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The Return to Capital in China

CHINA HAS ONE of the highest investment rates in the world, over 40 percent of its GDP in recent years. A natural question to ask is: Does China invest too much? On the one hand, China is still a low-income economy, with a capital-labor ratio that is low compared with those of advanced economies, and thus the potential returns to investment could be high. On the other hand, as Robert Lucas pointed out,¹ other constraints, such as low levels of human capital, backward technology, and low quality of institutions, may limit the realization of these potential high returns in China as in other developing countries. The fact that capital often flows from poor to rich countries reminds us that the return to capital is not always higher in poor countries.

What does it mean to say that China invests too much? A natural metric to use in answering this question is the return to capital. For example, China's economic growth rate might have been so high that the return to capital has fallen little, if at all, despite high investment rates. Put differently, the investment rate in China might be high precisely *because* the return to capital in China is high. The questions to be asked, then, are: Has the return to capital in China fallen significantly over time? Is it now low relative to returns in other countries?

Another issue concerns the *allocation* of investment within China—whether China has invested too much in certain sectors or certain regions and too little in other sectors and regions. Does the return to capital differ

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1. Lucas (1990).

significantly across sectors and provinces in China? Has this dispersion of returns changed over time?

This paper measures the return to capital in China, calculated using data on the share of capital in total income, the capital-output ratio (where both capital and output are measured at market prices), the depreciation rate, and the growth rate of output prices relative to capital prices. Although the approach is conceptually straightforward, the major challenge is the data, which we discuss below before presenting our estimates.

Although we are not aware of any other papers that estimate the aggregate return to capital in China, many papers have reported estimates of the capital stock in the course of estimating productivity growth in China.² Our estimates of the capital stock in China differ from these earlier estimates in two principal ways. First, we make use of the updated data reported by China's National Bureau of Statistics (NBS) after the 2004 census. Second, we calculate the capital stock in market prices rather than in constant prices. We do this because our goal is to calculate the return to capital, which is a function of the capital-output ratio measured at market prices.

We begin by discussing the methodology we use to estimate the return to capital. We next discuss the data and address several potential measurement problems. We then present our estimates of the aggregate return to capital in China, first for a base case using simple aggregate measures and then for a number of alternatives. These include alternative sectoral concepts that remove residential housing, agriculture, and mining, and alternative capital concepts that include inventories and consider various depreciation rates for fixed capital. We also measure after-tax returns for our base case, and we compare our base case estimate of the return to capital for China with estimates for other economies. Finally, we consider the efficiency of capital allocation in China by measuring the dispersion of the return to capital across sectors and regions and how it has changed over time.

Our base case estimate shows that the aggregate rate of return to capital in China fell from roughly 25 percent between 1979 and 1992 to about 20 percent between 1993 and 1998 and has remained in the vicinity of 20 percent since 1998. These rates of return are above those for most advanced economies calculated on a similar basis. They are also high relative to a large sample of economies at all stages of development. Estimates

2. For example, Perkins (1988), Chow and Li (2002), Huang, Ren, and Liu (2002), and Young (2003).

with the alternative treatment of residential housing and business inventories show returns rising in recent years. All in all, our findings on the return to capital provide no evidence to believe that China invests too much in the aggregate—all sectors, regions, and types of ownership included. And what evidence we have on the dispersion of returns suggests that investment in China is being distributed more efficiently than in the past.

Methodology

There are several methods one can use to measure the return to capital. One method is to use estimates of the return to capital in financial markets to back out the aggregate return to capital. This would be a natural method to use in a country with well-developed financial markets, but it is clearly inappropriate in the Chinese context. A second method is to estimate the return to capital by regressing output on a measure of the capital stock. However, this method would lead to biased estimates of the return to capital, because the capital stock is surely affected by omitted variables that also affect aggregate output.

The method we will use to measure the return to capital is quite simple in that it is based on only one assumption and one accounting identity. Consider a decision by a firm at the margin to purchase a unit of capital for use in production. If we assume that the firm takes the output price as given (we will relax this assumption later), the nominal return from this transaction is

$$(1) \quad i(t) = \frac{P_Y(t)MPK_j(t)}{P_{K_j}(t)} - \delta_j + \hat{P}_{K_j}(t).$$

Here i is the nominal rate of return, P_Y is the price of the output good, P_{K_j} is the price of capital of type j , δ_j is the depreciation rate of type j capital, MPK_j is the marginal *physical* product of type j capital, and \hat{P}_{K_j} is the percentage rate of change of the price of type j capital. (This is simply a rewriting of the Hall-Jorgenson rental price equation.) Two things are important to notice about this equation. First, if asset markets for capital goods are working efficiently, the return from investing in capital should be the same for every type of capital and for every investor. Clearly,

capital markets may not work efficiently. Second, what matters for determining the return to capital is not the marginal *physical* product of capital, but rather the ratio of the marginal *revenue* product of capital to the price of capital.

We cannot estimate the nominal return to capital directly from the above equation, because we do not observe the marginal product of capital. However, we can infer it from data on capital's share of total output, which we may proxy as 1 minus labor's share, or $1 - \frac{W(t)L(t)}{P_Y(t)Y(t)}$, where W is wages and L employment. The share of payments to capital is given by

$$(2) \quad \alpha(t) \equiv \frac{\sum_j P_Y(t)MPK_j(t)K_j(t)}{P_Y(t)Y(t)}.$$

Substituting equation 1 into this accounting identity, we get

$$(3) \quad \alpha(t) = \frac{P_K(t)K(t) \left[i(t) - \hat{P}_K(t) + \delta(t) \right]}{P_Y(t)Y(t)}.$$

Here

$$P_K(t)K(t) \equiv \sum_j P_{K_j}(t)K_j(t)$$

denotes the nominal value of the aggregate capital stock,

$$\hat{P}_K(t) \equiv \frac{\sum_j P_{K_j}(t)K_j(t)\hat{P}_{K_j}(t)}{P_K(t)K(t)}$$

denotes the average growth rate of the price of capital, and

$$\delta(t) \equiv \frac{\sum_j P_{K_j}(t)K_j(t)\delta_j}{P_K(t)K(t)}$$

denotes the average depreciation rate, which changes over time with the composition of the capital stock. The real rate of return to capital $r(t)$ can then be calculated from equation 3 as

i.e. $r = \alpha/\beta + \text{real rate of capital gains}$

$$(4) \quad r(t) = i(t) - \hat{P}_Y(t) = \frac{\alpha(t)}{P_K(t)K(t)/P_Y(t)Y(t)} + [\hat{P}_K(t) - \hat{P}_Y(t)] - \delta(t).$$

We will use this formula to measure the real rate of return to capital in China (which we refer to as the “return to capital” for short).

The key thing to notice about equation 4 is that we measure the capital-output ratio at market prices, which includes any expected change in the price of capital as part of its return. Francesco Caselli and James Feyrer also make this point in the context of measuring differences in the return to capital across countries.³ When the price of capital is equal to the price of output and the growth rates of these two prices are the same, equation 4 boils down to the familiar expression that the real rate of return to capital is the ratio of the capital share in income to the real capital-output ratio minus the depreciation rate.

Our expression for the return to capital assumes that firms take output prices as given. When the output price exceeds marginal cost, the capital share will include profits (π), reflecting imperfect competition. In this case the marginal revenue product is $\frac{P_Y}{\mu} MPK_j$, where $\mu \geq 1$ denotes the ratio of price to marginal cost (or 1 plus the markup). Thus equation 2 becomes

$$(5) \quad \alpha(t) \equiv \frac{\sum_j \frac{P_Y(t)}{\mu} MPK_j(t)K_j(t)}{P_Y(t)Y(t)} + \frac{\pi(t)}{P_Y(t)Y(t)}.$$

Since the portion of revenue accruing to such profits is given by $\frac{\mu - 1}{\mu}$, the real return to capital is now

$$(6) \quad r(t) = i(t) - \hat{P}_Y(t) = \frac{\alpha(t) - \frac{\mu - 1}{\mu}}{P_K(t)K(t)/P_Y(t)Y(t)} + [\hat{P}_K(t) - \hat{P}_Y(t)] - \delta(t).$$

This shows that ignoring the presence of imperfect competition gives an upward bias to the marginal return to capital realized by firms.

3. Caselli and Feyrer (2007).

What are plausible magnitudes of the resulting bias? If we assume that the price of capital grows at the same rate as the price of output; that the labor share is 50 percent, the depreciation rate 10 percent, and the nominal capital-output ratio 1.67;⁴ and that firms take output prices as given, the real return to capital is 20 percent. If we relax the price-taking assumption and assume a markup over marginal cost of 10 percent, the real return to capital falls to 14 percent instead. We will not take the markup into account when estimating the real return to capital in China. Since our goal is to compare the return to capital in China over time and with returns to capital in other countries, this comparison based on our estimates will be misleading only if the bias due to imperfect competition has changed over time in China or is either more or less prevalent in China than in other countries in the world.

Data

We need three pieces of data to back out the return to capital: a measure of aggregate output, a measure of the aggregate capital stock, and a measure of the share of payments to capital. We describe each in turn.

Aggregate Output

As with data for any country, one always has to consider the possibility that the GDP estimates provided by China's NBS are inaccurate. Two important institutional details about the Chinese statistical system matter in this context. First, the backbone of the Chinese national accounts is the data provided by local governments to the NBS. Many observers argue that local governments have an incentive to overstate local GDP. Although this has been true in certain periods, the NBS is well aware of the problem and uses independently sourced data to adjust the data provided by local governments. As a result, reported aggregate GDP is typically lower than the sum of reported provincial GDPs. In addition, local governments do not always have an incentive to overstate GDP. In recent years, for example, the central government has been trying to cool down the economy, and this has given local governments an incentive to understate local GDP so as to evade the central government's contractionary macroeconomic policies.

