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Article

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Industrial reform policies: does marketization enhance productivity more than privatization?

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Abstract

Placing state-owned firms into the private sector is understood to yield productivity gains, but this effect is seldom decomposed into changes in ownership (privatization) and changes in firm characteristics to match privately owned firms without changing ownership (marketization). This article presents an empirical assessment of Chinese firm-level data using a counterfactual design approach to identify if the Chinese 'grasp the large and let go of the small' industrial policy reform initiative reduced the efficiency gap between state-owned and non-state-owned enterprises and whether any gains were associated with privatization or marketization. Our empirical results show that marketization was associated with stronger increases in productivity than was privatization, suggesting that industrial reforms should consolidate assets, enhance cash flows, and reduce the need for external liquidity rather than focusing on changing ownership.

Keywords: marketization; privatization; productivity; state ownership
JEL classifications: L33, P21, P31

1. Introduction

Governments with under-performing state-owned enterprises (SOEs) face the choice of selling these firms to private stakeholders (privatization) or restructuring them for market operations without ownership change (marketization). The literature emphasizes that privatization leads to increases in workers' wages (Bastos, Monteiro, and Straume 2014) and to greater efficiency for restructuring firms (Boycko, Shleifer, and Vishny 1996), especially when governments invest in firms they intend to privatize (Norbäck and Persson 2012). Although plentiful literature discusses the effects of privatization, very little research focuses on marketization, which we define as a transformation of an SOE so that it becomes congruous with the characteristics of private enterprises without transferring ownership away from the state. Ownership is not the only distinction between SOEs and private firms; they also differ in size, age, and major financial variables (Ding, Guariglia, and Knight 2013) that contribute to

differences in productivity. The productivity benefits of privatization should be measured independent of the benefits of marketization, such that the benefits of privatization stem from the differences in productivity between SOEs and private firms that cannot be attributed to differences in firm characteristics. Thus, the three aims of this article are, first, to identify if privatizing an SOE into an otherwise comparable private firm is associated with a beneficial change in productivity; second, to appraise if marketization that aligns characteristics of an SOE with those of a private firm (with no ownership change) is associated with a beneficial change in productivity; and third, to evaluate whether privatization or marketization is associated with superior productivity increases for economies transitioning to a market economy.

China's enterprise reforms provide a perfect testbed to fulfil these aims. Under the motto 'grasp the large and let go of the small', many small and loss-making SOEs were either shutdown or privatized after the mid-1990s (Chen et al. 2021). The aim of the 'grasp the large' approach was to retain state ownership of larger enterprises during their restructuring to make them more viable in market competition. Many large SOEs in strategic sectors or with good financial standing were corporatized, experienced a consolidation of state control (Berkowitz, Ma, and Nishioka 2017), and/or experienced contemporaneous marketization reforms (Hsieh and Song 2015).[1] Marketization began from the adoption of corporate finance and accounting principles in all SOEs in 1993, and other marketization reforms followed including management decentralization and contracting out (Zhang, Zhang, and Zhao 2001; Lu and Dranove 2013). In contrast, the 'let go of the small' approach provided medium- and small-sized enterprises with a wide range of reform solutions, such as ownership restructuring, merger and acquisition, stock participation, outright sale of control rights, and closure. Empirical studies of China's industrial reforms document vibrant productivity growth across Chinese industries and particularly among SOEs (Jefferson and Rawski 1994; Brandt, Van Biesebroeck, and Zhang 2012; Curtis 2016; Berkowitz, Ma, and Nishioka 2017), with Chen et al. (2021) showing that private firms produce 53 per cent more than their SOE peers when endowed with the same amounts of inputs. However, these studies stop short of identifying whether privatization policies were more effective in boosting productivity than were marketization policies, and importantly whether privatization and marketization effects were felt equally across the distribution of firms.

We draw on Chinese firm-level data from 1999 to 2007 and employ a counterfactual analysis following Rothe (2015) to analyse the effect of marketization and privatization measures on the productivity of Chinese SOEs. Application of a counterfactual analysis permits the construction of a productivity distribution of SOEs that share the same observable characteristics as private firms but without ownership change. This approach makes it possible to decompose the evolving productivity gap between SOEs and private firms into a difference due to ownership type (privatization, i.e. the structural effect) and a difference due to observable firm-level characteristics (marketization, i.e. the composition effect). Rothe's (2015) method is immune to the sample selection bias that plagues panel data methods and also facilitates decomposition of the composition effect into marginal effects without dependence on the order of decomposition.[2] We then assess the extent that individual characteristics, such as firm size or cash flow, contribute to the productivity gap between SOEs and private firms net of the ownership effect to identify what is behind any marketization effect on productivity. Finally, application of a quantile analysis identifies

[1] The Chinese government's State Council issued an official announcement in 1992 that provided a clear policy guide on how to 'transform operation mechanisms' of state-owned manufacturers (全民所有制工业企业转换经营机制条例_2011 · 1□增刊_中国政府网 (www.gov.cn)). The indicators that we use below (such as cash flow, ROA, and leverage ratio) match well to the specific targets mentioned in their guide.

[2] Although all reasonable steps were taken to avoid endogeneity issues, it is not possible to fully exclude the impact of firm selection into private and SOE groups. We do not look at firms which actually privatised, rather the Rothe (2015) method allows us to compare firms with a counterfactual of alternative ownership. The membership of SOE and private groups is still affected by selection of firms to privatize. The selection of firms to privatise represents an empirical limitation for work on privatization.

the privatization (structural) and marketization (composition) effects at a disaggregate level across productivity quantiles and permits the examination of heterogeneity between industries and over time.

Our results indicate that the process of marketization was, in general, associated with greater increases in productivity than privatization, with ownership change associated with smaller increases in productivity than were consolidations of SOE assets, enhancements in cash flow, and reductions in external liquidity. We provide three further additions to the literature. First, our results suggest that there were larger benefits from privatization during the earlier stages of the reform, with this structural effect being comparable in magnitude to the composition effect of marketizations. Although the effects of both privatization and marketization diminished over time, the average effect of privatization vanished by 2007 whereas the mean effect of marketization remained effective in boosting the productivity of the remaining SOEs, and thereby providing support for policies that continue the marketization process. Second, we show that the effects of privatization were felt more by less productive SOEs, lending support to the 'let go of the small' policy initiative, and that there are non-linear effects identified through implementation of Rothe's (2015) method which reveal that privatization could be harmful to the most productive SOEs. Third, although the 'grasp the large' measures contributed to improving inventory management and were successful in reducing the productivity divide between SOEs and private firms, we find that this industrial policy had stronger effects than the 'let go of the small' initiative because of the significant benefits gained through marketization.

This article is organized as follows. Section 2 summarizes the theories and empirical evidence on privatization and marketization and reviews China's enterprise reforms. Section 3 describes the dataset and Section 4 details the analytical approach. Section 5 presents the empirical results and Section 6 discusses the results and draws conclusions.

2. Background

The debate about the choice between the private and public provision of goods and services is grounded on the classical argument that public provision is needed due to market failures, including those relating to monopoly, externalities, and public goods (Megginson and Netter 2001). Under these conditions, state ownership should be more efficient than private ownership (Shleifer and Vishny 1997; Shleifer 1998; Megginson and Netter 2001). However, Sappington and Stiglitz (1987) offer a different perspective on this debate and argue that when public and private provision appear similar in everyday functioning then the government can achieve the same objectives by contracting production to private firms. One ownership type may be advantageous over the other when there exist differences in risk aversion, liability, commitment ability, contracting cost, or information asymmetry. Public provision is superior when the government is more tolerant to risk, SOEs face beneficial hierarchical controls, the government's commitment ability is stronger than private firms' commitment, the government has superior knowledge of the production process and can influence supply chains, contracting costs are high, and when government has more complete knowledge of social benefits. Government monitoring can also be an effective policy instrument to improve the performance of SOEs. If technological complexity, scale economies, and depth of experience require limited competition to lower average production costs, then large SOEs may accrue considerably more social and productive advantages relative to private producers. Hence, an important consideration regarding the benefits of privatization relates to the characteristics of SOEs.

Shleifer and Vishny (1997) examined ownership issues from the perspective of an agency problem and remind us that managers have substantial residual control rights due to incomplete contracts, and hence efficiency losses can arise when managers fail to align their behaviours with the interest of owners. The ownership problem is exemplified by the state

vs. private ownership dichotomy for two reasons: first, bureaucrats have concentrated control rights over SOEs but have no significant cash flow rights, and second, bureaucrats that control SOEs typically have political interests that differ from efficiency concerns.

Further concerns with SOEs exist, such as Berglof and Roland's (1998) and Frydman et al.'s (1999) assertion that a major source of inefficiency due to government ownership relates to the 'soft' budget constraint, which allows inefficient SOEs to survive through a reliance on government funding. Inefficient SOEs in China could survive because they have preferential access to credit from state banks (Song, Storesletten, and Zilibotti 2011) and some Chinese SOEs would appear to be inefficient because they were obliged to provide social welfare (employment) as well as meet profit objectives (Bai et al. 2000). The lack of clarity on whether state or private ownership is optimal led Laffont and Tirole (1993) to conclude that theory alone is unlikely to be conclusive, and hence a crucial omission from our knowledge remains whether state or private ownership is optimal from an empirical standpoint. This article contributes to the literature by filling some of these gaps, and specifically we test the following hypotheses:

H01: Privatizing an SOE is associated with an increase in its productivity when other firm characteristics remain the same, and this effect is uniform across the productivity distribution.

H02: Marketizing an SOE is associated with an increase in its productivity when there is no change in ownership, and this effect is uniform across the productivity distribution.

H03: Marketized firms experienced a larger increase in productivity than privatized firms across the productivity distribution.

Empirical results relating to these hypotheses will permit the evaluation of whether privatization is superior to marketization in terms of productivity gains for economies transitioning to a market economy, which is a crucial finding that could guide policy.

