion

5.1 Summary

This paper shows that China's macroeconomic performance is an outlier with respect to (i) global norms and (ii) the prior experience of other rapidly-growing Asian economies. In particular, China shows highly elevated savings and investment rates, coupled with depressed consumption and a depressed labor share. The paper then considers micro-institutional features of the Chinese system that can lead to these unusual aggregate phenomena. The

[14] Recall that we are assuming perfectly elastic demand for rural and urban output. If demand is instead downward sloping, then the reallocation advantage becomes more muted as θ increases, because the urban-rural price ratio falls. This effect further reinforces the diminishing returns to equilibrium GDP from relaxing θ. Analysis of the model and further calibrations with downward sloping demand are available from the authors upon request.

model shows how the hukou system, limiting migration from rural to urban areas, can create surplus labor supply for higher-productivity jobs in cities, depressing the labor share and expanding savings. Meanwhile, government control of capital markets, including cross-border capital controls and state-controlled domestic lending, direct elevated savings into unusually high domestic investment rates. In addition to suggesting an explanation for unusual macroeconomic aggregates, the model is also broadly consistent with elevated enterprise saving rates and, perhaps most importantly, the large wage discount for migrant workers in China's cities that has been discussed extensively in the micro-literature.

5.2 Additional Applications

The model may also help inform other macroeconomic phenomena. For example, China's current account surplus follows automatically when domestic investment rates do not absorb all domestic savings, and while earlier periods featured more neutral trade positions, China has seen large trade surpluses in recent years. Fixing an investment path, the trade surplus could be seen as a side effect of increased savings as the hukou policy relaxes. More generally, the current account surplus follows if Chinese policymakers set $\beta < 1$. While the determination of this parameter is left outside the model, two natural explanations for setting $\beta < 1$ may be consistent with the growth objectives in the five-year plans. First, Chinese policy may explicitly favor export-led growth in pursuit of technology spillovers or other productivity benefits. Second, having observed the Asian financial crisis in 1997-1998, Chinese leaders may have explicitly built foreign reserves as self-insurance. Both motives compete with a pure domestic investment strategy for domestic savings (where $\beta = 1$), choosing additional avenues to facilitate growth.

Lastly, the model suggests views on China's path forward. As Chinese leaders wrestle with tradeoffs between investment growth and inequality, and consider methods to increase domestic consumption, they may naturally consider both (i) productivity-enhancing rural reforms and (ii) relaxing the hukou system. Rural reforms will help meet inequality goals, but the model of this paper suggests that they will also cut against savings and limit investment growth. In contrast, further relaxing the hukou system may, surprisingly, raise migrant wages and yet further suppress the labor share and elevate the saving rate initially. Here, reducing inequality among urban workers may actually facilitate high savings and

investment. Ironically, additional moves toward a freer labor market may initially drive China yet further from antecedent macroeconomic norms. Over the longer term, however, if China fully relaxes the hukou policy, the hukou-savings mechanism identified in this paper would ultimately cause the labor share to return to global averages. In such a scenario, more limited domestic saving would put pressure on the capacity of China to maintain both a current account surplus and a high domestic investment rate.

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6 Appendix

Proof of Lemma 1

China's labor share is $\Lambda = (1-\alpha)\left[1 - \frac{\theta}{1+\theta}\frac{(1-q)\left(1-\frac{A_a}{A_u}\right)}{1+\frac{A_a}{A_u}\left(\frac{1}{(1+\theta)s_u}-1\right)}\right]$, where $q = \frac{\frac{n\theta s_u}{1-(1+\theta)s_u}+\tilde{r}}{\frac{n\theta s_u}{1-(1+\theta)s_u}\left(1+\frac{1}{z}\right)+2\tilde{r}}$ and $z = b^{-1}\left(\frac{n\theta s_u}{1-(1+\theta)s_u}\right)$.

Proof. From (8), and noting that per-capita urban output is $y_u = Y_u/\left[(1+\theta)\,L_u\right]$, we can write the labor share as

$$\Lambda = (1-\alpha) - \frac{w_u}{y_u}\frac{\theta}{1+\theta}\left(1-\frac{w_m}{w_u}\right)\frac{Y_u}{Y} \tag{13}$$

With urban-registered workers paid their marginal products, we have

$$\frac{w_u}{y_u} = 1-\alpha \tag{14}$$

Meanwhile, from (6), and noting that $w_a/w_u = A_a/A_u$

$$\frac{w_m}{w_u} = (1-q)\frac{A_a}{A_u} + q \tag{15}$$

Lastly, the urban GDP share is

$$\frac{Y_u}{Y} = \frac{y_u(1+\theta)L_u}{y_u(1+\theta)L_u + y_a L_a} = \frac{1}{1+\frac{A_a}{A_u}\left(\frac{1}{(1+\theta)s_u}-1\right)} \tag{16}$$

where we have divided through by the numerator, replaced $L_a = L-(1+\theta)\,L_u$, and used $s_u = L_u/L$.

Hence, putting (14), (15), and (16) into (13) we can write

$$\Lambda = (1-\alpha)\left[1-\frac{\theta}{1+\theta}\frac{(1-q)\left(1-\frac{A_a}{A_u}\right)}{1+\frac{A_a}{A_u}\left(\frac{1}{(1+\theta)s_u}-1\right)}\right]$$

proving the first part of the Lemma.

