Privatization and economic performance: evidence from Chinese provinces

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Abstract

Based upon an aggregate production function, this paper develops a growth model to test the hypothesis that the further the ownership moves into private hands, the greater are efficiency gains and the more rapid is economic growth. Using provincial data in the period 1985–1997, the paper finds that the hypothesis cannot be rejected in China. That is to say, provinces with greater progress in privatization witnessed greater gains in marginal productivity of capital and more rapid economic growth. To test the robustness of the finding, the study classifies forms of ownership into different categories that represent variant degree of the privatization process. The finding suggests that China should pursue the ownership reform in the direction of privatization to maintain growth momentum.

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1. Introduction

In the last two decades or so, socialist countries started to move from a planned economic system to a market-based economic system one after another, and privatization, either gradual or rapid, was at the core of the transition process in all these countries. The popularity of privatization was largely attributed to the increasing realization that economic inefficiency was closely associated with public ownership, and was causing tremendous damage to the economy. Privatization was believed to be a promising measure to resolve this problem.

However, evidence of the impact of privatization on productivity gains and economic growth in the transition economies was ambiguous or even confusing. In the case of China, for instance, many empirical studies found that the private sector did not achieve greater

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productivity gains than the collectives, although they did achieve greater productivity gains than the state sector (Svejnar, 1990; McGuckin and Nguyen, 1993; Dong and Putterman, 1997). Inspired by the finding, some even claimed that the Chinese collectives posed a severe challenge to “prescriptions favoring privatization” (Bowles and Dong, 1999, p. 1).

This line of argument suffered, however, from at least two shortcomings. First, it used a simplistic concept of privatization. Explicitly or implicitly, privatization was considered as the rapid, direct, and once-for-all transfer of the state assets to private hands without going through any intermediate forms of ownership such as the collectives. The success of the intermediate forms of ownership was, therefore, taken as a case against privatization. Secondly, the argument was based upon empirical studies that used data of a small sample of firms in a very short period of time at the early stage of China’s economic reform and, therefore, was likely to suffer from biases in sample selection.¹

In this study, privatization is considered as a process in which properties move, either gradually or rapidly, into private hands. In the case of gradual privatization, there could be a wide spectrum in between the most public ownership (the state ownership) and the most private ownership. Any move in the spectrum toward the most private is part of the privatization process, although the move may not lead to full private ownership at once. The move of property from the state to the private sector is, for instance, considered as part of the privatization process, so is the move of property from the state to the collective sector, the move of property from the collective to the private sector, and so forth. This conceptualization of privatization is particularly crucial to the understanding of China’s privatization where private property rights developed under the disguise of the intermediate forms of ownership, particularly the collectives. To avoid biases in sample selection, this study uses aggregate provincial data of the period 1985–1997 to estimate the economy-wide, long-term impact of privatization on productivity gains and economic growth.

The remainder of the article proceeds as follows. In Section 2, we examine the process of privatization in China in the light of the debate over approaches to privatization. In Section 3, we explain the model for the estimation of the effect of privatization at aggregate provincial level. In Section 4, we describe the date and variables used in the empirical estimation. The results of the estimation are presented and interpreted in Section 5. The final section summarizes the principle findings and their policy implications.

2. Privatization in China

There has been, as noted by Oi and Walder (1999), fierce debate over approaches to privatization in transition economies. Some argued that problems with the state ownership in transition economies should be addressed “on a comprehensive and rapid basis” (Sachs, 1992, p. 44), and that state ownership should be turned into clear-cut private ownership without going through any intermediate or hybrid forms of ownership (Sachs, 1993; Peck and Richardson, 1991; Blanchard et al., 1991). Others opposed this approach on the ground that rapid and comprehensive privatization could not succeed in the absence of related institutional and legal frameworks, which could not be created overnight. Hence, privatization

¹ Most of these studies used data of the 1980s.
should proceed on a gradual and experimental basis with a range of hybrid or intermediate forms of ownership (Murrell, 1992; Stark, 1996).

