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State ownership and returns to capital in China: 2002-2004 and 2011

By Paul Hubbard*

This paper estimates returns to capital for Chinese state owned enterprises (SOEs) and non-state owned enterprises using firm-level accounting data collected by the World Bank in 2005 and 2012. Using the same data and regression model as Dollar and Wei (2007), this paper replicates their finding that SOEs had lower capital returns from 2002 to 2004. However, the result does not hold for firms surveyed in 2012. The average capital returns to the 6 wholly-owned SOEs surveyed in 2012 is no lower than for other firms, while 48 majority SOEs have returns significantly above other ownership types. Consistent with theory for profit maximising firms, there is some evidence that firms that have access to bank loans have lower returns to capital consistent with a lower cost of capital. However, this does not explain why majority SOEs have significantly higher returns in the later survey. This paper suggests an alternative explanation that Chinese firms – particularly SOEs – may not be meeting the first order conditions for profit maximisation. An alternative regression framework including the firm's capital-labour ratio helps explain this result.

The story of Chinese economic reform has been that of an emerging, dynamic private sector growing along-side the old, inefficient state owned economy (Naughton 1996). In many industrial sectors, the private sector now dominates state enterprise (Lardy 2014). Yet China's policymakers remain committed to public ownership.

The most authoritative economic reform document is the "Decision of the Central Committee of the Communist Party of China on Some Major Issues Concerning Comprehensively Deepening the Reform" (the Decision) released in November 2013. The Decision's breakthrough commitment to "deepen economic system reform by centering on the decisive role of the market in allocating resources" is tempered by a reiteration of the fundamental importance of a "basic economic system with public ownership playing a dominant role" (Communist Party of China 2014). This apparent contradiction can be resolved if the improvement in allocative efficiency brought about by market forces can take place regardless of the underlying ownership of capital.

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A major strategy bringing market discipline to state assets over the last two decades has been to mixed state capital with private capital. Firms that used to be fully owned and manged by the state have been corporatised, privatised and partially opened to non-state capital (Garnaut and Song 2004). The Decision continues this policy of strengthening this "amplification function of state-owned capital, ensuring the appreciation of its value and raising its competitiveness". Whether, and in what circumstances, state owned capital can be used as efficiently as private capital is an important question for Chinese policy makers in structuring their reforms, and for external observers assessing China's potential to become a high income country.

This paper contributes to this debate by estimating the return on capital for Chinese firms, based on their ownership type. Following standard production theory we assume that a profit-maximising firm chooses a capital stock such that marginal return on capital equates to its marginal cost of capital. In a perfectly competitive economy, the capital would be allocated between all firms such that the marginal return on capital is equal. If different firms face different marginal returns, this is symptomatic of inefficient capital allocation. In particular, if SOEs have lower returns to capital from non-SOEs, then efficiency could be improved by reallocating capital from less efficient to more efficient firms.

In this framework, variation in marginal returns across ownership types could also be explained by profit-maximising firms facing distorted prices of capital (for example, if SOEs pay a lower rate of interest). The paper then considers variations that occur if the profit-maximisation assumption is relaxed. In this case, the firm may not achieve the technically efficiency capital-labour ratio, either because it is constrained in its ability to adjust its capital or labour, or its management is pursuing objectives that deviate from profit maximisation.

Following the methodology of Dollar and Wei (2007), the average revenue product of capital (ARPK) will be estimated for various ownership types. This paper uses the same 2005 survey data as Dollar and Wei, which includes annual financial information on 12,400 firms across China between 2002 and 2004. The same methodology is then applied to a 2012 World Bank survey, which asked similar questions of 2,848 firms, mostly in China's coastal provinces. Both surveys include the ownership shares of government, foreign and private owners. This paper extends the analysis of Dollar and Wei by testing whether additional factors from the survey relating to access to finance are associated with higher marginal return on capital.

The paper replicates Dollar and Wei's results based on the ICS, showing that SOEs had a lower return on capital than their private sector competitors. This is for both wholly and partially state owned enterprises. However, the same re-

sults are not found in the 2012 survey. Here, the estimated return on capital for majority SOEs firms is higher than the average for private firms, even after controlling for industry, region and firm size using ordinary least squares regression. An extension to the regression model tests whether access to finance affects these results. Robustness tests check whether directly calculating the marginal product of capital, the use of market value estimates of capital rather than book value, and alternative ownership measures alter these results.

Because this paper relies on comparative static analysis, it cannot describe the underlying dynamics or disentangle causal factors. Moreover, the use of two separate samples rather than an ongoing panel means that the result may be driven by biases in the underlying samples. In both cases, because the World Bank surveys are explicitly designed to focus on private sector development, it does not include the few, massive centrally controlled SOEs that monopolise sectors such as oil, utilities and communications. However, the study does provide a snapshot of relative performance in a limited range of manufacturing sectors, which can be further tested by a larger study based on China's national industrial survey.

I. Literature Review

Policies that maintain an inefficient state sector at the expense of a more efficient private sector are a drag on growth (Restuccia and Rogerson 2008). At the beginning of China's economic reform and opening up in 1978, there were 83,700 fully state owned enterprises in China's industrial sector, which by 1995 had grown to 118,000. The closure and partial privatisation of SOEs in the late 1990s precipitated a rapid decline, with the number of industrial SOEs halving between 1996 and 1999. By 2013, only 6,831 non-corporatised, wholly SOEs remain in China's industrial sector (National Bureau of Statistics of China 2013).

At the same time, a broader set of state owned and state-holding companies emerged that included not only full state owned enterprises, but those corporatised and semi-privatised in which the state maintained a controlling (though not necessarily a majority) shareholding [1]. There were 53,489 state owned and state holding companies in China's industrial sector in 2000 across all industrial sectors, which had declined to 18,197 by 2013. SOEs, and later state holding companies, which had produced almost 80 per cent of China's industrial output at the beginning of reform and opening up in 1978 produce around a quarter by 2012, but used around 40 per cent of industrial assets to do so (National Bureau of Statistics of China 2013).

[1] For the purposes of this paper, and the other papers cited below, the term SOE includes these state owned holding companies unless otherwise specified.

The early empirical literature on Chinese SOEs finds them to be much less efficient than non-state firms. In the early 1990s, the measured total factor productivity growth in SOEs lagged significantly behind that of private sector firms according to a survey of 384 firms (Marks, Kong and Wan 1999). A larger survey of Shanghai industrial firms between 1996-1998 used data envelope analysis to estimate that non-SOEs were 12 per cent more efficient than non-SOEs (Zhang, Zhang and Zhao 2002). Based on Industrial Survey data collected by the National Bureau of Statistics, Liu and Siu (2011) estimated a significant lower return on capital investments for SOEs as compared to non-SOEs. Using firm-level data from a World Bank survey of 12,400 firms in 120 cities between 2002 and 2004, Dollar and Wei (2007) estimated that even after controlling for firm size, industry sector and regional location, SOEs had a significantly lower marginal revenue product (between 23-54 percentage points) of capital than other firm types.