The second part of the Lemma considers the value of q. With state policy setting the registered urban worker population as L_u, population growth at rate n, and the hukou policy set to achieve $L_m = \theta L_u$, then the rate of matching is $\dot{L}_m = M\left(L-(1+\theta)\,L_u, V\right) = n\theta L_u$. From the definition of $b\,(z)$, we can then write

$$b(z) = \frac{n\theta s_u}{1-(1+\theta)\,s_u} \tag{17}$$

It then follows from (7) that

$$q = \frac{\frac{n\theta s_u}{1-(1+\theta)s_u} + \tilde{r}}{\frac{n\theta s_u}{1-(1+\theta)s_u}\left(1+\frac{1}{z}\right)+2\tilde{r}}$$

where we recall that $d(z) = b(z)/z$. Further, since $b(z)$ is monotonically increasing, we can write

$$z = b^{-1}\left(\frac{n\theta s_u}{1-(1+\theta)\,s_u}\right)$$

completing the proof. ■

Proof of Corollary 1

The labor share is decreasing in A_u/A_a, while the saving rate and investment rate are increasing in A_u/A_a.

Proof. Note that the migrant's bargaining power q does not depend on A_u/A_a. From Lemma 1, it is then clear by inspection that a rise in A_u/A_a causes $\frac{1-\frac{A_a}{A_u}}{1+\frac{A_a}{A_u}\left(\frac{1}{(1+\theta)s_u}-1\right)}$ to rise. Hence, the labor share falls. By (9) and (10), the saving and investment rates then rise. ■

Proof of Lemma 2

$q'(\theta) \geq 0$, and $\{q(0), q(\theta_{\max})\} = \{0, 1\}$. Moreover, $\omega'(\theta) \geq 0$, and $\{\omega(0), \omega(\theta_{\max})\} = \{w_a/w_u, 1\}$.

Proof. The migrant's bargaining power, from (7), is $q = \frac{b+\tilde{r}}{b+d+2\tilde{r}}$. By the chain rule $\frac{\partial q}{\partial \theta} = \frac{\partial q}{\partial z}\frac{\partial z}{\partial \theta}$ where

$$\frac{\partial q}{\partial z} = \frac{b'd - bd' + (b' - d')\tilde{r}}{(b + d + 2\tilde{r})^2} \geq 0$$

This expression is signed recalling that $b'(z) \geq 0$ and $d'(z) \leq 0$.

Meanwhile, the function $z(\theta)$ is defined implicitly by (17), which implies that

$$z'(\theta) = \frac{1}{b'(z)} \frac{ns_u(1 - s_u)}{(1 - (1 + \theta)s_u)^2} \geq 0$$

We therefore have $q'(\theta) \geq 0$.

Next, note that $z(\theta)_{\theta=0} = 0$. This follows because $b(z)_{\theta=0} = 0$ (from (17)), while the properties of matching function tell us that $b(z) = 0$ only when $z = 0$. Hence

$$\lim_{\theta \to 0} q(z(\theta)) = \lim_{z \to 0} \frac{b(z) + \tilde{r}}{b(z) + d(z) + 2\tilde{r}} = 0$$

where we use $b(0) = 0$ and $d(0) = \infty$.

Next, note that $z(\theta_{\max}) = \infty$. This follows from (17), where $b(z(\theta_{\max})) = \infty$, which in turn implies $z = \infty$ from the properties of the matching function. Hence

$$\lim_{\theta \to \theta_{\max}} q(z(\theta)) = \lim_{z \to \infty} \frac{b(z) + \tilde{r}}{b(z) + d(z) + 2\tilde{r}} = 1$$

where we use $b(\infty) = \infty$ and $d(\infty) = 0$.

Turning to the migrant wage, we note from (6) that $\omega = w_m/w_u = (1-q)w_a/w_u + q$. Since $\theta = 0$ implies $q = 0$ (above) it also follows that $\theta = 0$ implies $\omega = w_a/w_u$. Furthermore, $\theta = \theta_{\max}$ implies $q = 1$ (above), which implies $\omega = 1$.

Lastly, since $w_a/w_u = A_a/A_u$, which is not a function of the hukou policy, it follows from $q'(\theta) \geq 0$ and $A_a/A_u < 1$ that $\omega'(\theta) = q'(\theta)(1 - A_a/A_u) \geq 0$, completing the proof. ■

Proof of Lemma 3

$\Lambda(0) = \Lambda(\theta_{\max}) = 1 - \alpha$, but $\Lambda(\theta) < 1 - \alpha$ for all $0 < \theta < \theta_{\max}$.

Proof. Recall that

$$\Lambda(\theta) = (1-\alpha)\left[1 - \frac{\theta}{1+\theta}\frac{(1-q)\left(1-\frac{A_a}{A_u}\right)}{1+\frac{A_a}{A_u}\left(\frac{1}{(1+\theta)s_u}-1\right)}\right]$$

Noting that (i) $A_a < A_u$, (ii) $s_u < 1$, (iii) $\theta \leq \theta_{\max} = \frac{1}{s_u} - 1$, and (iv) $q(\theta) \in [0,1]$ it follows by inspection of $\Lambda(\theta)$ that the expression in square brackets is weakly less than 1. Hence $\Lambda(\theta) \leq 1 - \alpha$. At any value of the hukou parameter, θ, the labor share is weakly less than the competitive market norm.

It also follows by inspection that $\Lambda(0) = 1 - \alpha$. (In this circumstance, there are no migrant workers, so that all laborers are paid their marginal products.) Similarly, noting from Lemma 2 that $q(\theta_{\max}) = 1$, it also follows by inspection that $\Lambda(\theta_{\max}) = 1 - \alpha$. (In this circumstance, there are many migrant workers but they receive their full marginal product.) Hence we have shown that $\Lambda(0) = \Lambda(\theta_{\max}) = 1 - \alpha$.

We can show that $\Lambda(\theta) < 1 - \alpha$ for all $0 < \theta < \theta_{\max}$ as follows.