4. As discussed later, these are the rough numbers in the case of China.

Second, the NBS bases its adjustment to the locally provided data on nationwide economic censuses, which historically have been conducted every ten years.⁵ After a census is conducted, the NBS retrospectively revises its previous estimates of aggregate GDP. Clearly, if the economy has been growing rapidly, the unrevised data will be less accurate as one gets further away from the latest census year, and thus the retrospective adjustments in the most recent years will be larger as well. Fortunately, the last such census took place fairly recently, in 2004, and the NBS has revised its estimates of nominal GDP from 1978 through 2004 on the basis of this census.⁶ In these new data, GDP in 2004 was revised upward by 16.8 percent, or several times the 4.4 percent upward revision for gross fixed capital formation from the same census. We will use the revised national accounts data provided by the NBS for our estimates, which will obviously account for some of the differences between the numbers we use for the investment rate in China and those used in previous studies. To maintain consistency, we also adjust the provincial estimates so that the sum of provincial GDPs equals the estimate of national GDP.⁷

Angus Maddison has criticized China's GDP data from two perspectives, arguing that official GDP was underestimated for 1978 and that the growth rate of the official GDP deflator is too low.⁸ However, any potential problem with the 1978 estimate would obviously only affect our estimate of the return to capital in that year, and not those for more recent years. The potential problem with the GDP deflator does not affect our estimate of the nominal return to capital, because we measure GDP in current instead of constant prices, but it would obviously affect our estimate of the real return to capital. We note, however, that the NBS retrospectively increased the growth rate of the GDP deflators after the 2004 census, and we use these revised deflators for our estimates.

5. Two censuses resulted in major revisions to the GDP data. The 1993 census was for the tertiary sector, and the 2004 census was for all nonagricultural sectors.

6. Revised GDP data are reported in *China Statistical Yearbook 2006*.

7. Provincial GDP data are reported in Hsueh and Li (1999), NBS (2003), and the 2004–06 editions of *China Statistical Yearbook*. Because we are mainly interested in the dispersion of returns among provinces, we did not revise provincial GDP and investment data after the 2004 census. Allocating the increase in GDP and investment among provinces proportionally would not change the results.

8. Maddison (1998). To address the potential bias in the GDP deflator, Young (2003) uses alternative price indices to deflate nominal GDP.

One might also be concerned about the profit data reported by firms, and in particular the possibility of overstatement. For example, if multinational firms face lower tax rates in China than in their home countries, they may deliberately, through their internal transfer pricing, overstate their profits and the value added of their Chinese operations so as to reduce their tax liability in the home country. There are several reasons why this need not be a real problem, however. First of all, the profits reported to the government statistical agencies by firms in China are not to be used for tax purposes.⁹ Second, some multinational firms can claim a tax credit in their home country for taxes paid to the Chinese government. Third, the problem just described affects only foreign firms; domestic firms do not necessarily face incentives to overstate their profits. In fact, Hongbin Cai, Qiao Liu, and Geng Xiao find evidence that domestic firms *understate* profits in order to evade taxes.¹⁰

Capital Stock

The second thing we need to measure is the capital stock. China's NBS releases a series called "investment in fixed assets." This statistic, reported monthly, is the one most frequently used by Chinese government officials to measure aggregate investment. Figure 1 shows that investment in fixed assets increased from 20 percent of GDP in 1981 to just below 50 percent in 2005. This evidence has prompted many observers to conclude not only that China's investment rate is too high, but also that this ongoing trend of a rising investment share in GDP cannot be sustained.

However, there are two reasons why this widely used series may not provide an accurate measure of the change in China's capital stock.¹¹ The first is that the NBS counts the value of purchased land and expenditure on used machinery and preexisting structures as part of investment in fixed assets. Clearly, neither of these should be regarded as an increase in China's reproducible capital stock. The second is that the series is based

9. Article 33 of "Regulations on National Economic Census" states that "[T]he use of materials regarding units and individuals collected in economic census shall be strictly limited to the purpose of economic census and shall not be used by any unit as the basis for imposing penalties on respondents of economic census."

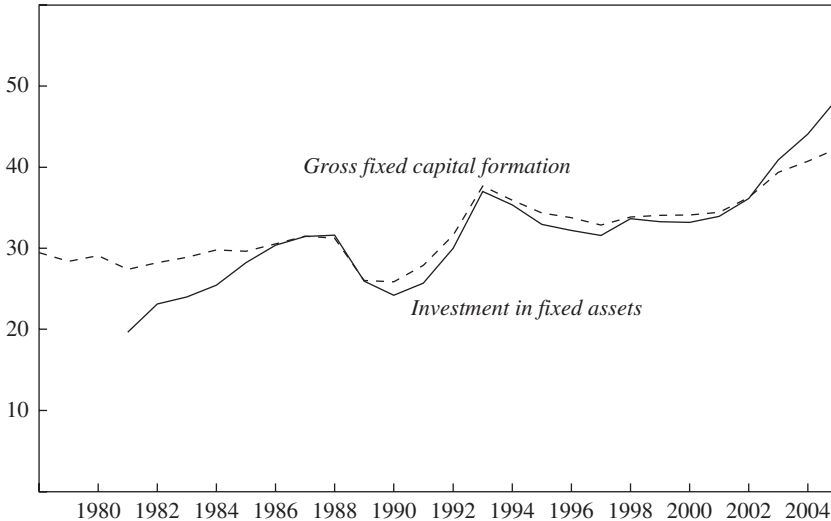
10. Cai, Liu, and Xiao (2005).

11. Xu (2000).

Figure 1. Investment in China, 1978–2005

GFCF/GDP in World Bank WDI = 40% in 2005. So GFCF plotted here consistent with WB

Percent of GDP



Source: NBS.

on survey data for large investment projects only, which will obviously understate aggregate investment.¹²

Although less widely used, an alternative estimate of investment that addresses these problems, called “gross fixed capital formation,” is available from the NBS, but only once a year rather than monthly. The NBS calculates this measure by subtracting the value of land sales and expenditure on used machinery and buildings from investment in fixed assets, and then adds expenditure on small-scale investment projects. As figure 1 shows, the investment rate as measured by the share of gross fixed capital formation in GDP increased much less rapidly than did that measured by investment in fixed assets, rising from 30 percent in 1978 to 42 percent in 2005. Since gross fixed capital formation is a more accurate measure of the change in China’s reproducible capital stock, this is the series we will use to measure the capital stock in China.

12. Specifically, before 1997 the investment survey asked firms to report all investment expenditures over 50,000 yuan. Beginning in 1997 the threshold was increased to investment expenditures over 500,000 yuan.

The main limitation of this series is that it is not disaggregated into different types of investment, whereas the series on investment in fixed assets is disaggregated into investment in structures and buildings and investment in machinery and equipment.¹³ To get around this problem, we assume that the shares of the two types of capital in fixed capital formation are the same as those for total investment in fixed assets.¹⁴

We now turn to the investment price deflators. After 1990 the NBS reports separate price indices for investment in structures and buildings and for investment in machinery and equipment. For 1978–89 we assume that the price of structures is accurately measured by the deflator of value added in the construction industry.¹⁵ Similarly, we assume that the price of machinery and equipment during the same period is accurately measured by the output price deflator of the domestic machinery and equipment industry. Before 1978 we assume that the growth rate of the prices of the two types of investment goods is simply the growth rate of the aggregate price of fixed capital formation.¹⁶

With data on nominal investment and investment prices in hand, we estimate the quantity of the two types of capital using the standard perpetual inventory approach. We initialize the capital stock in 1952 as the ratio of investment in 1953 (the first year for which investment data are available) to the sum of the average growth rate of investment in 1953–58 and the depreciation rate. We assume that the depreciation rate is 8 percent for structures and 24 percent for machinery.¹⁷

Our procedure for calculating the capital stock differs from those used by other authors. Dwight Perkins uses the capital accumulation series reported by the NBS under the Material Production System (the national accounts system used under central planning); this series is no longer available after

13. This is why many Chinese researchers (for example, Huang, Ren, and Liu, 2002; Wang and Wu, 2003) use investment in fixed assets series to estimate the capital stock.

14. Our data for 1952–77 are from Hsueh and Li (1999). Data for 1978–2004 were adjusted after the 2004 National Economic Census and are published in *China Statistical Yearbook 2006* together with the 2005 data.

15. From 1990 to 2004 (when both series are available), the correlation between the construction output deflator and the deflator for investment in structures is 0.95.

16. The price indices for fixed capital formation before 1978 are from Hsueh and Li (1999).

17. We arrive at these estimates of depreciation rates from estimates in Wang and Wu (2003) of the useful lives of structures and buildings (thirty-eight years) and machinery and equipment (twelve years).

In 1953, GFCF was 12% of GDP (Young, 2003, p. 1248), growth of investment was important over 1952-1958, and the depreciation rates they take are big. This generates a $K/Y < 1$ in 1952.
Plus: what about non-produced capital? (=land)

1993.¹⁸ He assumes an annual depreciation rate of 5 percent and an initial capital-output ratio (in 1980) of 3. Gregory Chow and Kui-Wai Li measure investment by gross capital formation (including inventories), use accounting depreciation as reported in the national accounts instead of economic depreciation, and use Chow's proprietary data to estimate the initial capital stock (in 1953).¹⁹ The procedure we use is conceptually similar to that used by Yongfeng Huang, Ruoen Ren, and Xiaosheng Liu and by Alwyn Young,²⁰ although the details differ. Huang, Ren, and Liu use investment in fixed assets disaggregated into investment in structures and buildings and investment in machinery and equipment. They deflate nominal investment (of both types of capital) by the retail price index. Young computes the capital stock for the nonagricultural sector from the NBS series on gross fixed capital formation but does not distinguish between the two types of capital. In turn, he imputes the price index for investment as the residual of the price of aggregate nonagricultural output after subtracting the price of consumption and export goods.