These results are often explained according to SOEs' social obligations (for example, lifetime responsibility for employee welfare) during that period; consistent with Levy's (1987) theory that SOE performance is reduced in an attempt to pursue multiple objectives. Since consistent deviation from profit maximisation leads to persistent losses for the firm, loss-making SOEs will be at a disadvantage in a competitive market where profits are driven to zero.

In this case, firm closure can only be avoided if an external agent is willing to cover its losses and prevent the firm from closing. This could either be the state itself or another related party such as a state owned bank, either by means of direct subsidy (an outright grant of capital) or indirectly (administrative measures that protect the firm from competition, subsidies on the cost of capital or forbearance on bad debts). This is the concept of the 'soft budget constraint' (Kornai, Maskin and Roland 2014). However, if the soft budget constraint is hardened then the effect of competition to weed out relatively inefficient firms (whether public or privately owned) might reveal the"primacy of competition versus ownership" (Vining and Boardman 1992) in which the performance of surviving firms is indistinguishable over time on the basis of ownership.

The operating environment for SOEs has indeed changed over the last decade. Partly as a result of undertakings made by China in the context of accession to the World Trade Organization in December 2001, China has significantly reduced the level of subsidy paid to sustain loss-making SOEs (Bajona and Chu 2010). Furthermore, the consolidation of various ministries' oversight over SOEs in to the State-owned Assets Supervision and Administration in 2003 may have helped resolve the competing claims on SOEs by better articulating and enforcing state ownership goals through a single agency.[2]

[2]This has been suggested by Qi Zhen, from the Chinese Academy of Social Sciences in an unpublished conference paper

Possibly as a result of the above reforms, more recent productivity estimates of Chinese SOEs suggest a convergence with non-state firms. Using the Nationwide Industrial Survey between 1998-2005, Hiseh and Klenow (2009) detect a marked improvement in total factor productivity between 2002 and 2005, including through the exit of loss-making SOEs. More recently, Wei and Rong (2012) use the same survey between 2000-2009 to estimate using a stochastic production frontier that SOEs in competitive sectors had converged in terms of efficiency with non-SOEs in the last two years of the survey. By contrast, estimates based on provincial level data, and including SOEs across the non-agricultural economy, including health and education sectors shows no such convergence between 1985 and 2007 (Brandt, Tombe and Zhu 2013).

Unfortunately, the ability to draw definitive conclusions from this literature is limited by the mix of estimation techniques, degree of aggregation (firm or provincial level statistics) and economic sectors considered in each of these surveys, as well as different definitions of state owned enterprise.

II. The Model

This paper follows the same conceptual framework as Dollar and Wei. Consider a firm j in an industry produces that output by combining capital and labour:

$$Y_j = A_j f(K_j, L_j) \tag{1}$$

where Y_j is the value of the output of the j^{th} firm, A_j is firm-specific total factor productivity, K_j is the value of capital utilised by the firm and L_j is the quantity of labour employed by the firm. The firm seeks to maximise profit $\Pi_j = p_j Y_j - r_j K_j - w_j L_j$ where p_j, r_j and w_j are given to firm j as its output price, rental cost of capital and wage rate. These market prices are given.

Profit maximisation implies that capital and labour are employed until the value of the marginal revenue product of each factor equals the (firm specific) factor cost. For capital, this implies that the value marginal revenue product of capital (MRPK) is equal to the interest rate faced by the firm.

$$MRPK_j = p_j A_j f'(K_j, L_j) = r_j \tag{2}$$

Assume that the production function is Cobb-Douglas with constant returns to scale, so $f(K_j, L_j) = AK_j^{\alpha} L_j^{1-\alpha}$, in which case the marginal revenue product of capital $f'_K = \alpha p_j A K_j^{\alpha-1} L_j^{1-\alpha}$ is proportional to the average revenue product of capital $\alpha p_j A Y_j / K_j$, given that $f'_K = \alpha A p_j K_j^{\alpha-1} L_j^{1-\alpha} = \alpha A p_j K_j^{\alpha} L_j^{1-\alpha} / K_j =$

$\alpha A p_j Y_j / K_j$. Therefore:

$$ARPK_j = p_j Y_j / K_j = (1/\alpha) MRPK_j \tag{3}$$

Firms might face firm-specific distortions on market prices for output d_{jY}, capital d_{jK} and labour d_{jL}, such that the firm-specific prices can be written as follows:

$$p_j = p(1 - d_{jY}) \tag{4}$$

$$r_j = r(1 + d_{jK}) \tag{5}$$

$$w_j = w(1 + d_{jL}) \tag{6}$$

Therefore the observed Average Revenue Product of Capital ($ARPK_j^O$) is

$$ARPK_j^O = pY_j / K_j = p_j Y_j / [K_j(1 - d_{jY})] \tag{7}$$

From the relationship between $ARPK_j$ and $MRPK_j$, we have

$$ARPK_j^O = MRPK_j / [\alpha(1 - d_{jY})] \tag{8}$$

And from the first order condition for $MRPK_j = r_j$

$$ARPK_j^O = r_j / [a(1 - d_{jY})] \tag{9}$$

Substituting in the distortion $r_j = r(1 + d_{jK})$:

$$ARPK_j^O = [r(1 + d_{jK})] / [\alpha(1 - d_{jY})] = (r/\alpha)(1 + d_{jK})/(1 - d_{jY}) \tag{10}$$

For small distortions on K and Y this can be expressed as a log approximation:

$$logARPK_j^O \approx log(r/\alpha) + d_{jK} + d_{jY} \tag{11}$$

The first term can be understood as an common industry component $log(r/\alpha)$, while d_{jK} and d_{jY} reveal the firm specific distortions on capital and output. A firm which faces a below-market interest rate (d_{jK} is negative) will have a lower observed $ARPK_j^O$ than the industry. Likewise, a firm which receives an output price below the market rate (d_{jY} is positive) would have a higher observed $ARPK_j^O$.

In a sample combining different cities, industries and regions, the non-firm specific components should be decomposed to allow for changes in the rate of interest over time, different rental costs of capital in different regional markets,

and different labour-capital shares between different industries. The coefficient on the ownership variable can therefore be interpreted as the average firm-specific distortions on capital and output $(d_{jK} + d_{jY})$ for firms of that ownership type.

$$ARPK_j^O = b_0 + b_1 \text{ownership} + b_2 \text{location} + b_3 sector \times year + e_j \tag{12}$$

Where b_0 is a constant, $b_{1..4}$ are vectors of coefficients on the dummy variables. Here, the coefficients on the ownership dummies can be interpreted as the capital and output distortions faced by a firm of that ownership type, relative to domestic private firms. For example, a negative coefficient on an SOE dummy would represent a subsidy to that firm.