First, we have just observed that $\Lambda(\theta) \leq 1 - \alpha$.

Second, by contradiction, assume there exists some $0 < \hat{\theta} < \theta_{\max}$ where $\Lambda\left(\hat{\theta}\right) = 1 - \alpha$. Inspection of $\Lambda(\theta)$ above shows we then require that $q\left(\hat{\theta}\right) = 1$. However, from Lemma 2, we know that $q(\theta_{\max}) = 1$ and $q'(\theta) \geq 0$. Therefore, if $q'(\theta_{\max}) > 0$, then it must follow that $q(\theta) < 1$ for all $\theta \in (0,1)$, which is a contradiction. The proof can thus simply establish that $q'(\theta_{\max}) > 0$.

After some algebra, write $q'(\theta)$ as

$$q' = \frac{\frac{\tilde{r}b'}{b^2}(1 - 1/z) + \frac{2b'}{zb}(1 + \tilde{r}/b)}{(1 + 1/z + 2\tilde{r}/b)^2}$$

Noting that $\lim_{\theta\to\theta_{\max}} b(\theta) = \infty$ and $\lim_{\theta\to\theta_{\max}} z = \infty$, it follows that

$$\lim_{\theta\to\theta_{\max}} q'(\theta) = \lim_{\theta\to\theta_{\max}} \left[\frac{\tilde{r}b'}{b^2} + \frac{2b'}{zb}\right] \geq \lim_{\theta\to\theta_{\max}} \frac{\tilde{r}b'}{b^2}$$

where the weak inequality follows noting that $\frac{2b'}{zb} \geq 0$ for all θ.

From (17), we can show that $\lim_{\theta\to\theta_{\max}} b'(\theta)/b(\theta) = \frac{1}{n\left(\frac{1}{s_u}-1\right)}$. Hence

$$\lim_{\theta\to\theta_{\max}} q'(\theta) \geq \frac{\tilde{r}}{n\left(\frac{1}{s_u}-1\right)} > 0$$

which establishes, by contradiction, that $\Lambda(\theta) < 1-\alpha$ for all $0 < \theta < \theta_{\max}$. ■

Proof of Lemma 4

$Y'\left(\hat{\theta}\right) > 0$. $Y'(\theta_{\max}) < 0$ if $\frac{\tilde{r}}{n} > \frac{1-c(1-\alpha)}{\alpha c}$

Proof. Taking logs of aggregate GDP from (12), we can write

$$\log Y = \frac{\alpha}{1-\alpha}\log(1-c\Lambda) + \log\left[A_u - A_a\right)(1+\theta)L_u + A_a L] + B$$

where the B term is not a function of θ. The comparative static with respect to the hukou policy is

$$\frac{\partial \log Y}{\partial \theta} = -\frac{\alpha}{1-\alpha}\frac{c\Lambda'(\theta)}{1-c\Lambda} + \frac{(A_u - A_a)L_u}{(A_u - A_a)(1+\theta)L_u + A_a L} \tag{18}$$

(i) Consider $Y'(\hat{\theta})$. At the minimum labor share, $\Lambda'\left(\hat{\theta}\right) = 0$. Therefore, from (18)

$$\left.\frac{\partial \log Y}{\partial \theta}\right|_{\hat{\theta}} = \frac{(A_u - A_a)L_u}{(A_u - A_a)\left(1+\hat{\theta}\right)L_u + A_a L} > 0$$

where the last inequality follows recalling that $A_a < A_u$. Intuitively, where the labor share is minimized, further small relaxations of the hukou policy have no effect on the saving rate, so that the only force operating is the reallocation of workers to higher productive urban labor, which strictly raises national output.

(ii) Consider $Y'(\theta_{\max})$. At $\theta = \theta_{\max}$, $L = (1+\theta_{\max})L_u$ and $\Lambda = 1-\alpha$, implying

$$\left.\frac{\partial \log Y}{\partial \theta}\right|_{\theta_{\max}} = -\frac{\alpha}{1-\alpha}\frac{c\Lambda'(\theta_{\max})}{1-c(1-\alpha)} + \frac{A_u - A_a}{A_u(1+\theta_{\max})}$$

It follows that $Y'(\theta_{\max}) < 0$ if and only if

$$\Lambda'(\theta_{\max}) > \frac{1-\alpha}{\alpha}\frac{1-c(1-\alpha)}{c}\frac{A_u - A_a}{A_u(1+\theta_{\max})} \tag{19}$$

Recalling Lemma 1, which determines $\Lambda(\theta)$, it is straightforward to show that

$$\Lambda'(\theta) = -(1-\alpha)\left(1-\frac{A_a}{A_u}\right)G(\theta)$$

where

$$G(\theta) = \frac{1}{1+\theta}\frac{1}{1+\frac{A_a}{A_u}\left(\frac{1}{(1+\theta)s_u}-1\right)}\left[\frac{1-q(\theta)}{1+\theta} - \theta q'(\theta) + \frac{\theta(1-q(\theta))\frac{A_a}{A_u}\frac{1}{(1+\theta)^2 s_u}}{1+\frac{A_a}{A_u}\left(\frac{1}{(1+\theta)s_u}-1\right)}\right]$$

Recalling $(1+\theta_{\max})s_u = 1$ and $q(\theta_{\max}) = 1$, it follows that

$$\Lambda'(\theta_{\max}) = (1-\alpha)\left(\frac{A_u - A_a}{A_u}\right)\left[\frac{\theta_{\max}}{1+\theta_{\max}}q'(\theta_{\max})\right] \tag{20}$$

