REBALANCING CHINA'S ECONOMY: WHAT DOES GROWTH THEORY TELL US?[1]

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Abstract

This paper uses the standard one-sector neoclassical growth model to investigate why China's consumption has been low and investment high. It finds that the low cost of capital has been quantitatively an important factor. Theory predicts that the price of capital may have been significantly distorted in the 1990s and 2000s. The distortion could have been caused by nonperforming loans, borrowing constraints, and uncertainty over changes in government guidance in bank lending. In one form or the other, these distortions have implied significant transfers from households to firms. If China is to rebalance growth towards relying more on consumption and less on exports and investment, banking sector reforms and financial market development could, therefore, turn out to be key.

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Contents

I. INTRODUCTION

In the last 20 years, China has added about $2 trillion to world GDP, created 120 million new jobs, and pulled 400 million people out of poverty. These are big numbers equivalent to adding a country of the economic size of Portugal every year, creating as many new jobs a year as Australia employs altogether, and eradicating poverty in Ethiopia, Nigeria, Tanzania, and Zambia combined. In recent years, China has grown in excess of 10 percent annually, keeping inflation below 3 percent. Today, it is the fourth largest economy in the world and the second largest trading nation.

These are remarkable achievements, yet there is growing unease about the state of the economy both within China and abroad. China's emergence as an economic powerhouse in the last two decades has been driven by a growth strategy that has relied on high savings, high investment, and high external demand. While this strategy has paid obvious dividends, increasingly questions are being raised about its sustainability. Before the National People's Congress this March, Premier Wen Jiabao cautioned, "the biggest problem in China's economy is that the growth is unstable, unbalanced, uncoordinated, and unsustainable." More generally, the big question is whether the pace of growth is sustainable or whether the imbalances in the economy might slow growth, perhaps significantly. From the Chinese policymakers' point of view, the current drivers of growth, namely investment and exports, are seen to be unsustainable. Higher rates of investment run the risk of creating overcapacity, leading to deflationary pressures and nonperforming loans down the road. Excessive reliance on exports also exposes the economy to sudden changes in external conditions. From an international perspective, boosting consumption is seen by a growing chorus of policymakers and analysts to be an important way of reducing China's rising external surplus.

Several recent studies have analyzed why China's consumption is low and savings high, and what needs to be done to rebalance them (Blanchard and Giavazzi (2005), Kuijs (2005), Modigliani and Cao (2004), Chamon and Prasad (2005), Prasad and Rajan (2005)). Factors identified in these papers range from deliberate government policy favoring exports and investment to capital and labor market distortions. Other factors, such as the aging of the population and increasing uncertainty over pension, health, and education costs, have been underscored as important reasons behind the high saving rate. Reflecting the myriad of factors, a wide range of policies has been suggested to redress the situation. These have ranged from short-run measures, such as imposing an export tax, to longer-run reforms that include restructuring the banking sector and reforming the pension system.

Given the size and complexity of the Chinese economy, it is likely that all these factors have been at play in varying degrees and thus a wide variety of policy changes and structural reforms are needed to rebalance growth. However, the relative importance of these factors is unclear, such that it becomes difficult to prioritize which of the policies and reforms are more significant and urgent than others. This paper attempts to shed light on this question using the neoclassical growth theory. Apart from the advantages of working in a general equilibrium environment (unlike most econometrics-based studies), policies based on the neoclassical growth model are among the most researched in the literature and thus their implications are much better understood.

The framework used here follows what has come to be known as business cycle accounting (BCA) following Chari, Kehoe, and McGrattan (2004). Early examples of this approach are the studies by Chari, Kehoe, and McGrattan (2002a and 2002b); Hayashi and Prescott (2002); Bergeoing and others (2002); and Kydland and Zarazaga (2002) who analyzed the Great Depression and the long downturns in the Japanese, Mexican, Chilean, and the Argentine economies in the 1980s and 1990s.

In broad terms, the premise of the BCA literature extends the conventional one-sector Solow growth model to include various types of market imperfections or wedges that distort decisions of agents operating in otherwise competitive markets. Typically, these wedges look like simple productivity shocks, time-varying labor income and capital income taxes, and government consumption and are labeled as efficiency, labor, investment, and government wedges. However, as it turns out, equilibria of a large variety of commonly used models, including those that depend on asymmetric information, financial distortions, and heterogeneity across firms and households, are found to be equivalent to those of an one-sector Solow growth model with one or more of these wedges. Thus, these wedges, despite their apparent simplicity, can reflect rich and complex economic environments and contractual arrangements among firms and households.

Data are used to estimate the size and temporal behavior of these wedges by using explicitly derived equilibrium conditions of a neoclassical growth model embedded with simple market frictions. The estimated frictions act as a guide for the types of market distortions that are quantitatively more important than others in explaining the comovement of output, labor, consumption, and investment in the actual data. The quantitatively more important wedges are then mapped into more complex market environments that could be plausible explanations for such frictions. Once such a mapping is achieved, one has a framework to assess which policy changes or reforms are relatively more important than others.

In deriving the wedges, preference and technology parameters in this paper were chosen to be as close as possible to the ones that are typically assumed in the literature. This is in contrast to some studies such as by Fehr, Jokisch, and Kotlikoff (2005) who choose preference parameters to match Chinese savings behavior. This is unappealing since it virtually leaves little room for policy changes or reforms to play any role. In contrast, the prototype Chinese economy in this paper is different from other economies because of differences in market structures and policies, which lead to different kinds of market distortions. In the presence of such distortions, rational behavior delivers, in equilibrium, comovements of growth, consumption, and investment that mimic those of the Chinese economy.

The results from this exercise for China suggest that the cost of capital has been lower than what would have been the case in a standard one-sector Solow growth model without any frictions. If this distortion is interpreted as a negative tax on capital, then the accounting exercise suggests that this is quantitatively important in understanding why China's investment-to-GDP ratio is high and the consumption-to-GDP ratio low. In terms of the framework of the neoclassical paradigm, this negative tax implies that households have made significant transfers to firms.

The results are surprising because the model abstracts from many features that the other studies consider important in explaining the Chinese economy. For example, the model does not differentiate households by age, thus the aging of the population, which is considered an

important factor behind the high saving rate is not brought into play. Similarly, the model does not have any role for uncertainties over pension and health costs in explaining China's low consumption. Neither is labor market frictions introduced in the model. In fact, as explained later in the paper, labor-leisure choices are ruled out a priori because of data difficulties. In such a sparse and seemingly uninteresting environment, one would have expected the neoclassical growth model to fail, perhaps even dramatically, to reproduce the features of the Chinese economy, especially when contrasted against the conventional view of China being a complex developing economy that still retains significant government controls and is mired in market imperfections.

The paper puts forward a number of reasons why the cost of capital has been distorted. In particular, the use of the banking sector to provide cheap financing by tolerating a large level of nonperforming loans (because of government policy, at least in the past, and poor institutional arrangements) is found to be important. The role played by internal savings by firms may be significant too. Chinese firms in recent years have enjoyed high profits, which have not been distributed to their shareholders (especially to the government). Instead, these profits have been saved and reinvested. One of the reasons why internal saving has been high and on the rise in recent years could be because of poor financial intermediation by China's banks. Weak financial intermediation may have led banks to lend only to those firms that have high internal funds that serve as collateral. For many firms, especially the small and medium-scale enterprises, constraints on their ability to borrow have been binding. In recent years, when banks have been restructuring and thus have become more cautious about their operations, these constraints may have intensified. To get around the constraint, firms have resorted to increased internal savings to loosen the lending constraint, which appears as a rise in the return to investment and or a decline in the cost of capital.

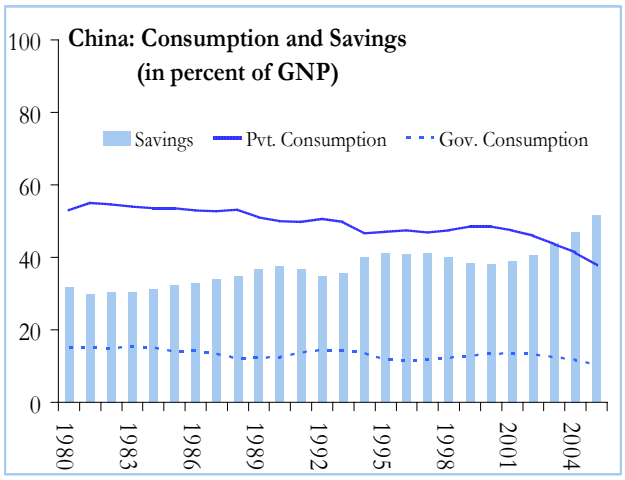
In terms of policy options to rebalance growth, removing distortions that have led to the low cost of capital, such as by reforming the banking sector to function on purely commercial principles, stands out to be key. To be sure, the government has already begun the task of reforming many of China's large banks. Recapitalizing three of the four of the largest state-owned banks has been completed. But this is just the first step. Improving the banks' operations and risk management capabilities remains a challenge. Pushing ahead with such reforms, including by reforming those banks that are still unrestructured, is thus critical. This is not to suggest that this is the only area of reform or that reforming the banks is the panacea. The other areas of reform suggested by the previous studies are all steps in the right direction as they move the economy towards a less distortionary environment. The point of the analysis here is that improving financial intermediation, which should be done in any event, is quantitatively significant in rebalancing growth.

II. CONSUMPTION, INVESTMENT, AND SAVINGS IN CHINA

Last year Chinese households consumed less than 40 percent of GDP.[2] However, this was not always the case. The consumption-to-GDP ratio stood at 51 percent back in 1980 when the liberalization of China's economy had just begun, but it has steadily declined since then. At the

[2] In this section of the paper, all ratios to GDP are computed in nominal terms and expressed in percent of expenditure-side GDP.

same time, there has been a steady increase in domestic investment. Investment's share in GDP was around 40 percent of GDP in 2005. On the other side, China's low consumption-to-GDP ratio is mirrored in high savings of nearly 48 percent in 2004.



It should be emphasized, however, that consumption by Chinese households has grown at a rapid pace. Since the early 1990s, real consumption has grown at an average annual rate of 8 percent. Nonetheless, consumption growth has lagged the average annual rate of GDP of around 10 percent over this period, such that consumption's share in GDP has fallen by around 7 percentage points.

Indeed, a decline in consumption relative to GDP was to be expected, as China's development took off in the 1980s. A significant increase in the rate of capital accumulation has been the major driver of growth, as experienced by almost all other countries in the initial stages of development. Thus, a rise in the saving rate was, as many economists would argue, necessary for economic catch up. What has been surprising is the extent of the increase.