Compared with privatization in other transition economies, privatization in China can be said to be an example of the gradualist approach. Although China started economic reform much earlier than most of the former socialist countries, the share of the private sector in GDP was much smaller in China than in most of the transition economies. Up to 1995, according to the World Bank (1996), the share of the private sector in GDP was about 70% in the Czech Republic, 60% in Poland, Hungary, Slovak Republic, Estonia, Albania, Latvia, Russia and Mongolia, but only 28% in China. And yet, China admittedly developed a wider range of intermediate forms of ownership, where private property rights grew under the disguise of public ownership. This phenomenon was referred to as hidden privatization, informal privatization, partial privatization or covert privatization (Francis, 1999; Krug, 1997).

The Chinese collectives are one of the most important intermediate forms of ownership under hidden privatization (World Bank, 1996). In agriculture, along with the adoption of the “household contract responsibility system” in agriculture in the late 1970s and early 1980s, farmers obtained the rights to use a piece of land for a period of time by signing a contract with the production brigade, the owner of the land. From the mid 1980s onwards, the length of the land contracts were extended, first to a minimum duration of 15 years, and then 30 years. In the meantime, the land could be subcontracted, the rights to use land could be traded, and a second market emerged. Although the collective ownership to the land was formally maintained, “the land was reprivatized de facto” under the household contract responsibility system (Kornai, 1990, p. 451), since “such a long duration brought lease contracts close to full ownership” (Krug, 1997, p. 279).

In industry and commerce, the collectives were also under the process of hidden privatization. According to a survey conducted by the National Bureau of Administration of Industry and Commerce in 1995, most collectives had private-owned assets, and 20% of these collectives had >51% share of the private-owned assets (Zhang and Ming, 1999). Many township and village enterprises (TVEs) were found to be fake collectives in the sense that they were private enterprises in nature, but they used the collective label for political protection and economic benefit. Case studies in Oi and Walder (1999) suggested that the kind of TVEs that served as a form of “disguise of private enterprises” were commonly observed in the coastal region, but were rare in the interior in the 1980s. Into the 1990s, however, the interior began to “feel this trend”. Thus, collectives, in agriculture and non-agriculture alike, became virtually a hybrid form of ownership combining elements of public and private property rights, though they were still formally under the name of collective ownership.

The hidden privatization could be explained by the lack of legal and institutional protection to private property rights at the early stage of economic transition. Although small-scale, household-based individual production was accepted and encouraged in as early as the early

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2 Even this estimation was exaggerated since it included all non-state and non-collective sectors, part of which is, as shown below, not pure private. According to a recent estimation by China Bureau of Administration of Industry and Commerce, pure private sector in non-primary industry accounted for only about 9% of GDP in 1995 (Zhang and Ming, 1999).
1980s, private enterprises did not achieve legal status until 1988 when the Amendment to the Constitution and the Provisional Regulations on Private Enterprises of the People’s Republic of China were passed in the People’s Congress. Owing to the Tiananmen Square Incident in 1989, the legal and institutional protection to private enterprises did not really take effect until 1992 when Deng Xiaoping reaffirmed the friendly policy toward private enterprises in his historic southern tour.

After 1988, particularly after 1992, private property rights began to develop in a more open manner. In addition to fully private-owned enterprises, private property rights developed rapidly in, for instance, share-holding companies, share-holding cooperatives, joint-owned enterprises and enterprises with foreign direct investments, where property rights were openly reassigned to individuals to varying degrees. In the 1990s, the openly private-participated sector developed very rapidly and began to replace the collectives as the main force in the Chinese economy that squeezed out the inefficient SOEs.

The hidden privatization, however, makes it hard to distinguish between private and public ownership; in fact, even the China Statistical Bureau (CSB) cannot provide accurate and reliable data of the private sector in China. Nevertheless, as CSB provides consistent data of both the state sector and the collective sector for the entire reform period, we can consider the remaining as representing the sector of most private nature and call it openly private-participated sector. This is in contrast to the hybrid collective sector under hidden privatization, and the state sector of the most public nature. Accordingly, we can consider the three economic sectors as representing variant degree of the privatization process, and compare the effect of each of these sectors on productivity gains and output growth using a formal model of economic growth.