Recalling that $\lim_{\theta\to\theta_{\max}} q'(\theta) \geq \frac{\tilde{r}}{n\theta_{\max}}$ (see the proof to Lemma 3) we can then write a sufficient condition for $Y'(\theta_{\max}) < 0$, using (19) and (20), as

$$\frac{\tilde{r}}{n} > \frac{1-c(1-\alpha)}{\alpha c}$$

■

Figure 1A: Labor Shares, China versus Rest of World

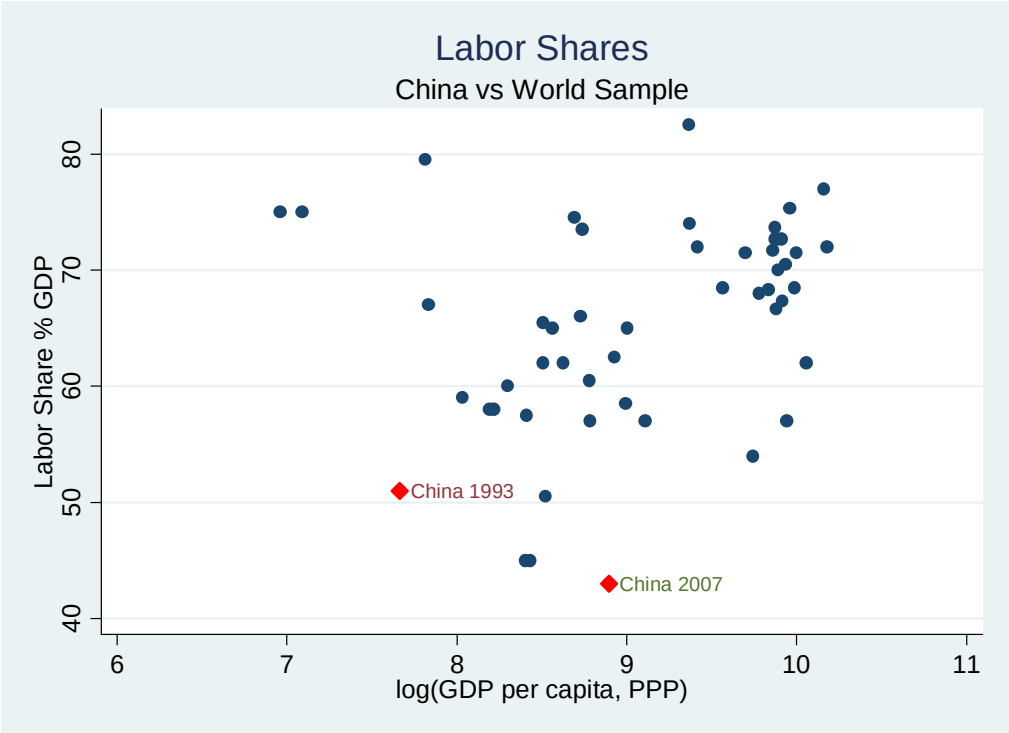

Figure 1B: China's Labor Share, Various Sources

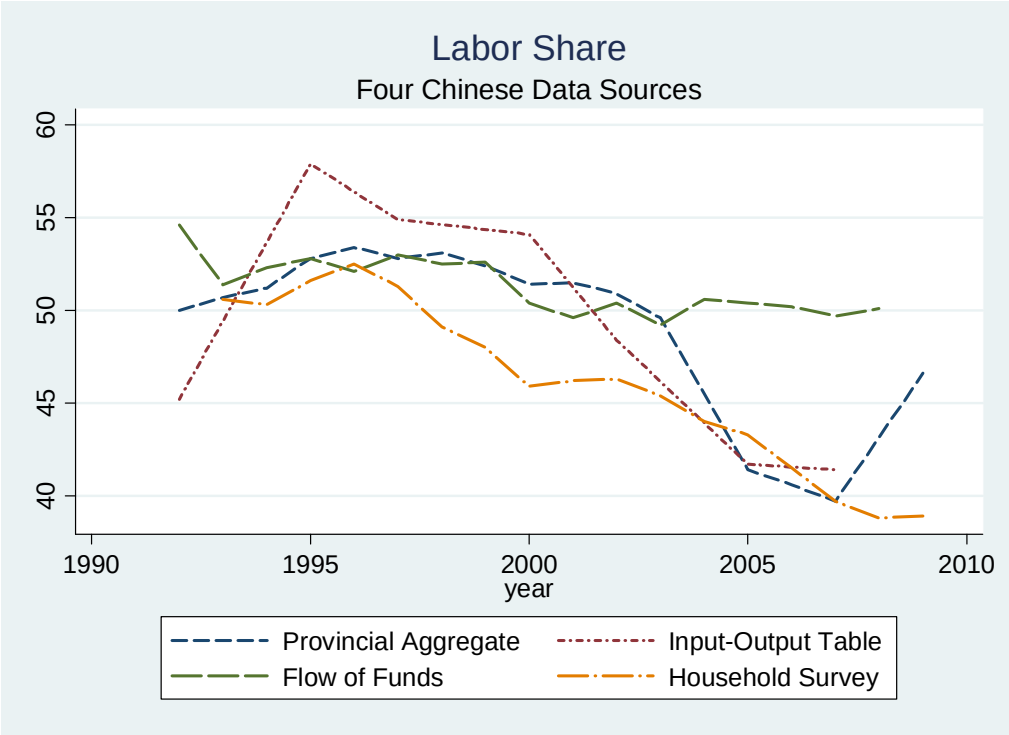

Figure 2A: Saving Rates, China versus Rest of World

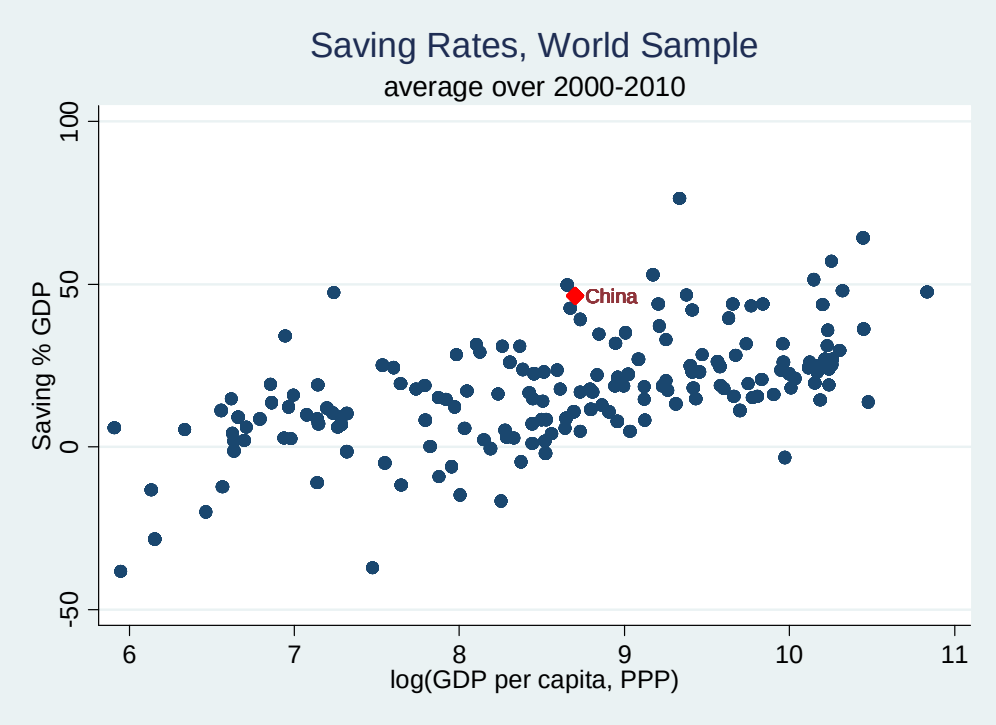

Figure 2B: Saving Rates, China versus Rest of World Excluding Oil States and States with Less than 1 Million Inhabitants