Selected Countries: Consumption, 2004
(In percent of GDP, unless otherwise indicated)

	Personal Disposable Income	Taxes on personal income[1]	Personal Consumption/ Disposable Income	Personal Consumption	Labor Income	Government Consumption on Health and Education[2]	Adjusted Consumption[3]
US	74	9	95	70	57	10	80
UK	66	10	98	65	56	12	77
Australia	58	12	103	60	49	11	71
Canada	58	12	96	56	50	7	63
Korea	54	3	95	51	44	5	56
France	62	8	90	56	52	6	62
Germany	66	9	88	57	51	6	63
Italy	67	11	90	60	42	12	72
Japan	59	8	96	57	51	5	62
India	84	2	76	67	...	4	70
China	60	1	69	41	56	3	44

Sources: OECD; CEIC Data Company Ltd; IMF desks.
[1] 2003 figures for all except India and China.
[2] 2002 figures for all except India, and China.
[3] Personal consumption and government consumption on health and education.

China's consumption ratio is also low when compared to other countries. Such international comparison, however, should be done cautiously with considerations for institutional differences across countries**.** While several countries, including Australia, Canada, and Korea have quite modest personal disposable income-to-GDP ratios, they often reflect institutional differences that are not captured in aggregate national account data. For example, households in Australia and Canada transfer a much higher proportion of GDP as income taxes to the government. In

return, households receive substantial publicly provided goods that are privately consumed, such as healthcare and education, that are not included in measures of personal consumption in the national accounts. In contrast, income-related taxes are relatively low in China, while government provision of health and education services has declined and is one of the lowest in the sample of countries. Taking into account such institutional differences, the gap between China's consumption-to-GDP ratio and that in other countries ends up increasing.

III. THE CHINESE ECONOMY AS A NEOCLASSICAL GROWTH MODEL

Against this background, the analysis begins by asking the question whether the standard one-sector neoclassical growth model can explain the behavior of macroeconomic variables in China. The answer should be no. The exercise, however, serves as a benchmark and helps to understand the specific ways in which the Chinese economy departs from the standard model.

In this one-sector economy, a representative household lives infinitely in a world of certainty, each period choosing consumption and investment to maximize lifetime utility. As is customary, households own capital and rent it out to firms and, in turn, own these firms.
Typically, in such models, the household also chooses its working hours, and for industrial countries, this choice typically turns out to be important. In the case of China, data on hours worked is hard to come by and although the International Labor Organization has some survey information, it is patchy and covers only a few manufacturing industries. Acknowledging this drawback of the model, we drop labor choice from the household's maximization problem. This simplifies the household's problem to maximizing:

$$\sum_{t=0}^{\infty} \beta^t N_t \log(c_t)$$

subject to the budget constraint:

$$N_t c_t + X_t \leq w_t + r_t K_t + \Pi_t \tag{1}$$

where N is the size of working-age population, c is per capita consumption $\frac{C}{N}$, X is investment, K is capital, and Π is total transfers (including government transfers net of taxes and corporate profits). There are two relative prices—w the real wage rate and r the real return from renting capital.

On the production side, a representative firm operates a Cobb-Douglas technology given by $Y = A_t K_t^{\alpha} L_t^{1-\alpha}$, where Y is aggregate output, A measures the level of total factor productivity (TFP), and L is the number of workers employed. Using these notations, the firm's problem is to maximize profit given by

$$\sum_{t=0}^{\infty} \lambda_t \left(A_t K_t^{\alpha} L_t^{1-\alpha} - w_t L_t - r K_t \right) \tag{2}$$

There are two feasibility constraints in this model economy, which are the national income identity:

$$C_t + X_t + G_t = Y_t \tag{3}$$

where *G* is government purchases, and the law of capital accumulation given by:

$$K_{t+1} = (1-\delta)K_t + X_t \tag{4}$$

Where δ is the depreciation rate. To derive the policy functions and the steady-state of the system, all aggregate variables are detrended as follows:

$$k_t = \frac{K_t}{A^{\frac{1}{1-\alpha}} N_t}, c_t = \frac{C_t}{A^{\frac{1}{1-\alpha}} N_t}, y_t = \frac{Y_t}{A^{\frac{1}{1-\alpha}} N_t}, \gamma_{t+1} = \left(\frac{A_{t+1}}{A_t}\right)^{\frac{1}{1-\alpha}}, g_t = \frac{G_t}{Y_t}, n_{t+1} = \frac{N_{t+1}}{N_t}, \; e_t = \frac{L_t}{N_t}$$

Using these notations, one arrives at:

$$\text{Aggregate production function: } y_t = k_t^{\alpha} e^{1-\alpha} \tag{5}$$

$$\text{Marginal product of capital: } r_t = \alpha k_t^{\alpha-1} e_t^{1-\alpha} \tag{6}$$

$$\text{Marginal product of labor: } w_t = (1-\alpha) k_t^{\alpha} e_t^{1-\alpha} \tag{7}$$

$$\text{Resource constraint: } c_t + \gamma_{t+1} n_{t+1} k_{t+1} - (1-\delta)k_t = (1-g_t) y_t \tag{8}$$

Substituting and rearranging the terms (5)-(8) lead to the following three relationships:

$$\lambda_t = \frac{\beta^t}{c_t A_t^{\frac{1}{1-\alpha}}}$$

$$c_{t+1} = \frac{c_t}{\gamma_{t+1}} \beta \left[1 - \delta + \alpha \left(\frac{e_{t+1}}{k_{t+1}} \right)^{1-\alpha} \right] \tag{9}$$

$$k_{t+1} = \frac{1}{\gamma_{t+1} n_{t+1}} \left[\left\{ (1-\delta) + (1-g_t) \left(\frac{e_t}{k_t} \right)^{1-\alpha} \right\} k_t - c_t \right] \tag{10}$$

where, λ_t, is the multiplier associated with the household's budget constraint. The solutions to (9) and (10) constitute equilibrium for this economy.

The balanced growth path of the model is given by:

$$\frac{k_s}{e_s} = \left(\frac{\frac{\gamma}{\beta} - (1-\delta)}{\alpha} \right)^{-\frac{1}{1-\alpha}}$$

$$c_s = k_s \left(1 - \delta + (1 - g_s) \left(\frac{e_s}{k_s} \right)^{1-\alpha} - \gamma n \right)$$

$$y_s = k_s^{\alpha} e_s^{1-\alpha} \ ,$$

where the variables with subscript "*s*" denote their respective steady-state levels. In terms of the language in the BCA literature, the sequence of "Solow" residuals, $\{A_t\}$, given by $A_t = \frac{Y_t}{K_t^{\alpha} E_t^{1-\alpha}}$, is the *efficiency wedge*, while the sequence of $\{g_t\}$ is the *government wedge*.

IV. CALIBRATING THE GROWTH MODEL[3]

The next step is to calibrate the model, but before that is done some data issues need to be clarified. China's official statistical agency—the National Bureau of Statistics (NBS)—publishes a large volume of economic information (for example as contained in the China Statistical Yearbooks), but these are typically on physical variables and national accounts data are weak. An added complication has been the recent (January 2006) revision to the production-side GDP numbers from 1992–2004. The revision was the result of the country's first comprehensive economic census of industry and services and resulted in a 16.8 percent upward revision to the 2004 GDP data, mainly reflecting new service-sector activity covered in the census and changes to the methodology used in estimating the output of owner-occupied dwellings and financial services. The service sector share of GDP rose 9 percentage points to 41 percent of GDP in 2004, with most of this gain accounted for by lower shares of manufacturing and construction.

In revising the production-side GDP back to 1992, the NBS assumed that the new activity emerged smoothly since the early 1990s.[4] However, this need not have been the case. It is likely

[3] Much of this section draws upon the work done by Ray Brooks and Steve Barnett in estimating China's GDP from the expenditure side (see Barnett and Brooks, What is Driving Investment in China?, IMF Working Paper 06/265). The author is thankful to them for sharing their data.

[4] In practice, the NBS used the benchmark derived from the 2004 census to revise nominal GDP back to 1992 by applying the "trend deviation" method. The method, used by many OECD countries, involved calculating the deviation from the trend over 1992-2004 in the original data, and applying this annual deviation

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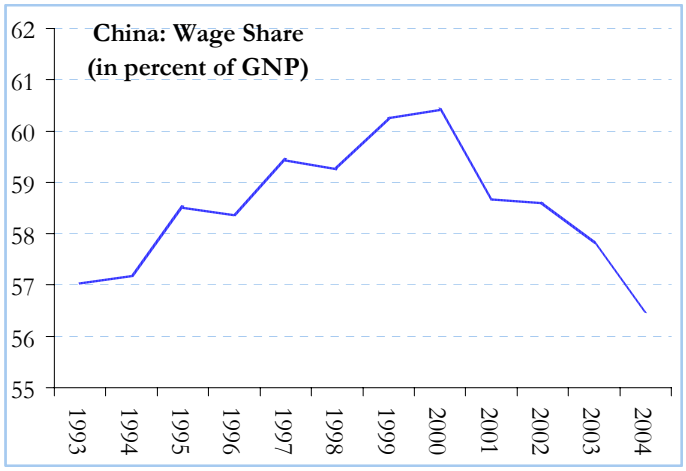

that the bulk of the new activity emerged since the late 1990s when state-owned enterprise (SOE) reform picked up and China entered the World Trade Organization. In addition, the services price deflator (used to derive the real production-side GDP numbers) appears to be on the high side and inconsistent with service price developments in the consumer price index(CPI). In particular, while the original deflator for services increased by 7 percent for 2000–04, the revised deflator rose by 13 percent, almost twice the pace. The implicit deflator for the newly covered services activities reported by the 2004 census has an annual inflation rate of 7 percent since 2000. This pace is much quicker than the same service components covered by the CPI. Housing services were the fastest growing service in the CPI and its growth averaged only 2½ percent in 2000–04. The GDP revision implies either that CPI inflation has been understated or that prices of services provided as an intermediate input to industry or exported have grown much faster than consumer service prices. An alternative interpretation is that actual real GDP growth may be still understated despite the statistical revision.

To avoid these problems, the data used in this exercise are based on the official nominal expenditure-side GDP (China does not publish real expenditure-side GDP). Real GDP and its components are calculated using the official nominal figures that are deflated by the price indices. For rural and urban household consumption, rural and urban CPI were used, respectively, while for government consumption the general CPI was used.[5] To deflate the nominal gross fixed capital formation series, a deflator was derived from published real growth rates of the sub-components of investment for the period before 2002 (for which information is available).[6] For 2002 onwards, the gross fixed capital formation deflator is based on the published fixed asset investment deflator adjusted for an estimate of land sales that is derived from the volume of land transactions and land sales price. This is needed as the published fixed asset investment deflator contains land sales. For inventories, the implicit GDP deflator from the production-side numbers was used. On the trade side, real data is published only for net exports; exports and imports of goods and services are thus estimated from the balance of payments. Export and import of goods are deflated using the IMF's global commodity (GEE)

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to the new trend for 1992-2004 based on the revised 2004 data. The calculation was done by the NBS for a number of sub-sectors and aggregate GDP was derived as the sum of the parts.