3. The model

The model is based upon the aggregate production function

\[ Y_t = A_t F(K_t, L_t) \]  

where \( Y \) is the real aggregate output (GDP), \( L \) the aggregate labor force, \( K \) the aggregate capital stock, and \( A \) represents aggregate production technology. In addition, “\( t \) in subscript” denotes year. The production function exhibits constant returns to scale across all factors. It was estimated that there were 36,000 share-holding companies and 4 million share-holding cooperatives in China in 1997 (Qi, 1998). Up to 1998, 92% of the accumulated foreign direct investment came to China after 1992.

3. The share of the collective sector in the output of industry rose, for instance, from 22% in 1978 to 32% in 1988, and remained at that level in 1998. The share of the openly private-participated sector in the output of industry rose from 7% in 1988 to 38% in 1998!

5. The National Bureau of Administration of Industry and Commerce of the PRC provided some data of the private sector, which are not, however, sufficient for econometric analysis.

6. Empirical studies of productivity growth often use, as summarized by Griliches (1963, 1988), production functions (such as the well-known Cobb-Douglas production function) that exhibit constant returns to scale. Such an approach has been applied not only to empirical studies using cross-country data (see, for example, Hayami and Ruttan, 1970), but also to empirical studies using data of Chinese provinces (see, for example, Lin, 1999).
Let $P_t$ be the total population, and $y_t = Y_t / P_t$, $l_t = L_t / P_t$, and $k_t = K_t / P_t$. Divided by $P_t$ on both sides, Eq. (1) can be written as

$$y_t = A_t f(k_t, l_t)$$  \hspace{1cm} (2)$$

which relates GDP per capita to capital stock per capita, the ratio of labor force to the population and production technology.

By totally differentiating Eq. (2), we obtain

$$d y_t = f d A_t + A_t \frac{\partial f}{\partial k_t} d k_t + A_t \frac{\partial f}{\partial l_t} d l_t$$
$$= f d A_t + \frac{\partial f A_t}{\partial k_t} \left( \frac{d K_t}{P_t} - \frac{K_t}{P_t} \frac{d P_t}{P_t} \right) + \frac{\partial f A_t}{\partial l_t} \left( \frac{d L_t}{P_t} - \frac{L_t}{P_t} \frac{d P_t}{P_t} \right)$$  \hspace{1cm} (3)$$

Dividing both sides of Eq. (3) by $y_t$, we obtain

$$\frac{d y_t}{y_t} = \frac{f}{Y_t} \frac{d A_t}{A_t} + \frac{\partial f A_t}{\partial k_t} \frac{d K_t}{k_t Y_t} + \frac{\partial f A_t}{\partial l_t} \frac{d L_t}{l_t y_t} - \left( \frac{\partial f A_t}{\partial k_t} \frac{K_t}{k_t Y_t} + \frac{\partial f A_t}{\partial l_t} \frac{L_t}{l_t Y_t} \right) \frac{d P_t}{P_t}$$
$$= \frac{d A_t}{A_t} + \frac{\partial y_t}{k_t Y_t} + \frac{\partial y_t}{l_t y_t} \frac{1}{y_t} - \left( \frac{\partial y_t}{k_t Y_t} + \frac{\partial y_t}{l_t Y_t} \right) \frac{d P_t}{P_t}$$  \hspace{1cm} (4)$$

Letting

$$\dot{y}_t = \frac{d y_t}{y_t}, \quad \ddot{A}_t = \frac{d A_t}{A_t}, \quad I_t = \frac{d K_t}{k_t Y_t}, \quad \dot{P}_t = \frac{d P_t}{P_t}, \quad \text{and} \quad \beta = \frac{\partial y_t}{k_t Y_t},$$

Eq. (4) can be written as

$$\dot{y}_t = \ddot{A}_t + \beta I_t + \delta l + \lambda \dot{P}_t$$  \hspace{1cm} (5)$$

which relates the growth of GDP per capita to technology progress, the ratio of investment to GDP, the ratio of labor force to the population and the growth of population. Here, it is important to note that $\beta$ is the marginal productivity of capital.