Extending Dollar and Wei, additional factors, such as the access to finance or taxes on output, can be included alongside the ownership dummies to test for firm-specific factors affecting the cost of capital that may be uncorrelated to ownership, such as access to finance.

$$ARPK_j^O = b_0 + b_1 \text{other factors} + b_2 \text{ownership} + b_3 \text{location} + b_4 sector \times year + e_j \tag{13}$$

III. Data and sample

This study uses multiple World Bank surveys that are available to external researches on a confidential basis. Due to confidentiality requirements, statistics with fewer than five firm observations are suppressed in this paper.

The first dataset is the same 2005 Investment Climate Survey (ICS) used by Dollar and Wei. Survey data was collected from July-November 2005. It is a panel dataset covering 12,400 firms with sampling stratified across 120 cities, sectors and firm sizes. The survey was conducted from July-November 2005 and collected information on firm ownership structures, as well as annual accounting data from 2002 to 2004. It includes SOEs, foreign firms, collectives and private domestic firms.

The second dataset is from the People's Republic of China 2012 Enterprise Survey (ES), also collected by the World Bank between December 2011 and February 2013 based on data for the 2011 fiscal year. It is smaller than the ICS, with 2,700 observations of firms with some positive level of private ownership , at least five employees and across a range of non-agricultural industries (World Bank China 2012 Implementation Report). Sampling was stratified across industry, establishment size and city. It includes SOEs that are not wholly owned SOEs, foreign firms and private domestic firms.[3]

[3]Firms previously registered as collectives will appear here as private domestic firms.

The third dataset is an additional component of the ES designed to sample 148 wholly state-owned enterprises. Not all of the 148 SOEs sampled were in fact wholly owned state owned enterprises according to their responses, and are therefore categorised according to their ownership responses. For this study, this dataset of 148 SOEs has been merged with the second dataset. Firms in this sample were categorised into a separate 'state-owned' industry sector. For 108 of 148 SOEs, it was possible to manually recode industries based on a free text description given of the SOE's activity consistent with the other datasets.

The ICS included 120 cities, with 100 firms surveyed in each with the exception of Beijing, Shanghai, Tianjin and Chongqing in which 200 firms were surveyed. The ES was conducted on a subset of the original cities in which around 120 firms were surveyed in each city, including Beijing but not Tianjin or Chongqing. Shanghai was also included in the latter survey, but only 37 valid responses to the survey were made. The survey implementation attributes the failure to complete the sample in Shanghai to firms not having time, not being willing to share information, or concerns about corporate espionage (World Bank Group 2013).

Both surveys cover a subset of industrial enterprises, notably manufacturing of food, tobacco, textiles, garments, leather, wood, paper, recorded media, refined petroleum product, chemicals, plastics and rubber, non metallic mineral products, basic metals, fabricated metal products, machinery and equipment, electronics, precision instruments, transport machines, furniture and recycling. The ES also included services relating to construction, motor vehicles, wholesale, retail, hospitality, transport and information technology. To allow comparisons between the ICS and ES, only the manufacturing sub-sectors will be included in regression results. Observations for tobacco, leather, wood and paper sectors are also dropped due to an absence of SOEs in these sectors for each survey.

While SOEs are active in all the remaining sectors, it notably excludes extractive industries (including petroleum) and network utilities in which large state owned monopolies are active, and amongst the largest and most important Chinese firms. The results of the comparison in this paper therefore should not be generalised to the comparative performance of large monopoly SOEs.

IV. Ownership definitions

To replicate Dollar and Wei (2007), this paper follows their definition of ownership based on the actual ownership firms reported in the survey, categorised into eight mutually exclusive ownership types consistent with Table 1 in Dollar and Wei. Where there is inconsistency Dollar and Wei between their description of ownership shares and the figures presented in their table, rules that are consistent with their numerical presentation are followed.

- State owned, wholly: if state ownership share = 100 per cent
- State owned, majority: if state share is more than 50 per cent, but less than 100 per cent.
- State owned, minority: if state share is more than 0, but less than or equal to 50 per cent.
- Foreign owned, wholly: if foreign share = 100 per cent.
- Foreign owned, majority: if foreign share is more than 50 per cent, but less than 100 per cent.
- Foreign owned, minority: if foreign share is less than or equal to 50 per cent, and there is no state share.
- Collectively owned if firm is registered as a collective, and with collective share is 100 per cent.
- All other firms are categorised as (domestically) privately owned.

Following Dollar and Wei, observations are dropped for three firms in the ICS that are officially registered as majority privately owned, but are majority state owned according to ownership shares. The ES does not include official registration status.

A comparison of ownership types in the different datasets is in Table 1. The initial survey contains significantly more state owned firms (approximately 17 per cent) compared to the later survey (approximately 7 per cent). In addition, the initial survey is weighted more heavily toward foreign firms.

One significant difference between the two surveys is the smaller shares of SOEs in the ES compared to the ICS. The figure reported for wholly SOEs may not be reflective of the broader universe of Chinese industrial firms, given that these were selected on the basis of state ownership. That said, there has been a dramatic fall in both the absolute and proportional number of SOEs according to the aggregate data available from the National Bureau of Statistics of China (2013) and reported in the next table.[4]

[4]The apparent decline in the number of small private and foreign firms in 2011 is a result of an increase in the reporting thresholds for small, non-state firms.

Table 1—Firms surveyed by ownership type

	ICS		ES	
Ownership Type	Count	Percent	Count	Percent
State owned, wholly	1139	9.19	109	3.83
State owned, majority	481	3.88	96	3.37
State owned, minority	524	4.23	17	0.6
Foreign owned, wholly	1087	8.77	61	2.14
Foreign owned, majority	594	4.79	27	0.95
Foreign owned, minority	765	6.17	76	2.67
Collective owned	595	4.8		
Privately Owned	7212	58.18	2463	86.45
Total	12397	100	2849	100

Table 2—Firm populations in selected subsectors, by ownership.

	Surveyed Manufacturing Sectors				Share of Total			
	State	Private	Foreign	Total	State	Private	Foreign	Not specified
2003	21,121	56,602	32,332	154,770	14%	37%	21%	29%
2004	22,715	101,115	49,080	224,468	10%	45%	22%	23%
2005	16,469	103,062	48,280	218,429	8%	47%	22%	23%
2006	14,572	123,885	52,143	242,666	6%	51%	21%	21%
2007	12,109	146,428	58,044	272,527	4%	54%	21%	21%
2008	12,445	204,120	67,439	347,541	4%	59%	19%	18%
2009	11,754	211,534	65,231	353,271	3%	60%	18%	18%
2010	11,435	225,814	64,193	368,656	3%	61%	17%	18%
2011	9,405	146,325	49,538	260,019	4%	56%	19%	21%

V. Variable definitions and summary statistics

Value added (VA) for each firm is calculated from the survey data.