[5] Private consumption is not adjusted for government spending on education and health, although these are essentially private goods, as the amounts are small (less than 3 percent of GDP in 2004) and because it is difficult to find reliable data on them in the 1980s. In general, spending on education and health by the state was not high even in the 1980s as much of spending was carried out by state-owned enterprises (SOEs) before the reforms of the mid- and late 1990s and data on spending by these enterprises are not available.

[6] See *Data of Gross Domestic Products (1996-2002)*. In addition, data for inventories are only published up to 1999.

deflator for 2003 and earlier and the published customs deflator for 2004 onwards. Service exports are deflated by China's CPI and service imports by U.S. consumer price inflation (services represent only about 10 percent of exports and imports). Finally, income flows from balance of payments statistics is deflated using export and import deflators to arrive at real the real current account position and the real GNP series.

Turning to the parameters of the growth model, we assume that $\alpha = 0.35$, as is standard. The share of labor income in China's national income is less than 0.65 and has fluctuated around 0.58 since 1993 (based on household survey data). In several countries, the share of wages in the national account is different from the standard assumption of 0.65 and in particular, in the many of the fast-growing Asian economies this share tends to be quite a bit less. However, weak statistical coverage and institutional factors—such as high markups enjoyed by firms—are often cited as the causes. As a recent study shows, in most countries once such data issues are accounted for, the share of labor is around two-thirds (Gollin, 2002). In this paper, we do not attempt to resolve this issue, instead we acknowledge this weakness, note that statistical adjustments as undertaken in Gollin may be the cause of this, and proceed with the growth accounting. [7]

The capital stock series is constructed using the perpetual inventory method. Real gross fixed domestic investment is augmented with the real current account deficit or surplus to arrive at gross national investment, which is then used to construct the capital stock series. The initial capital stock for 1979 is chosen to be such that the capital-output ratio is 2.1 as in Nehru, Swanson, and Dubey (2002), who used PPP-adjusted national accounts as reported in the Penn World Tables.[8] The depreciation rate is chosen to be 0.06. The NBS does not publish a breakdown of gross capital formation, although such a breakdown for fixed asset investment as reported by firms is available. The fixed asset investment series is made up of three categories, namely structures, equipment, and other, the latter composed of real estate purchases and of used equipment

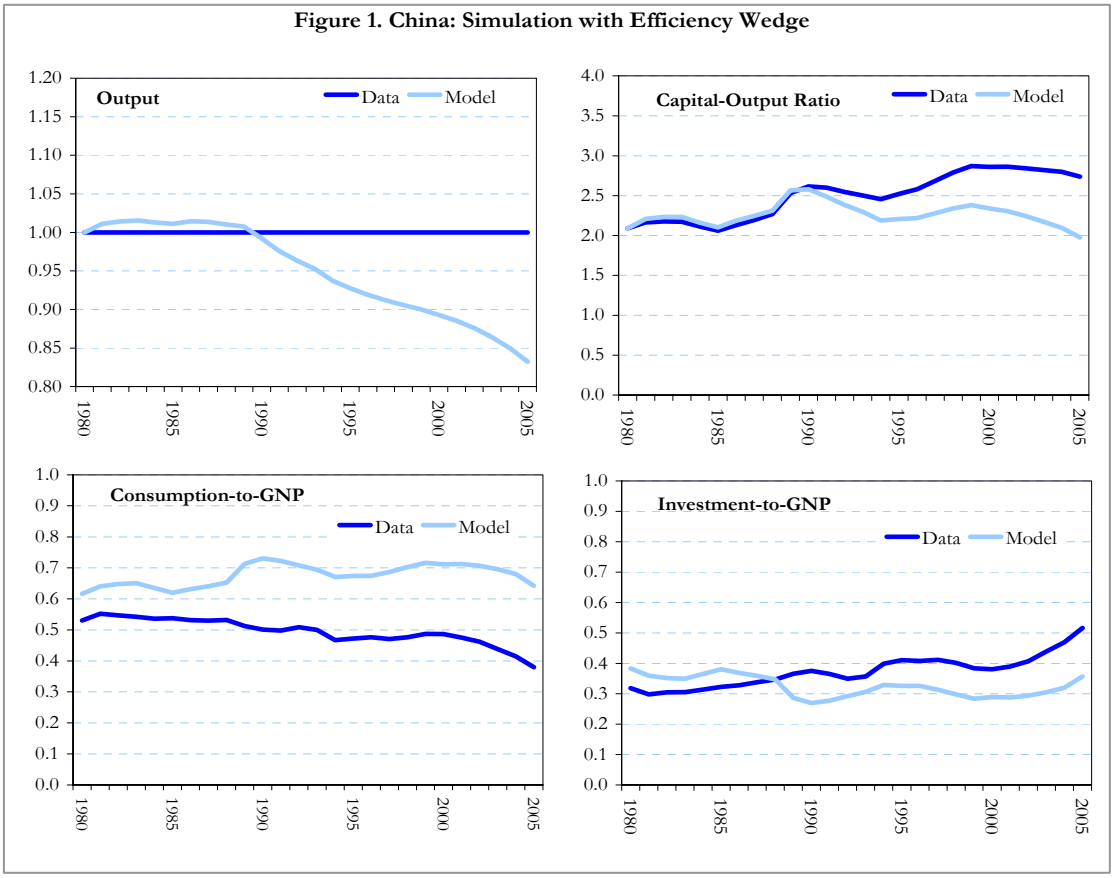
[7] Interestingly, studies that have estimated production functions directly for China such as Chow (1993), Chow and Li (2002), and Heytens and Zebregs (2002), have found similar values for capital's share in national income.

[8] In this paper, data from the Penn tables were not used for two main reasons. First, China has not directly participated in the ICP exercise and second the latest data is only up to 2000. In addition, this paper does not focus on cross-country comparisons such that the usefulness of comparable inter-country data is not obvious. Others have also attempted to derive capital stock measures for China, such as by Chow (1993), Chow and Li (2002), and Heytens and Zebregs (2002). The capital-output ratios reported there are exceptionally high, at around between 3.5 to 4.2, for China's state of development in 1979. More recent studies, such as in Scheibe (2003) derive the capita-output ratio similar to the ratio used in this paper.

and structures. It is this third category, which is also the fastest rising (accounting for around 20 percent of fixed asset investment in 2004), that is adjusted to arrive at fixed investment in the national accounts. Ignoring the third category, structures have been roughly 70 percent of fixed investment. Assuming that structures last for 25 years and equipment for 10 years, we arrive at an average depreciation rate of 6 percent.[9] Data on employment is taken from published labor statistics and include employment in the agricultural sector. The share of employment, *e*, is derived by deflating total employment by the working-age population, as is standard in the BCA literature.

Using the calibrated parameters as a starting point, we first derive the sequence of the technology parameter, $\{A_t\}$. As can be seen from the above figure, much of the China's remarkable increase in labor productivity since the 1980s has been due to technological improvements with substantial contribution from rising capital per worker. On the other hand, the capital-output ratio, after falling through the 1980s, rose sharply in the late-1980s and early 1990s before contracting by the mid-1990s. Since then it has risen steadily. These estimates are similar to those of Scheibe (2003).

Figure 1. China: Simulation with Efficiency Wedge



[9] As an aside, some authors such as Maddison (1998) have argued that China's national account statistics includes military goods in investment. To correct for this, he allocated 7 percent of investment to government

(continued…)

V. SIMULATING THE MODEL: THE FIRST CUT

The model is next simulated for the period 1980–2005. The sequence of technological shocks is treated as exogenous with $\{A_t\}_{t=1980}^{2004}$ set equal to its derived value in the growth accounting exercise of the previous section, while from 2004 onwards the growth rate in TFP is set equal to its average over 1990–2004. The discount factor β=0.97, such that the long-term real interest rate is around 3 percent. As discussed earlier, α=0.35 and the initial stock of capital set at its derived value in $\tilde{K}_{1979}$. The simulation is carried out using the "shooting algorithm" discussed in Hayashi and Prescott (2002) such that the economy reaches a balanced growth path by 2015. The algorithm requires simulating equations (9) and (10) forward for a given initial level of consumption and then solving for this initial level such that the economy is in a steady state in 2015 and beyond. Changing the terminal date does not affect the results.

With $\{A_t\}$ as the only exogenous shock, the simulated output path closely traces the actual path until around the late 1980s, after which they deviate and the former ends up about 17-18 percent below the latter by 2005. Consumption's share of GNP is much higher than in the data (nearly 20 percentage points), while the investment-to-GNP ratio is that much lower. As a result, the capital-output ratio does not increase as much as it does in the data and labor productivity is lower. This in a sense underlies the current concern over China's growth pattern, namely, "too much" dependence on investment and too little on consumption. Put differently, Chinese consumers are not consuming as much as the high growth rate of the economy would imply.

Adding the government wedge improves the model's fit somewhat. The sequence of government consumption $\{g_t\}_{t=1980}^{2004}$, is set equal to its value in the data derived above and is assumed to remain at its 1990–2005 average level beyond 2005. Simulated output is 15 percent lower than the actual by 2005. Consumption as a share of GNP is still higher than in the data, but the gap closes to around 15 percentage points.

VI. INTRODUCING INVESTMENT WEDGE

Borrowing from the BCA literature, an investment wedge is introduced in the model in the form of a time-varying tax on gross capital income, τ_t. Different studies introduce the wedge differently, for example, Chari, Kehoe, and McGrattan (2004) impose a tax on investment, while Hayashi and Prescott (2002) tax net capital income. While such a formulation may appear to be over simplistic, as discussed in the former, and as will be shown in later, the time-varying tax can be shown to represent a variety of financial distortions, market frictions, and government policies, not just a tax on capital income.

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consumption. We do not make any such adjustment since it is difficult ascertain the extent of this problem.