Technology progress, $\ddot{A}$, is generally assumed to be the total factor productivity (TFP) to capture any effect on output growth that is not attributable to aggregate labor force and aggregate physical capital, and therefore, has been identified with many different types of variables in empirical studies on growth. It has been found, for instance, that openness could increase competition and bring in advanced foreign technology (Balassa, 1978; Feder, 1983; Ram, 1985), and that human capital was crucial to the spread of knowledge and economic growth (Lucas, 1988; Barro, 1991). In growth empirics, therefore, $\ddot{A}$ can be replaced with the variables that are believed to be closely related to TFP progress. In this study, we use tentatively openness and human capital to capture the effect of technology progress, and therefore, rewrite Eq. (5) as

$$\dot{y} = a + \phi O + \gamma E + \beta I + \delta l + \lambda \dot{P} + u$$  \hspace{1cm} (6)$$

\text{where} \ Y = a + \phi O + \gamma E + \beta I + \delta l + \lambda \dot{P} + u $$
where \( O \) is the ratio of foreign trade to GDP to represent economic openness, \( E \) the ratio of the literate to population to represent the level of education, \( u \) a stochastic component, and time scripts are ignored.

On the basis of this growth regression equation, we can estimate the effect of privatization on efficiency gains and economic growth by decomposing the ratio of the aggregate investment to GDP, \( I \), into different components. In China’s case, for instance, the ratio of the aggregate investment to GDP can be decomposed into the ratio of the state investment to GDP, \( I_s \), the ratio of the collective investment to GDP, \( I_c \), and the ratio of the openly private-participated investment to GDP, \( I_p \). Accordingly, Eq. (6) can be rewritten as

\[
\hat{y} = a + \varphi O + \gamma E + \beta_s I_s + \beta_c I_c + \beta_p I_p + \delta l + \lambda \hat{P} + u
\]

(7)

where \( \beta_s \) is the marginal productivity of capital of the state sector, \( \beta_c \) the marginal productivity of capital of the collective sector, and \( \beta_p \) the marginal productivity of capital of the openly private-participated sector. As shown in the last section, collectives in China are virtually hybrid or intermediate forms of ownership, so we can take them as being in between the state and the openly private-participated sector in the ownership spectrum of the privatization process. We then test the hypothesis \( \beta_p > \beta_c > \beta_s \).

Alternatively, we can combine \( I_s \) with \( I_c \), and test the hypothesis \( \beta_p > \beta_{sc} \) by estimating the equation

\[
\hat{y} = a + \varphi O + \gamma E + \beta_{sc} I_{sc} + \beta_p I_p + \delta l + \lambda \hat{P} + u
\]

(8)

where \( I_{sc} \) represents the ratio of the state investment plus the collective investment to GDP. We can also combine \( I_p \) with \( I_c \), and test the hypothesis \( \beta_{pc} > \beta_s \) by estimating the equation

\[
\hat{y} = a + \varphi O + \gamma E + \beta_s I_s + \beta_{pc} I_{pc} + \delta l + \lambda \hat{P} + u
\]

(9)

where \( I_{pc} \) represents the ratio of the openly private-participated investment plus the collective investment to GDP. If it occurred, therefore, that the closer to the private end of the ownership spectrum, the more productive at the margin is the capital, then we would expect that \( \beta_p > \beta_c > \beta_s \), or \( \beta_p > \beta_{sc} \), or \( \beta_{pc} > \beta_s \).

4. The data

The data for 30 Chinese provinces and municipalities (hereinafter provinces) for the period 1985–1997 are used for the empirical test, and they are collected from official publications by the China Statistical Bureau, including Statistical Yearbook of China, The Gross Domestic Product of China 1952–1995, China Regional Economy: A Profile of 17 Years of Reform and Opening-Up, Compilation of Historical Statistics for Each Province, Autonomous Region, and the Directly Administered Municipalities 1949–1989, China Statistical Yearbook of Population, and statistical yearbooks of the sample provinces.\(^7\)

To capture the long-term effect, we use the average values for each variable in the 13-year period.