For the ICS: VA_{jt} = core business income$_{jt}$ - value of raw materials$_{jt}$

For the ES, from the firm's income statement:

VA_j = total annual sales for all goods and services$_j$ - total annual cost of raw materials and intermediate goods used in production$_j$ + total annual costs of fuel$_j$ + other costs of production excluding labour and rental costs$_j$

The value of the capital stock (K) is taken directly from the survey data.

For ICS: K_{jt} = net fixed asset value$_{jt}$

For ES, from the firm's Balance Sheet:

K_j = net book value of machinery, vehicles, equipment, land and buildings$_j$

The ARPK in both cases[5] is calculated easily: $ARPK_j = VA_j/K_j$

Dollar and Wei apply a number of filters to exclude data entry errors and extreme outliers in responses. In particular, they exploit the nature of the panel in the ICS to exclude observations where the annual growth rate in raw materials, value added, the ratio of value added to raw materials, or capital stock exceeds 500 per cent in absolute value. Here, the same filters are applied to the ICS, but not the ES given the inability to calculate annual growth rates from cross section data. Following Dollar and Wei, absolute values over 1,000 per cent for $ARPK_j$ are excluded.

Later regressions control for firm size using the total employment of the firm. For the ICS this is:

L_{jt} = Total Employment$_{jt}$

For the ES: L_j = Permanent, full-time workers at end of fiscal year$_j$

VI. Replication of Dollar and Wei, using full sample

After filtering outliers, and excluding observations for which there are missing observations for K or VA, there remain 31,492 observations over the three years

[5]omitting the time subscript for the ICS

2002 to 2004, from the smallest firms with only one employee and very little capital, to large firms with up to 135,559 staff and 4.8 billion RMB (approx $US 582 million in 2005 dollars) in capital. Summary statistics for these variables are reported in the following table.

Table 3—ICS - Summary Statistics

	L	K (1000 RMB)	VA (1000 RMB)
Mean	895	142191.6	168487.2
Median	260	14013.5	15609.75
Maximum	135,559	48220524	95635935
Minimum	1	1.2	0.4
Std. Dev.	2,790	922303.7	1131336
Skewness	19	25.65554	34.55781
Kurtosis	594	922.0972	2049.437
Observations	31492	31492	31492

The ARPK for each of the ownership categories are reported in the next table. This shows that SOEs have a lower average revenue product of capital compared to foreign and private ownership categories. These estimates are higher than those reported in Table 4 of Dollar and Wei. The sample size here is roughly 10 per cent higher than Dollar and Wei, suggesting either that included additional filters that are not reported in their paper, or alternatively that they deduct additional undocumented expenses from the calculation of value added (for example, a combination of operation expenses, overhead expenses or financial expenses). The maximum in all cases is less than 10 given the filtering rules applied.

Although the absolute magnitudes are higher than Dollar and Wei's results, the ordinal ranking is the same. The next table normalises the average for all firms to one, and shows that the relative results for all categories are similar.

The unconditional results might be skewed by the concentration of state ownership in particular industrial sectors, or particular regions, or from the possibility that firm size is correlated with ownership type. To control for this, following Dollar and Wei, first we regress the natural logarithm of ARPK on ownership.[6] as well as industry-year and city dummies. The domestic private firm is the base

[6] A disadvantage of using a logarithm as the dependent variable is losing observations of non-negative numbers (when revenue from outputs is less than the cost of inputs, then ARPK will be negative). This is potentially problematic if negative ARPK is associated with ownership type. However, the number of negative observations of ARPK is low, probably since the cost of labour inputs is not included in the calculation of value added. Between the years 2002-2004, there are 538 observations with negative

Table 4—ICS - ARPK by ownership

	Mean	Median	Max	Min.	Std. Dev.	Obs.
State owned, wholly	1.36	0.83	9.93	0.00	1.57	3094
State owned, majority	1.75	1.07	9.94	0.00	1.84	1293
State owned, minority	1.77	1.16	9.86	0.00	1.82	1371
Foreign owned, wholly	2.01	1.28	9.95	0.00	2.01	2663
Foreign owned, majority	2.12	1.32	9.97	0.00	2.07	1549
Foreign owned, minority	2.02	1.36	9.96	0.00	1.96	2000
Collective owned	2.22	1.55	9.87	0.03	2.08	1446
Privately Owned	2.03	1.29	9.98	0.00	2.05	18125
All	1.95	1.23	9.98	0.00	1.99	31541

Table 5—ICS - ARPK by ownership

	Reported Result		Normalised	
Ownership	D&W	Replication	D&W	Replication
State owned, wholly	0.99	1.36	0.68	0.70
State owned, majority	1.24	1.75	0.86	0.89
State owned, minority	1.33	1.77	0.92	0.91
Foreign owned, wholly	1.48	2.01	1.02	1.03
Foreign owned, minority	1.50	2.02	1.03	1.03
Privately Owned	1.51	2.03	1.04	1.04
Foreign owned, majority	1.58	2.12	1.09	1.09
Collective owned	1.72	2.22	1.19	1.14
All	1.45	1.95	1.00	1.00
Observations	28374	31541		

case for all following regressions.

The coefficients in the following table can be easily interpreted as the relative capital and output tax in percentage terms compared to domestic private firms. Wholly state owned enterprises, majority SOEs and minority SOEs appear to enjoy an effective subsidy of 46 per cent, 17 per cent and 10 per cent respectively. This is close to Dollar and Wei's equivalent estimates of 42 per cent, 15 per cent and 8 per cent. Collective firms by contrast faced an effective tax on capital (or output) of 16 per cent compared to private firms (22 per cent in Dollar and Wei).

Table 6—ICS - Regression on log(ARPK)

Variable	Coefficient	t-Statistic	
Constant	0.11	0.17	
State owned, wholly	-0.46	-20.89	*
State owned, majority	-0.17	-5.45	*
State owned, minority	-0.10	-3.20	*
Foreign owned, wholly	-0.11	-4.18	*
Foreign owned, majority	-0.01	-0.27	
Foreign owned, minority	-0.04	-1.70	
Collective owned	0.16	5.28	*
City and Industry-Year Fixed Effects Suppressed			
Observations	31541		
R-squared	0.0823		
Adjusted R-squared	0.0760		

In addition to industry and regional effects, the average return on capital may be affected by the size of the firm. To control for this, the natural log of total employment for each firm is added to the regression with results reported in the next table. This assumes that potential differences in capital stock are controlled by industry dummies. Dollar and Wei found that adding firm size to the regression had a negative but insignificant effect on the average revenue product of capital. This regression finds a statistically significant[7] but very small result; that is, a one per cent increase in firm employment is equivalent to a 0.01 per cent increase

ARPK, more than half of which are for private firms. Excluding these negative observations increases average ARPK over those years by 2.6 per cent, with no category increasing more than 4 per cent. In the 2012 survey there are only 5 observations for which ARPK is negative. Excluding these observations has a less raises average ARPK by less than 0.2 per cent, with no effect on the average ARPK of SOEs.