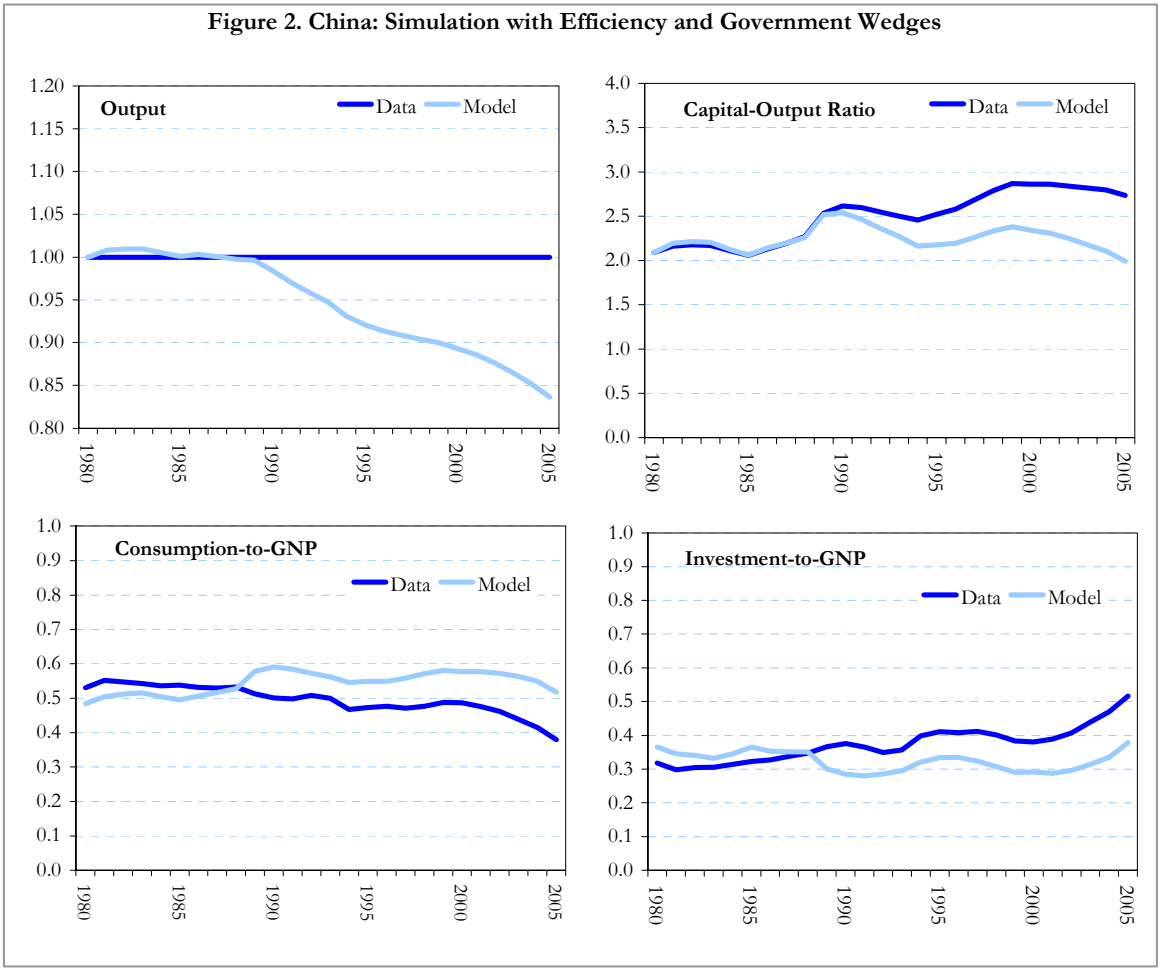
As a result, the household's budget constraint changes to:

$$C_t + X_t \leq w_t + (1-\tau_t) r_t K_t + \Pi_t \tag{11}$$

and the intertemporal equilibrium condition becomes:

$$c_{t+1} = \frac{c_t}{\gamma_{t+1}} \beta \left[(1-\delta) + (1-\tau_{t+1}) \alpha k_{t+1}^{\alpha-1} \right] \tag{12}$$

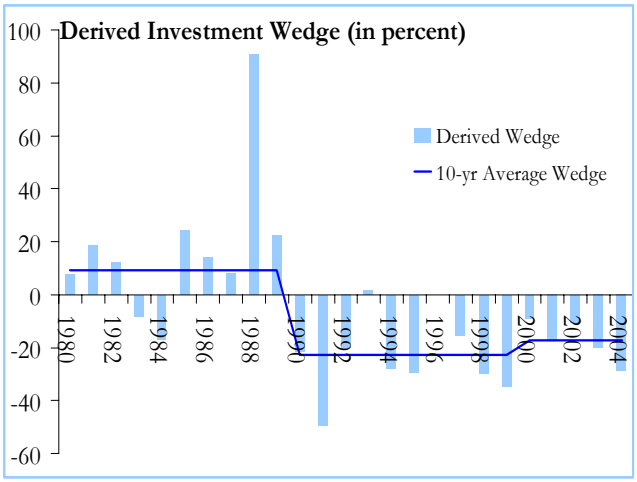
Figure 2. China: Simulation with Efficiency and Government Wedges



As can be easily seen from equation (12), the investment wedge is essentially the difference between the marginal rate of intertemporal substitution in consumption (given the log utility function, this is just the growth rate of consumption) and the marginal product of capital. The sequence of investment wedge $\{\tau_t\}_{1980}^{2004}$ is computed using the growth rate of real consumption in the data, the derived sequence of capital stock $\{k_t\}_{1980}^{2004}$ and the calibrated parameters, β and δ.

The result is striking. Virtually all through the last two decades the investment wedge has been negative. (The sharp increase in capital income tax in 1988 is an artifact of the way the wedge has been constructed and is due to a significant fall in real consumption growth in a year of very high inflation.) While in the 1980s the wedge, on average, was positive at around 9 percent, it turned negative in the 1990s to around 25 percent, before easing modestly to 15 percent in the 2000s. In terms of return to capital, while in the 1980s, the wedge reduced the return on capital by 2.6 percentage points, while it added, in the 1990s and 2000s, 3.1 and 2.2 percentage points, respectively.

This is in sharp contrast to investment wedges that have been derived for other countries, including Mexico, Chile, and Japan. In these countries, the wedge is positive, reflecting not only high income tax rates, but also a variety of frictions that increase the cost of capital, although they are not explicitly captured in the sparse environment of the one-sector Solow growth model. In Japan, this wedge is broadly equivalent to the effective marginal income tax rate (Hayashi and Prescott (2002)), while in Mexico and Chile the wedges are greater than the effective tax rates suggesting other significant costs of capital (Bergoeing and others (2002)).



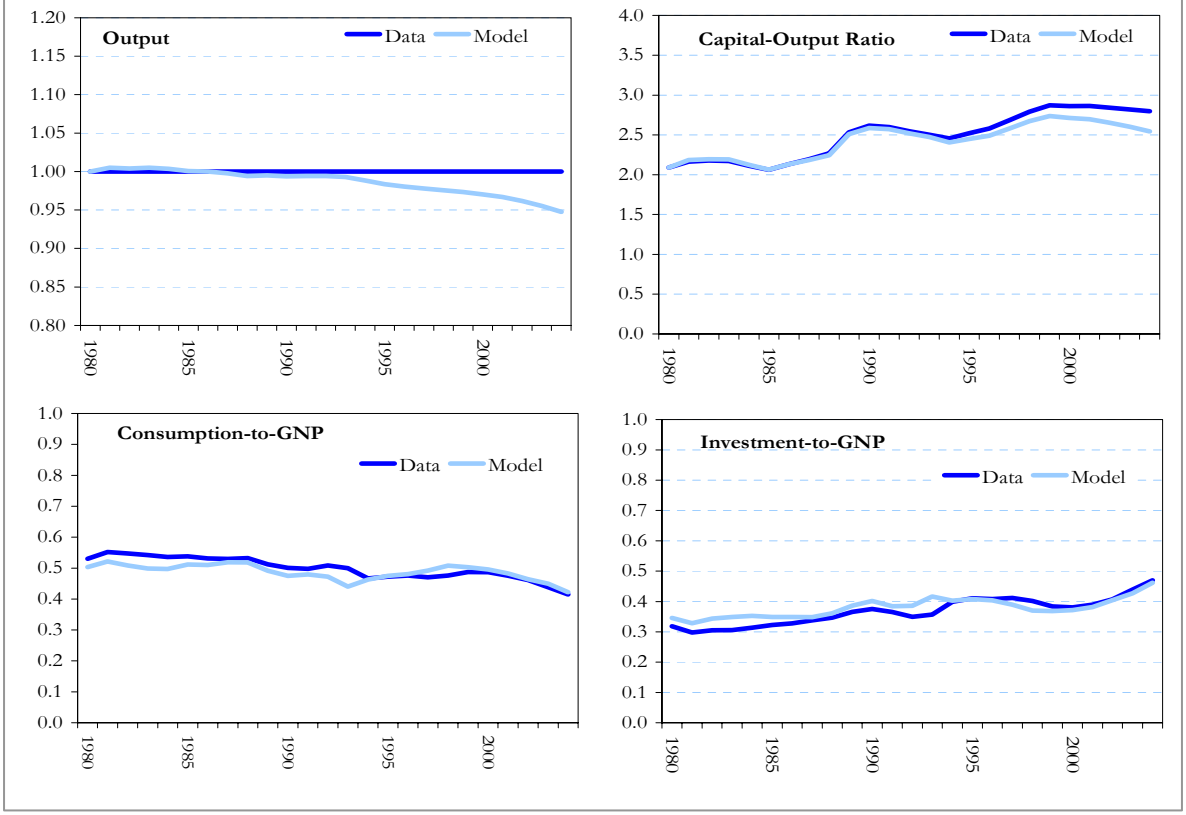
Simulations including the investment wedge as shown in Figure 3 virtually close the entire gap between the simulated and actual data. Comparing the gap when only the efficiency and government wedges were used, the cumulative effects of the investment wedge explains about 12-13 percent of 2004 GNP, and lowers the consumption-to-GNP ratio (increases the investment-to-GDP ratio) by 12-13 percentage points. These are large numbers and they underscore the role played by the distortion to the cost of capital in inducing such large investment rates. Put differently, one can construct a counterfactual scenario where an economy identical to China, except for a zero investment wedge, would reach a level of GNP in 2004 which is 5 percent lower than China's actual output, but with consumption's share of GNP 13 percentage points higher.