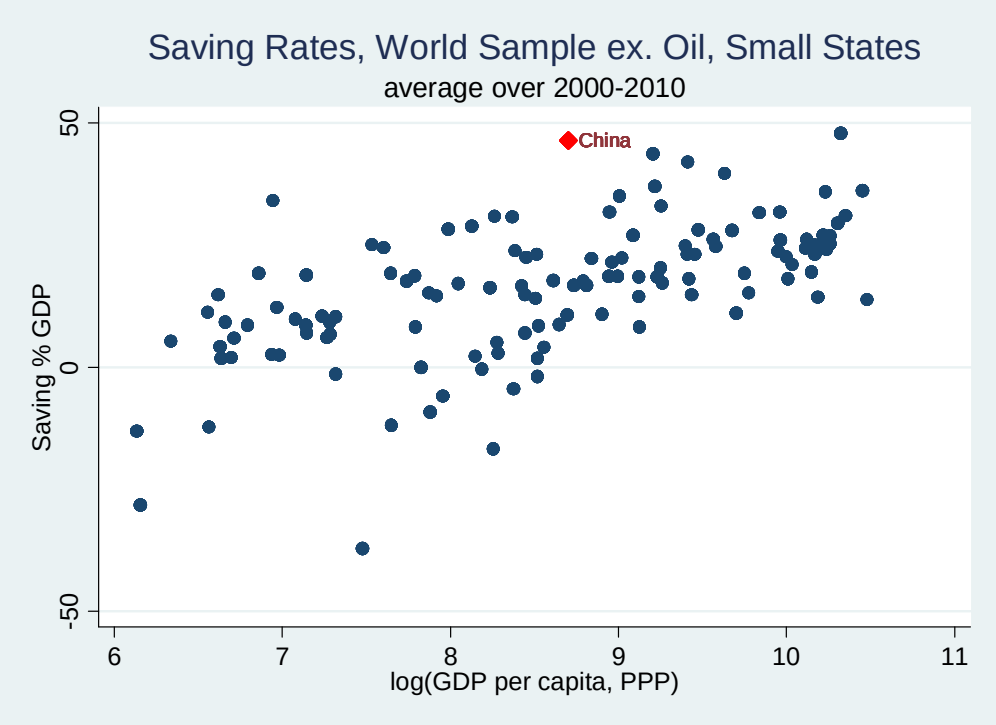

Figure 2C: Saving Rates, China versus Other Asian Countries

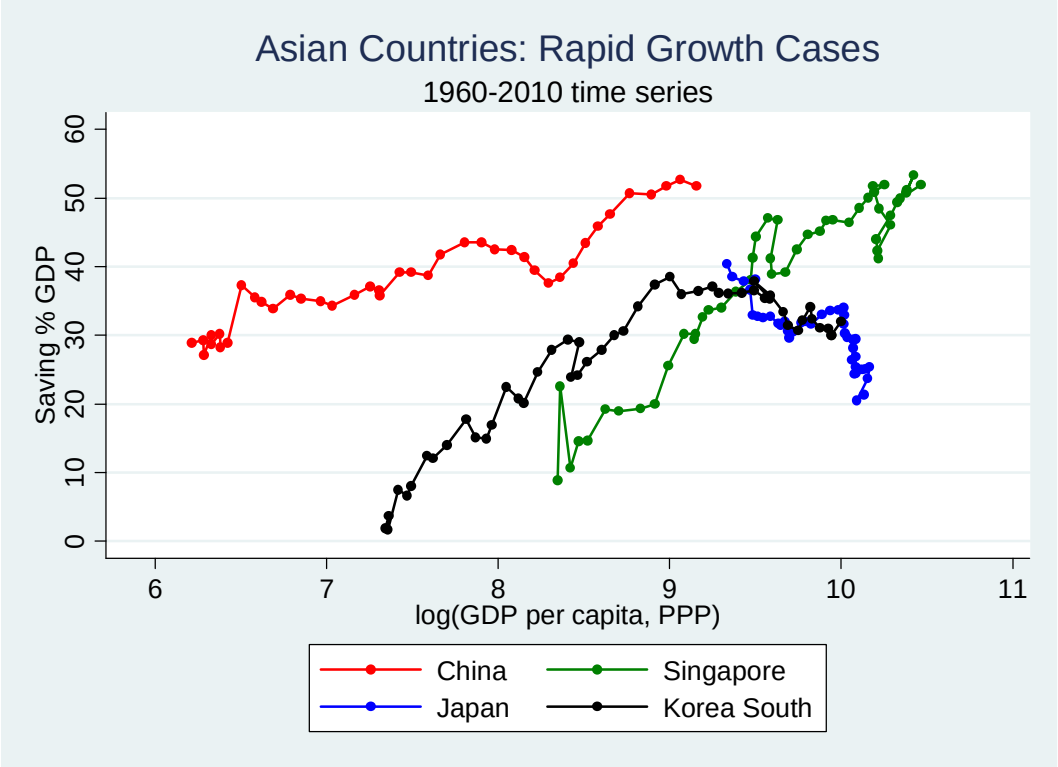

Figure 3A: Consumption Rates, China versus Rest of World