[7]All tests for statistically significance in this paper are reported at the 5 per cent level unless otherwise specified

in capital returns.

TABLE 7—ICS - REGRESSION ON LOG(ARPK), WITH FIRM SIZE

Variable	Coefficient	t-Statistic	
Constant	0.05	0.07	
Log (Employment)	0.01	2.85	*
State owned, wholly	-0.48	-20.95	*
State owned, majority	-0.19	-5.84	*
State owned, minority	-0.11	-3.63	*
Foreign owned, wholly	-0.11	-4.35	*
Foreign owned, majority	-0.01	-0.44	
Foreign owned, minority	-0.05	-1.91	
Collective owned	0.16	5.35	*
City and Industry-Year Fixed Effects Suppressed			
Observations	31483		
R-squared	0.0825		
Adjusted R-squared	0.0762		

VII. Comparison of results 2005 Investment Climate Survey and 2012 Enterprise Survey

In order to compare the results from the ICS with the later ES, the ICS sample is restricted to a single year (2004) and to the 25 cities (mainly coastal cities) that were included in the ES. Not only does this facilitate a more direct comparison of cities and industries, but it reduces the sample size in the regression to 1,613 observations. This is much closer to the size of the ES, and so allows easier comparison of statistical significance between the two samples. Summary statistics show that these firms tend to be larger in terms of capital and labour and output.

Table 8—ICS - Summary statistics for full and restricted samples

	L		K		VA	
			(1000 RMB)		(1000 RMB)	
	Full	Restricted	Full	Restricted	Full	Restricted
Mean	895	1,575	142,192	381,276	168,487	511,417
Median	260	511	14,014	44,373	15,610	62,496
Max.	135,559	85,487	48,220,524	37,583,816	95,635,935	39,407,741
Min.	1	12	1	45	0.4	64
Obs.	31,492	1,473	31,492	1,473	31,492	1,473

Repeating the previous regression on the restricted ICS, the coefficient on wholly owned SOEs remains significant and negative, while other coefficients are insignificant.

TABLE 9—ICS (RESTRICTED) - REGRESSION ON LOG(ARPK), WITH FIRM SIZE

Variable	Coefficient	t-Statistic	
Constant	0.92	3.91	*
Log(Employment)	-0.03	-1.46	
State owned, wholly	-0.36	-3.83	*
State owned, majority	-0.18	-1.39	
State owned, minority	0.05	0.36	
Foreign owned, wholly	0.16	1.65	
Foreign owned, majority	-0.09	-0.89	
Foreign owned, minority	0.05	0.48	
Collective owned	0.21	1.51	
City and Industry-Year Fixed Effects Suppressed			
Observations	1473		
R-squared	0.0901		
Adjusted R-squared	0.0601		

Turning to the the ES, firms in the later survey are much smaller. Although the regression analysis will control for firm size, this suggests that any direct comparisons between the two surveys should be made with caution.

Table 10—ICS (Restricted) and ES - Summary

	L		K		VA	
			(1000 RMB)		(1000 RMB)	
	ICS	ES	ICS	ES	ICS	ES
Mean	1,575	266	381,276	120,000	511,417	53,180
Median	511	80	44,373	8,000	62,496	8,000
Maximum	85,487	50,000	37,583,816	80,000,000	39,407,741	9,270,000
Minimum	12	5	45	30	64	40
Std. Dev.	4,103	1,770	1,800,283	2,510,000	2,273,283	360,000
Observations	1,473	1,032	1,473	1,032	1,473	1,032

Considering first the unconditional estimates of ARPK for the ES, note that wholly SOEs and majority SOEs have a higher ARPK than private firms, although the number of observations of SOEs is quite small. The results on minority SOEs are suppressed according to the confidentiality condition that results with fewer than five observations are not reported.

Table 11—ES - ARPK Summary Statistics

	Mean	Median	Max	Min.	Std. Dev.	Obs.
State owned, wholly	0.44	0.69	1.56	- 0.83	0.97	6
State owned, majority	0.89	0.84	2.29	- 1.89	0.88	48
State owned, minority	..	..	..	..	..	3
Foreign owned, wholly	0.17	0.28	2.29	- 3.00	1.13	35
Foreign owned, majority	0.04	- 0.15	2.09	- 1.65	1.35	16
Foreign owned, minority	- 0.07	0.08	2.20	- 3.26	1.38	32
Privately Owned	0.19	0.19	2.30	- 3.75	1.12	892
All	0.22	0.23	2.30	- 3.75	1.14	1,032

Reapplying the same regression framework as for the ICS, the coefficient on wholly SOEs is now statistically insignificant. A more surprising result is that majority SOEs appear to have a significantly higher ARPK. This is equivalent under the profit-maximising framework to a 42 per cent tax on capital or output. Larger firms also appear to have a higher return on capital. Both these

results appear somewhat implausible. While the removal of the soft-budget constraint and the discipline of competitive markets might potentially explain a convergence of performance between SOEs and non-SOEs, there is no reason why profit-maximising SOEs would face a higher cost of capital. For this reason, a model which allows for deviation from profit maximisation will be applied later.

Table 12—ES - Regression on log(ARPK), with firm size

Variable	Coefficient	t-Statistic	
Constant	-0.19	-0.38	
Log(Employment)	0.12	4.74	*
State owned, wholly	0.01	0.02	
State owned, majority	0.42	2.41	*
State owned, minority	...	...	
Foreign owned, wholly	-0.01	-0.05	
Foreign owned, majority	-0.10	-0.39	
Foreign owned, minority	-0.24	-1.30	
City and Industry-Year Fixed Effects Suppressed			
Observations	1032		
R-squared	0.2618		
Adjusted R-squared	0.2273		

VIII. Potential distortions to the cost of capital

According to the conceptual framework, firms that can access finance at below market interest rates will have a lower average revenue product of capital. This can be tested based by exploiting two questions common to the ICS and ES. The first is a simple dummy variable that asks whether the enterprise currently has a loan from a bank or a financial institution. An enterprise with a loan from a financial institution might expect a lower cost of capital to those that do not. The second question asks the manager to rate, on a scale of 0 to 4, whether access to finance impedes the company's operation, with 0 being no impediment, and 4 being a severe impediment.