VII. Financial Frictions as Investment Wedges

So what form did the investment wedge take? Was it government support or was it in the form of more complex arrangements? The answer is probably both. To see that, consider the role nonperforming bank loans played in lowering the cost of capital, where firms (e.g., large SOEs) were able to default on their loans without facing significant punitive actions. Much has been written about China's weak banking system and how it has been used by the government to direct lending to priority sectors and firms (Anderson (2006); Lardy (1998); Karacadeg (2003); Dobson and Kashyap (2006)). This practice eventually led to the accumulation of very large nonperforming loans and a banking system that has only recently begun the process of restructuring towards functioning on a purely commercial basis. This does not ignore the fact that a large number of small and medium-scale enterprises, many of whom are not fully government owned and whose contribution to output is significant, face significant borrowing constraints. Indeed, one would argue that a corollary of directed lending to selected sectors or firms is that others in the economy would have difficult access to bank financing. The question posed here is whether characterizing the "average" or representative firm as one that faces a lower cost of capital because it can default on part of its loan without facing sanctions is quantitatively a sufficiently large distortion to explain the observed high investment-to-GNP and low consumption-to-GNP ratios. The paper also explores whether characterizing the representative firm as being credit constrained distorts its internal savings behavior sufficiently to produce the same macroeconomic behavior. As shown later, both practices would appear as distortions that increase the return to capital over its marginal product and lead to higher savings and lower consumption.

A. Nonperforming Bank Loans

Figure 3. China: Simulation with Efficiency, Government, and Investment Wedges



To see the impact of nonperforming loans(NPLs) on consumption and investment behavior, let μ_t be the proportion of loans that a firm does not repay, either because the firm does not fear effective punitive actions or the banks have been implicitly allowed to do so (what is generally called "legacy" loans) under government directives. The firm's profit, under these conditions, is given by

$$\sum_{t=0}^{\infty} \lambda_t \left(k_t^{\alpha} e_t^{1-\alpha} - w_t e_t - r_t (1-\mu_t) k_t \right).$$

with the associated necessary profit maximization condition $(1-\mu_t) r_t = \alpha \left(\frac{e_{t+1}}{k_{t+1}} \right)^{1-\alpha}$.

Consumers still receive r_t which is equivalent to $\left(\frac{1}{1-\mu_t} \right) \alpha \left(\frac{e_{t+1}}{k_{t+1}} \right)^{1-\alpha}$.

It is easy to see that if one defines $\hat{\tau}_t = \left(\frac{\mu_t}{1-\mu_t} \right)$ then $r_t = (1+\hat{\tau}_t) \alpha \left(\frac{e_{t+1}}{k_{t+1}} \right)^{1-\alpha}$ and consumption is given by

$$c_{t+1} = \frac{c_t}{\gamma_{t+1}} \beta \left[(1-\delta) + (1+\hat{\tau}_{t+1}) \alpha \left(\frac{e_{t+1}}{k_{t+1}} \right)^{1-\alpha} \right],$$

which is the same as equation (12).

The household's budget constraint becomes $c_t + x_t \leq w_t e_t + (1-\hat{\tau}_t) r_t k_t + \hat{\pi}_t$, where $\hat{\pi}_t = \pi_t - \hat{\tau}_t r_t k_t$. As a result, the two economies—the one with the investment wedge and the one with NPLs—yield identical allocations. In the steady state of such an economy, $\frac{k_s}{e_s} = \left(\frac{\frac{\gamma}{\beta} - (1-\delta)}{\alpha (1+\hat{\tau})} \right)^{-\frac{1}{1-\alpha}}$ as opposed to $\left(\frac{\frac{\gamma}{\beta} - (1-\delta)}{\alpha} \right)^{-\frac{1}{1-\alpha}}$ when there is no distortion. As is easily evident a higher $\hat{\tau}$ leads to a higher capital stock in the steady state.

However, the question is whether this effect was large enough to matter at the macroeconomic level. Based on official estimates, the stock of NPLs that was created in the last 10-15 years would, at the end of 2004 amount to around 26 percent of GNP. However, this figure is larger than the level of NPLs currently carried by banks, which is around 11 percent of GNP. The difference reflects the amount that has been restructured, written off, and transferred to asset management companies (AMCs). While it is difficult to match the timing of the creation of an NPL and when it is recorded in the books of the banks (this depends on the specific loan

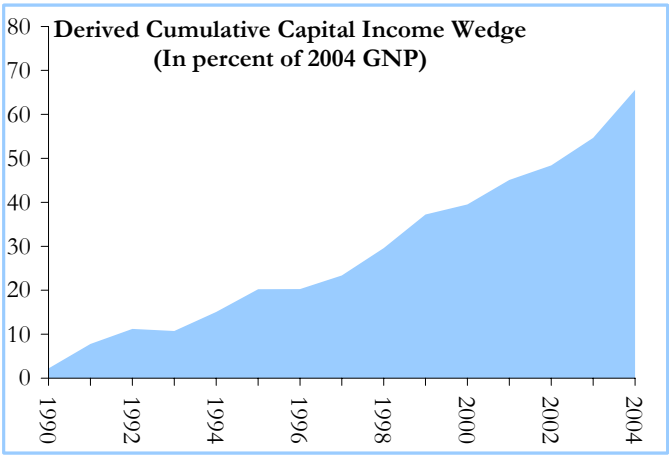
classification rules) the stock of NPLs appear to be better estimated in recent years, especially after three of the four large state-owned banks (CCB, BOC, and ICBC) began seeking strategic investors and issuing public offerings of their shares. The fourth large bank, Agricultural Bank of China, is the second largest in terms of deposits and is still without a formal restructuring plan. It is possible that when such a plan is put in place the bank's recorded NPLs will increase. In addition, banks in China also classify certain loans as "special mention" loans. These are loans that are not being fully serviced at present, but for legal reasons or because the corporate client is undergoing restructuring, they are not classified as nonperforming. It is possible that some or substantial portion of these loans could turn out to be nonperforming. The amount of special mention loans outstanding at end-2004 was roughly RMB 1140 billion or about 8 percent of 2004 GNP, which would increase the potential NPLs to around 35 percent of 2004 GNP.

China: Official Estimate of NPLs Created (end-2004)
(In billions of renminbi)

Reported NPLs on balance sheet	**1575**
NPLs transferred to AMCs	**1770**
Original transfer in 1999-2000	**1420**
Additional BOC and CCB transfer	**350**
Write-offs	**324**
Total	**3668**
(In percent of 2004 GNP)	**25.8**
Special mention loans	**1140**
(In percent of 2004 GNP)	**8.0**

Notwithstanding the improvement that has occurred in monitoring NPLs, many industry analysts and other researchers believe that the official estimate of NPLs may be an underestimation. A case in point is the recent estimate of China's NPLs by Anderson (2006). He estimates the total amount of NPLs created by China's banks to be around $850 billion, which would put the level of NPLs around 50 percent of 2004 GNP.

In the prototype economy with the investment wedge discussed above, the stock of net negative wedge at the end of 2004 stood at around 60 percent of 2004 GNP (assuming a zero starting stock in 1990). This is higher than the 35 percent of GNP in officially accounted NPLs and above the 50 percent of GNP estimate by Anderson (2006). However, it is typically the case that there is a time lag between when a loan becomes nonperforming in the economic sense and when it gets classified as such in the accounting sense. If this time lag was about two years, which is not atypical of Chinese banking practice, then the reported NPLs in 2004 would be reflecting NPLs created in 2002.



Taking into account the time lag in reporting, the 2002 negative wedge in terms of the 2004 GNP of the prototype economy stands at around 46 percent. However, one needs to add to this capital income tax received by the government. In China, the flat income tax rate is currently 33 percent for domestic firms and 15 percent for foreign firms. These rates were higher in the past. However, the income tax collected has been substantially lower than what these rates and the profit share of national income would suggest. Indeed, the effective average income tax rate has been around 4-5 percent (on gross capital income), on average, since the early 1990s, and is around 6-7 percent.[10] This reflects a wide range of general and specific concessions awarded to firms, which are quite complex and difficult to quantify. Using the above corporate tax rates and adding the derived capital income tax to the net wedge raises the gross wedge that would be reported in 2004 in the prototype economy to around 48 percent of GNP. This is still higher than the created NPLs reported by Chinese banks, but closer to estimates by outside analysts. While an exact mapping of the reported NPLs and the model-based wedges cannot be clearly established, it is clear that NPLs may have been a major conduit through which investment was supported and that the wedge derived from the Solow growth model is not unrealistic.

B. Borrowing Constraints and Internal Savings

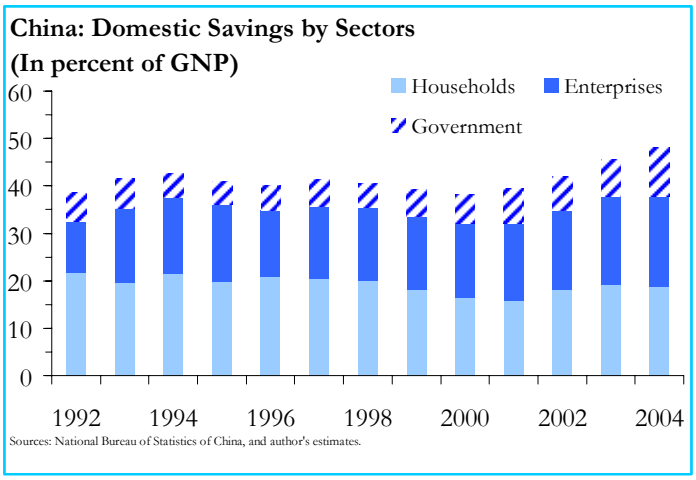
In the last few years, however, significant progress has been made in reforming China's banking sector. While it may be too early to evaluate the impact of these reforms on bank behavior (Podpiera, 2006), it appears that at least the three big banks (BOC, CCB, and ICBC) may have put in place internal controls which could have potentially slowed the creation of new NPLs. Yet the estimated investment wedge appears to have increased in the last few years, although, on average, it is lower than in the 1990s.

To address this issue, we begin by highlighting a striking feature of the Chinese economy, namely, that corporate savings is the largest source of financing investment. While China does not publish the sources of funding investment in the national account sense, data on fixed asset investment is published. (The difference between the two concepts of investment as used in Chinese statistics is discussed earlier in Section II). At least since 1999, corporate profits have been a major and rising source of financing investment. By 2004, more than half of China's investment was financed by internal savings and bank borrowing accounted for only one-quarter

[10] The rate is somewhat higher around 9-10 percent on capital income net of depreciation. Note that these are the average effective tax rates, and not the marginal tax rates. Given the lack of adequate information, it is difficult to compute the marginal rate. In addition, data on capital income tax is available only from 1992 as published in the Chinese Statistical Yearbook, prior to this period separate income tax data is not available.

of the investment, as much of corporate bank lending goes to finance working capital of firms. Using flow of funds data, Kuijis (2005) comes to similar conclusions for the period 1983–2004 as do Brooks and Barnett (2006). In particular, they argue that while internal funds had always been a significant source of financing, it has increased since the late 1990s and reaches the conclusion that about half of investment (national account sense) is financed by corporate savings.