\( ^7 \) Although there were doubts about the reliability of official statistics, Chow (1993, p. 810) found “Chinese statistics, by and large, to be internally consistent and accurate enough for empirical work.”
These official publications provide consistent data of provincial GDP, population, labor force, fixed asset investments, illiteracy ratio and foreign trade for the whole period. Literacy ratio is calculated according to illiteracy ratio. The values of foreign trade were initially given in US dollar, and are converted to Chinese yuan based on the dollar-yuan exchange rates. To capture the long-term effect, we use the average values for each variable in the 13-year period.

Measurement of investments by the openly private-participated sector is a key challenge for this study. The best data available concern fixed asset investments by ownership. As a result of China’s gradual privatization, these data do not include a category of investment by fully private-owned sector, and are not consistent in regard to classification of ownership over time. In the pre-1993 period, the data of fixed asset investments included four categories: “state-owned units”, “collective-owned units”, “individuals” and “other types of ownership”. From 1993 onwards, the data began to include eight categories: “state-owned units”, “collective-owned units”, “individuals”, “joint-owned economic units”, “share-holding economic units”, “foreign-funded economic units”, “economic units funded by entrepreneurs from Hong Kong, Macao, and Taiwan” and “economic units of other types of ownership”.8 We need to organize these categories into period-consistent groups representing different degree of the privatization process.

One approach is to group all these types of investments into three basic categories, i.e. state investments, collective investments and the rest. Included in the rest are the last two categories for the pre-1993 period and the last six categories for the post-1993 period, which bear a common feature: private investments are openly involved, either totally or partially. We therefore, call this category “openly private-involved investments” or “openly private-participated investments” and consider it as representing investments of the most private nature among the three categories.9 The most public are state investments, and collective investments lies somewhere in between. This approach is adopted to estimate the Benchmark model of this study, as expressed in Eq. (7).

An alternative to the three-category division is to group all these types of investments into state investments and non-state investments (I_{pc}), with the latter being total investments minus state investments. This approach overlooks the difference between the collective investments and the “openly private-participated” investments, and considers both as representing investments of a more private nature than state investments. Another alternative is to group all these types of investments into formal public investments (I_{sc}) and “openly private-participated investments,” with the former being the state investment plus collective investments and the latter being the remaining investments. This approach overlooks the difference between state and collective investments, and considers both as representing investments of a more public nature than “openly private-participated investments”. As both of the above two alternatives can also provide a kind of degree measure of the privatization process, they will be tried in the robust test.

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8 Share-holding companies with >50% of state-owned shares are in the category of “state-owned units”.

9 It is possible that there is no private participation at all in some “joint-owned economic units” that are jointly owned by the state and the collective. Given that investments of the “joint-owned economic units” accounted for only 1% of the total investments of the “openly private-participated sector”, we can ignore this problem. Indeed, the regression results hardly change when we exclude the “joint-owned economic units” from the “openly private-participated sector”.

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### Table 1

Descriptive statistics of variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observation</th>
<th>Mean</th>
<th>S.D.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>30</td>
<td>0.0840</td>
<td>0.0179</td>
<td>0.0506</td>
<td>0.1209</td>
</tr>
<tr>
<td>$O$</td>
<td>30</td>
<td>0.1704</td>
<td>0.1679</td>
<td>0.0489</td>
<td>0.7994</td>
</tr>
<tr>
<td>$E$</td>
<td>30</td>
<td>0.8365</td>
<td>0.0756</td>
<td>0.5704</td>
<td>0.9157</td>
</tr>
<tr>
<td>$P$</td>
<td>30</td>
<td>0.0126</td>
<td>0.0035</td>
<td>0.0059</td>
<td>0.0203</td>
</tr>
<tr>
<td>$l$</td>
<td>30</td>
<td>0.5022</td>
<td>0.0481</td>
<td>0.4094</td>
<td>0.6089</td>
</tr>
<tr>
<td>$I$</td>
<td>30</td>
<td>0.3085</td>
<td>0.0685</td>
<td>0.2202</td>
<td>0.4448</td>
</tr>
<tr>
<td>$I_s$</td>
<td>30</td>
<td>0.0337</td>
<td>0.0203</td>
<td>0.0146</td>
<td>0.0900</td>
</tr>
<tr>
<td>$I_p$</td>
<td>30</td>
<td>0.0678</td>
<td>0.0228</td>
<td>0.0327</td>
<td>0.1242</td>
</tr>
<tr>
<td>$I_{pc}$</td>
<td>30</td>
<td>0.2389</td>
<td>0.0785</td>
<td>0.1379</td>
<td>0.3918</td>
</tr>
<tr>
<td>$I_{sc}$</td>
<td>30</td>
<td>0.1039</td>
<td>0.0397</td>
<td>0.0478</td>
<td>0.2198</td>
</tr>
</tbody>
</table>