According to these data, around two thirds of firms in the restricted ICS sample had a bank loan. Collective owned enterprises and wholly foreign owned enterprises were much less likely to have a bank loan, which is consistent with them having a higher return on capital. By contrast, fewer than one third of firms included in the ES sample reported having a loan. Majority SOEs, which reported

higher than average rates of bank loans in 2005, report a particular low take up of bank loans in the ES, consistent with higher costs of capital, and therefore higher returns. In terms of perceptions of access to finance, all types of SOE in the ICS reported access to finance as a more severe impediment to the company than non-SOEs. However, despite the low take up of bank loans, majority SOEs in the ES did not report access to finance as a severe impediment.

Table 13—ICS (Restricted) and ES - Access to finance

	Loans from Banks (0-1)		Hard access to finance (0-4)	
	ICS	ES	ICS	ES
State owned, wholly	0.67	0.33	1.59	1.50
State owned, majority	0.80	0.06	1.97	0.13
State owned, minority	0.77		1.42	
Foreign owned, wholly	0.51	0.43	0.73	0.80
Foreign owned, majority	0.58	0.67	1.12	1.19
Foreign owned, minority	0.79	0.38	1.12	0.94
Collective	0.51		0.96	
Private	0.67	0.30	1.27	0.98
All	0.66	0.30	1.25	0.94

Turning to the regression framework, consistent with theory enterprises with a bank loan report a significant, lower return on capital of around of around 18 per cent. The coefficient on the access to finance variable is also significant, but unexpectedly negative. This implies firms that perceive access to finance to be an obstacle to growth appear to have a lower cost of capital. This suggests that a firm manager's subjective response to the impact of finance on growth may not reflect actual firm behaviour or constraints.

Regression results for the ES are reported next. The relationship with bank finance holds for the later survey, although the quantitative effect has more than doubled to an effective 30 per cent subsidy to capital. The access to finance dummy remains negative, but not statistically significant. This does not greatly impact the coefficient on the majority state owned dummy, suggesting that the significantly higher capital returns to majority SOEs in the later survey are not explained by access to finance. The coefficient on access to finance has become positive, but is not statistically significant. Introducing these new terms reduces the equivalent tax on majority SOEs marginally from 42 per cent to 37 per cent, while its statistical significance holds.

Table 14—ICS (Restricted) - Regression on log(ARPK), including finance

Variable	Coefficient	t-Statistic	
Constant	0.98	4.19	*
Log(Employment)	0.00	-0.11	
Has a bank loan	-0.18	-2.88	*
Access to finance is an impediment	-0.06	-2.68	*
State owned, wholly	-0.37	-3.95	*
State owned, majority	-0.15	-1.18	
State owned, minority	0.05	0.41	
Foreign owned, wholly	0.10	1.10	
Foreign owned, majority	-0.12	-1.12	
Foreign owned, minority	0.05	0.49	
Collective owned	0.17	1.26	
City and Industry-Year Fixed Effects Suppressed			
Observations	1471		
R-squared	0.1015		
Adjusted R-squared	0.0705		

Table 15—ES - Regression on log(ARPK), including finance

Variable	Coefficient	t-Statistic	
Constant	-0.08	-0.17	
Log(Employment)	0.15	5.53	*
Has a bank loan	-0.30	-3.56	*
Access to finance is an impediment	-0.07	-1.58	
State owned, wholly	0.00	0.00	
State owned, majority	0.37	2.15	*
State owned, minority	...	...	
Foreign owned, wholly	0.02	0.11	
Foreign owned, majority	0.00	0.00	
Foreign owned, minority	-0.25	-1.38	
City and Industry-Year Fixed Effects Suppressed			
Observations	1008		
R-squared	0.2583		
Adjusted R-squared	0.2212		

IX. Regional fixed effects

If capital is allocated optimally there should be no regional variation in the marginal product of capital. For the 25 primarily coastal cities that are common between the two samples, we can compare the fixed city effects. The city of Wenzhou (famous for its private sector) is the base case, with regression coefficients reported for the other 24 cities after controlling for firm size (log of permanent employees), ownership type, industry and year. There is no obvious correlation between the two surveys. However, as the common cities tend to be located in coastal provinces, the bigger question about regional disparity between coastal, central and western provinces cannot be addressed by these datasets.

Table 16—ICS (Restricted) and ES - City Fixed Effects

	ICS		ES	
Hefei	-0.33		-0.99	*
Beijing	-0.25		0.31	
Guangzhou	-0.71	*	1.03	*
Shenzhen	0.03		0.66	*
Foshan	-0.48		-0.38	
Dongguan	-0.77	*	0.17	
Shijiazhuang	-0.54	*	0.11	
Tangshan	-0.49	*	-0.09	
Zhengzhou	-0.48	*	-0.42	
Luoyang	-0.39		-0.46	*
Wuhan	-0.34		-0.13	
Nanjing	-0.35		-0.75	*
Wuxi	-0.15		0.50	*
Suzhou	-0.35		0.46	*
Nantong	-0.28		-0.52	*
Shenyang	-0.82	*	-0.02	
Dalian	-0.72	*	-0.36	
Jinan	-0.22		0.77	*
Qingdao	-0.57	*	0.26	
Yantai	-0.06		-0.70	*
Shanghai	-0.22		0.83	
Chengdu	-0.61	*	0.09	
Hangzhou	-0.35		0.07	
Ningbo	-0.47		1.23	*
Correlation coefficient	0.004			

X. Industry fixed effects

The coefficients on the industry dummies can also be compared between years to see whether particular industries have consistently higher or lower capital returns. This shows that none of the coefficients for the industry dummies is statistically significant in either of the samples.

TABLE 17—ICS (RESTRICTED) AND ES - INDUSTRY FIXED EFFECTS

	ICS	ES
Food	-0.70	-0.06
Textiles	-0.04	-0.26
Garments	0.26	-0.02
Recorded media	0.19	-0.61
Refined petroleum product	-0.81	-0.13
Chemicals	0.61	-0.16
Plastics & rubber	-0.07	-0.18
Non metallic mineral products	0.08	-0.12
Basic metals	-0.16	-0.14
Fabricated metal products	-0.49	-0.27
Machinery and equipment	-0.30	-0.09
Electronics	-0.04	-0.04
Precision instruments	-0.11	-0.10
Transport machines	0.15	0.01
Furniture	-0.01	0.22
Correlation coefficient	-0.06	

XI. Model without profit maximisation

Theory suggests that profit maximisation may not be a good assumption for SOEs that face competing policy objectives and a soft-budget constraint. Even SOEs attempting to maximise profits could be constrained by policies that prevent optimal adjustment of capital stock or labour force. For example, the implementation of state macroeconomic policy through increasing or restricting credit to SOEs would reduce the capacity of an individual firm to invest optimally.