Share of Capital

The final piece of information we need is the share of capital in total income, which we calculate as the residual of labor income. The NBS provides annual data on the labor share for each province and each sector but not for the aggregate economy.²¹ We therefore estimate the aggregate labor share as the average of the provincial labor shares weighted by the share of each province in GDP. As table 1 shows, the resulting estimate of the capital share typically fluctuates between 46 and 50 percent of GDP but experiences a sharp rise from 2003 through 2005.

There are potentially two concerns about our use of the NBS estimate of aggregate labor income in this calculation. First, the reported labor shares may understate true labor income (and thus overstate true capital income) if there are unmeasured nonwage benefits. However, the NBS explicitly

Rise of alpha in 2004 = methodo
change by NBS, see Bai & Qian
(2010). Alpha is over-estimated

18. Perkins (1988).

19. Chow and Li (2002); Chow (1993).

20. Huang, Ren, and Liu (2002); Young (2003).

21. See Hsueh and Li (1999) for 1978–95, NBS (2003) for 1996–2002, *China Statistical Yearbook 2004* for 2003, and *China Statistical Yearbook 2006* for 2005. The share of capital in total income for 2004 is missing from the official data and is therefore taken to be the average of those for 2003 and 2005.

Includes output taxes in K income, see below

Probably too small, at least initially, because initial (1953) K/Y seems too low (<1)

The difference between both growth rates gives real capital gains only to the extent that the price of existing capital varies like the price of newly created capital.

Table 1. Variables Used in Calculating the Return to Capital in China, 1978–2005

Year	Capital share of income (percent)	GDP (billions of yuan) ^a	Capital-output ratio	Depreciation rate (percent a year)	Growth rate (percent a year) of		Return to capital (percent a year) ^b
					Investment goods deflator	GDP deflator	
1978	50.33	364.52	1.39	12.06	0.94	1.92	23.15
1979	48.62	406.26	1.37	11.93	2.14	3.58	22.04
1980	48.85	454.56	1.36	11.77	4.98	3.79	25.40
1981	47.32	489.16	1.44	11.38	1.79	2.29	20.92
1982	46.43	532.34	1.45	11.00	2.35	-0.25	23.65
1983	46.46	596.27	1.43	10.76	3.77	1.00	24.47
1984	46.32	720.81	1.34	10.60	4.81	4.94	23.91
1985	47.10	901.60	1.24	10.63	8.61	10.21	25.74
1986	47.18	1,027.52	1.32	10.81	7.53	4.75	27.83
1987	47.47	1,205.86	1.34	10.75	6.99	5.16	26.57
1988	48.28	1,504.28	1.28	10.78	12.50	12.08	27.45
1989	48.49	1,699.23	1.41	10.82	9.52	8.51	24.55
1990	46.64	1,866.78	1.49	10.94	7.31	5.84	21.89
1991	49.97	2,178.15	1.44	10.85	9.06	6.85	26.08

1992	49.91	2,692.35	1.36	10.73	15.53	8.24	26.37
1993	49.63	3,533.39	1.31	10.65	29.37	15.12	27.92
1994	48.89	4,819.78	1.39	10.59	10.25	20.61	24.86
1995	47.44	6,079.37	1.37	10.68	4.97	13.74	24.05
1996	47.20	7,117.66	1.39	10.65	4.52	6.44	21.38
1997	47.11	7,897.30	1.48	10.55	2.13	1.51	21.99
1998	46.88	8,440.23	1.57	10.55	0.02	-0.86	20.18
1999	47.58	8,967.71	1.64	10.53	-0.14	-1.26	19.56
2000	48.52	9,921.46	1.63	10.53	1.61	2.06	18.71
2001	48.54	10,965.52	1.65	10.50	0.71	2.05	17.50
2002	49.08	12,033.27	1.67	10.49	0.38	0.58	18.61
2003	50.38	13,582.28	1.66	10.49	3.10	2.61	20.43
2004 ^c	54.49	15,987.83	1.63	10.48	6.87	6.91	22.82
2005 ^c	58.60	18,308.48	1.72	10.47	1.43	3.92	21.04

Sources: NBS and authors' calculations.

a. At current prices.

b. Using GDP deflator adjusted as described in the text for 1992–95. Estimated returns to capital without making the adjustment are 33.30, 41.47, 14.26, and 15.16 percent for 1992, 1993, 1994, and 1995, respectively.

c. Preliminary.

What is hard to understand is why their K/Y is not rising more. Starting from 139% in 1978, one easily gets >300% K/Y in the 2000s simply using net investment rates and real rate of GDP growth, and assuming 0 K gains. Maybe it's because of their high depreciation?

includes an estimate of nonwage benefits in the numbers for labor income. In the manufacturing sector, for example, nonwage benefits account for 20 percent and wage income for 30 percent of aggregate income in the sector.²²

Second, the NBS estimates may again understate the labor share if, as in many developing countries, the reported figures for aggregate labor income exclude the imputed labor income of self-employed workers.²³ In fact, before 2005, the NBS counted *all* self-employment income as labor income. Therefore our estimates for those years actually *overstate* the true labor share and understate the true capital share. In 2005 the NBS for the first time explicitly excluded the imputed capital income of self-employed workers from the published estimates of labor income. Unfortunately, the NBS does not report the magnitude of this adjustment, and so we are unable to adjust our capital share estimates accordingly for the years before 2005.

Estimates of the Return to Capital

Figure 2 plots our base case estimate of the aggregate rate of return to capital in China, derived from equation 4 and the data in table 1. Again, this estimate properly aggregates structures and equipment and measures the capital-output ratio in current prices. As the figure shows, the annual return to capital in China fell between 1993 and 1998 from roughly 25 percent to 20 percent. Since 1998 the annual return to capital has remained in the vicinity of 20 percent, despite the 8-percentage-point increase in the investment rate (figure 1). Therefore a central finding is that, despite China having one of the highest rates of investment in the world, the return to capital in China does not appear to be significantly lower than that in the rest of the world.²⁴

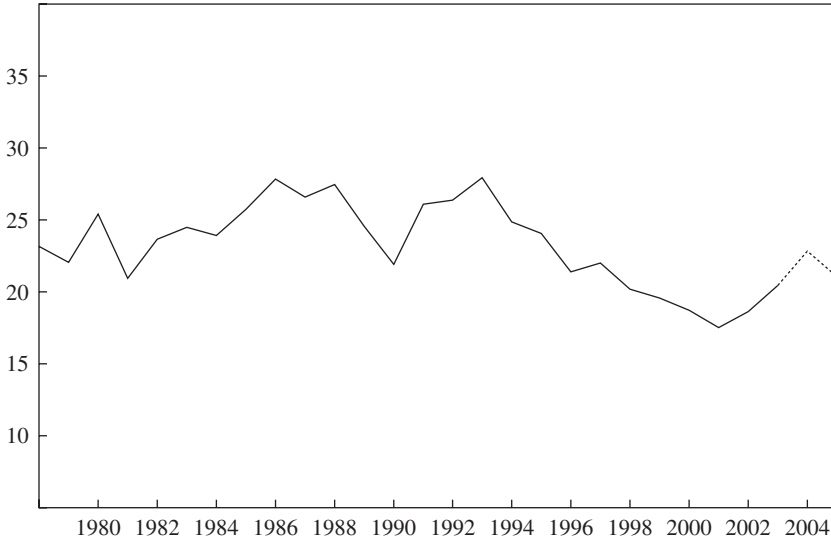
22. We get the 30 percent wage income share by aggregating wage payments and value added from firm-level data from the Chinese industrial survey in 2003. Since the NBS reports that the share of total labor *compensation* (including nonwage benefits) in the manufacturing sector is 50 percent, the NBS's imputed nonwage income must be 20 percent of manufacturing value added.

23. Gollin (2002).

24. See, for example, Poterba (1998) for a comparison of rates of return to capital in a sample of countries in the Organization for Economic Cooperation and Development.

Figure 2. Base Case Estimate of Return to Capital, 1978–2005^a

Percent a year



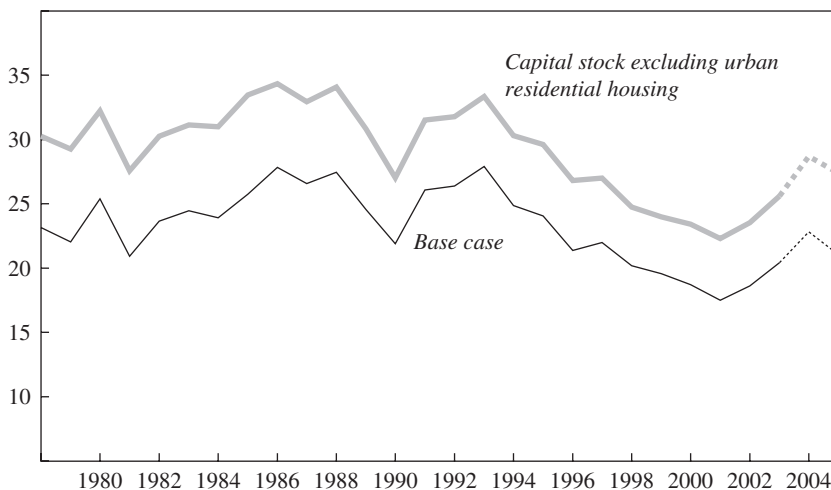
Sources: NBS and authors' calculations.
 a. Dashed line indicates preliminary results.