2.1 Further considerations

Much of the literature confounds the effects of privatization and marketization on productivity which makes it difficult to formulate effective policy recommendations. Berkowitz, Ma, and Nishioka (2017) argued that corporatization without privatization cannot generate efficiency gains, which was the first evidence regarding marketization, and consistent with Shleifer's (1998) prediction. Some articles following Ehrlich et al.'s (1994) approach find that the change from state to private ownership in the airline industry increased productivity growth by 1.6–2 per cent a year in the long run (short-run effects on productivity were ambiguous) and part of this increase in productivity growth will be due to the upward convergence of SOEs towards the productivity of private firms. Moreover, Berkowitz, Ma, and Nishioka (2017) showed that restructured SOEs were 4.2 per cent less productive between 1998 and 2002 than SOEs that were privatized between 2003 and 2007, and Hsieh and Song (2015) revealed that the productivity of SOEs converged to that of private firms despite having lower capital utilization and that growth was faster for SOEs than for private firms. Thus, disentangling the effects of privatization and marketization on productivity remains an important concern, and we meet this challenge below through application of the Rothe (2015) approach.

The existing literature provides some indirect answers to two of our research questions albeit at the aggregate level. According to Jefferson, Rawski, and Zhang (2008), 46 per cent of China's industrial total factor productivity (TFP) growth between 1998 and 2005 can be explained by firm turnover, whereas Brandt, Van Biesebroeck, and Zhang (2012) claim this to be even greater at 72 per cent albeit between 1998 and 2007. While large numbers of SOEs were shut down or privatized after the mid-1990s (Chen et al. 2021),

productive resources were reallocated from the state sector to the private sector, which contributed to prolonged productivity growth (Hsieh and Klenow 2009; Song, Storesletten, and Zilibotti 2011). Although SOEs remained relatively less productive than private firms, this productivity gap narrowed substantially by the end of the reform period (Brandt, Van Biesebroeck, and Zhang 2012) until large SOEs with central affiliations became as productive as non-SOEs in 2007 (Berkowitz, Ma, and Nishioka 2017). Collectively, these results portray enterprise reforms as a government-led Darwinian selection that knocked out under-productive SOEs and boosted the productive efficiency of SOEs remaining under government control. However, this strand of literature does not identify the direct productivity benefits of privatization at the micro level, nor does it clarify whether these benefits vary across firms with different levels of productivity; our empirical research below meets both of these needs.

Researchers have sought to evaluate the effects of ownership change using panel econometric methods applied to firm-level data, and thus measure the average effect both in the cross section and in time. However, although SOEs differ from private firms according to a range of characteristics (Ding, Guariglia, and Knight 2013; Li and Yamada 2015), any effects at the firm level will be purged through the use of firm-level fixed effects. Moreover, applications of panel methods necessarily assume that firm-level productivity gains due to ownership change are captured through the examination of differences between *ex ante* and *ex post x post* productivity levels around the date when ownership change occurs (Ehrlich et al. 1994; Chen et al., 2017) and hence are understood as though ownership change was an unanticipated switch, when this is unlikely to be the case.

Applications of panel methods are problematic in meeting our empirical needs for the following reasons. First, ownership change is unlikely to be exogenous to productivity issues as less productive firms are more likely to experience ownership change in the near future (Lichtenberg et al. 1987). Second, China's enterprise reforms complicate the sample selection problem as exiting (closed or privatized) SOEs were the least productive (Berkowitz, Ma, and Nishioka 2017). Third, governments are less likely to relinquish control over SOEs that have larger workforces or with greater valuations (Li and Yamada 2015), with the employment incentive being stronger for local governments. Fourth, there tend to be significant deteriorations in performance prior to privatization because insiders have the incentive to maximize their benefits from the privatization process (Lu and Dranove 2013). Hence, if ownership change does not occur randomly then the fixed effects estimator will be subject to selection bias, and it is for this reason that researchers employ alternative statistical methods to tackle this endogeneity problem.

To increase clarity of the separate productivity impacts of the two distinct industrial reform policy initiatives of privatization and marketization, we proceed below to conduct a counterfactual experiment specifically designed to analyse both the structural effect derived from privatization and the composition effect derived from marketization. Following Ding, Guariglia, and Knight (2013) and Poncet, Steingress, and Vandenbussche (2010), we further decomposed the composition effect into marginal effects measured through firm size, firm age, leverage ratio, cash flow, inventory-to-sales ratio, exports, Research and Development (R&D), and competition. Our results presented below thus disentangle marketization and privatization effects and evaluate which specific market-oriented policy measures are effective in bridging the productivity gap between state-owned and private firms. The findings continue to have rich implications for ongoing enterprise reforms in China and provide guidance to plan reforms in other transitioning economies.

3. Data

The empirical contribution of this study requires information on both privatization and marketization, and for this we draw from the Chinese Industrial Survey conducted by the

National Bureau of Statistics (NBS). The survey was conducted annually, covering all SOEs and non-state firms with annual sales above 5 million RMB. The sample size steadily increased from 163,000 in 1998 to 334,000 in 2007. Accounting and financial variables present in the dataset enable us to estimate firm-level productivity and control for firm-level characteristics. Because of its wide coverage and comprehensive information, this unique dataset is highly visible in an array of studies focusing on the Chinese economy.

The dataset provides a four-digit industry classification code (CICS) for each firm. Using the first two digits, we divide the annual samples for thirty sectors, which range from agri-food processing to recycling. We employ data from four representative industries across varied technology levels based on the OECD definition: food, beverage, and tobacco (14–16, low-tech), rubber and plastics (29–30, medium-low tech), transportation equipment (37, medium-high tech), and pharmaceuticals (27, high tech). Inclusion of the food, beverage and tobacco industry is based on its relatively large size and a high percentage of state ownership. Over the period 1999–2007, the annual average number of firms in this industry was 2,445 and 26 per cent of these were SOEs. These firms employed 2.2 million workers and produced 751 million RMB worth of goods. Although rubber and plastics is not one of the largest among all medium-low-tech industries, this industry was chosen because of its strategic importance in the national economy.

Choice of the other two industries is based on multiple concerns. First, both transportation equipment and pharmaceuticals are large industries in terms of firm number, employment, and output among medium-high-tech and high-tech categories. Second, both industries had high shares of state ownership (21 per cent) during the study period. Third, according to the Chinese Catalogue of High-Technology Industrial Classification (2013) and the Catalogue of Strategically Emerging Industrial Classification (2012), all subsectors of pharmaceuticals and a few subsectors (3761, 3762, and 3769) of transportation equipment are defined as high-tech as well as strategically emerging sectors.[3] Both of these industries were targeted by the 'grasp the large' industrial policy.

Our analysis was conducted on three evenly spaced cross-sections for the years 1999, 2003, and 2007. Annual sample sizes ranged from 3,862 (pharmaceuticals in 1999) to 12,798 (rubber and plastic manufacture in 2007) as shown in Table 1. After three stages of enterprise reforms, the pharmaceuticals and transportation equipment industries had the highest ratios of SOEs by the end of the sample period.

3.1 Variable definition

As ownership is a central theme of this study, a proper definition of state ownership is crucial for analysis. Studies of Chinese manufacturing define state ownership either by registration status (Brandt, Van Biesebroeck, and Zhang 2012; Berkowitz, Ma, and Nishioka 2017) or by *de facto* controlling stake (Ding, Guariglia, and Knight 2013; Hsieh and Song 2015),[4] but a discrepancy arises here because a firm registered as non-state (e.g. stock corporation or foreign-invested firm) may have the state acting as the dominant stakeholder.[5] We adopted a two-step procedure that combines the controlling stake and registration status in determining the ownership type of each firm. In step one, we identify the registered capital owned by different entities (state, collective, private, and foreign). A firm is defined as state-owned if the share of the state outweighs the share of other types, with other ownership types following equivalent definitions. When information on controlling shares is

[3] See www.stats.gov.cn/tjsj/tjbz/201310/P020131021347576415205.pdf for the Catalogue of High-Technology Industrial Classification and www.stats.gov.cn/tjsj/tjbz/201301/U020131021375903103360.pdf for the Catalogue of Strategically Emerging Industrial Classification.

[4] Chen et al. (2017) show these are interchangeable when analysing the impacts of ownership on productivity.

[5] When large SOEs are incorporated, typically the ownership of the firm was transferred from the government (central or local) to the State-Owned Assets Supervision and Administration Commission (SASAC). The SASAC oversees daily operations while the Ministry/Department of Organization appoints the key positions.

Table 1. Firm numbers and summary statistics.

Industry	1999				2003				2007			
	State	Priv	Total	%	State	Priv	Total	%	State	Priv	Total	%
Food, beverage, and tobacco	3,484	6,040	9,524	36.6	1,384	5,391	6,775	20.4	631	7,501	8,132	6.9
Pharmaceuticals	1,288	2,574	3,862	33.4	692	2,872	3,564	19.4	395	3,936	4,331	8.5
Rubber and plastic	1,079	5,147	6,226	17.3	514	6,823	7,337	7.0	266	12,532	12,798	1.6
Transportation equipment	2,185	5,210	7,395	29.6	1,350	6,106	7,456	18.1	911	9,843	10,754	7.6