A cursory look at the breakdown of savings across sectors shows that while household savings has fallen from around 21 percent of GDP in the early 1990s to 19 percent of GDP in 2004,[11] corporate and government savings, on the other hand, has steadily increased. In fact, during the past five years, enterprise and government saving each rose by around 4 percentage points of GDP, and they now represent around 19 and 10 percent of GDP, respectively. The breakdown of savings is derived by computing household savings from published household survey, computing government saving from the budget, and treating corporate savings as a residual category.



The dominance of internal savings in financing investment is in a large part due to the structure of firm ownership and China's poor financial intermediation, i.e., due to an underdeveloped banking system, which has been unable to meet the investment needs, particularly of the vast number of small and medium-scale enterprises, many of whom are in the private sector. Surveys and studies show that the private Chinese firms are constrained in their access to credit. Such constraints reflect the lending practices and regulatory framework that favor the state-owned enterprises over the private firms (Huang (2003)), the lengthy bank restructuring since the late 1990s, which discouraged lending until recently, and the underdeveloped bond and equity markets, which provide few channels of indirect financing. Indeed, according to the business environment survey conducted by the World Bank, the share of Chinese firms that complain about access to financing as a key obstacle to their business is significantly higher than other East Asian economies. The smaller the firms, the more constrained they are.[12] This of course

[11] Household savings for the period before 1992 are discussed in Kraay (2000), which showed a steady decline of the household savings to GNP between 1983 and 1995. The exact magnitude of the components of overall savings, i.e., savings by households, enterprises, and the government are difficult to disentangle, but estimates suggest that households save about 16-18 percent of GDP, while enterprises around 18-22 percent of GDP, and government between 6-10 percent of GDP (estimates by Kuijs (2005) and Chamon and Prasad (2005) are broadly similar).

[12] The World Bank survey taken in 1999 showed that 80 percent of private firms face financial constraints in China, and Chinese firms' reliance on retained earnings is higher than in other countries.

does not preclude many other firms, especially the large SOEs, from borrowing from banks without facing any constraints. The intention, as in the previous section, is to see whether characterizing the representative firm as being credit constrained leads to a distortion that is quantitatively large enough to explain the observed aggregate behavior of consumption and investment. The question posed is whether, on average, borrowing constraints induce firms to increase its internal savings and thereby raise overall savings and lowers consumption.

That financial market frictions lead to investment wedges has been discussed in a variety of studies including Chari, Kehoe, and McGrattan (2004). To illustrate the nature of this problem, assume that due to informational asymmetry and costly verification, households (or banks) are not willing to lend without collateral and the capital owned by entrepreneurs (the owners of firms) can only be used for this purpose. Several authors have constructed detailed environments and derived optimal contractual arrangements that lead to such borrowing constraints. However, in the presence of the borrowing constraint, a firm's return to saving an additional unit of capital is not only the marginal product of capital it receives next period but also the "return" from loosening the borrowing constraint. Thus, the return to internal savings of entrepreneurs is higher than the marginal product of capital as long as the borrowing constraint is binding, and this could lead to higher accumulation of capital than otherwise. The detailed microeconomic environment where such borrowing constraints appear as optimal arrangements is not discussed here and the interested reader is referred to Bernanke and Gertler (1989) and Carlstrom and Fuerst (1997). Versions of these models have been more recently used to explain Japan's lost decade of the 1990s (Chakraborty (2005) and Kobayashi and Inaba (2005)), while the equivalence of such an environment with a standard growth model with an investment wedge is established in Chari, Kehoe, and McGrattan (2004).

In this paper, a simplified version of the Chari, Kehoe, and McGrattan (2004) model is used. It is assumed that wages are paid in advance of production each period and therefore firms need to borrow funds to do so. Since there is no uncertainty in the model, the setup is difficult to justify and should be seen only as a device to introduce the use of working capital. In particular, it is also assumed that all working capital is borrowed and all investment is undertaken from internal savings of firms. This is clearly an extreme assumption as firms borrow both for working capital and for investment purposes. The assumption, however, keeps the model simple and helps to highlight the issue.

The households budget constraint: changes to $c_t + \gamma_{t+1} n_{t+1} l_{t+1} - l_t \leq w_t e_t + r_t l_t + \pi_t$, where l_t is the household's savings.

Firms act on behalf of the shareholders and maximize

$$\sum_{t=0}^{\infty} \lambda_t \left(k_t^{\alpha} e_t^{1-\alpha} - (1+r_t) w_t e_t - \left(\gamma_{t+1} n_{t+1} k_{t+1} - (1-\delta) k_t \right) \right),$$

subject to

$$(1+r_t) w_t e_t \leq \theta_t k_t$$

As noted earlier, wages need to be paid before production so that firms need to borrow $w_t e_t$. However, the funds that a firm can borrow are subject to a collateral constraint. The only collateral is the capital the firm owns. Banks lend to firms such that its debt service, $(1+r_t)w_t e_t$, does not exceed, $0<\theta_t<1$, fraction of the firm's capital stock.

A question that arises at this point is how representative is this stylization of the Chinese economy. Using the World Bank survey of firms, Aziz and Cui (2007) show that 40 percent of all firms and 80 percent of privately owned firms are financially constrained in meeting their working capital needs and that this constraint adversely affects the number of workers firms employ. The average employment growth for firms that are not financially constrained is about 5.5 percent annually, while in firms that reported facing financial constraints employment growth was less than 0.8 percent per year. In contrast, financial constraint had no impact on firm investment, i.e., the investment growth was statistically the same for firms that were financial constrained and those that were are not. This evidence and the fact that there are few alternative sources of collateral in China suggest that the stylized representation in this section is not unrealistic.

The first-order conditions of the firm's problems are:

$$\lambda_t\left((1-\alpha)\left(\frac{e_t}{k_t}\right)^{-\alpha}-(1+r_t)w_t\right)=(1+r_t)\eta_t w_t \tag{13}$$

$$\gamma_{t+1}n_{t+1}\lambda_t=\lambda_{t+1}\left(1-\delta+\alpha\left(\frac{e_{t+1}}{k_{t+1}}\right)^{1-\alpha}\right)+\eta_{t+1}\theta_{t+1} \tag{14}$$

where λ_t is the Lagrangian associated with the household's budget constraint, while η_t is associated with the firm's borrowing constraint.

Interestingly, in this economy, share of labor income is $w_t e_t=\frac{(1-\alpha)y_t}{(1+r_t)}\left(\frac{\lambda_t}{\lambda_t+\eta_t}\right)$, while household income, given by the sum of wages and interest income is $w_t e_t(1+r_t)=(1-\alpha)y_t\left(\frac{\lambda_t}{\lambda_t+\eta_t}\right)$. Thus as long as $\eta_t>0$, i.e., the borrowing constraint is binding, labor share and household income will be less than α. Depending on how this constraint become more or less binding over time, η_t will rise or fall, thus changing the share of household income in GDP. Since household income has been falling in China, one would expect η_t to be rising, which of course can occur only if the constraint becomes more binding over time, i.e., θ_t falls over time. Anecdotal evidence suggests that since the late 1990s, as part of the restructuring process Chinese banks have become more conservative and cautious in their lending operations. This would, in the context of this model, imply a lowering of θ_t. To see how

this would effect consumption and investment decisions, note that by using the household's first-order conditions and $(1+r_t)w_t e_t = \theta_t k_t$, i.e., that the borrowing constraint binds, one gets $\eta_{t+1}\theta_{t+1} = \lambda_{t+1}\left((1-\alpha)\left(\frac{e_{t+1}}{k_{t+1}}\right)^{1-\alpha} - \theta_{t+1}\right)$. Substituting this in the firms savings function, when the borrowing constraint is binding:

$$c_{t+1} = \frac{c_t}{\gamma_{t+1}}\beta\left(1-\delta+\left(\frac{e_{t+1}}{k_{t+1}}\right)^{1-\alpha} - \theta_{t+1}\right) \tag{15}$$

$$k_{t+1} + l_{t+1} = \frac{1}{\gamma_{t+1}n_{t+1}}\left((1-g_t)y_t + (1-\delta)k_t - c_t + l_t\right)$$

$$r_t = \left(\frac{e_t}{k_t}\right)^{1-\alpha} - \theta_t - \delta$$

Household investment is $\gamma_{t+1}n_{t+1}l_{t+1} - l_t = \gamma_{t+1}n_{t+1}\frac{\theta_{t+1}k_{t+1}}{(1+r_{t+1})} - \frac{\theta_t k_t}{(1+r_t)}$

While household income becomes $c_t + \gamma_{t+1}n_{t+1}l_{t+1} - l_t = c_t + \gamma_{t+1}n_{t+1}\frac{\theta_{t+1}k_{t+1}}{(1+r_{t+1})} - \frac{\theta_t k_t}{(1+r_t)}$

And capital stock evolves via

$$k_{t+1} = \frac{1+r_{t+1}}{(1+r_{t+1}+\theta_{t+1})\gamma_{t+1}n_{t+1}}\left((1-g_t)y_t + (1-\delta)k_t - c_t + \frac{\theta_t k_t}{(1+r_t)}\right) \tag{16}$$

In the steady state, the capital-labor ratio is $\frac{k_s}{e_s} = \left(\frac{\gamma}{\beta} - (1-\delta) + \theta_s\right)^{-\frac{1}{1-\alpha}}$

Total savings is $k_s + l_s = \frac{1}{\gamma n}\left((1-g_s)\left(\frac{e_s}{k_s}\right)^{1-\alpha} k_s + (1-\delta)k_s - c_s + l_s\right)$

Household investment is $(\gamma n-1)l_s=(\gamma n-1)\frac{\theta k_s}{1+r}=(\gamma n-1)\frac{\theta\beta k_s}{\gamma}$

Household consumption is $c_s=k_s\left((1-g_s)\left(\frac{e_s}{k_s}\right)^{1-\alpha}+(1-\delta)-\gamma n-(\gamma n-1)\frac{\theta\beta}{\gamma}\right)$.

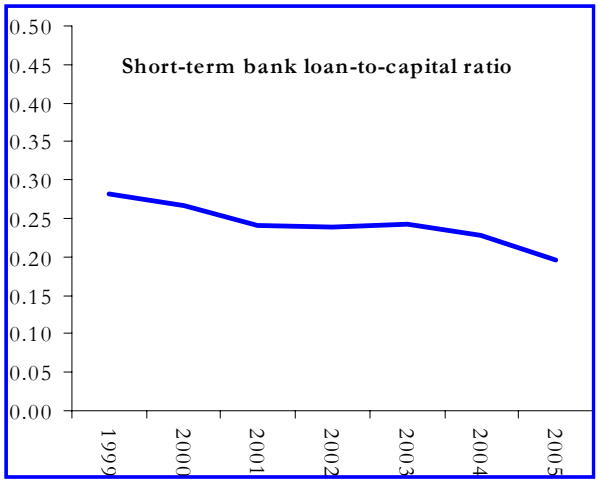
Comparing this steady state with that of the standard model, it is clear that capital will be higher as long as θ_s is appropriately small.