Two remarks about the underlying data are in order. First, the gap between the growth rate of the investment goods deflator and the growth rate of the GDP deflator was extremely volatile during the 1992–95 period: on average, the relative price of capital rose 10 percent a year in 1992–93 and fell by 10 percent a year in 1994–95. In all other years the relative price of capital grew at a fairly stable annual rate of between –3 and 3 percent. To eliminate the volatility in the estimated return to capital caused by the volatility in the relative price of capital during 1992–95, we adjust the GDP deflator over this period by assuming that its growth rate was proportional to that of the investment goods deflator over the same period, while maintaining the accumulated growth of the GDP deflator over this period.

Second, the data we use for 2004 and 2005 are preliminary, for three reasons. One is that the NBS did not provide an estimate of the labor share in 2004. We therefore assumed that the labor share in 2004 is the average of the labor share in 2003 and 2005. Another is that, as noted earlier, the labor share in 2005 excludes the imputed capital income of self-employed workers,

Figure 3. Return to Capital Excluding Urban Residential Housing, 1978–2005^a

Percent a year



Sources: NBS and authors' calculations.

a. Dashed lines indicate preliminary results.

but the NBS does not make a similar adjustment for earlier years. Finally, the 2005 data reported in the 2006 *China Statistical Yearbook* are preliminary and are likely to be revised by the NBS in 2007.

The base case provides estimates of the rate of return that are most comparable with commonly cited aggregate measures for other countries. Alternative measures that require additional, disaggregated data may be more useful for some purposes, but these data may be less reliable. Nonetheless, it is useful to look at some alternative estimates using the data that are available. These estimates address both conceptual and measurement issues that affect the base case. They include alternative measures of the capital stock relevant for business investment and alternative measures of the income associated with such investment.

We first measure the return to capital excluding residential housing. Investment in residential housing has increased very rapidly in China, but it is possible that the flow of services generated by the housing stock is undervalued in the Chinese national accounts. Specifically, the NBS imputes the rental value of the housing stock as 3 percent of the original value of the housing stock. Figure 3 presents our estimate of the return to the non-

housing capital stock, which we calculate by excluding the urban residential housing stock from the aggregate capital stock and subtracting the imputed rent on urban residential housing from our estimate of aggregate output and capital income.²⁵ As the figure shows, the annual return to nonhousing capital is roughly 5 percentage points higher than the annual return to the aggregate capital stock.

In the base case we measure capital income as the difference between labor income and total income. However, nonlabor income includes rents to agricultural land and mineral resources as well as the return to reproducible capital. Ideally, one would like to exclude these rents from our measure of capital income. In the absence of data that would allow us to do this, we estimate the return to capital in the nonagricultural and nonmining (and petroleum) sectors.²⁶ That is, we exclude the (reproducible) capital stock in the agriculture and mining sectors from the capital stock: we exclude output in these two sectors from our estimate of aggregate output; and we exclude capital income in these two sectors from our measure of aggregate capital income.

As can be seen in figure 4, the return to capital in the nonagricultural sectors slightly exceeds the aggregate return to capital in the early 1980s, but the two are virtually the same after 1988. Similarly, the return to capital in the nonmining sectors (figure 5) is higher than the aggregate return to capital in the 1980s. During this period the government set prices of mineral products artificially low. However, the gap narrows in the 1990s, after the prices of mineral products and petroleum went up sharply. For most of the period, the returns in these two alternative measures differ little from the returns in the base case.

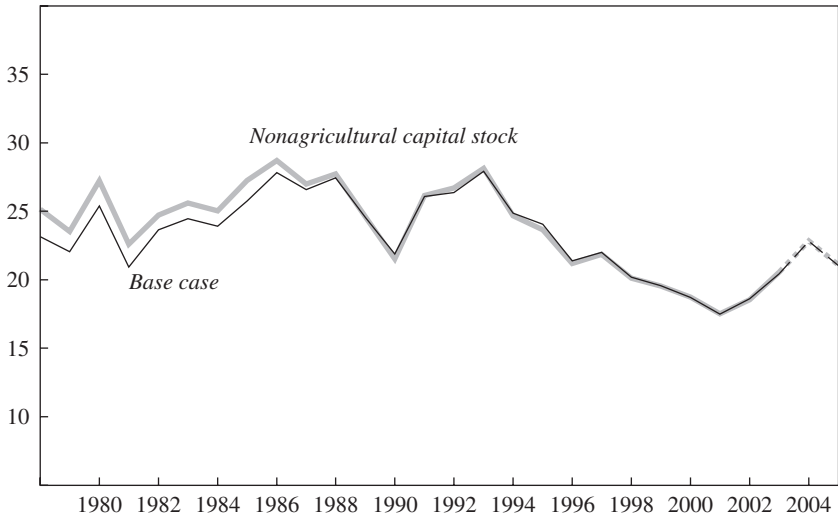
Our base case estimate assumes constant depreciation rates over time. However, given that depreciation reflects not only physical depreciation but

25. Data on investment in residential housing are from *China Statistical Yearbook*, various years. The price index and the depreciation rate for buildings and structures are used to construct the stock of residential housing. Total residential rent is computed by multiplying urban population by urban housing rent (or expense) per capita, obtained from *China Statistical Yearbook*, various years.

26. Data on the value added of mining industries before 1995 are from *China Industrial Economy Statistical Yearbook* and those after 1995 are from *China Statistical Yearbook*. Data on investment in the mining industries before 2000 are from NBS (2002), and those after 2000 are from *China Statistical Yearbook 2006*. The investment data include only construction and installation. The underestimate of the investment in the mining sector will result in a downward bias of the estimated return to capital when the mining sector is excluded.

Figure 4. Return to Nonagricultural Capital, 1978–2005^a

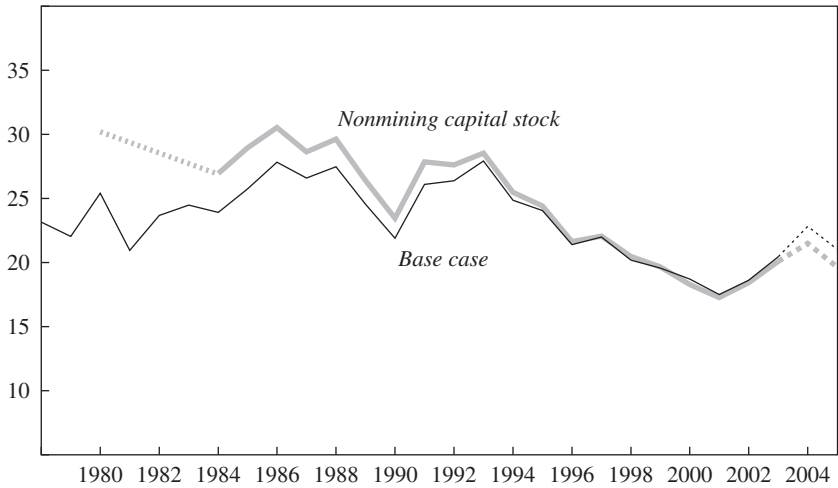
Percent a year



Sources: NBS and authors' calculations.
a. Dashed lines indicate preliminary results.

Figure 5. Return to Nonmining Capital, 1978–2005^a

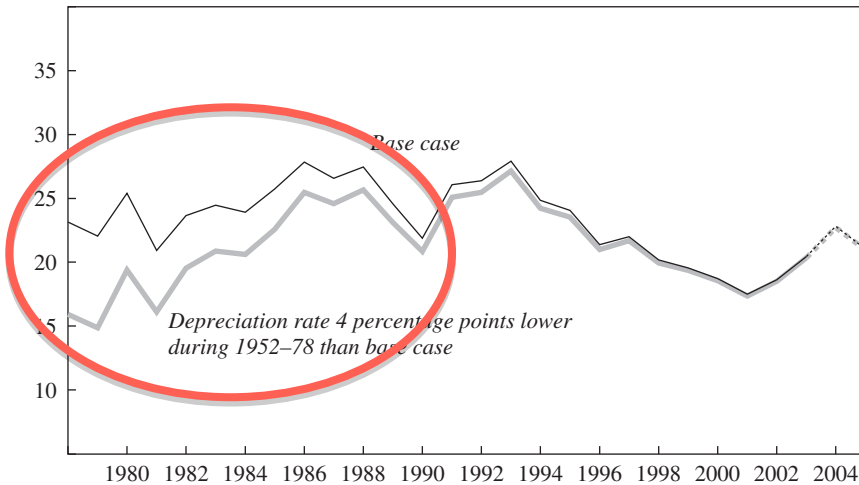
Percent a year



Sources: NBS and authors' calculations.
a. Dashed lines indicate preliminary results or (for 1981–83 return to nonmining capital) unavailable data.

Figure 6. Return to Capital under Different Assumed Depreciation Rates, 1978–2005^a

Percent a year



Sources: NBS and authors' calculations.

a. Dashed lines indicate preliminary results.

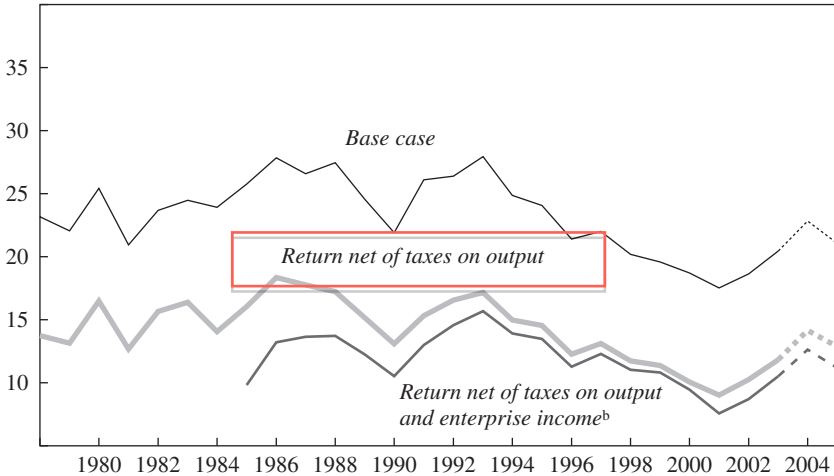
also technological obsolescence, it seems plausible that obsolescence was lower before 1978, when there was presumably less technical progress. To consider the implications of this possibility, we estimate the return to capital under the assumption that the depreciation rate was 4 percentage points lower between 1952 and 1978 than after 1978, which changes our estimate of the capital stock. As figure 6 reveals, this alternative assumption leads to a lower return to capital in the earlier period and a similar return to capital in the later period compared with the base case.