		1999		2003		2007	
		Mean	s.d.	Mean	s.d.	Mean	s.d.
Food, beverage, and tobacco	TFP	0.844	1.146	1.515	0.999	2.218	0.873
	competition	0.587	0.304	0.547	0.310	0.427	0.291
	Firm age (years)	23.39	17.27	18.30	16.80	12.93	13.50
	Assets (log)	9.628	1.734	9.946	1.689	10.11	1.535
	Inventory	0.630	2.777	0.742	3.345	0.204	0.401
	Leverage	0.742	0.423	0.622	0.401	0.524	0.329
	Cashflow	0.039	0.515	0.071	0.141	0.162	0.273
	R&D (%)	1.385	8.543	2.062	10.69	3.169	13.97
	Exports (%)	5.492	20.19	8.331	24.55	7.622	23.18
Pharmaceuticals	TFP	2.363	0.973	2.861	0.860	3.321	0.884
	Competition	0.534	0.310	0.470	0.306	0.385	0.282
	Firm age (years)	20.22	15.05	18.06	15.27	14.92	14.03
	Assets (log)	10.10	1.434	10.51	1.442	10.63	1.363
	Inventory	0.610	3.873	0.376	1.079	0.230	0.344
	Leverage	0.683	0.334	0.585	0.318	0.526	0.287
	Cashflow	0.047	0.104	0.067	0.127	0.124	0.204
	R&D (%)	6.517	18.51	7.421	20.56	8.550	22.76
	Exports (%)	7.613	21.56	7.759	21.73	7.560	21.60
Rubber and plastics	TFP	1.955	0.874	2.412	0.750	2.779	0.727
	Competition	0.374	0.328	0.272	0.290	0.183	0.238
	Firm age (years)	14.65	12.98	12.27	10.96	10.05	8.483
	Assets (log)	9.510	1.421	9.576	1.311	9.644	1.258
	Inventory	0.308	0.524	0.193	0.310	0.138	0.189
	Leverage	0.628	0.314	0.561	0.305	0.557	0.270
	Cashflow	0.072	0.153	0.095	0.151	0.138	0.212
	R&D (%)	2.516	12.28	2.088	11.45	3.019	14.22
	Exports (%)	16.02	33.28	17.88	34.86	17.46	34.22
Transportation equipment	TFP	1.231	1.039	1.921	0.869	2.556	0.758
	Competition	0.373	0.280	0.301	0.261	0.201	0.220
	Firm age (years)	21.57	15.85	18.21	15.72	13.46	13.39
	Assets (log)	9.853	1.853	10.09	1.719	10.26	1.627
	Inventory	0.485	0.867	0.270	0.414	0.174	0.288
	Leverage	0.661	0.331	0.631	0.371	0.598	0.277
	Cashflow	0.046	0.162	0.078	0.212	0.117	0.191
	R&D (%)	5.579	17.03	5.639	17.53	6.571	19.54
	Exports (%)	5.732	19.63	8.672	24.05	10.34	26.12

Notes: Firm numbers are after removal of missing values and winzorization at the 95 per cent level on TFP. Private ownership represents only those firms who are under Chinese ownership. Foreign owned firms are excluded. TFP is calculated using the Olley–Pakes approach. Competition is calculated as the Herfindahl index for the 2-digit sector. Firm ages are capped such that no firm has a start date before 1949. R&D is expressed as the percentage of outputs that are new products. Exports are expressed as a percentage of total sales. Numbers are calculated after the removal of firms with missing values. All variables are winzorized at the 95 per cent level. Foreign owned firms are excluded from the analysis. *Source*: Authors' calculations.

insufficient[6] we go to step two and use registration information if it is unambiguous about controlling stake.[7] The number of SOEs in each industry–year is presented in Table 1. Private firms include only those classed as domestic, excluding foreign-owned enterprises. Our omission of foreign-owned firms ensures maximal comparability on control variables without unduly affecting the conclusions. The number of SOEs experienced a sharp decline during this period with the decline more marked before 2003 than after. The percentage of SOEs in the samples drops from 17–37 per cent to 1.6–8.5 per cent because of the diminishing size of the state sector and the rapid growth of the non-state sector.

Our TFP productivity measure is estimated using the Olley and Pakes (1996) approach and we control for a variety of items that affect TFP. Recent studies identify a series of firm-level characteristics that affect firm efficiency; these include R&D activity (Boeing, Mueller, and Sandner 2016), export behaviour (Bao, Huang, and Wang 2015), age (Ding, Guariglia, and Knight 2013; Hsieh and Klenow, 2009), asset size (Ding, Guariglia, and Knight 2013; Lu and Dranove 2013), leverage (Chen et al. 2017; Ding, Guariglia, and Knight 2013), cash flow (Poncet, Steingress, and Vandenbussche 2010), and inventory-sales ratio (Ding, Guariglia, and Knight 2013). We measure firm-level R&D activity using the fraction of output that are new products. Export intensity is measured by the fraction of sales that are exported. Measurements of age and asset size are straightforward,[8] though the financial variables (leverage, cash flow, and inventory) need more elaboration. Leverage, which is defined as the ratio of total liabilities to total assets, measures a firm's external financial constraint (Guariglia, Liu, and Song 2011), where a larger value reflects a more financially constrained firm. Cash flow is defined as the sum of total profits and current depreciation divided by total assets, and this measure reflects the internal financial constraint of a firm (Guariglia, Liu, and Song 2011) whereby a larger value means the firm is less internally constrained. The inventory-to-sales ratio captures the fraction of inventory investment financed by ongoing revenue, which measures the firm's external liquidity needs (Ding, Guariglia, and Knight 2013) and higher values indicate a greater need for external liquidity. Guariglia, Liu, and Song (2011) and Ding, Guariglia, and Knight (2013) suggest that SOEs differ considerably from non-SOEs across these financial variables, and hence we expect them to play a role in explaining the marketization composition effect. Finally, we control for market competition, which is defined as the Herfindahl–Hirschman index of firm-level employment in the industry–county pair (Combes, Magnac, and Robin 2004), with a larger index value reflecting less competition in the local market.

3.2 Summary statistics

Table 1 documents averages and standard deviations grouped by industry and year.[9] There has been considerable productivity growth in all four industries. Reductions in the competition index indicate that an average firm faced increasing competition from local firms in the same industry. However, the average age reduced over time, indicating the exit of old and the presence of new market entrants. The average size of firms increased slightly despite the entry of small firms.

[6] This happens when all registered capital is owned by legal persons, which can be either state, collective, private, or foreign.

[7] Firms registered as state-owned enterprises, state-owned partnerships, and state-owned limited liability companies are defined as SOEs. Firms registered as collective enterprises and collective partnerships are defined as collective-owned. Firms registered as sole proprietorships, private partnerships, private limited liability companies, and private joint-stock companies are defined as private-owned. Finally, firms registered as wholly foreign-owned companies (including those registered in Hong Kong, Macau, and Taiwan) are defined as foreign-owned.

[8] The data report each firm's year of birth. Sometimes the birth year is very early (e.g. 19th century), which may reflect the firm's predecessor. For consistency, any birth year that is earlier than 1949 is converted to 1949, which is when the current regime was established.

[9] Full summary statistics, including at the aggregate level, are available in the Supplementary material.

The inventory-to-sales and leverage ratios both decreased over time, while the cash flow-to-assets ratio increased. These highlight that private firms had lower values in the first two ratios but higher values in the third ratio relative to SOEs, and the rising proportion of private firms in the sample steered these mean values. Rising R&D and export activities are consistent with the opening of the Chinese economy, accession to the WTO, and the increasingly outward-looking industrial policy of the time.

Two-sample *t*-tests presented in Table 2 reveal a significant productivity gap between SOEs and private firms. Although the gap was closing quickly, it was still significant in 2007. Such a closure of the SOE–private productivity gap is consistent with evidence in Fig. 1 and with the findings of Berkowitz, Ma, and Nishioka (2017). There was an increase in the asset holdings of state firms in each industry, as well as a reduction in leverage. The latter is partially a consequence of the former, but primarily a consequence of the conversion of liabilities to shares as part of government policy reforms. Compared to private firms, SOEs were facing less competition, and they were older and larger. Of the three financial variables, the inventory-to-sales and leverage ratios were both higher among SOEs, while the cash flow-to-assets ratio was lower among SOEs. These observations verify inference made by Poncet, Steingress, and Vandenbussche (2010) and Ding, Guariglia, and Knight (2013) that SOEs face much less external financial constraints than private firms.

The 'grasp the large and let go of the small' policy privatized small firms and consolidated larger ones, thereby increasing SOEs' asset holdings and enlarging the asset gap between SOEs and private firms. Following a dramatic decrease in the inventory-to-sales ratio among SOEs, this ratio converged between the SOEs and private firms. Enterprise reforms substantially reduced the leverage ratio and increased cash flows among SOEs. However, the SOE–private firm gap in the inventory-to-sales ratio, leverage, and cash flow remained significant as private firms experienced similar changes. Finally, we observe an increasing SOE–private gap for R&D and a reduction in the SOE–private gap for exports. Although we observe a reduction in the difference between SOEs and private firms, this is not necessarily a reflection of marketization policies. Thus, we proceed to investigate whether marketization factors contributed to observed changes in the productivity gap between SOEs and private firms.

3.3 Productivity distributions

Productivity by all measures rose year-on-year, as evidenced by the right shift of TFP in each panel of Fig. 1. Though subtle, a larger shift is visible in the lower tail of the distribution, which reflects heterogeneous policy outcomes across productivity quantiles. In all cases, greater increases in productivity at the lower end of the distribution are intuitive given diminishing marginal returns to investment in productivity improvements.

TFP growth was present among private firms and SOEs. There were considerable productivity gaps between SOEs and private firms for each year, although there is evidence of the TFP gap closing within each plot, particularly at the lower end of the productivity range and especially for the transportation equipment sector. There are subtle differences between industries: the spread of TFP in the lower technology food, beverage, and tobacco manufacturing case contrasts with the narrow ranges in the transportation equipment sector. Differences between private and state firms are least pronounced in the pharmaceutical sector, and there is a large section of rubber and plastics firms around the upper quartile where the 2007 state–private differential is almost non-existent. These plots provide initial evidence that the 'grasp the large and let go of the small' approach altered the distribution of productivity in the state and private sectors, and our study contributes a first detailed analysis of this important change.

Table 2. Two-sample *t*-tests.