The average ratios or shares are calculated using the formula: $m = 1/T \sum M_t$, where $M_t$ is the ratio or share in year "$t" in subscript", $T$ the time span, and $m$ the average ratio or share over the time span. The average annual growth rates are calculated using the formula: $\bar{X} = (\ln X_t - \ln X_0) / T$, where $X$ represents the variable to be calculated, $\bar{X}$ is the average annual growth rate of the variable, $X_0$ and $X_t$ are the values of the variable for the initial year and the end year, respectively, and $T$ is the time span. Growth rate of GDP per capita is calculated in real terms according to official GDP index.

The basic descriptive statistics of major variables are reported in Table 1. Attention should be paid to the variables representing investments under different forms of ownership. The average ratio of total fixed asset investment to GDP, $I$, was 31%, quite high as compared with most of the other countries in the world. The state accounted for, however, the majority of the investments. The average ratio of the fixed asset investment of the state sector to GDP, $I_s$, was 21%, while that of the collective sector, $I_c$, was 3%, and that of the openly private-participated sector, $I_p$, was 7%. The average ratio of the fixed asset investment of the state sector plus the collective sector to GDP, $I_{sc}$, was 24%, while that of the collective sector plus the openly private-participated sector, $I_{pc}$, was 10%. With such distribution, the effect of the total investments will be primarily determined by the marginal productivity of state capital.

To detect the possible multi-collinearity among the independent variables, Table 2 presents the correlation coefficients of these variables are reported in Table 2. $I$ seems positively related to $I_s$ and $I_{sc}$, with a correlation coefficient of 0.85 and 0.81, respectively. $I_p$ is positively related to $I_{pc}$, with a correlation coefficient of 0.89. These highly correlated variables are not in the same regression, so we need not worry about the problem of multi-collinearity.

### 5. Regression analysis

Table 3 presents the regression results. Row 1 contains the estimates of Eq. (7), the benchmark model of this study. The coefficient of the ratio of openly private-participated investments to GDP, $I_p$, is positive and statistically significant, so is the coefficient of the...
Table 2
Correlation coefficients of explanatory variables