In the base case, capital income includes taxes, both on output (such as the value added tax) and on enterprise income. Although society as a whole receives the return to capital gross of taxes, business investment is driven by the after-tax return. Figure 7 presents an estimate of the return to capital when we exclude these taxes from capital income.²⁷ As the figure shows,

27. Data for net taxes on production are from Hsueh and Li (1999), NBS (2003), and *China Statistical Yearbook 2004* and 2006. Data on enterprise income tax are from *China Statistical Yearbook 2006*.

Figure 7. Return to Capital after Taxes, 1978–2005^a

Percent a year



Sources: NBS; Hsueh and Li (1999); authors' calculations.

a. Dashed lines indicate preliminary results.

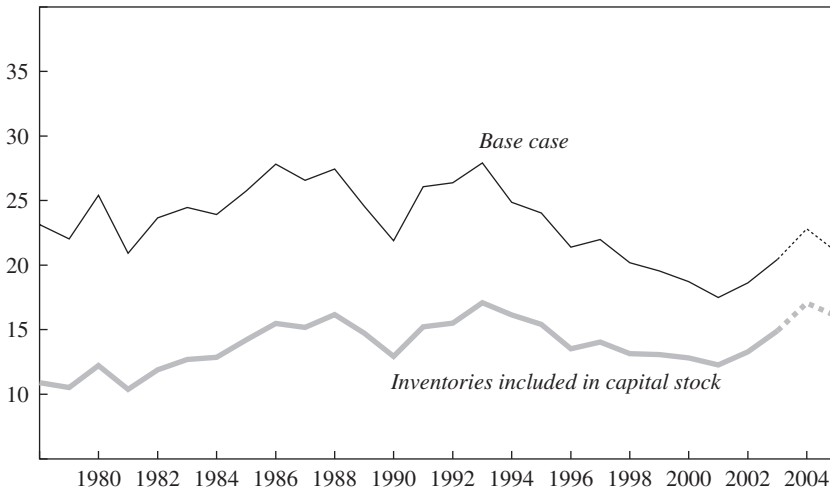
b. Data on enterprise income tax are unavailable before 1985.

the after-tax return to capital is about 10 percentage points lower than the before-tax return.

So far we have treated the return to capital as a return to investment in *fixed* capital. But business also invests in *inventory*. Assigning all the return to fixed investment in effect treats the return to inventory investment as zero. Yet, in many cases, the inventory stock may be an important part of an enterprise's total investment. Our next alternative therefore adds inventories to the stock of fixed capital in order to calculate the return on total reproducible capital. As can be seen in figure 8, the inclusion of inventories results in a more than 10-percentage-point drop in the return to capital in the early 1980s and a 5-percentage-point drop in recent years. (We use the GDP deflator as the price index for inventory and assume zero depreciation.) The reason is that the increase in inventories was a much larger share of gross capital formation in earlier years than it is now (22.1 percent in 1978, compared with 2.6 percent in 2005). Perhaps more important than this effect on the estimated level of the return to capital is the observation that including inventories results in a modest rise in the return to

Figure 8. Return to Capital Inclusive of Inventories, 1978–2005^a

Percent a year



Sources: NBS and authors' calculations.
 a. Dashed lines indicate preliminary results.

capital from 1978 to 2004 instead of the small decline seen in the base case estimate.

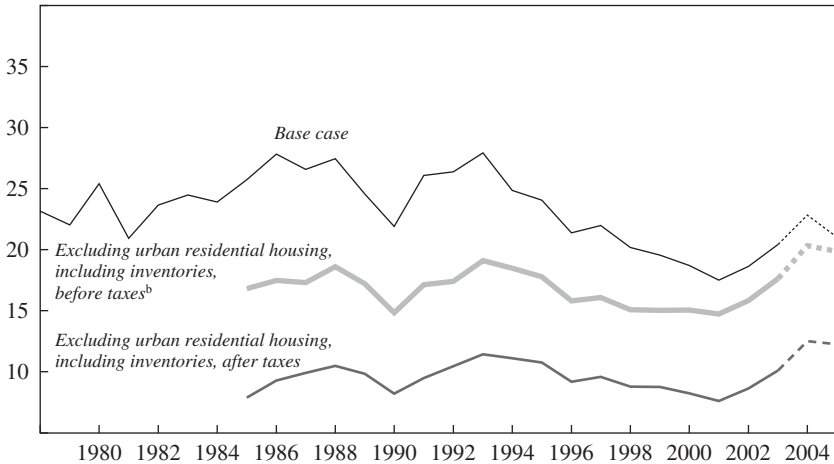
Three of the alternatives we have considered—those for residential housing, inventories, and taxes—make a substantial change to either the level or the time path of the estimated rate of return in the base case. Figure 9 presents estimates of the return to capital between 1985 and 2005 when these alternatives are combined and compares them with the base case. The middle curve represents the estimate when taxes are not removed from capital income. The resulting annual return is between 15 and 20 percent and is rising to new highs in recent years. The lower curve represents the estimate when taxes are excluded from capital income. Here the annual return fluctuates around 10 percent, and it, too, has recently risen to new highs.

We can compare our results with estimates by the Organization for Economic Cooperation and Development (OECD) that use data from the industrial firm database provided by the NBS.²⁸ The NBS database covers

28. Dougherty and Herd (2005).

Figure 9. Before- and After-Tax Return to Capital Excluding Urban Residential Housing and Including Inventories, 1978–2005^a

Percent a year



Sources: NBS and authors' calculations.

a. Dashed lines indicate preliminary results.

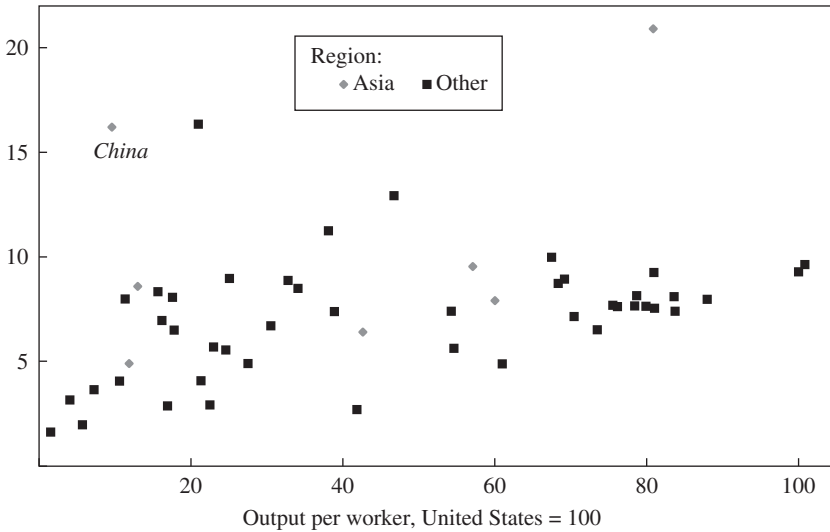
b. Data on enterprise income tax are unavailable before 1985.

the period from 1998 to 2003 and includes all industrial enterprises with annual sales of 5 million yuan or higher. Average rates of return on physical capital estimated for these industrial enterprises are 6.1 percent for 1998 and 12.2 percent for 2003, figures that roughly correspond to our estimates that include inventories in the capital stock and exclude urban residential housing and taxes (8.8 percent and 10.1 percent, respectively).

However, one has to be cautious about estimates of the return to capital measured from firm-level data, for several reasons. First, these estimates almost always measure the capital stock at book value rather than market value. Second, such data are rarely comprehensive, which obviously makes it difficult to make inferences about the return to capital in the aggregate economy from such estimates. Third, because firm-level data can contain information about existing firms only, they do not capture the return to capital of firms that have gone out of business. With aggregate data the aggregate capital stock includes the capital stock of firms that have disappeared from the marketplace. Therefore our estimates based on aggregate data should capture the effect of business failures on

Figure 10. Return to Capital and Output per Worker in a Sample of Economies, 1998^a

Return to capital, percent a year



Sources: Penn World Tables; Bernanke and Gurkaynak (2002); authors' calculations.
 a. Data are for fifty-two developed and developing economies worldwide.

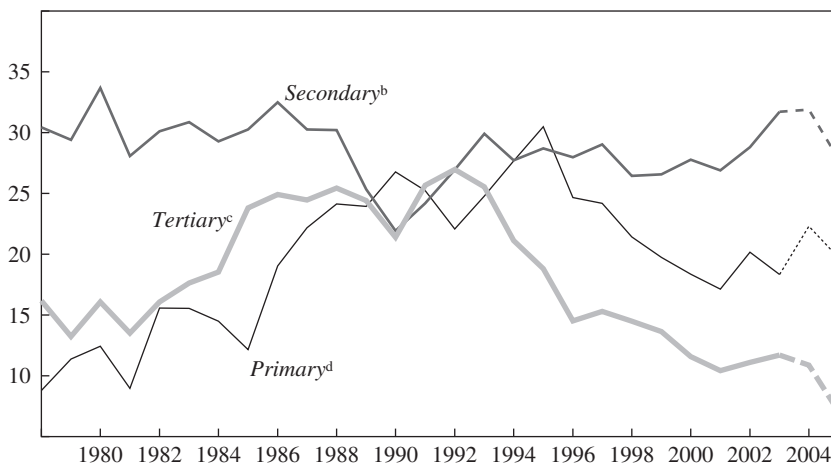
the aggregate return to capital, whereas estimates based on firm-level data do not.