		1999			2003			2007		
		Priv	State	Diff	Priv	State	Diff	Priv	State	Diff
Food, beverage, and tobacco	TFP	1.441	0.565	0.875***	1.719	1.150	0.569***	2.264	2.008	0.256***
	Competition	0.506	0.639	−0.133***	0.517	0.655	−0.138***	0.417	0.575	−0.158***
	Firm age	2.271	3.042	−0.771***	2.178	3.035	−0.857***	2.022	2.822	−0.800***
	Assets (log)	9.388	9.582	−0.194***	9.485	10.28	−0.794***	9.692	11.21	−1.517***
	Inventory	0.349	0.767	−0.419***	0.332	0.483	−0.151***	0.184	0.306	−0.122***
	Leverage	0.643	0.800	−0.157***	0.572	0.731	−0.159***	0.504	0.644	−0.140***
	Cashflow	0.086	0.032	0.065***	0.095	0.035	0.060***	0.181	0.097	0.085***
	R&D (%)	1.255	1.406	−0.151	2.098	2.090	0.008	2.980	3.309	−0.329
	Exports (%)	7.492	3.153	4.338***	7.642	3.692	3.950***	5.720	3.205	2.515***
Pharmaceuticals	TFP	2.655	2.169	0.486***	2.922	2.667	0.255***	3.333	3.120	0.212***
	Competition	0.489	0.574	−0.085***	0.467	0.506	−0.040**	0.397	0.414	−0.017
	Firm age	2.318	2.930	−0.612***	2.299	2.939	−0.640***	2.178	2.989	−0.812***
	Assets (log)	9.842	10.15	−0.309***	10.25	10.74	−0.491***	10.36	11.34	−0.978***
	Inventory	0.372	0.746	−0.374**	0.325	0.462	−0.137**	0.210	0.298	−0.088***
	Leverage	0.644	0.719	−0.075***	0.566	0.633	−0.067***	0.528	0.570	−0.043*
	Cashflow	0.079	0.029	0.051***	0.077	0.044	0.033***	0.136	0.074	0.062***
	R&D (%)	6.246	6.366	−0.012	6.846	8.052	−1.206	7.906	10.22	−2.309
	Exports (%)	9.955	4.749	5.205***	7.685	4.615	3.070***	5.532	4.812	0.719
Rubber and plastics	TFP	2.156	1.521	0.634***	2.490	2.017	0.473***	2.821	2.694	0.127**
	Competition	0.353	0.533	−0.180***	0.276	0.487	−0.211***	0.195	0.411	−0.216***
	Firm age	2.303	2.661	−0.358***	2.150	2.792	−0.643***	2.006	2.699	−0.693***
	Assets (log)	9.244	9.574	−0.330***	9.245	10.10	−0.851***	9.362	10.68	−1.322***
	Inventory	0.228	0.478	−0.250***	0.160	0.348	−0.188***	0.113	0.260	−0.147***
	Leverage	0.623	0.723	−0.100***	0.571	0.664	−0.093***	0.570	0.619	−0.049*
	Cashflow	0.097	0.028	0.068***	0.106	0.047	0.059***	0.150	0.071	0.079***
	R&D (%)	2.166	3.202	−1.036**	1.905	4.386	−2.481***	2.829	7.753	−4.924***
	Exports (%)	7.814	6.347	1.467*	9.479	4.927	4.553***	9.034	7.003	2.031

(continued)

Table 2. (continued)

		1999			2003			2007		
		Priv	State	Diff	Priv	State	Diff	Priv	State	Diff
Transportation equipment	TFP	1.710	0.830	0.881***	2.092	1.532	0.560***	2.596	2.372	0.224***
	Competition	0.299	0.443	−0.144***	0.256	0.415	−0.159***	0.190	0.310	−0.119***
	Firm age	2.423	3.037	−0.614***	2.263	3.126	−0.863***	2.107	3.045	−0.938***
	Assets (log)	9.470	9.988	−0.527***	9.580	10.72	−1.142***	9.747	11.71	−1.958***
	Inventory	0.284	0.649	−0.364***	0.189	0.428	−0.239***	0.142	0.307	−0.165***
	Leverage	0.640	0.699	−0.058***	0.617	0.710	−0.092***	0.604	0.672	−0.068***
	Cashflow	0.096	0.009	0.087***	0.101	0.026	0.075***	0.130	0.060	0.069***
	R&D (%)	2.720	7.372	−4.652***	3.265	10.23	−6.969***	4.747	15.27	−10.52***
	Exports (%)	4.022	3.335	0.687	6.811	3.897	2.913***	6.284	5.966	0.318

Notes: Tests reported are for the equality of means between the state-owned and private firms within each industry for each of the three years studied. TFP is calculated using the Olley–Pakes approach. Competition is calculated as the Herfindahl index for the 2-digit sector. Firm ages are capped such that no firm has a start date before 1949. R&D (R&D) is expressed as the percentage of outputs that are new products. Exports are expressed as a percentage of total sales. Numbers are calculated after the removal of firms with missing values. All variables are winzorized at the 95 per cent level. Foreign owned firms are excluded from the analysis. Significance given by
*** $P < .001$, ** $P < .01$, and * $P < 0.05$. *Source*: Authors' calculations.

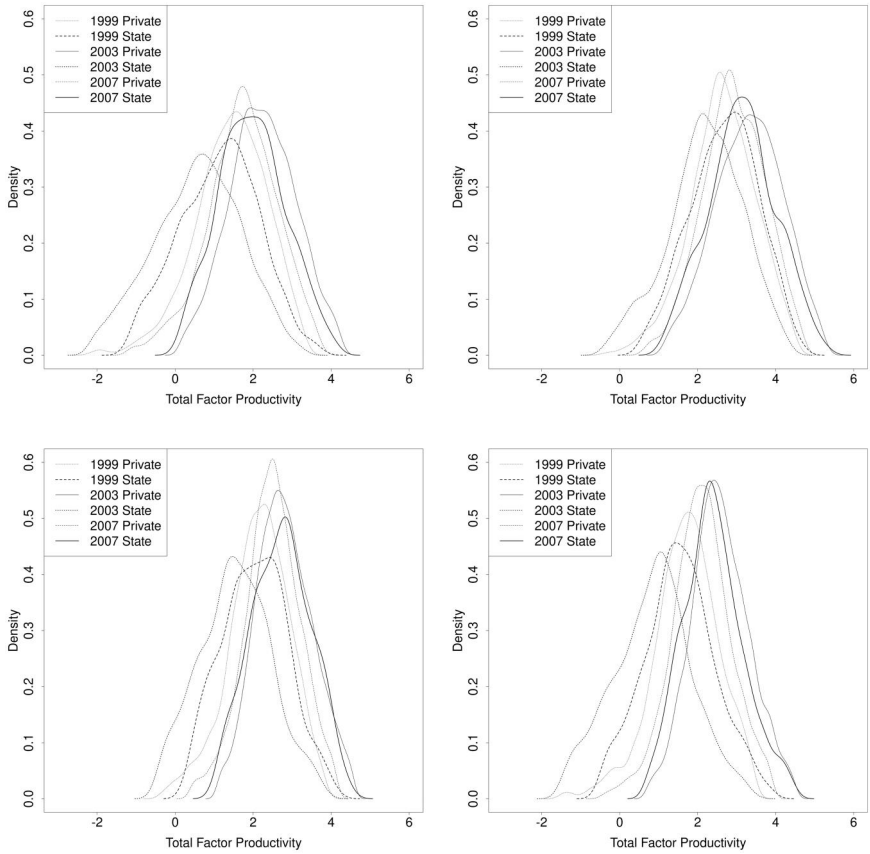

Figure 1. Density plots.

Notes: Densities are plotted on identical axes for comparability across industries. TFP is calculated using the Olley–Pakes approach. Private ownership refers to domestic private firms only. Plots including foreign firms are available in the Supplementary appendix. *Source*: Authors' calculations.

4. Empirical approach

Megginson and Netter (2001) emphasize that there are problems with existing empirical work that assesses the effects of privatization. First, changes in ownership and TFP can simultaneously shape and be shaped by firm-level characteristics and market competition, suggesting the potential for endogeneity. Second, the government may desire to control the most efficient enterprises and transfer ownership of less efficient ones to private hands or make privatization look promising by privatizing the healthiest firms first (Chen et al. 2017). There is evidence of insider incentives to manipulate the performance of soon-to-be privatized firms in China so that investors can acquire them at less than fair value (Lu and Dranove 2013) and a similar sample selection problem stems from the unavailability of data for worse performing firms, making these research issues under-represented in empirical analyses. Third, it is challenging to determine a benchmark when comparing state-owned and non-state-owned firms, especially for economies with a limited private sector like China.

As highlighted above, China's industrial reform was characterized by gradualism: marketization in the pre-1995 era followed by the privatization of selected SOEs in the post-1995 era. The first stage marketization drove SOEs towards the efficiency levels found in competitive markets, and subsequent privatization saw changes in ownership from state to

private. Prior to ownership change, many Chinese SOEs were already engaged in the market, which was in radical contrast to the shock therapy approach practiced in former Soviet states (Megginson and Netter 2001). In this context, we disentangle the effect of marketization with and without ownership change.

Conventional single-equation regressions are unable to distinguish marketization and ownership change effects because they assume the same structural effect of covariates on both types of firms. The celebrated Oaxaca–Blinder decomposition, which is built upon the linear regression model, was a first attempt to separate the genuine ownership effect from the effect of (differences in) covariates and is used to motivate (though not estimate) our counterfactual analysis. Consider the linear model:

$$Y_g = X'_g\beta_g + \varepsilon_g, \;\; E(\varepsilon_g|X_g) = 0, \;\; g \in \{0,1\} \tag{1}$$

where Y denotes productivity and X reflects covariates; $g = 0$ denotes state ownership and $g = 1$ denotes private ownership. Subscripts g on X and β mean that SOEs and private firms have different observable characteristics as well as different structural parameters. Within each group, least squares yield an estimate for $E(Y_g)$ as $\bar{Y} = \bar{X}'_g\hat{\beta}_g$. It follows that:

$$\bar{Y}_1 - \bar{Y}_0 = (\bar{X}_1 - \bar{X}_0)'\hat{\beta}_0 + \bar{X}'_1\left(\hat{\beta}_1 - \hat{\beta}_0\right) \tag{2}$$

In Equation (2), the first term gives the change in $\bar{Y}$ due to changes in the mean of the covariates, holding the parameter constant at $\hat{\beta}_0$, whereas the second term gives the change in $\bar{Y}$ due to changes in the parameters, holding the covariates constant at $\bar{X}_1$. The first term measures the change in mean productivity if SOEs were given the observable characteristics of private firms even though they retain state ownership $\hat{\beta}_0$, and the second term corresponds to the net effect of ownership change after these firms are bestowed the characteristics of private firms $\left(\bar{X}'_1\right)$. Thus, the Oaxaca–Blinder method apportions the productivity gap to the effect of marketization and the effect of the follow-up ownership change. However, the Oaxaca–Blinder decomposition does not apply to non-linear models, and it only evaluates the mean effect. Thus, it is incapable of answering questions such as whether marketization and ownership change effects are heterogeneous across firms with different levels of productivity, and thus whether the 'grasp the large' policy was appropriate. More recent research sought to move away from examining only mean values, with Oaxaca–Blinder type decompositions based on quantile regression techniques developed to address such distributional questions, and this is made possible through application of Rothe's (2015) approach.