<table>
<thead>
<tr>
<th></th>
<th>O</th>
<th>E</th>
<th>P</th>
<th>I</th>
<th>Ic</th>
<th>Ip</th>
<th>Is</th>
<th>IpC</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>1.00</td>
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<td>-0.22</td>
<td>0.26</td>
<td>0.44</td>
<td>0.17</td>
<td>0.18</td>
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<td></td>
<td></td>
<td>0.06</td>
<td>0.10</td>
<td>0.15</td>
<td>0.03</td>
<td>0.36</td>
<td>0.33</td>
<td>0.02</td>
</tr>
<tr>
<td>E</td>
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<td>1.00</td>
<td>-0.30</td>
<td>0.03</td>
<td>-0.09</td>
<td>-0.19</td>
<td>0.33</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>0.06</td>
<td></td>
<td>-0.09</td>
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<td>0.06</td>
<td>0.37</td>
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<td>P</td>
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<td>0.20</td>
<td>0.42</td>
<td>-0.10</td>
</tr>
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<td></td>
<td>0.91</td>
<td></td>
<td>0.09</td>
<td>0.00</td>
<td>0.50</td>
<td>0.28</td>
<td>0.02</td>
<td>0.95</td>
</tr>
<tr>
<td>I</td>
<td>0.26</td>
<td>0.03</td>
<td>0.47</td>
<td>1.00</td>
<td>0.21</td>
<td>-0.12</td>
<td>0.76</td>
<td>0.43</td>
</tr>
<tr>
<td></td>
<td>0.15</td>
<td></td>
<td>0.85</td>
<td>0.00</td>
<td>0.26</td>
<td>0.52</td>
<td>0.68</td>
<td>0.01</td>
</tr>
<tr>
<td>Ic</td>
<td>0.17</td>
<td>-0.09</td>
<td>0.12</td>
<td>0.21</td>
<td>1.00</td>
<td>0.84</td>
<td>-0.02</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>0.01</td>
<td>0.60</td>
<td>0.02</td>
<td>0.26</td>
<td>0.00</td>
<td>0.89</td>
<td>0.82</td>
<td>0.00</td>
</tr>
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<td>Ip</td>
<td>0.14</td>
<td>0.20</td>
<td>-0.12</td>
<td>0.84</td>
<td>1.00</td>
<td>-0.01</td>
<td>-0.44</td>
<td>0.96</td>
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<td>-0.02</td>
<td>-0.01</td>
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* Correlation is significant at the 0.05 level (two-tailed).
** Correlation is significant at the 0.01 level (two-tailed).

However, the value of $I_c$ is smaller than the value of $I_p$. The coefficient of the ratio of state investments to GDP, $I_s$, is negative and statistically significant. We then run a linearly restricted regression to test if the hypothesis $\beta_p > \beta_c > \beta_s$ is statistically significant, with the null hypothesis $\beta_p - \beta_c = 0$. The calculated $F$ value is 6.4, larger than the critical value (4.3) at the 5% significance level. With the null hypothesis $\beta_p - \beta_c = 0$ rejected, therefore, we cannot reject the hypothesis $\beta_p > \beta_c > \beta_s$. Provided that the coefficients represent the marginal productivity of capital, the finding suggests that the increase in the capital of the openly private-participated sector and the increase in the capital of the collective sector both had a positive impact on productivity gains and economic growth, but the impact of the former was greater than that of the latter. The increase in the capital of the state sector had a negative impact on productivity gains and economic growth. The finding indicates that the closer to the private end of the ownership spectrum, the more productive at the margin is the capital.

To examine the robustness of this finding to alternative classification of forms of ownership, we estimate Eqs. (8) and (9), respectively, using reclassified categories of investment ratio to GDP. Row 2 contains the estimates of Eq. (8). The coefficient of $I_{Sc}$, the combined ratio, is negative and statistically significant while the coefficient of $I_p$ remains positive and
Table 3
Regression results on the real growth rate of GDP per capita

<table>
<thead>
<tr>
<th></th>
<th>Intercept</th>
<th>O</th>
<th>E</th>
<th>F</th>
<th>l</th>
<th>l_S</th>
<th>l_C</th>
<th>l_P</th>
<th>l_N</th>
<th>l_I</th>
<th>r^2</th>
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</thead>
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<tr>
<td></td>
<td>0.048 (1.376)</td>
<td>0.040** (3.135)</td>
<td>0.033 (1.077)</td>
<td>0.513 (0.703)</td>
<td>-0.016 (-0.398)</td>
<td>-0.100** (-3.193)</td>
<td>0.192** (2.106)</td>
<td>0.248** (2.222)</td>
<td>0.078 (1.435)</td>
<td>0.041** (3.269)</td>
<td>0.032 (1.097)</td>
</tr>
</tbody>
</table>

* Significant at the 10% significance level.
** Significant at the 5% significance level.
The finding suggests that the increase in the capital of the state and the collective sectors together had a negative impact on productivity gains and economic growth while the increase in the capital of the openly private-participated sector had a positive impact on productivity gains and economic growth. With $\beta_p > \beta_{sc}$, the finding also indicates that the closer to the private end of the ownership spectrum, the more productive at the margin is the capital.