Finally, it is worth comparing the return to capital in China with that in other economies. Ideally, one would want to measure the capital share and the capital-output ratio in all economies worldwide with the same degree of detail with which we measure these variables in China, but this would be prohibitively time consuming. As a shortcut, we instead compute the capital-output ratio for the sample of economies in the Penn World Tables. For the capital share of income, we take the residual of the labor income share reported in 2001 by Ben Bernanke and Refet Gurkaynak; we also assume a depreciation rate of 6 percent a year.²⁹ This produces somewhat different estimates for China than those from our detailed analysis above, but the common data set provides a more direct comparison with the other economies. Figure 10 plots the return to capital against output per

29. Bernanke and Gurkaynak (2002).

Figure 11. Return to Capital by Sector, 1978–2005^a

Percent a year



Sources: NBS and authors' calculations.

a. Dashed lines indicate preliminary results.

b. Construction, mining, and manufacturing.

c. Services.

d. Agriculture.

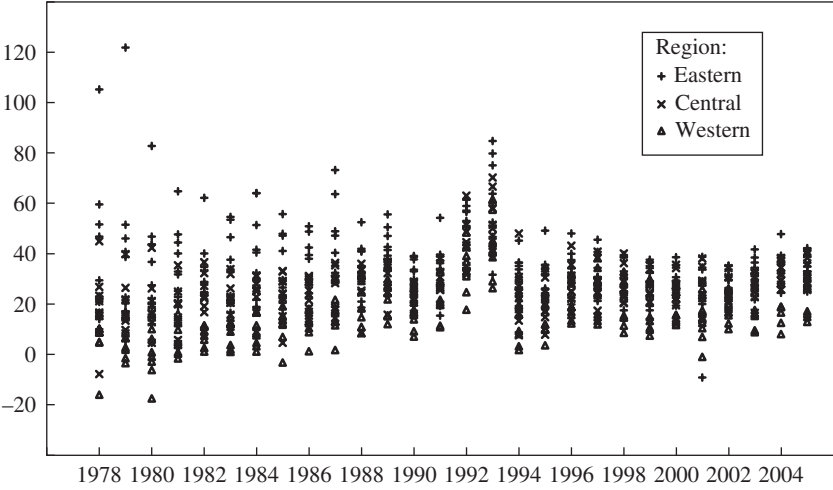
worker for this set of economies, again using equation 4 and measuring the capital-output ratio at market prices. As the figure shows, the return to capital is significantly higher in China than in most of the other economies.

Returns to Capital across Sectors and Regions

We now examine the heterogeneity in returns to capital in China, considering first the allocation of capital across sectors. Figure 11 plots the return to capital in China's primary (agriculture), secondary (construction, mining, and manufacturing), and tertiary (services) sectors. At the beginning of China's reforms, the return to capital was high in the secondary sector, low in the tertiary sector, and still lower in the primary sector. The returns to capital in the three sectors converged through 1989, with a large increase in the primary and tertiary sectors and a decline in the secondary sector. However, returns to capital have again diverged since 1991, with an increased return in the secondary sector, a slight decline in the primary sector, and a significant decline in the tertiary sector. These estimates use the adjusted

Figure 12. Return to Capital by Province, 1978–2005^a

Percent a year



Sources: NBS and authors' calculations.

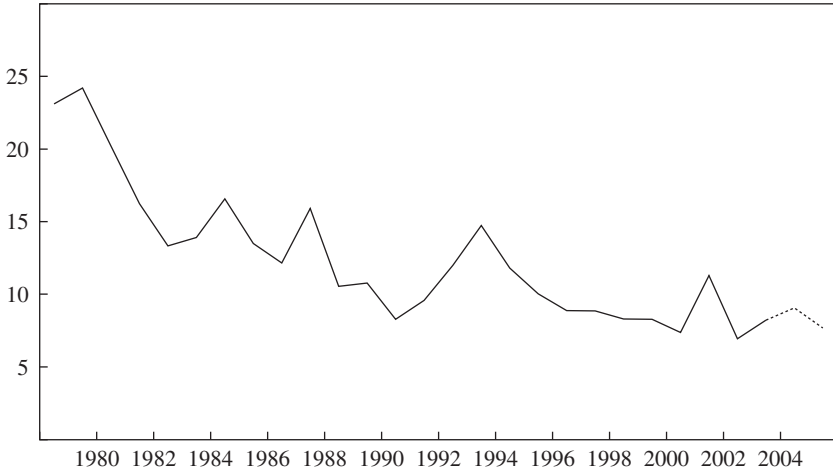
a. Data for 2004 and 2005 are preliminary; each observation represents the estimated return in one of twenty-eight provinces.

GDP data, where the revisions largely affected services output. One possible interpretation of the data is that, in the 1990s, many investments made in the tertiary sector (schools and infrastructure, for example) increased returns in the secondary sector rather than in the tertiary sector itself. It is also likely that much of the investment in the tertiary sector contributed to productivity and output with a substantial lag.

Figure 12 plots the return to capital, again computed from equation 4, for each of China's provinces in each year from 1978 to 2005. Provinces are assigned to one of three regions, eastern, central, and western, each represented in the figure by a common symbol. Two observations can be made immediately from the figure. First, the return to capital is generally highest in the eastern region, followed by the central region, and lowest in the western region. Second, the dispersion of returns to capital across provinces has decreased over time. Whereas in the early years of reform (1978–82), one province, Shanghai, stood out with a much higher return than all other provinces, the difference between Shanghai and the other provinces has been much less prominent in later years. Figure 13 shows

Figure 13. Standard Deviation of Returns to Capital across Provinces, 1978–2005^a

Percent a year



Sources: NBS and authors' calculations.

a. Dashed line indicates preliminary results; data are for twenty-eight provinces.

that the standard deviation of the return to capital across all provinces follows a generally declining trend.

Table 2 presents transition matrices in the return to capital across provinces in four subperiods. China's twenty-eight provinces are grouped into quartiles based on the return to capital in the province; we then compute for each province the probability that, during a given period, it moves from its initial quartile to one of the other three. The results show little change in the rankings between the 1978–84 subperiod and the 1985–91 subperiod. However, the mobility among the different groups markedly increases thereafter. For example, roughly 60 percent of provinces moved to a different quartile between the 1985–91 and the 1992–98 subperiod. Finally, it is worth noting that this mobility is observed mostly among the provinces in the top three quartiles. The vast majority of provinces in the lowest quartile remain there across all subperiods.³⁰

30. Others have examined the relationship between investment flow and marginal product of capital across provinces (Gong and Xie, 2004; Boyreau-Debray and Wei, 2005).

Table 2. Transition Matrices for China's Provinces Ranked by Return to Capital^a

Initial quartile	Final quartile			
	1	2	3	4
<i>From 1978–84 to 1985–91</i>				
1 (highest)	0.71	0.14	0.14	0.00
2	0.29	0.71	0.00	0.00
3	0.00	0.14	0.57	0.29
4 (lowest)	0.00	0.00	0.29	0.71
<i>From 1985–91 to 1992–98</i>				
1	0.43	0.29	0.29	0.00
2	0.43	0.29	0.14	0.14
3	0.14	0.43	0.14	0.29
4	0.00	0.00	0.43	0.57
<i>From 1992–98 to 1999–2005</i>				
1	0.43	0.29	0.14	0.14
2	0.57	0.14	0.14	0.14
3	0.00	0.43	0.43	0.14
4	0.00	0.14	0.29	0.57
<i>From 1978–84 to 1999–2005</i>				
1	0.43	0.29	0.14	0.14
2	0.57	0.14	0.14	0.14
3	0.00	0.43	0.43	0.14
4	0.00	0.14	0.29	0.57

Source: Authors' calculations using NBS data.

a. Table reports the probability that a province moves from the indicated group in the initial period to the indicated group in the final period. Group 1 consists of those Chinese provinces ranked 1 through 7 by return to capital in the indicated period; group 2, those ranked 8 through 14; group 3, those ranked 15 through 21; and group 4, those ranked 22 through 28.

Conclusions

Our estimates from China's national accounts data suggest that the return to capital in China has remained high despite China's remarkably high investment rates. Our base case estimate is that the aggregate real rate of return to capital in China is currently about 20 percent a year, somewhat lower than the estimates for the early 1990s, for example, but not low by comparison with other economies. Our alternative estimates, which adjust the base case for inventories, residential capital, and taxes, average somewhat lower returns but show those returns rising to new highs in recent years.

Why have China's high investment rates not brought low returns to capital? We see two possible reasons. First, output growth, driven by growth in total factor productivity and in the labor force, appears to have been quite

rapid. Therefore the capital-output ratio does not appear to have risen by much, despite the high investment rate. Second, the capital share of aggregate income has increased steadily in China since 1998, precisely the period that witnessed a significant increase in the investment rate. One explanation for this might be that a gradual restructuring of China's industrial sector has moved it toward more capital-intensive industries, requiring higher aggregate investment rates in the steady state. Our data do not allow us to examine the sources of the increase in the aggregate capital share since 1998, but this is clearly a fruitful avenue for future research.