To relax the assumption that firms are maximising profits, denote the optimal (profit-maximising) average revenue product of capital as:

$$ARPK_j^* = p_j Y_j / K_j^* = (1/\alpha) MRPK_j \tag{14}$$

where the profit-maximising firm has chosen its optimal capital stock K^* consistent with the particular production technology employed.

A re-arrangement of the Cobb-Douglas production function gives an expression for the log of the average revenue product of capital in terms of the firm's total factor productivity (A), the capital share of output (α) and the capital/labour ratio (K/L). Firm subscripts are omitted:

$$\begin{gathered} Y = AK^{\alpha}L^{(1-\alpha)} \\ Y/K = AK^{(\alpha-1)}L^{(1-\alpha)} \\ log(Y/K) = logA + (\alpha-1)logK + (1-\alpha)log(L) \\ log(Y/K) = logA + (\alpha-1)logK - (\alpha-1)log(L) \\ log(Y/K) = logA + (\alpha-1)(logK - logL) \\ logARPK = logA + (\alpha-1)log(K/L) \end{gathered}$$

Therefore, the ARPK given the optimal capital labour ratio can be written as follows:

(15) $logARPK^* = logA + (\alpha-1)log(K^*/L)$, given the optimal K/L ratio.

However, suppose a firm has over-invested in capital (K') relative to the efficient K/L ratio. In this case $K'/L > K^*/L$. This implies that $log(K'/L) > log(K^*/L)$. Since $0 < \alpha < 1$, $(\alpha-1) < 0$, so $(\alpha-1)log(K'/L) < (\alpha-1)log(K^*/L)$, this demonstrates that $logARPK' < logARPK^*$. The converse applies for under-investment.

To rephrase this intuitively, over-investment in capital relative to labour leads to a lower average revenue product of capital. By the same logic, under-investment in capital leads to a higher average revenue product of capital. Therefore, apparent distortions in the rental rate of capital or the output price facing a profit-maximising firm in Dollar and Wei's decomposition could alternatively be explained in deviation by firms from profit maximisation, even in the absence of price distortions.

To allow for such deviation, an alternative model includes the capital-labour ratio as a dependent variable:

(16)
$$logARPK_j^O = b_0 + b_1 log(K/L) + b_2 ownership + b_2 location + b_3 sector \times year + e_j$$

In this model, the ownership dummies can be interpreted as a pure ownership effect after controlling for over- or under-investment in capital stock.

Returning the data, a comparison of summary statistics between the two surveys suggests that differences in capital-labour ratios may well be driving the results. The SOEs surveyed in the ICS were much more capital intensive than

private firms. The capital intensity of private firms is for times larger (in nominal terms) in the ES than the ICS, while SOEs in the the ES have a lower capital intensity (even in nominal terms) than those in the ES. This suggests either a radical underlying shift in the capital intensity of SOEs, or perhaps more likely, a failure to capture large, capital-intensive SOEs in the ES.

Table 18—ICS (Restricted) and ES - Capital Labour Ratio ('000 RMB per full time employee)

	ICS			ES		
	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.
State owned, wholly	172.1	266.1	150	94.4	107.0	6
State owned, majority	221.2	480.8	71	194.9	675.2	48
State owned, minority	822.3	5506.3	71	..	..	3
Foreign owned, wholly	340.6	992.9	154	203.3	177.2	35
Foreign owned, majority	465.9	1158.2	111	269.6	241.6	16
Foreign owned, minority	256.0	350.5	118	188.2	192.3	32
Collective	52.9	59.4	57			
Private	131.3	289.5	741	555.0	10714.7	892
All	227.1	1320.5	1473	508.7	9962.9	1032

Including the logarithm of the capital-labour ratio in the regression framework, a one per cent increase in the capital labour ratio is equivalent to a 0.41 per cent decrease in the ARPK of the firm. That is, firms that are more capital intensive have a lower return on capital. Wholly SOEs still have significantly lower returns beyond what is explained by capital intensity.

Introduction of the capital-labour ratio in the ES data has the effect of removing the implausibly high ARPK for majority SOEs, with the coefficient falling to a level that remains positive but statistically insignificant. The coefficient on wholly SOEs is almost the same between the surveys, although given the very small number of observations of wholly SOEs in the ES the coefficient there is not statistically significant. After controlling for the capital labour ratio, firm ownership does not appear to play a role in explaining the higher returns to capital for majority SOEs in the ES.

Table 19—ICS (Restricted) - Regression on log(ARPK) including Capital-Labour Ratio

Variable	Coefficient	t-Statistic	
Constant	2.26	11.13	*
Log(Capital Labour Ratio)	-0.41	-19.34	*
State owned, wholly	-0.25	-3.00	*
State owned, majority	-0.03	-0.31	
State owned, minority	0.18	1.60	
Foreign owned, wholly	0.40	4.72	*
Foreign owned, majority	0.22	2.39	*
Foreign owned, minority	0.30	3.40	*
Collective owned	-0.04	-0.34	
City and Industry-Year Fixed Effects Suppressed			
Observations	1473		
R-squared	0.2783		
Adjusted R-squared	0.2544		

Table 20—ES - Regression on log(ARPK) including Capital-Labour Ratio

Variable	Coefficient	t-Statistic	
Constant	6.41	14.98	*
Log(Capital Labour Ratio)	-0.57	-27.84	*
State owned, wholly	-0.27	-0.84	
State owned, majority	0.05	0.37	
State owned, minority			
Foreign owned, wholly	0.20	1.51	
Foreign owned, majority	0.23	1.19	
Foreign owned, minority	-0.23	-1.68	
City and Industry-Year Fixed Effects Suppressed			
Observations	1032		
R-squared	0.5774		
Adjusted R-squared	0.5577		

XII. Analysis of results

These results suggest significant differences in returns on capital between SOEs and non-SOEs in the samples studied from the ICS and the ES. Not only do SOEs not receive lower returns on capital in the ES, but some appear to be earning a return on capital higher than private firms. This suggests that an alternative model that allows for firms to deviate from profit-maximisation capital-labour ratios may provide a better explanation than the model provided by Dollar and Wei.

Previously inefficient SOEs might have been loss making and forced to exit the market, but that only explains a convergence to average returns on capital - not higher returns. The result is even more surprising given China's policy reaction to the global financial crisis, in which much of the economic stimulus package was reported to have been pushed through the state-sector at the expense both of investment efficiency in the state sector and to the relative detriment of the non-state sector. In this case, one would expect to see lower average returns on capital to SOEs in the aftermath.