As before, define $\hat{\tau}_t=\frac{(1-\alpha)\left(\frac{e_{t+1}}{k_{t+1}}\right)^{1-\alpha}-\theta_t}{\left(\frac{e_{t+1}}{k_{t+1}}\right)^{1-\alpha}}$, then the household savings function (15),

becomes $c_{t+1}=\beta\frac{c_t}{\gamma_{t+1}}\left((1-\delta)+(1+\hat{\tau}_{t+1})\alpha\left(\frac{e_{t+1}}{k_{t+1}}\right)^{1-\alpha}\right)$,

which is equivalent to equation (12) and the borrowing constraint looks identical to an investment wedge. This wedge will be positive, i.e., the implicit rate of return to capital will be higher than in the standard model as long as $\eta_t>0$, or the borrowing constraint is binding. To see this note that when $\eta_t>0$, $(1-\alpha)\left(\frac{e_t}{k_t}\right)^{-\alpha}-(1+r_t)w_t>0$ and $\theta_t\frac{k_t}{e_t}=(1+r_t)w_t$, and thus $(1-\alpha)\left(\frac{e_t}{k_t}\right)^{1-\alpha}-\theta_t>0$.

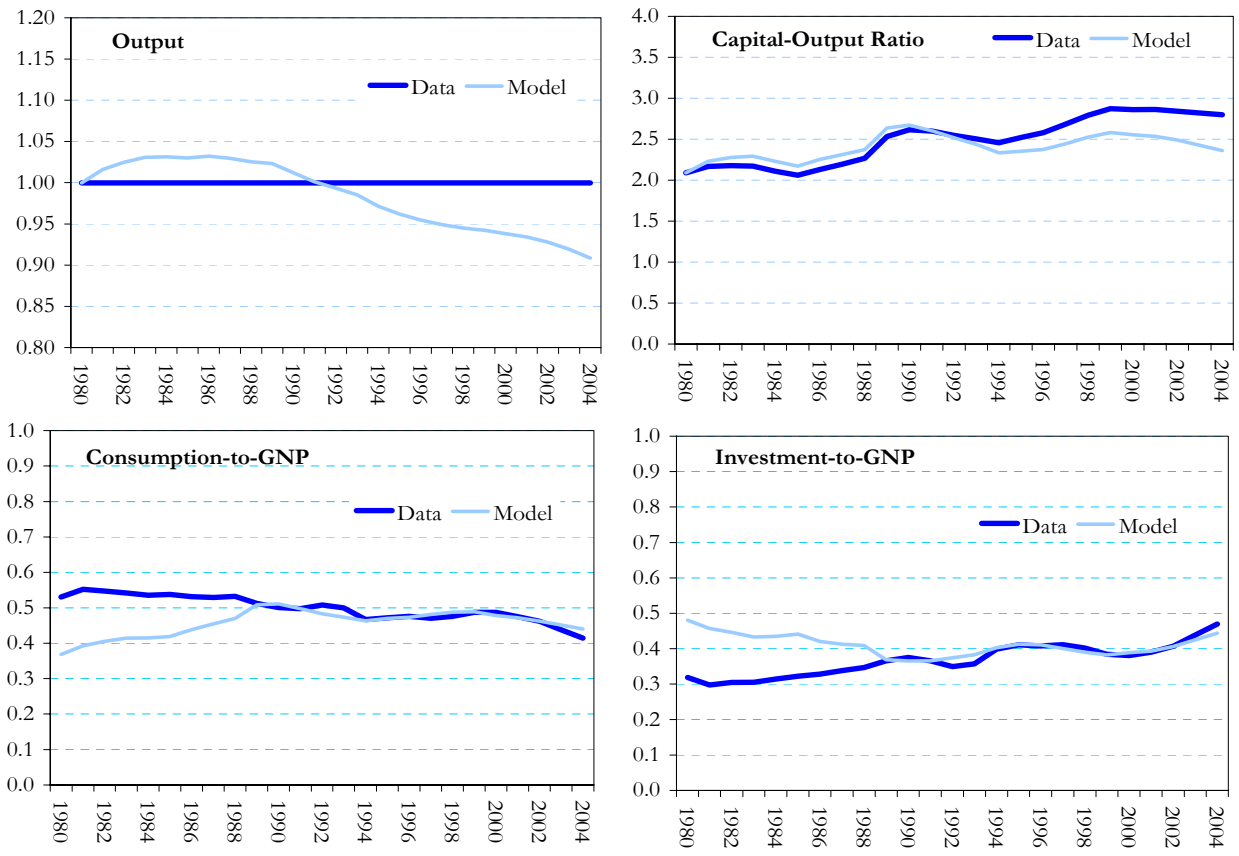
Consequently, the equilibrium of such an economy will look the same as one where there is negative tax on capital income equivalent to $\hat{\tau}$. As the stock of capital goes up, firms can borrow more from households and increase profit. In a period when banks are restructuring, such as in recent years in China, banks become more cautious about their lending. This intensifies the borrowing constraints faced by firms. As a result, the returns from loosening the constraint increases, which appears as a rise in the negative tax to capital income and encourages firms to increase its internal savings as can be observed.



It is difficult to pin down the value of θ_t from Chinese banking data as working

Figure 4a. China: Simulation with Borrowing Constraint

Theta=0.25



capital is not separately recorded. While prudential norms related to maximum loan-to-value ratios exist, it is unclear how extensively these have been implemented and to what extent they have been binding. Approximating working capital as short-term loans (less than one-year maturity) less trade credits, data from 1999-2005 reveals that the ratio of such loans to capital stock has been declining and on average over this period the ratio stood around 0.25. For simulation purposes, two experiments were conducted. In the first, θ_t was set to 0.25 for the entire period 1980–2004, and in the second experiment it was raised to 0.4 for 1980–1989 and lowered to 0.25 from 1990–2004. The results of the simulation are shown in Figures 4a and 4b. With $\theta_t = 0.25$ for the entire period, the simulated consumption and investment path mimics well the consumption and investment path for the period 1990-2004, but does rather poorly before that. In particular, in the 1980s, consumption is too low and investment too high compared with the data. This suggests that the borrowing constraint may not have been that severe in the 1980s. Easing the constraint by increasing θ_t to 0.4 in the 1980s improves the fit of the simulation better (Figure 4b). Indeed, for this path of $\{\theta_t\}$ the simulated consumption and investment path tracks the data on consumption and investment quite well. However, the implied path for output tracks the data less well. By 2004, simulated GNP is about 10 percent below that in the data.

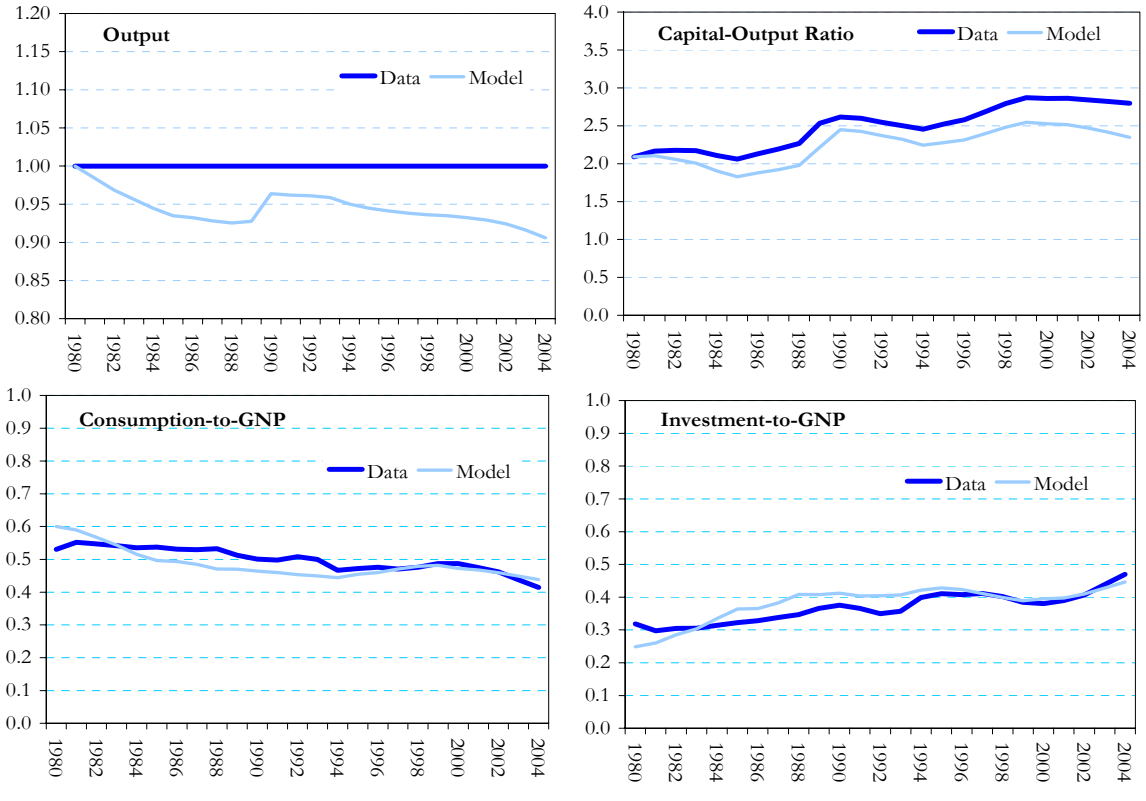
In the absence of firm evidence on θ_t, it is difficult to ascertain the contribution of this factor. Nonetheless, anecdotal evidence suggests that quite a large number of firms are constrained in their ability to borrow from the banking system. What the exercise here shows is that such borrowing constraints can potentially explain some part of the consumption-investment comovement in the Chinese data and that it is possible that the recent bank reforms have led to a tightening of the constraint that may have induced higher internal savings by firms.

C. Government Guidance to Bank Lending

Another reason why firms have been increasing internal saving may have to do with the way government has tended to guide lending. While government has steadily removed itself from intervening directly in the economy, one of the indirect ways it has retained its intervention is by guiding lending to specific sectors depending on what it has viewed as being priority areas for investment. Much of this has been on allocating resources sectorally, but to some extent this practice has also been a tool to control overall investment. In general, the government has tried to control investment by providing guidance to banks on areas where the government has considered the current level of investment to be adequate and where there is a need for further investment. Under such guidance, banks have correspondingly changed their portfolio allocations. Depending on its reading of the economic situation, the government has made changes to the sectors in the guidance list.