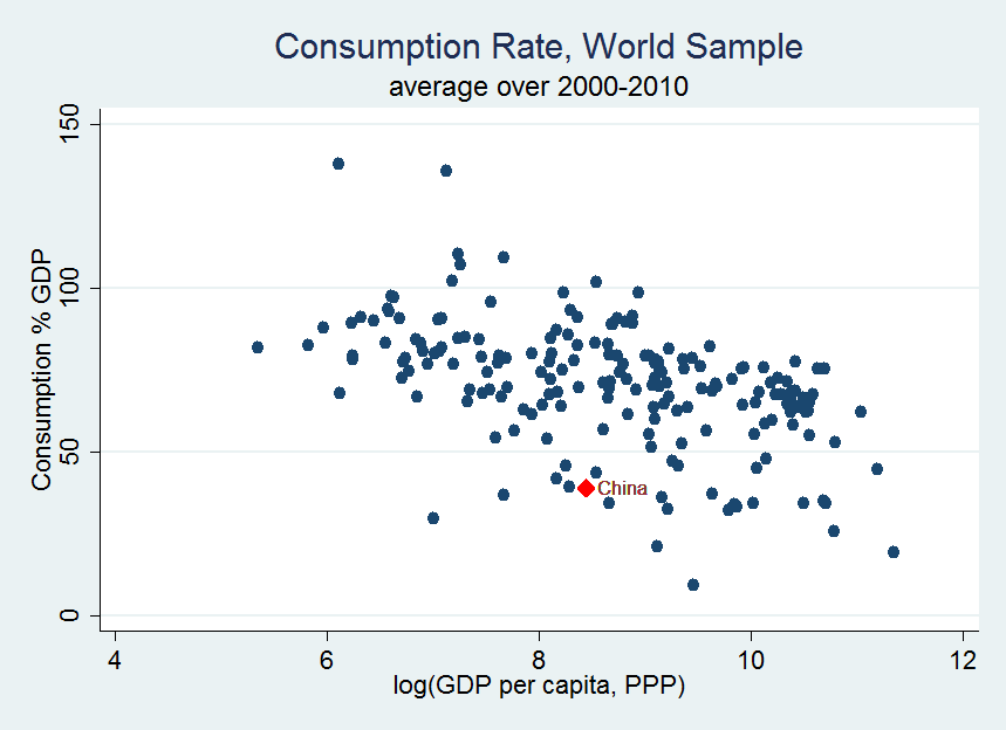

Figure 3B: Consumptions Rates, China versus Other Asian Countries

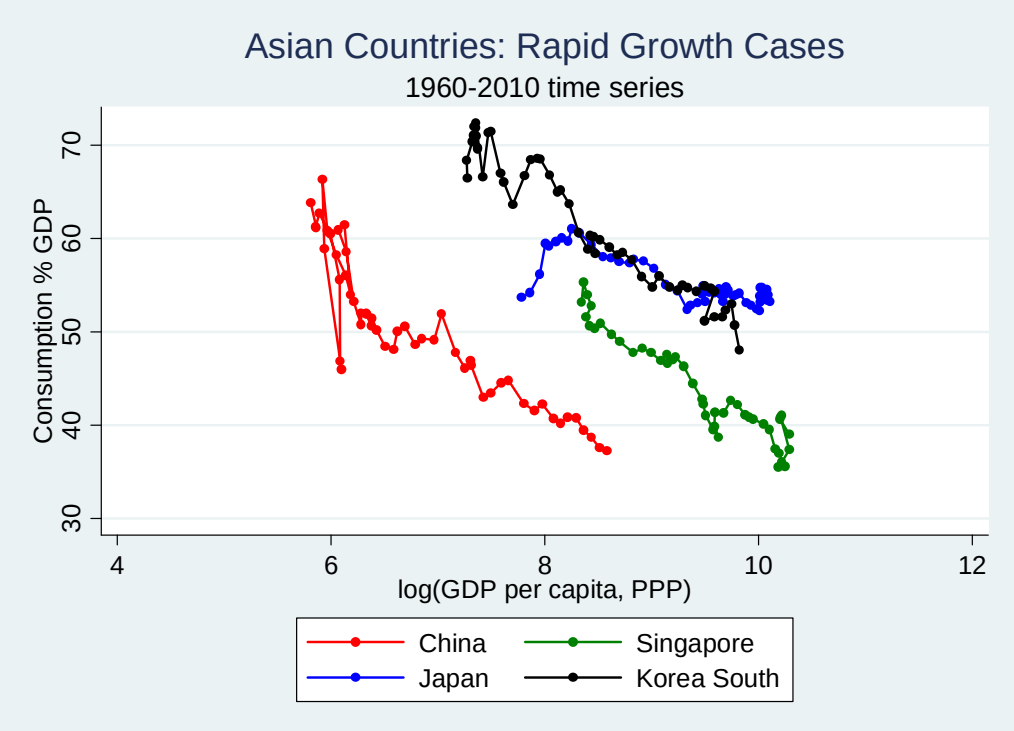