An alternative explanation is that firms may be financing investment through retained earnings, and that firms with lower retained earnings (or losses) are therefore underinvesting relative to the optimal rate. Alternatively, SOEs or their supervisors may continue to pursue objectives other than profit maximisation and so do not invest optimally in capital.

XIII. Robustness analysis

A. Market value not book value

Dollar and Wei speculate that one reason for the apparently higher returns in absolute values could be due to the use of book value of firm capital rather than market value. This can be tested in the ES, which asks firms for both book value and market value of capital. Comparing book value to market valuation, the modal response is (from 268 firms) is to provide the same value for book and market value. Nevertheless, SOEs report a higher book valuation of assets, which would reduce the estimate of the ARPK.

In the original profit-maximisation model, the use of market value rather than book value returns the same result that majority SOEs have a significantly higher ARPK than private firms.

In the alternative framework using the capital labour ratio, the coefficient on majority SOEs is reduced, but remains positive and significant, contrary to the finding when market value is used. This result appears to be influenced by a

Table 21—ES - Regression using market value of assets

Variable	Coefficient	t-Statistic	
Constant	-0.86	-1.60	
Log(Employment)	0.17	6.52	*
State owned, wholly	0.10	0.24	
State owned, majority	0.52	2.96	*
State owned, minority			
Foreign owned, wholly	-0.04	-0.21	
Foreign owned, majority	0.01	0.04	
Foreign owned, minority	-0.07	-0.39	
City and Industry-Year Fixed Effects Suppressed			
Observations	1073		
R-squared	0.3164		
Adjusted R-squared	0.2858		

slightly different sample of firms in the survey for which there are observations for market value of capital compared to firms with observations for book value of capital. This reinforces that the results in this paper are highly susceptible to sampling biases in the underlying surveys.

TABLE 22—ES - REGRESSION ON LOG(ARPK), USING MARKET VALUE OF CAPITAL

Variable	Coefficient	t-Statistic	
Constant	5.81	12.10	*
Log(Capital Labour Ratio)	-0.56	-25.86	*
State owned, wholly	-0.15	-0.45	
State owned, majority	0.28	2.03	*
State owned, minority			
Foreign owned, wholly	0.19	1.37	
Foreign owned, majority	0.17	0.85	
Foreign owned, minority	-0.01	-0.05	
City and Industry-Year Fixed Effects Suppressed			
Observations	1073		
R-squared	0.5690		
Adjusted R-squared	0.5497		

B. Direct calculation of the Marginal Revenue Product of Capital

Following Dollar and Wei, an alternative to inferring the marginal revenue product of capital from the average revenue product of capital is to calculate it directly based on the firm's wage bill, provided that wages are accurately observed.

$$MRPK_j = (VA_j - w_j L_j)/K_j \tag{17}$$

This has the advantage of not assuming a Cobb-Douglas production function, and allowing capital shares to vary between firms within an industry. As with ARPK, $MRPK_j$ that exceeds 1,000 per cent in absolute value is excluded.

For the restricted sample in the ICS, this provides the result that same wholly SOEs have significantly lower MRPK than all other firm types.

Table 23—ICS (Restricted) - Regression on Log(MRPK)

Variable	Coefficient	t-Statistic	
Constant	1.86	7.96	*
Log(Capital Labour Ratio)	-0.37	-15.27	*
State owned, wholly	-0.28	-2.93	*
State owned, majority	0.03	0.22	
State owned, minority	0.22	1.72	
Foreign owned, wholly	0.39	4.02	*
Foreign owned, majority	0.11	1.02	
Foreign owned, minority	0.34	3.38	*
Collective owned	0.01	0.10	
City and Industry-Year Fixed Effects Suppressed			
Observations	1467		
R-squared	0.2046		
Adjusted R-squared	0.1783		

The result that state ownership is not significant after controlling for the capital-labour ratio also holds when the MRPK is calculated directly from the ES.

Table 24—ES - Regression on Log(MRPK)

Variable	Coefficient	t-Statistic	
Constant	5.40	10.94	*
Log(Capital Labour Ratio)	-0.52	-21.28	*
State owned, wholly	-0.15	-0.45	
State owned, majority	0.17	1.05	
State owned, minority			
Foreign owned, wholly	0.36	2.12	*
Foreign owned, majority	0.18	0.74	
Foreign owned, minority	-0.14	-0.78	
City and Industry-Year Fixed Effects Suppressed			
Observations	1048		
R-squared	0.4950		
Adjusted R-squared	0.4718		

C. Alternative ownership specifications

The paper has followed Dollar and Wei's ownership definitions. A simple alternative method would be to include the state and foreign ownership shares directly in the regression, although this could miss non-linear effects as ownership reaches certain thresholds. For the ICS, it returns the result that state ownership is associated with significant and lower returns on capital, even after controlling for the capital labour ratio and other fixed effects.

Table 25—ICS (Restricted) - Regression on log(ARPK) with ownership shares.

Variable	Coefficient	t-Statistic	
Constant	2.25	11.07	*
Log(Capital Labour Ratio)	-0.40	-19.42	*
State Ownership Share	-0.0021	-2.78	*
Foreign Ownership Share	0.0042	5.52	*
City and Industry-Year Fixed Effects Suppressed			
Observations	1473		
R-squared	0.2753		
Adjusted R-squared	0.2540		

For the ES, coefficients on state and foreign ownership shares are insignificant after controlling for the capital labour ratio and other fixed effects.

Table 26—ES - Regression on log(ARPK) with ownership shares.

Variable	Coefficient	t-Statistic	
Constant	6.47	15.20	*
Log(Capital Labour Ratio)	-0.57	-27.71	*
State Ownership Share	0.0004	0.25	
Foreign Ownership Share	0.0012	1.03	
City and Industry-Year Fixed Effects Suppressed			
Observations	1031		
R-squared	0.5755		
Adjusted R-squared	0.5574		

XIV. Conclusion

This paper replicates Dollar and Wei's finding that SOEs in 2002-2004 tended to have a lower return on capital. However, applying the same regression framework to the World Bank's 2012 Enterprise Survey finds that majority SOEs have above-average returns on capital. This result does not seem to be well explained by Dollar and Wei's model. Some convergence in returns between SOEs and non-SOEs might be expected, but not higher returns given SOEs are unlikely to face higher costs of capital to their private market competitors. Deviation from profit maximisation, rather than deviation in the cost of capital for profit maximising firms may provide a better explanation.

One avenue for further research is to apply similar techniques to the National Industrial Survey. This is a large panel dataset collected annually by China's National Bureau of Statistics. Firm-level data for this survey is currently available from 1992 to at least 2009. As well as attempting to replicate these results on a much larger dataset, the dynamics for any apparent change in capital efficiency can be observed by following firm survival over time. Moreover, the larger survey would provide sufficient observations to test whether these findings are consistent within different industries and over time.

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