One question we leave open concerns the allocation of investment in China. We have provided some evidence on the efficiency of investment allocation across provinces and across major sectors. We find clear evidence of misallocation but also some evidence that it may have lessened over time. However, it could be that the bulk of the capital misallocation takes place within provinces and within the three broad sectors. Data at the firm and farm levels would be needed to address this question. However, we note that estimates by Hsieh and Peter Klenow, using firm-level manufacturing data, indicate improvement in the allocation of capital across firms within sectors since 1995.³¹

31. Hsieh and Klenow (2006).

Comments and Discussion

Olivier Blanchard: This is a very useful paper. There is a widely held belief that the return to capital in China is low, driven down by an investment rate in excess of 40 percent of GDP. The paper looks at the data carefully and concludes that this is not the case: the rate of return decreased in the 1990s but is now stable, yet still high, at roughly 20 percent.

The approach of the paper is straightforward. Simplifying a bit: it defines the rate of return to capital as the ratio of profit to the value of the capital stock, minus the depreciation rate:

$$R \equiv \frac{P_Y Y - WL}{P_K K} - \delta.$$

It then rewrites this expression as

$$\frac{P_Y Y - WL}{P_K K} - \delta = \frac{P_Y Y - WL}{P_Y Y} \cdot \frac{P_Y Y}{P_K K} - \delta = \frac{\alpha}{P_K K / P_Y Y} - \delta,$$

where α is the share of capital in output.

Turning to the data, the authors find that the ratio of the value of capital to the value of output is relatively low in China, and the share of capital in output is relatively high. Together these two findings imply a high rate of return on capital. In 2005, for example, the capital-output ratio was 1.72, the share of capital was 58 percent, and the depreciation rate was 10 percent, implying a rate of return of 24 percent. This ignores the impact of the relative growth rates of capital and output prices, which I have left out of the definition above but is (correctly) included in the authors' computation.

Do the computations leave room for disagreement? The authors clearly do as careful an empirical job as one can, given the somewhat unreliable data. Still, the high value of the capital share is striking, about 15 to 20 percentage points above values in other countries at similar levels of development.¹ To those of us who (for no good reason) like to think of production largely in Cobb-Douglas terms, such a dramatic difference in capital shares is puzzling. Thus, for the presentation of the paper at the Brookings conference, I tried my best to come up with various stories for measurement error, from the misallocation of self-employment income to the different incentives for township and village enterprises, state-owned firms, or multinationals to misstate profits. In this final draft the authors have done a great job of maiming if not killing most of my tentative hypotheses. However, I still want to take up two issues.

The first is that of self-employment. In most low- and middle-income countries, the reported capital share is indeed very high, often above 0.6. But, as is well understood, a large part of what is classified as capital revenue is in fact self-employment income, much of which should be counted as labor income. When Douglas Gollin makes this adjustment, the resulting capital share drops, often by more than 20 percentage points.² I suspected that the same was likely to be true in China. It turns out, however, that until 2005 the Chinese statistical authorities classified all self-employment income as labor income. In other words, if anything, the reported capital share understated true capital income, at least until 2005. I must admit that I am stumped; all I can do is be a bad loser and suggest that someone look over the shoulders of the Chinese statistical authorities to see how the statistics are put together.

The second issue is the implication of the reported capital share for another standard exercise, namely, the computation of total factor productivity growth. My table 1 summarizes the conclusions from a number of studies, which differ on a number of empirical dimensions but typically use capital shares for the construction of the Solow residual roughly similar to those used in this paper. The general pattern is that of a decrease in measured TFP growth over time, with very slow growth in recent years.

That true TFP growth would have slowed in China in recent years is, on the face of it, implausible. State firms are being restructured. Foreign direct

1. I am using here the values for the capital share constructed by Gollin (2002).

2. Gollin (2002).

Table 1. Estimates of Total Factor Productivity Growth in China by Various Authors

<i>Author and date of estimate</i>	<i>Period</i>	<i>Estimated growth (percent a year)</i>
Maddison (1998)	1952–78	–0.8
	1978–95	2.2
Zheng and Hu (2004)	1979–84	7.7
	1985–90	2.2
	1991–95	3.7
	1996–2001	0.6
OECD (2005)	1978–96	4.0
	1997–2002	3.2
	2003	2.8
Kuijs and Wang (2005)	1978–93	3.7
	1993–2004	2.7

Source: Blanchard and Giavazzi (2006), updated by the author.

investment has been very high, and we know from a number of studies that foreign firms in China, or joint ventures including foreign firms, have higher productivity than domestic firms. So, again, measurement error seems to be a plausible explanation. And a natural possibility in this context is again an overstatement of the capital share. To see why, suppose that true TFP growth is given by

$$S = g_Y - \alpha_K g_K - (1 - \alpha_K)g_L,$$

and measured TFP growth by

$$\tilde{S} = g_Y - \tilde{\alpha}_K g_K - (1 - \tilde{\alpha}_K)g_L,$$

where g_Y , g_K , and g_L are the growth rates of output, capital, and labor, and α_K and $\tilde{\alpha}_K$ are the true and the measured capital shares, respectively. Then,

$$\tilde{S} = S + (\alpha_K - \tilde{\alpha}_K)(g_K - g_L).$$

Thus, because $(g_K - g_L)$ is typically positive, if the capital share is overstated, measured TFP growth will understate true TFP growth. And the downward bias will be stronger the larger is $(g_K - g_L)$, and thus the higher the investment rate. For $(g_K - g_L) = 10$ percent, for example, an overstatement of the capital share by 20 percentage points will lead to an underestimation of TFP growth by 2 percentage points—a substantial magnitude. One can therefore interpret declining measured TFP growth as an indication that the capital share is overstated. Of course, this is not a proof, only suggestive evidence.

Table 2. Rates of Return in Chinese Firms by Type of Ownership^a

Percent a year

<i>Ownership type</i>	<i>1999</i>	<i>2003</i>
Private	8.8	15.0
Individually controlled	12.2	16.3
Non-mainland controlled	6.9	14.2
State controlled	5.4	10.2
Directly controlled	4.8	8.2

Source: Organization for Economic Cooperation and Development (2005).

a. Profit plus interest as percent of physical capital stock and inventories, net of depreciation and taxation.

Let me end with a remark about differences in rates of return across firms. The paper offers a decomposition by province and by sector—primary, secondary, and tertiary. (One may question the estimates of the rate of return in the primary sector, given the difficulty of distinguishing revenue accruing to land from revenue accruing to reproducible capital.) Although this is an interesting analysis, two of the central questions in China have to do with other decompositions. The first is the rate of return to spending on health: the provision of health care, especially in the rural areas, has sharply declined, and it is widely believed that the social rate of return there is very high, justifying a reallocation of investment toward that sector.³ Clearly, such an analysis falls outside the scope of this paper. The second is differences in rates of return by type of ownership. Many observers suspect that the rate of return in state firms is considerably lower than that in new, privately owned firms.

As the authors indicate, there is no way to construct rates of return for each ownership type separately with the data they use. But some information is available from estimates using individual-firm data from the industrial sector (table 2). These rates of return reflect the inclusion of inventories in capital, and they are measured after taxes. Thus they are lower than—but consistent with—the base case estimates of the paper. What the table shows, however, is a clear difference across ownership types. Private firms have much higher rates of return than state firms. The average rate of return for state firms is still high (and appears to have increased since 1999), but this average hides substantial heterogeneity: the median annual rate of return is only about 1.5 percent, and 35 percent of state firms report negative profits. This has obvious implications for China's growth strategy.

3. Blanchard and Giavazzi (2006).

Richard N. Cooper: Chong-En Bai, Chang-Tai Hsieh, and Yingyi Qian have made a bold and worthy effort to calculate the rate of return to capital in China since the major economic reforms began in that country in 1978. Their principal findings are intuitively plausible, although for the reasons offered below they are not entirely convincing. The authors find that annual returns to capital generally rose to above 25 percent from the mid-1980s, after the reforms were seriously launched in the nonagricultural sector, to the early 1990s and then gradually declined to just below 20 percent in the period 1998–2005. The authors’ most important interpretation of these results is that the admittedly high rate of investment in China—over 40 percent of GDP in recent years—does not seem to have been too high from an economic perspective, given that rates of return have remained high.

The authors also find, on the basis of estimates of returns to capital by province, that the geographical dispersion of returns has declined since 1978 (with a brief uptick in 1990–1993), but at a slower rate since 1998, although dispersion presumably remains higher than would be the case with a fully integrated national capital market. In contrast, however, they find that rates of return have been diverging since the mid-1990s among the three identified sectors of the economy: primary (mainly agriculture), secondary (mainly manufacturing and construction), and services. One puzzle in their results is that, in recent years, returns have been among the highest in Heilongjiang and high as well in Liaoning, provinces in the northeastern “rust belt” of China that contain many old, state-owned heavy industrial firms, which are supposedly the country’s biggest money losers (not reported in the authors’ final draft).

The data in this paper are taken from official Chinese sources, supplemented where necessary by assumptions by the authors. The Chinese tradition of business accounting and the reliance on local officials for statistical reporting leave little confidence in Chinese economic statistics. Officials in the National Bureau of Statistics are well trained and doing their best, but with raw material of uncertain value. Angus Maddison, for instance, recalculated China’s GDP over the period 1978–95 and arrived at an annual growth rate that was 2.4 percentage points below the official growth rate of 9.9 percent.¹ The main reasons for the difference are, first, that Maddison believes official GDP was underestimated for the early

1. Maddison (1998).

years, leading, *ceteris paribus*, to a reported nominal growth rate higher than the reality; and second, that the official price index for deflating nominal GDP is too low, leading to a higher recorded real growth rate. Maddison did not report earnings on capital, so that the implications of his downward revision of GDP growth for the rate of return to investment are not entirely clear, but use of his revised figures would probably lower them.