We adopt Rothe's (2015) approach, which enables the decomposition for any characteristic of a distribution including the quantile function. We begin with two observed populations, where 1 represents private firms and 0 denotes SOEs. F^1_Y and F^0_Y represent the productivity distributions for private firms and SOEs respectively. Following Rothe (2015), we define $\nu(F)$ as a real-value distributional feature of any distribution function F.[10]

We write the difference in observed distributional features as $\Delta^{\nu}_O = \nu\left(F^1_Y\right) - \nu\left(F^0_Y\right)$. Define $F^{0|1}_Y$ as the counterfactual distribution of productivity that would be expected if the SOE sample were given the observable characteristics of the private sample, such that:

$$F^{0|1}_Y(y) = \int F^0_{Y|X}(y,x)dF^1_X(x) \tag{3}$$

where $F^0_{Y|X}(y,\ x)$ is the conditional distribution of productivity among SOEs, whereas

[10] In the case of the τ-th quantile, $\nu(F) = F^{-1}(\tau)$.

$F_X^1(x)$ denotes the distribution of the covariates among private firms. This gives the Oaxaca–Blinder type decomposition of Δ_O^v as:

$$\Delta_O^v = \left(v\left(F_Y^1\right) - v\left(F_Y^{0|1}\right)\right) + \left(v\left(F_Y^{0|1}\right) - v\left(F_Y^0\right)\right) = \Delta_S^v + \Delta_X^v \tag{4}$$

Note that Δ_X^v is called the composition effect, and it measures the change in the distributional feature after the counterfactual experiment, which assigns the X distribution of private firms (F_X^1) to SOEs. Then note that Δ_S^v is called the structural effect, and this measures the change in the distributional feature after a follow-up counterfactual experiment that changes the conditional distribution from that of SOEs ($F_{Y|X}^0$) to that of private firms ($F_{Y|X}^1$). In this way, we apportion the effect of industrial reforms into separate marketization (composition) and privatization (structural) effects.

Rothe (2015) goes further than the Oaxaca–Blinder approach by permitting the decomposition of the composition effect, Δ_X^v, into a total marginal effect, Δ_M^v, and a dependence effect, Δ_D^v. The idea is rooted in the copula representation of F_X^g, $g = 0, 1$, such that:

$$F_X^g(x) = C^g\left(F_{X_1}^g(x_1), \ldots, F_k^g(x_k)\right) \tag{5}$$

where $C^g()$ is the copula function and $F_{x_l}^g(x_l)$ is the marginal distribution of the l-th covariate of X^g. Replacing F_X^0 by F_X^1 brings two effects: a change in the copula function, $C^g()$, and a change in the marginal distributions of the covariates, $F_{X_1}^g(x_1), \ldots, F_k^g(x_k)$. The first effect is named the dependence effect and the second is named the total marginal effect. Of particular interest here are the marginal effects of individual covariates:

$$\Delta_M^v(e_l) = v\left(F_Y^{0|0,e_l}\right) - v(F_Y^0), \ \textit{for } l = 1, \ldots, k \tag{6}$$

where:

$$F_Y^{0|0,e_l} = \int \ldots \int F_{Y|X}^0(y,x) C^0\left(F_{X_1}^1(x_1), \ldots, F_{X_k}^1(x_k), F_{X_1}^0(x_1), \ldots, F_{X_k}^0(x_k)\right). \tag{7}$$

$\Delta_M^v(e_l)$ is the effect of replacing the marginal distribution $F_{X_l}^0(x_l)$ by $F_{X_l}^1(x_l)$ while keeping the marginal distributions of all other covariates and the copula function unchanged; thus, it reveals the marginal contribution of a single covariate in the composition effect, holding everything else constant.[11] To facilitate the discussion of the decomposition at a specific quantile of the productivity distribution, we use τ to denote the quantile of the productivity distribution as shown in Tables 3–5.

A major advantage of the Rothe (2015) methodology is the lack of conditionality on other covariates in evaluating the individual marginal effects, evidenced in Equation (6). A side effect of this flexibility is that the asymptotic variances are complex and must be estimated using a bootstrap. We follow Rothe (2015) in estimating the conditional distributions $F_{Y|X}^g$ using a distributional regression model with a Gaussian link function; we use quadratic terms of the covariates (with full interactions) when estimating $F_{Y|X}^g$, and we estimate the copula function $C^g()$ as a Gaussian.

To summarize, a natural comparison arises between the decomposition approach adopted in this article and the alternative difference-in-difference approach, and we adopt

[11] Note that $\Delta_M^v(e_l)$, $l = 1, \ldots, k$ do not sum to the total marginal effect Δ_M^v. This happens because when we change one or more marginal distributions, there will be additional effects that arise from the different correlation structure among covariates; see Rothe (2015).

Table 3. Decomposition of total observed effect.

Industry	Marginal effect	Mean	Quantile (τ)				
			$\tau = 0.10$	$\tau = 0.25$	$\tau = 0.50$	$\tau = 0.75$	$\tau = 0.90$
Panel (a) 1999							
Food, beverage, and tobacco	Total	0.878***	1.266***	1.085***	0.891***	0.729***	0.571***
		(0.029)	(0.055)	(0.037)	(0.037)	(0.040)	(0.045)
	Structural	0.516***	0.825***	0.615***	0.537***	0.346***	0.315***
		(0.041)	(0.078)	(0.067)	(0.052)	(0.044)	(0.049)
	Composition	0.362***	0.441***	0.470***	0.354***	0.383***	0.255***
		(0.035)	(0.069)	(0.062)	(0.046)	(0.040)	(0.057)
Pharmaceuticals	Total	0.483***	0.708***	0.524***	0.451***	0.419***	0.403***
		(0.041)	(0.118)	(0.061)	(0.059)	(0.063)	(0.061)
	Structural	0.176***	0.318**	0.260***	0.083	0.080	0.031
		(0.049)	(0.122)	(0.064)	(0.065)	(0.083)	(0.072)
	Composition	0.307***	0.390***	0.264***	0.367***	0.339***	0.372***
		(0.034)	(0.095)	(0.050)	(0.041)	(0.055)	(0.070)
Rubber and plastics	Total	0.636***	0.829***	0.789***	0.699***	0.563***	0.480**
		(0.028)	(0.065)	(0.049)	(0.036)	(0.043)	(0.067)
	Structural	0.267***	0.482***	0.384***	0.247***	0.216***	0.079
		(0.035)	(0.065)	(0.058)	(0.047)	(0.056)	(0.077)
	Composition	0.369***	0.347***	0.405***	0.451***	0.347***	0.402***
		(0.029)	(0.062)	(0.057)	(0.046)	(0.057)	(0.070)
Transportation equipment	Total	0.876***	1.250***	1.055***	0.824***	0.745***	0.700***
		(0.038)	(0.052)	(0.042)	(0.031)	(0.033)	(0.051)
	Structural	0.416***	0.778***	0.487***	0.409***	0.310***	0.281*
		(0.041)	(0.057)	(0.059)	(0.063)	(0.080)	(0.118)
	Composition	0.460***	0.472***	0.568***	0.415***	0.435***	0.418***
		(0.043)	(0.063)	(0.068)	(0.067)	(0.080)	(0.119)

(continued)

Table 3. (continued)

Industry	Marginal effect	Mean	Quantile (τ)				
			τ = 0.10	τ = 0.25	τ = 0.50	τ = 0.75	τ = 0.90
Panel (b) 2003							
Food, beverage, and tobacco	Total	0.564***	0.852***	0.742***	0.591***	0.483***	0.436***
		(0.036)	(0.087)	(0.057)	(0.037)	(0.045)	(0.068)
	Structural	0.378***	0.554***	0.420***	0.342***	0.338***	0.400***
		(0.042)	(0.092)	(0.058)	(0.050)	(0.057)	(0.092)
	Composition	0.187***	0.298**	0.322***	0.249***	0145***	0.037
		(0.035)	(0.069)	(0.062)	(0.046)	(0.040)	(0.080)
Pharmaceuticals	Total	0.255***	0.411***	0.309***	0.211***	0.192***	0.192*
		(0.037)	(0.060)	(0.054)	(0.042)	(0.056)	(0.079)
	Structural	0.179***	0.381***	0.269***	0.096	0.130*	0.041
		(0.045)	(0.088)	(0.063)	(0.080)	(0.058)	(0.070)
	Composition	0.077*	0.029	0.039	0.115	0.062	0.151*
		(0.034)	(0.071)	(0.057)	(0.064)	(0.043)	(0.065)
Rubber and plastics	Total	0.477***	0.685***	0.603***	0.502***	0.389***	0.330**
		(0.040)	(0.049)	(0.055)	(0.050)	(0.054)	(0.072)
	Structural	0.213**	0.421***	0.429**	0.175*	0.144	−0.132
		(0.070)	(0.101)	(0.155)	(0.085)	(0.108)	(0.173)
	Composition	0.264***	0.264**	0.174	0.327***	0.245**	0.462**
		(0.055)	(0.097)	(0.141)	(0.081)	(0.090)	(0.156)
Transportation equipment	Total	0.557***	0.783***	0.690***	0.571***	0.477***	0.381***
		(0.027)	(0.050)	(0.040)	(0.036)	(0.040)	(0.070)
	Structural	0.117**	0.517***	0.330***	0.097	−0.137	−0.178**
		(0.043)	(0.084)	(0.049)	(0.059)	(0.110)	(0.061)
	Composition	0.439***	0.266**	0.360***	0.474***	0.614***	0.562***
		(0.039)	(0.089)	(0.056)	(0.055)	(0.104)	(0.073)