Row 3 contains the estimates of Eq. (9). The coefficient of $I_s$ remains negative and statistically significant while the coefficient of $I_{pc}$, the combined ratio, is positive and statistically significant. The finding suggests that the increase in state-owned capital had a negative impact on productivity gains and economic growth while the increase in non-state owned capital had a positive impact on productivity gains and economic growth. Again, with $\beta_{pc} > \beta_s$, the finding indicates that the closer to the private end of the ownership spectrum, the more productive at the margin is the capital.

Thus, the finding that the marginal productivity of capital is larger in economic sectors of a more private nature than in economic sectors of a less private nature is quite robust in all the regressions. The evidence shows that privatization indeed brought in productivity gains and economic growth in China. As provincial data are used in the regression, the results suggest that the more capital of a more private nature a province has, the greater productivity gains and the more rapid economic growth it can achieve, or visa versa.

The regression results also shed light on the effect of other variables on growth. The coefficient of foreign trade to GDP, $O$, is positive and statistically significant in all regressions, indicating that openness contributes significantly to productivity progress and economic growth in China. The finding is consistent with the neoclassical theory and most of the empirical studies on growth (see, for instance, Balassa, 1978, 1985; Feder, 1983; Ram, 1985; Edwards, 1992). The coefficient of population growth, $P$, is statistically indifferent from zero in all regressions, which is consistent with existing theory and most empirical findings (see Johnson, 1994, for instance). The coefficient of the ratio of labor force to population, $l$, is also statistically indifferent from zero in all regressions, indicating that the increase in the labor force has no significant effect on economic growth. This appears to be contrary to established theory, but could be explained by the fact that China is a developing country and a transition economy with enormous underemployment in agriculture and redundant workers in the state sector. What is interesting is the coefficient of the ratio of the literate to population, $E$, a proxy for the effect of human capital. This coefficient is not statistically significant in all regressions. The finding appears to be contrary to the new growth theory and most cross-country empirical studies (Barro and Sala-I-Martin, 1995), but it is consistent with other cross-province studies of China (see, for instance, Lu and Xue, 1997). The finding is not, however, sufficient to refute the new growth theory about the positive role of human capital since the literate ratio may not be a good proxy for human capital in China, and a better proxy has yet to be found at the provincial level.

With insignificant variables of population growth, the ratio of labor force to population and the literacy ratio included in the regressions, it is necessary to further test whether or not the estimated effect of different forms of ownership on productivity gains and economic growth is sensitive to the inclusion of these insignificant variables. We rerun, therefore, the regression with all insignificant variables excluded. As indicated in rows 4, 5 and 6, the estimates hardly vary. The finding that the closer to the private end of the ownership
spectrum, the more productive at the margin is the capital is insensitive to the inclusion of insignificant variables.

6. Conclusions

On the basis of a production function-based growth model, this study compares marginal productivity of capital of economic sectors under different forms of ownership and, thereby, estimates the effect of privatization on productivity gains and economic growth. It is found that the closer to the private end of the ownership spectrum, the greater are the marginal productivity gains, and the more rapid is economic growth. The finding is robust regardless of how the forms of ownership are classified and organized, and is not sensitive to the inclusion of insignificant variables. The policy implication of this finding is straightforward: governments in transition economies should pursue the ownership reform in the direction of privatization to improve economic efficiency.

The study also finds that although the openly private-participated sector and the collective sector under hidden privatization both had positive impact on economy-wide productivity gains and output growth, the impact of the former was significantly greater than the impact of the latter. This finding suggests that the collectives, as an intermediate form of ownership under hidden privatization, could play an important role in the process of privatization, but they should be replaced by the openly private-participated sector in due course. China needs to promote the development of the openly private-participated sector to maintain growth momentum in the years ahead.

We should be, however, aware of the limitations of this study. Owing to data constraints, for instance, the study cannot differentiate the purely private-owned sector from the partly private-owned sector, and thus, it is unable to compare the productivity performance between them. Moreover, some institutional constraints, other than ownership, may have contributed to the different economic performance between the economic sectors in the study, but have not been captured by the model. Further studies in these directions are encouraged when relevant data become available.

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