The authors invoke some economic theory, but in the end they rely mainly on accounting: they subtract earnings of labor from GDP to get returns to capital, and they use a perpetual inventory calculation on investment to estimate the capital stock, along with several strong assumptions of identity and proportionality to arrive at disaggregated versions of these measures. The accounting corresponds to the theory only under the strong assumptions of equilibrium, competition, and constant returns to scale. All three of these assumptions are doubtful for an economy that has changed radically its system for allocating resources, that started with a low and antiquated capital stock, that controlled entry and exit from many activities (particularly all large investments), and that has invested more than 35 percent of GDP in almost every year since reforms began. The authors offer a minimum of interpretive comment on their results and no discussion of the institutional setting in which such high investment rates occurred. The economy is not likely to have been in competitive equilibrium during most of this period, if indeed at any time, and, at least early in the period, new investment in modern techniques is likely to have enjoyed increasing returns to scale.

Their perpetual inventory method for calculating the capital stock draws on data from the period 1952–78. This, however, was a very different economy, starting with a very low capital stock and importing much equipment from the Soviet Union during the 1950s. Subsequent investment relied on the same technology to produce uniform products—from imitations of and spare parts for Soviet equipment to Mao suits for men and women—with little change either in production technique or in the nature of the goods produced. Thus machinery and plant could be used, with good maintenance, for several decades. Outside observers (including myself) in the early 1980s marveled at how well maintained was Chinese equipment dating from the 1950s and even, in some instances, from the 1930s. After 1979, however, China relied increasingly on sales to the world market, especially of manufactures, and to foreign visitors to China, with their

demand for high quality and constantly changing styles, products, and accommodations. Thus the same depreciation rates for capital goods should not be used for both periods: economic depreciation was much more rapid in the second period (see the authors' figure 6).

The focus of the authors is on the total fixed capital stock (that is, excluding inventories), broken down as necessary by province or by sector. I believe, however, that a sharp distinction should be made between the housing stock and capital used for more directly productive purposes—to produce other goods and services, not as a place to live. The distinction matters greatly in the case of China, where, as in France and Germany in the 1960s and 1970s, incomes have been rising rapidly and many people are moving out of agriculture into the cities. In real terms, China's income per capita grew by a factor of more than four between 1980 and 2004.² With such a sharp increase in income, people naturally want more and better residential space, and the Chinese economy has responded to this increased demand. Roughly one quarter of investment in recent years—nearly 10 percent of GDP—has been in residential construction, an increasing share of it privately owned.

How are rents on owner-occupied housing incorporated into China's GDP? The authors report that annual rents are imputed as 3 percent of the value of the residential capital stock, well below the 20 to 25 percent rate of return they report for total fixed capital stock. Thus, removing residential housing from the capital stock, and removing this imputed return from nonlabor income, raises the estimated return on the remaining capital by about 5 percentage points in recent years. (Allowing for inventories and work in progress, in contrast, reduces the calculated return by about 5 percentage points, as shown in the authors' figure 8.)

Cutting in the opposite direction, however, is the fact that returns to capital are calculated as the residual of national income less labor compensation. This residual includes, among other things, land rents, not just returns to capital. The authors deduct an estimate of agricultural and mineral rents from their base case estimate, but this adjustment has little impact after 1990. However, there was no market for land or structures in China before the mid-1990s, and since then there is only a very imperfect market for leaseholds. Land use is not in market equilibrium: private and social values could be increased significantly by converting agricultural

2. Maddison (2001).

land, especially near cities, to nonagricultural uses. This has taken place on a grand scale around virtually all of China's urban areas in the past decade, converting peasant agricultural land to business and residential space, as well as making room for highways and other infrastructure such as power plants. Such conversions are now the major source of social disturbance, as peasants rebel against having "their" land—which is technically owned by the village or county—taken away, sometimes with inadequate or even no compensation. These changes in land use bring large rewards to developers, to city governments, and often to city officials in the form of bribes, as well as to the businesses that get to use the land.

Given the authors' method of computing the return to capital, these high rewards to more efficient use of land will be imputed to capital; however, it is not clear that this is appropriate. It is true that they add to GDP (properly measured), and that they would not occur without new structures having been built on the land and without access roads, water and sewerage, and power. But an increase in land value caused by investment in infrastructure is not what one usually means by "marginal return to capital." Even if construction occurred under competitive conditions, there would still be a substantial increase in rental value that is somehow shared among the decisionmaking parties but imputed to capital under the method used here. Although the magnitude of these rewards to changes in land use is not fully known (to me at least), they are undoubtedly high. For instance, about one-third of local revenues are "off budget," mainly from sale of leases to land, according to China's National Bureau of Statistics. Their inclusion in the authors' calculations thus overstates the "returns to capital" as that term is normally interpreted. In particular, the very high returns—typically around 30 percent over the last decade—calculated for the "secondary" sector, which includes construction, may in part result from this attribution of increased rents from discrete changes in land use, starting from disequilibrium, to returns to capital. The value of urban land is such that the main economic value of many money-losing state-owned enterprises (SOEs) is the land they occupy, but that should not be counted as a return to their capital.

The authors say they want to measure the marginal return to capital. But in fact they measure its average return, after deducting labor compensation. That their estimate has not changed much over 1998–2004 suggests that the marginal rate of return does not differ substantially from the average, but their sectoral and provincial calculations belie this, suggesting that

the apparent stability of the national average return is a coincidence arising from the aggregation of very different returns that also change in offsetting directions.

The authors' base case estimates, however, get some support from the reported returns on U.S. direct investment in China, which averaged 19.7 percent over 2001–05, very close to the authors' estimates over the same period. It should be added that these data, too, are subject to problems of measurement and interpretation.

China is known to have an extremely inefficient capital market. Households save a lot but have only limited opportunities for financial investment, mainly in bank deposits. The corporate capital market is virtually nonexistent. Enterprises get loans from banks or, at much higher interest rates, from the informal curb market, often friends and relatives. Banks lend overwhelmingly to SOEs, many of which lose money, although some, particularly those with protected market positions, make large profits. SOEs pay taxes on their profits, but they pay no dividends; so the profitable SOEs either reinvest in their business, or buy out other firms, or deposit their funds in banks (business deposits account for a large portion of the high saving rate in China), perhaps to borrow their deposits again because of the private incentives to managers of both banks and firms. Thus, at present, domestic market pressures to equalize rates of return across regions and activities in China are limited. Some pressure is provided by foreign investors, who have many different locations to choose from and a choice of many activities to invest in (although not all are open to them, especially in the services sector).

If the paper's main finding—a continuing relatively high rate of return on capital formation in China—withstands closer scrutiny, it implies that, contrary to a widespread view, China may not be investing too much after all. Nonresidential investment in China is comparable to that in Japan and South Korea during their rapid-growth periods. New members of the non-agricultural labor force are arriving in great numbers and must be supported with places to work, modern equipment, and working capital. Moreover, as already discussed, “investment” in the national accounts includes investment in housing, and China contains millions of people on the move and other millions who desire and are able to upgrade significantly the quality of their housing. Neither of these processes is likely to stop anytime soon. China has moved over 20 percent of its labor force out of agriculture since the beginning of reform in 1978, yet agriculture still

accounts for nearly half of the labor force. China still has a relatively low capital-labor ratio in the productive sectors and ample unskilled labor; thus the investment boom may continue for some years without pushing down rates of return.

General discussion: William Nordhaus, following up on Olivier Blanchard's comment, noted the large difference, at least in the United States, between the average annual before-tax rate of return on capital for the whole economy and the after-tax return for the nonfinancial business sector. The first is typically between 15 and 20 percent, the second only around 6 percent. He suggested that the paper's most relevant estimates of returns were those that adjusted for inventories, housing, and taxes, and those for the secondary (predominantly manufacturing) sector. The base case returns, which are based on aggregate nonlabor income and a capital stock that includes residential structures but not inventories, seemed the least useful.

Wing Woo commented on how the authors' finding of persistent high rates of return informed some important issues confronting the Chinese economy. He suggested two explanations for why China is a net capital exporter despite high domestic returns to capital. The first is the high risk premium that international markets assign to Chinese investments because of official discrimination against private investment, weak protection of property rights, historical weakness in the rule of law, vulnerability of China's access to foreign markets, and rampant corruption. Two recent episodes illustrated the importance of these factors: foreign direct investment flows into China had surged after 1992, when Deng Xiaoping embarked on a much-publicized tour to move China toward a private market economy (seen as implying a reduction in discrimination against the private sector), and again after 2000 when it became clear that China would accede to the World Trade Organization and obtain guaranteed access to the U.S. market (seen as implying a reduction in market access risk). The second explanation is that China has an extraordinarily high saving rate, which, in turn, arises from two features of its economic system. First, with the advent of capitalism, social safety nets weakened, and the resulting increased insecurity led to greater saving. Second, the failures of China's banking system sharply limited the ability to borrow for investment, forcing individuals and most businesses to invest from their own

savings. Woo also speculated that the rate of return in agriculture would increase once agricultural land is privatized.

John Cochrane viewed China's situation in terms of a standard growth model in which the economy is not in a steady state. In a conventional production function using labor and physical capital, China's low capital-to-labor ratio might well lead one to expect investment to exceed 40 percent of GDP. If, on the other hand, the model's production function uses human capital rather than labor, one might expect a much lower investment rate. Cochrane also noted that a 20 percent real rate of return is very high, especially when compared with the U.S. real rate of interest, and he agreed with Woo that the difference should be understood as stemming largely from differences in risk.

Gary Jefferson compared the paper's estimates of the rate of return in manufacturing with results he and his colleagues at China's National Bureau of Statistics had obtained using firm-level data. Their estimates, which differed somewhat in levels from those in the paper because of different estimating assumptions, showed a noticeable recovery after 1998, which they attributed to the gradual conversion of state-owned enterprises to private ownership. The fraction of state-owned enterprises in the industrial sector declined substantially between 1995 and 2005.

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