(continued)

Table 3. (continued)

Industry	Marginal effect	Mean	Quantile (τ)				
			τ = 0.10	τ = 0.25	τ = 0.50	τ = 0.75	τ = 0.90
Panel (c) 2007							
Food, beverage, and tobacco	Total	0.255***	0.344***	0.360***	0.295***	0.247***	0.069
		(0.035)	(0.062)	(0.040)	(0.050)	(0.064)	(0.052)
	Structural	0.239***	0.378*	0.217***	0.219***	0.302***	0.312*
		(0.053)	(0.166)	(0.083)	(0.055)	(0.056)	(0.139)
	Composition	0.015	−0.034	0.143*	0.075	−0.055	−0.243
		(0.047)	(0.148)	(0.071)	(0.048)	(0.067)	(0.133)
Pharmaceuticals	Total	0.198***	0.269***	0.222***	0.250***	0.228**	0.096
		(0.049)	(0.065)	(0.071)	(0.057)	(0.080)	(0.081)
	Structural	0.057	0.273	0.098	0.135	−0.013	−0.191
		(0.059)	(0.145)	(0.105)	(0.101)	(0.133)	(0.153)
	Composition	0.142**	−0.004	0.124	0.115	0.241	0.287
		(0.055)	(0.135)	(0.083)	(0.081)	(0.136)	(0.157)
Rubber and plastics	Total	0.120**	0.231*	0.164**	0.040	0.079	0.069
		(0.043)	(0.094)	(0.062)	(0.070)	(0.051)	(0.073)
	Structural	−0.049	−0.028	−0.021	−0.069	−0.202	−0.025
		(0.072)	(0.085)	(0.120)	(0.062)	(0.111)	(0.128)
	Composition	0.170**	0.259*	0.185	0.109	0.281**	0.094
		(0.061)	(0.101)	(0.110)	(0.069)	(0.104)	(0.133)
Transportation equipment	Total	0.235***	0.305***	0.280***	0.230***	0.227***	0.220***
		(0.029)	(0.060)	(0.043)	(0.029)	(0.044)	(0.057)
	Structural	−0.065	0.120	0.020	−0.072	−0.206**	−0.276**
		(0.043)	(0.081)	(0.066)	(0.053)	(0.076)	(0.090)
	Composition	0.300***	0.185*	0.260***	0.303***	0.433***	0.496***
		(0.032)	(0.075)	(0.058)	(0.048)	(0.070)	(0.088)

Notes: First phase decomposition results, dividing the total observed effect into the structural and composition components. TFP is calculated using the Olley–Pakes approach. The quantile at which the effects are estimated is denoted as τ. Significance given by $^{***}P < 0.001$, $^{**}P < 0.01$, and $^{*}P < 0.05$. *Source*: Authors' calculations.

Table 4. Marginal effects of assets and cash flow.

Year	Industry	Mean	Quantile (τ)				
			$\tau = 0.10$	$\tau = 0.25$	$\tau = 0.50$	$\tau = 0.75$	$\tau = 0.90$
Panel (a): Assets							
1999	Food, beverage, and tobacco	−0.029***	−0.003	−0.017*	−0.037***	−0.059***	−0.062***
		(0.006)	(0.005)	(0.007)	(0.009)	(0.012)	(0.016)
	Pharmaceuticals	−0.033***	−0.038*	−0.027*	−0.040**	−0.048**	−0.030
		(0.008)	(0.017)	(0.011)	(0.013)	(0.017)	(0.016)
	Rubber and plastics	−0.025***	−0.024**	−0.041**	−0.021	−0.028	−0.014
		(0.007)	(0.008)	(0.013)	(0.013)	(0.017)	(0.021)
	Transportation equipment	−0.021**	−0.016	−0.043**	−0.023**	−0.013	−0.012
		(0.007)	(0.012)	(0.013)	(0.008)	(0.012)	(0.012)
2003	Food, beverage, and tobacco	−0.111***	0.022	−0.122***	−0.110***	−0.133***	−0.186***
		(0.015)	(0.045)	(0.026)	(0.026)	(0.029)	(0.050)
	Pharmaceuticals	−0.066***	−0.027	−0.057	−0.045	−0.104***	−0.106**
		(0.015)	(0.020)	(0.037)	(0.023)	(0.031)	(0.037)
	Rubber and plastics	−0.057***	−0.027	−0.070*	−0.039	−0.051	−0.047
		(0.017)	(0.022)	(0.031)	(0.027)	(0.027)	(0.038)
	Transportation equipment	−0.072***	−0.114***	−0.108***	−0.072**	−0.029	−0.064
		(0.016)	(0.032)	(0.031)	(0.024)	(0.020)	(0.037)
2007	Food, beverage, and tobacco	−0.120***	−0.141**	−0.047	−0.032	−0.131*	−0.269**
		(0.027)	(0.039)	(0.048)	(0.039)	(0.055)	(0.085)
	Pharmaceuticals	−0.167***	−0.118	−0.136*	−0.118**	−0.218***	−0.198**
		(0.024)	(0.075)	(0.058)	(0.041)	(0.060)	(0.067)
	Rubber and Plastics	−0.066	−0.010	−0.047	−0.059	−0.032	−0.143
		(0.044)	(0.082)	(0.040)	(0.096)	(0.102)	(0.044)
	Transportation equipment	−0.081**	−0.119*	−0.154**	−0.040	−0.110**	−0.073
		(0.025)	(0.047)	(0.051)	(0.036)	(0.038)	(0.054)

(continued)

Table 4. (continued)

Year	Industry	Mean	Quantile (τ)				
			$\tau = 0.10$	$\tau = 0.25$	$\tau = 0.50$	$\tau = 0.75$	$\tau = 0.90$
Panel (b): Cash Flow							
1999	Food, beverage, and tobacco	0.216***	0.128**	0.173***	0.267***	0.292***	0.246***
		(0.032)	(0.040)	(0.038)	(0.048)	(0.047)	(0.049)
	Pharmaceuticals	0.161***	0.158***	0.149***	0.218***	0.220***	0.151*
		(0.025)	(0.056)	(0.031)	(0.040)	(0.037)	(0.065)
	Rubber and plastics	0.170***	0.204***	0.248***	0.266***	0.100*	0.120*
		(0.024)	(0.049)	(0.055)	(0.055)	(0.040)	(0.058)
	Transportation equipment	0.146***	0.137***	0.220***	0.143***	0.148*	0.053
		(0.038)	(0.033)	(0.049)	(0.042)	(0.064)	(0.073)
2003	Food, beverage, and tobacco	0.162***	−0.056	0.173***	0.190***	0.220***	0.281***
		(0.021)	(0.042)	(0.036)	(0.042)	(0.034)	(0.060)
	Pharmaceuticals	0.073***	0.054	0.051	0.092***	0.087**	0.087**
		(0.014)	(0.030)	(0.027)	(0.026)	(0.033)	(0.031)
	Rubber and plastics	0.028	0.112*	0.012	0.080	0.024	0.011
		(0.057)	(0.048)	(0.062)	(0.087)	(0.058)	(0.087)
	Transportation equipment	0.162***	0.006	0.103*	0.205***	0.291***	0.324***
		(0.024)	(0.046)	(0.044)	(0.032)	(0.038)	(0.037)
2007	Food, beverage, and tobacco	0.168***	0.100	0.146***	0.198***	0.217***	0.169*
		(0.024)	(0.062)	(0.038)	(0.043)	(0.051)	(0.075)
	Pharmaceuticals	0.148**	0.037	0.145***	0.176***	0.263***	0.265***
		(0.022)	(0.052)	(0.042)	(0.039)	(0.068)	(0.080)
	Rubber and plastics	0.111***	0.136	0.151**	0.133*	0.130**	−0.002
		(0.029)	(0.075)	(0.054)	(0.052)	(0.048)	(0.103)
	Transportation equipment	0.141***	0.147***	0.165***	0.153***	0.157***	0.186**
		(0.018)	(0.030)	(0.034)	(0.025)	(0.037)	(0.059)

Notes: Figures report the marginal effect of assets, panel (a), and cash flow, panel (b). Values in parentheses are the estimated standard errors. Values are extracted from the decomposition of the composition effect in the observed difference between the TFP of state-owned and private enterprises. The quantile at which the effects are estimated is denoted as τ. Significance given by $^{***}P < .001$, $^{**}P < .01$, and $^{*}P < .05$. *Source*: Authors' calculations.

Table 5. Marginal effects of inventory-to-sales ratio and leverage.