Figure 4A: Investment Rates, China versus Rest of World

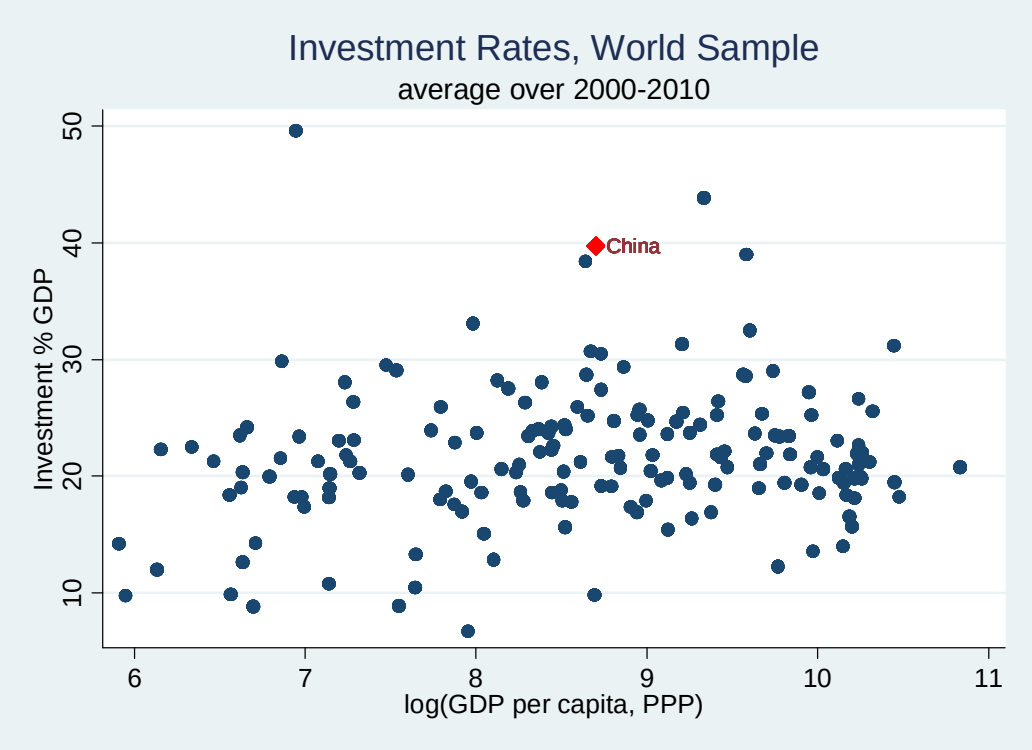

Figure 4B: Investment Rates, China versus Other Asian Countries

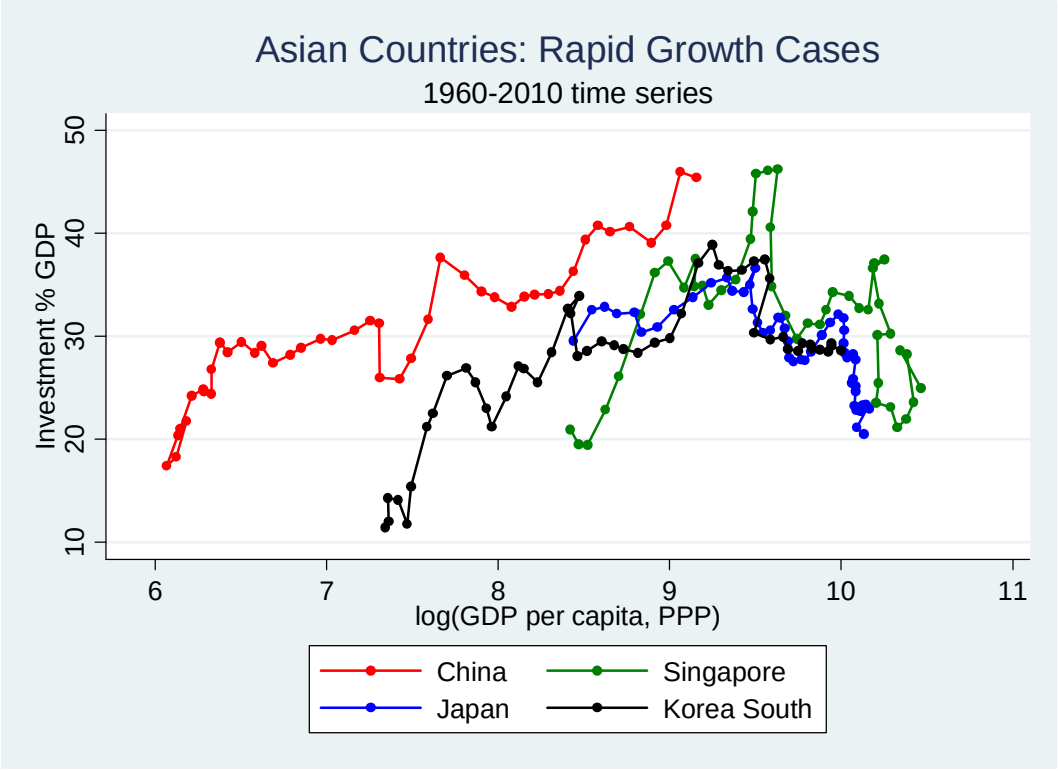