Figure 4b. China: Simulation with Borrowing Constraint

Theta=0.4 from 1980-89 and 0.25 thereafter



While the objective of this guidance has been to influence the sectoral allocation of investment funds, the practice may have had a general impact on firm behavior. Given that the government could change the status of a sector in the guidance list, all firms are faced with uncertainty over whether banks would provide loans or not. As this type of uncertainty is uninsurable, firms have sought to self insure through retaining profits as internal savings, and a rise in this uncertainty would lead to high corporate savings.

To see the impact of such government policy more clearly, the standard model is altered in the following way. At the end of each period, a firm applies to a bank for a loan. Bank loans are in the form of contracts that specify the interest rate and the amount, i.e., $\{r_t, x_t\}$. With probability ε_t the loan is approved and with probability $1-\varepsilon_t$ the loan is rejected. If the loan is rejected, the firm carries out production only with the capital stock it owns, otherwise it borrows the amount that it needs. Labor decisions by the firm are taken before the loan is approved. This assumption is needed to make the loan approval matter in equilibrium. To see this suppose a firm decides on its hiring decision after the bank loan is approved. In this case, firms with higher capital will hire more workers than firms with lower capital. Given that the technology follows constant returns to scale, aggregate output will not be affected by this contractual change.

Government policy in China is used to channel investment funds in certain sectors and away from others, thus the probability of approval is sector-specific with some sectors facing a lower probability of rejection than others do. However, to keep the analysis tractable here, it is assumed that all firms face the same risk and π_t is drawn independently each period, i.e., it is the risk faced by the representative firm. The firm's problem now becomes:

$$\text{Max} \sum_{t=0}^{\infty} \lambda_t \left(k_t^{\alpha} e_t^{1-\alpha} - \left(\gamma_{t+1} n_{t+1} m_{t+1} - (1-\delta) m_t \right) - w_t e_t - r_t x_t \right)$$

subject to $x_t > 0$ with probability ε_t and $x_t = 0$ with probability $1-\varepsilon_t$.

In an equilibrium, given that the uncertainty is independent of the state of nature in the previous period,

$$c_{t+1} = \beta \frac{c_t}{\gamma_{t+1}} \left(1 - \delta + \varepsilon_{t+1} \alpha \left(\frac{e_{t+1}}{m_{t+1} + x_{t+1}} \right)^{1-\alpha} + (1-\varepsilon_{t+1}) \alpha \left(\frac{e_{t+1}}{m_{t+1}} \right)^{1-\alpha} \right) \tag{17}$$

However, for firms that are unconstrained:

$$y_t^u = \left(\frac{e_t}{m_t + x_t} \right)^{1-\alpha} (m_t + x_t)$$

$$\gamma_{t+1} n_{t+1} m_{t+1} - (1-\delta) m_t + r_t x_t + \pi_t^u = \alpha y_t^u$$

While for constrained firms:

$$y_t^c = \left(\frac{e_t}{m_t}\right)^{1-\alpha} m_t$$

$$\gamma_{t+1} n_{t+1} m_{t+1} - (1-\delta) m_t + \pi_t^c = \alpha y_t^c$$

Where the superscripts *u* and *c* refer to unconstrained and constrained firms. Consequently, all firms have the same $\{m_t\}$. Assuming that the total measure of firms is 1 and that the law of large numbers holds, in equilibrium, ε_t firms will not be credit constrained, while $1-\varepsilon_t$ firms will be. Thus in equilibrium, $x_t = \frac{l_t}{\varepsilon_t}$, where l_t is household savings. Using $k_t = l_t + m_t$, aggregate output is given by

$$y_t = \left(\frac{\varepsilon_t e_t}{k_t - (1-\varepsilon_t) m_t}\right)^{1-\alpha} \left(k_t - (1-\varepsilon_t) m_t\right) + (1-\varepsilon_t)\left(\frac{e_t}{m_t}\right)^{1-\alpha} m_t$$

Letting $m_t = \rho_t k_t$, (17) can be rewritten as

$$c_{t+1} = \beta \frac{c_t}{\gamma_{t+1}} \left(1 - \delta + \alpha \left(\frac{e_{t+1}}{k_{t+1}}\right)^{1-\alpha} \left[\varepsilon_{t+1} \left(\frac{\varepsilon_{t+1}}{1 - \rho_{t+1}(1-\varepsilon_{t+1})}\right)^{1-\alpha} + (1-\varepsilon_{t+1})\left(\frac{1}{\theta_{t+1}}\right)^{1-\alpha}\right]\right) \tag{18}$$

If one defines $\hat{\tau}_t = \varepsilon_{t+1}\left(\frac{\varepsilon_{t+1}}{1-\theta_{t+1}(1-\varepsilon_{t+1})}\right)^{1-\alpha} + (1-\varepsilon_{t+1})\left(\frac{1}{\theta_{t+1}}\right)^{1-\alpha} - 1$, then (18) becomes

$c_{t+1} = \beta \frac{c_t}{\gamma_{t+1}} \left((1-\delta) + (1+\hat{\tau}_{t+1})\alpha \left(\frac{e_{t+1}}{k_{t+1}}\right)^{1-\alpha}\right)$, which again is equivalent to equation (12).

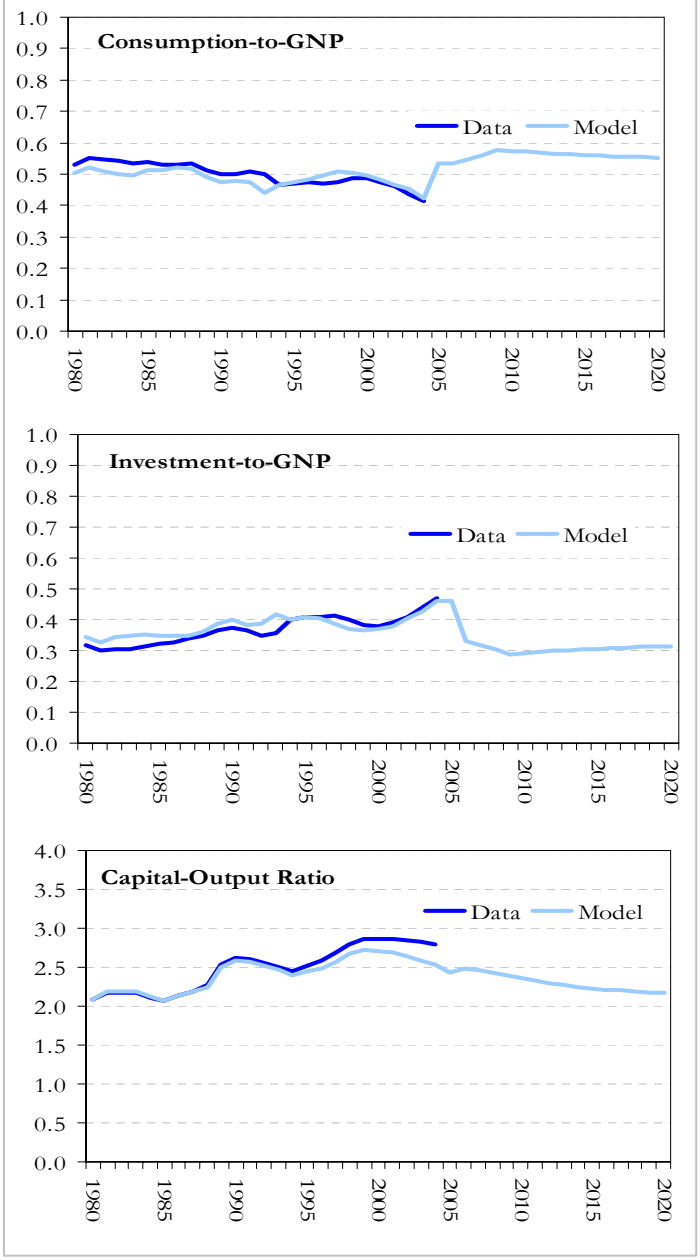
This expression for $\hat{\tau}_t$ is strictly positive as long as $0 < \varepsilon_t < 1$ and $0 < \theta_t < 1$ and thus $\hat{\tau}_t$ appears as a negative tax, raising the return on internal savings by firms above the marginal product of capital. In addition, as ε_t falls, i.e., the probability of being credit constrained increases, the wedge, $\hat{\tau}_t$, also increases. This provides greater incentive to save. To what extent this was a factor in inducing firms to increase corporate savings is difficult to pin down quantitatively. While China's state planning commission (NDRC) lists industries that are not in a priority sector or where there maybe overcapacity to banks and this list changes over time, it is difficult to use

this information to estimate $\{\varepsilon_t\}$ and no effort is made here to do so. This hypothesis is only put forward as a possible factor behind the rise in internal savings.

VIII. Conclusions

The implication of the analysis in the previous sections is that financial distortions may be crucial in understanding China's economic performance over the last two-and-a-half decades and financial sector reform may turn out to be key in China's efforts to rebalance growth. This is not to suggest that other factors put forward in the studies noted in the introduction are not relevant in explaining China's growth process or do not have a role to play in rebalancing growth. Rather the analysis suggests that the explanatory power of financial distortions may be quantitatively large and that focusing on reforming this sector may be quite important in rebalancing growth towards greater dependence on consumption. Indeed, simulations based on the prototype economy discussed in the previous sections indicate that if financial reforms were to remove these distortions, consumption to GNP could rise from its current level of below 40 percent to around 55 percent in steady state, which would imply that the investment-to-GNP ratio could fall to around 30 percent from its current level of over 45 percent. In the simulation, the average growth rate of output would fall by around 2 percentage points below the average

Figure 5. China: Simulating Policy Change



of the 1990s and 2000s to around 8 percent.[13]

Finally, a methodological issue: China's sustained double-digit growth rate over the last 25 years has, in a sense, surprised researchers, as it has been unprecedented. This has prompted many researchers to try to uncover the "China" model of development. What this paper suggests is that one need not look far beyond the neoclassical growth theory to uncover such a model. Many questions remain unanswered, such as what underlies the very high and sustained productivity growth that the growth accounting exercise throws up. Is it really just technological progress or are some important elements being missed? Echoing Hansen and Prescott (1998), what is still needed is a theory of total factor productivity to explain better China's growth. Nonetheless, neoclassical growth theory provides empirically reasonable answers to some key questions: China's unprecedented high saving and investment rate may just be the result of distorted financial incentives.

[13]In simulating the impact of such reforms, it was assumed that financial sector restructuring cuts the gross wedge on capital income from its 2004 level to zero, such that by 2010 the net tax on capital income reaches the average effective rate of the 1990s and 2000s, i.e., around 6 percent and remains at that level thereafter. All the other parameters remain unchanged.

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