Year	Industry	Mean	Quantile (τ)				
			$\tau = 0.10$	$\tau = 0.25$	$\tau = 0.50$	$\tau = 0.75$	$\tau = 0.90$
Panel (a): Inventory-to-Sales Ratio							
1999	Food, beverage, and tobacco	0.085***	0.091***	0.082***	0.085***	0.079**	0.105***
		(0.014)	(0.025)	(0.023)	(0.025)	(0.026)	(0.028)
	Pharmaceuticals	0.091***	0.151**	0.093***	0.093***	0.069**	0.192***
		(0.014)	(0.050)	(0.025)	(0.024)	(0.025)	(0.039)
	Rubber and plastics	0.117***	0.048	0.069	0.103*	0.164***	0.238***
		(0.018)	(0.031)	(0.044)	(0.041)	(0.038)	(0.063)
	Transportation equipment	0.149***	0.119***	0.154***	0.133***	0.149***	0.169***
		(0.022)	(0.029)	(0.039)	(0.036)	(0.032)	(0.045)
2003	Food, beverage, and tobacco	0.097***	0.010	0.125***	0.147***	0.124***	0.129***
		(0.014)	(0.050)	(0.032)	(0.023)	(0.025)	(0.033)
	Pharmaceuticals	0.053***	0.020	0.060*	0.047	0.049*	0.082*
		(0.012)	(0.017)	(0.025)	(0.027)	(0.024)	(0.034)
	Rubber and plastics	0.136***	0.039	0.048	0.218***	0.123**	0.095
		(0.023)	(0.053)	(0.058)	(0.056)	(0.043)	(0.084)
	Transportation equipment	0.125***	0.154***	0.171***	0.136***	0.127**	0.116*
		(0.021)	(0.033)	(0.030)	(0.033)	(0.042)	(0.050)
2007	Food, beverage, and tobacco	0.034**	0.029	0.034	0.021	0.052	0.035
		(0.011)	(0.028)	(0.018)	(0.014)	(0.034)	(0.037)
	Pharmaceuticals	0.061***	0.051	0.103**	0.050	0.049	0.095
		(0.016)	(0.039)	(0.037)	(0.033)	(0.034)	(0.062)
	Rubber and plastics	0.086*	0.011	0.037	0.059	0.023	0.290
		(0.036)	(0.051)	(0.057)	(0.050)	(0.077)	(0.160)
	Transportation equipment	0.093***	0.055*	0.072**	0.049	0.176***	0.189***
		(0.015)	(0.027)	(0.025)	(0.028)	(0.035)	(0.036)

(continued)

Table 5. (continued)

Year	Industry	Mean	Quantile (τ)				
			τ = 0.10	τ = 0.25	τ = 0.50	τ = 0.75	τ = 0.90
Panel (b): Leverage							
1999	Food, beverage, and tobacco	−0.002	−0.005	0.005	0.000	−0.010	−0.025
		(0.007)	(0.012)	(0.010)	(0.011)	(0.013)	(0.016)
	Pharmaceuticals	0.011	0.052*	0.027**	0.020*	0.007	−0.002
		(0.007)	(0.026)	(0.010)	(0.010)	(0.011)	(0.008)
	Rubber and plastics	−0.001	−0.013	0.021	0.011	0.004	−0.013
		(0.008)	(0.022)	(0.016)	(0.013)	(0.013)	(0.016)
	Transportation equipment	−0.001	0.001	0.007	−0.001	−0.005	−0.002
		(0.003)	(0.007)	(0.009)	(0.004)	(0.004)	(0.006)
2003	Food, beverage, and tobacco	0.002	0.006	−0.001	0.000	0.003	−0.007
		(0.009)	(0.031)	(0.019)	(0.014)	(0.016)	(0.022)
	Pharmaceuticals	0.000	0.013	0.015	0.000	−0.010	−0.016
		(0.006)	(0.013)	(0.013)	(0.011)	(0.014)	(0.019)
	Rubber and plastics	0.018	−0.001	0.018	0.033	0.025	−0.006
		(0.011)	(0.013)	(0.022)	(0.026)	(0.016)	(0.019)
	Transportation equipment	0.000	0.009	0.011	−0.006	−0.002	−0.011
		(0.006)	(0.011)	(0.011)	(0.009)	(0.008)	(0.012)
2007	Food, beverage, and tobacco	−0.005	−0.016	−0.008	−0.006	0.001	0.003
		(0.013)	(0.028)	(0.016)	(0.019)	(0.019)	(0.024)
	Pharmaceuticals	−0.005	0.004	0.000	−0.007	−0.028	−0.018
		(0.006)	(0.017)	(0.009)	(0.010)	(0.015)	(0.016)
	Rubber and plastics	0.000	−0.010	−0.017	−0.009	−0.001	0.005
		(0.008)	(0.019)	(0.014)	(0.015)	(0.012)	(0.014)
	Transportation equipment	−0.012*	−0.001	−0.007	−0.008	−0.017	−0.036*
		(0.006)	(0.011)	(0.011)	(0.008)	(0.014)	(0.015)

Notes: Figures report the marginal effect of the inventory-to-sales ratio, panel (a), and leverage, panel (b). Values in parentheses are the estimated standard errors. Values are extracted from the decomposition of the composition effect in the observed difference between the TFP of state-owned and private enterprises. The quantile at which the effects are estimated is denoted as τ. Significance given by $^{***}P<0.001$, $^{**}P<0.01$, and $^{*}P<0.05$. *Source*: Authors' calculations.

the Rothe (2015) decomposition and not the difference-in-difference approach for four main reasons. First, adopting a Rothe (2015) decomposition approach enables the use of all available data for the identification of the marketization counterfactual, whereas a difference-in-difference approach would place greater emphasis on firms that privatize. Second, the treatment of privatization would be required to be exogenous, but it is possible that privatizations would have been signalled to various bodies, such as owners or political affiliates or potential investors, ahead of the effect, and there is no instrument within the dataset that would allow us to control for the potential endogeneity of the privatization treatment. Third, the use of the difference-in-difference approach requires an assumption of parallel trends, which is questionable if the government undertakes modernization with SOEs as the effects of privatization and marketization may differ across the productivity distribution, whereas the Rothe (2015) approach permits is to explore these effects across the productivity distribution. Fourth, the difference-in-difference approach would report only an average effect whereas we seek to understand privatization across the distribution. Using quantile regression within the difference-in-difference would enable the consideration of the distribution of productivity but would then place greater emphasis on a lower number of privatizing firms. For these reasons, we focus on the Rothe (2015) decomposition, recognizing that a decomposition cannot necessarily mean causation in the way a difference-in-difference approach could.

5. Grasp the large, let go of the small

As evidenced above, the productivity gap between SOEs and private firms fell considerably in all four of our industries between 1999 and 2007. Distributional plots reveal that SOEs overtook private firms over some parts of the productivity range motivating the distributional analysis below. Such results are a combination of the structural effect of ownership change and of a change in the characteristics of firms conditional on the ownership type. From the former we gain insights into the effectiveness of privatization (aka 'let go of the small') and the latter helps us to understand the impact of marketization (aka 'grasp the large').

Employing the first phase decomposition from the Rothe (2015) approach, we seek to identify the net effect of privatization that is distinct from the marketization effect. Then, using the second phase decomposition, we explore the effects of the four main policy outcomes within the marketization story: consolidation of state assets, greater cash flows, improvement of inventory management, and deleveraging of debts.

5.1 Decomposition into privatization and marketization effects

Table 3 delivers a comprehensive overview of the first phase of the Rothe (2015) decomposition and reveals consistent patterns across industries. First, there is a positive total effect across distributions, underpinning the productivity gap between SOEs and private firms. The size of the total effect became smaller over time, and became insignificant for rubber and plastics in 2007, which corroborates Berkowitz, Ma, and Nishioka (2017) and Hsieh and Song's (2015) findings that the productivity of SOEs was catching up with private firms.

Second, the structural effect was positive and significant in three industries in 1999, indicating large benefits from privatization in the early stage of the reform. The marketization composition effect was positive and highly significant in 1999, suggesting that differences in observed characteristics explain the productivity advantage of private firms. Judging by the mean values, the privatization structural effect is comparable in magnitude to the composition effect of marketization. Third, both the structural and composition effects diminished in magnitude over time and the mean privatization structural effect was indistinguishable from zero whereas the mean marketization composition effect remained

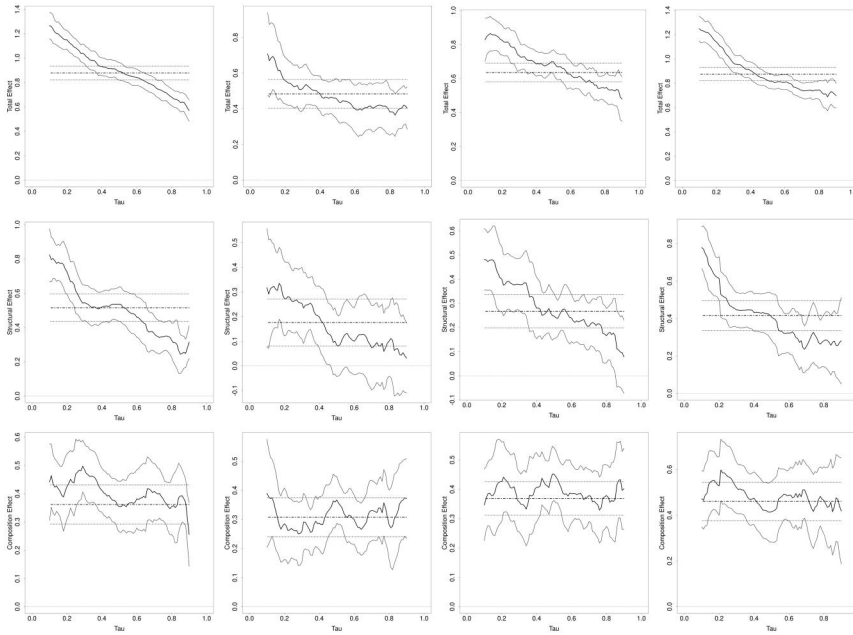

Figure 2. Total observed effect decomposition 1999.

Notes: Solid lines plot coefficients, with thinner lines giving 95 per cent confidence intervals there around. The horizontal axis is the quantile, τ, of the productivity distribution at which the effects are estimated. Horizontal dot dash lines give Blinder–Oaxaca results, and a further dotted line is added at 0 to indicate significance.
Source: Authors' calculations.

highly significant by 2007; the food, beverage, and tobacco sector is the only exception in both cases. These results inform us that the benefits from privatization vanished in the later stage of the enterprise reform while marketization measures remained effective in boosting productivity of the remaining SOEs.