Figure 5: Urban, Rural, and Migrant Wages in 2010

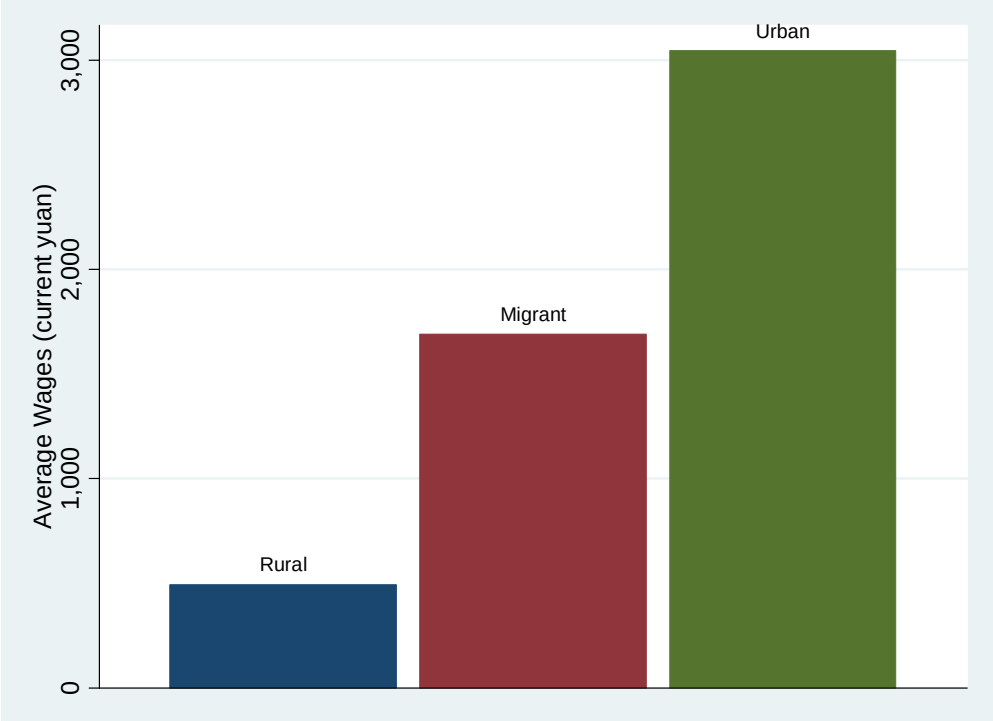

Figure 6: Enterprise Savings Rates in China

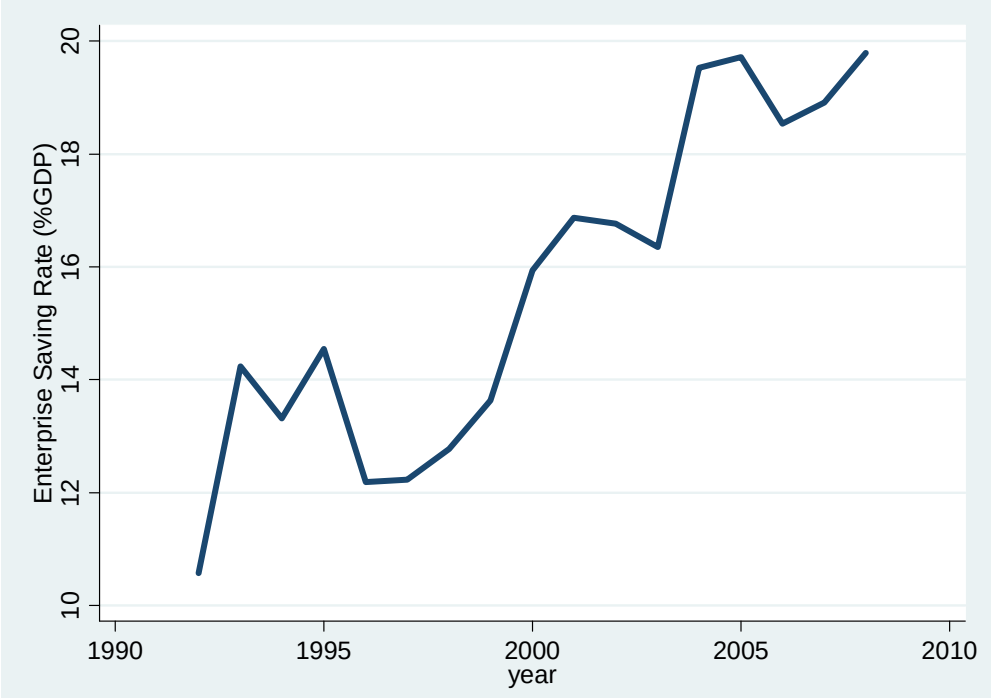

Figure 7: Calibration