Apparent from Figs. 2–4 is the merit of adopting the quantile approach, which demonstrates in many cases notable deviations of the identified distributional effect from the mean.[12] Non-linear effects provide us with a nuanced lens through which to evaluate policy gains for heterogeneous firms across the productivity distribution. Stories that are not revealed by the mean effect emerge. First, the size of the total effect is larger (smaller) than the estimated mean for the least (higher) productive SOEs, indicating a smaller state–private productivity gap for the most productive SOEs. Decomposing the total effect reveals the privatization structural effect as the primary driver of this pattern with marketization composition effects broadly similar across quantiles. This suggests that the benefit of privatization was felt more by the less productive SOEs, lending support to the 'let go of the small' initiative. Greater overall and structural effects at lower quantiles, τ, may be linked to the diminishing marginal returns to productivity investment. Investments to bring firms in line with market characteristics would have a stronger productivity effect at the lower end of the productivity distribution than it would at the higher end of the productivity distribution.

[12] A feature of these distributional decompositions is a variation between quantiles that appears noisy. Although smoothing can remove this, leaving noise within the plots highlights important variability and reminds that it is broader conclusions that should be sought. Figures 2–4 highlight both the broad insight gained by the decomposition and the noisy nature of the decomposition.

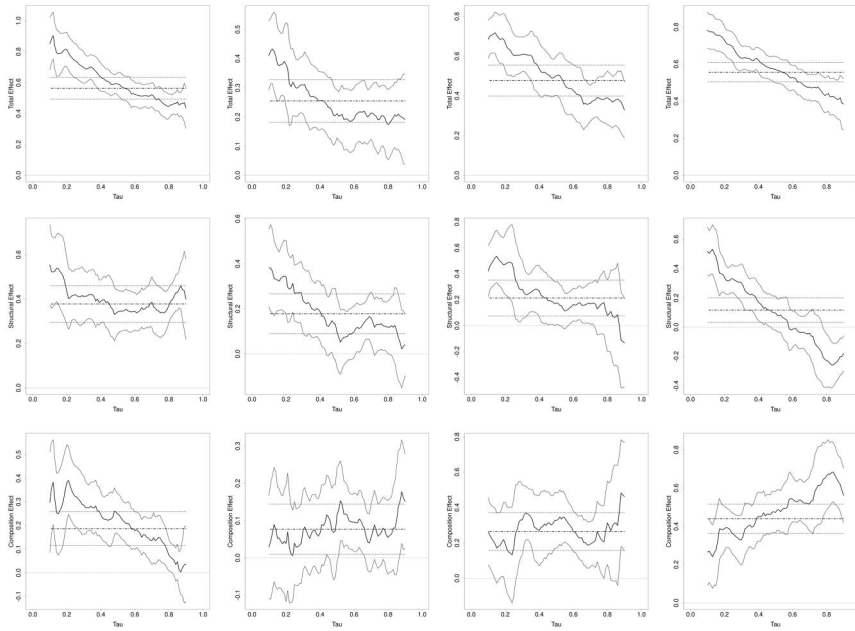

Figure 3. Total observed effect decomposition 2003.

Notes: Solid lines plot coefficients, with thinner lines giving 95 per cent confidence intervals there around. The horizontal axis is the quantile, τ, of the productivity distribution at which the effects are estimated. Horizontal dot dash lines give Blinder–Oaxaca results, and a further dotted line is added at 0 to indicate significance.
Source: Authors' calculations.

Second, the structural effect flattened over time, resulting in a dampening of the total effect; this indicates that the benefit of privatization vanished in the late stage of the reform perhaps because most unproductive SOEs had already been privatized. Third, the nonlinear effects reveal heterogeneity across industries. For instance, in both 2003 and 2007, the transportation equipment industry experienced a structural privatization effect that was significant and negative for large quantiles, τ, implying for this industry that state ownership would advantage the most productive SOEs over private firms. One explanation for this observation is that the most productive SOEs in this industry were more productive than their private counterparts with similar characteristics, though an alternative explanation is that we may have picked up unmeasured policy effects that favoured SOEs if the productivity gap induced by ownership was weak in the upper productivity quantiles. Nonetheless, even for large τ, the structural effect was dominated by the composite effect in both years, and hence favourable characteristics enjoyed by private firms in this industry still ensured that private firms remained more productive across the distribution.

5.2 Effective policies when 'Grasping the small and letting go of the large'

Several measures were implemented to restructure SOEs without changing their ownership. Some large SOEs were split into smaller firms to enhance competition while the establishment of the SASAC in 2003 consolidated state assets. These reforms either reduced or increased the size of firms and hence attention should focus on the marginal effects from assets within the second phase of the Rothe (2015) decomposition, shown in panel (a) of Table 4.

Table 4 highlights a significant productivity advantage for SOEs. A negative marginal effect for assets indicates that, other things being equal and ignoring the ownership effect,

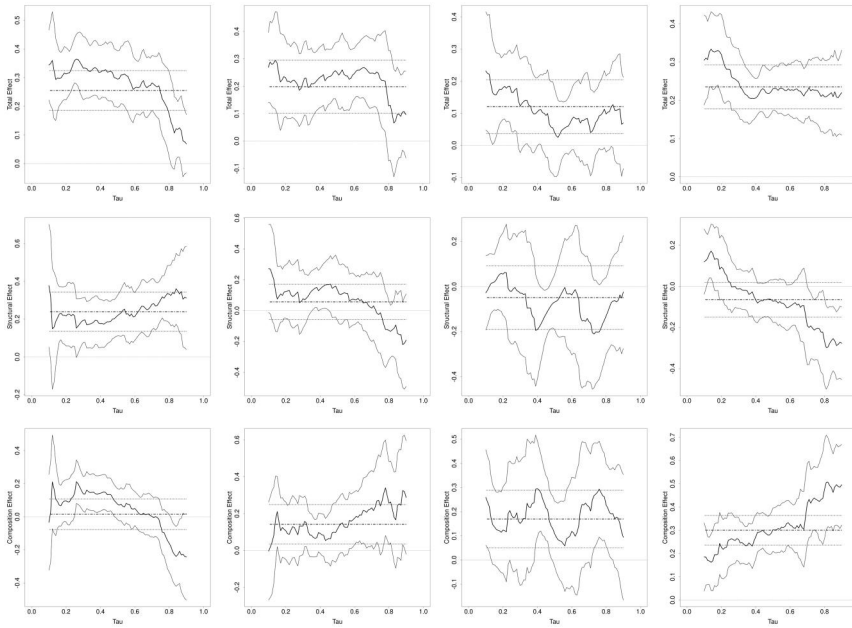

Figure 4. Total observed effect decomposition 2007.

Notes: Solid lines plot coefficients, with thinner lines giving 95 per cent confidence intervals there around. The horizontal axis is the quantile, τ, of the productivity distribution at which the effects are estimated. Horizontal dot dash lines give Blinder–Oaxaca results, and a further dotted line is added at 0 to indicate significance.
Source: Authors' calculations.

the assets differential makes private firms less productive than SOEs. In most industry–year combinations, the marginal effect was roughly constant across productivity quantiles, with the food, beverage, and tobacco sector exhibiting a clear downward pattern in 1999. Mean marginal effects in all four industries increased in magnitude over the period and remained significant except for rubber and plastics in 2007. It seems that by consolidating state assets and widening the state–private gap in assets, SOEs were able to enlarge their productivity advantage. Thus, the evidence supports SASAC policy but opposes the policy to split large SOEs into smaller units.

The quantile analysis reveals heterogeneity across industries and productivity quantiles. Food, beverage, and tobacco exhibited the highest level of significance in 1999 and 2003, but the significance was lost in the middle range $(0.2 < \tau < 0.8)$ in 2007. The latter pattern is also seen in transportation equipment. For rubber and plastics, the marginal effect was often insignificant in 2003 and became completely insignificant in 2007.

A second aspect of the 'grasp the large' initiative was to optimize the asset structure and increase the cash flow of SOEs. The literature emphasizes four channels to achieve this result, including debt-to-equity swaps, provision of loan subsidies, greater equity financing, and worker layoffs. These measures either reduced interest and labour expenses, or directly increased the cash holdings of SOEs. Table 4 also presents the marginal effect of cash flow. Judging by the mean effect, the marginal effect of cash flow is comparable to that of assets in magnitude and highly significant in almost all industry–year combinations, with the only exception being rubber and plastics in 2003. This implies that the ample cash flow of private firms did generate productivity advantages over SOEs, or equivalently, SOE productivity would benefit from measures that increase their cash flow. This finding is consistent with Chen and Gauriglia (2013) who find that, in general, ample cash flow promotes firms'

productivity. A distinct feature of the cash flow variable observed in Table 2 is that the state–private gap shrank in 2003 before expanding again in 2007, and the same pattern is observable in panel (b) of Table 4: the mean marginal effect of cash flow was smallest in 2003 but increased again in 2007. This result is further evidence that the state–private cash flow gap explains productivity differentials.[13]

Turning to the inventory-to-sales ratio, although it was never stated as a policy objective explicitly, data show considerable improvement in inventory control by SOEs during our study period (Table 2); thus, the 'grasp the large' measures contributed to improving inventory management. Table 5 presents a positive mean marginal effect of the inventory-to-sales ratio that is significant across all industry–year combinations; the lower level of external liquidity constraint on private firms yielded additional productivity advantages over SOEs. SOEs were able to reduce their inventory-to-sales ratio during the period of study (Table 2), which is evidence of additional productivity benefits resulting from lowering external liquidity constraints. The marginal effect was consistently significant over the full range of quantiles in 1999 and 2003 for three industries[14] though fell for 2007. The marginal effect remained significant over a wide range of quantiles in transportation equipment but was only marginally significant over the quantiles for food, beverage, and tobacco and pharmaceuticals, and became completely insignificant for rubber and plastics. The observations may reflect the ability of SOEs to reduce the state–private inventory-to-sales ratio gap, thereby not being sufficient to generate a significant productivity gap.

5.3 Reconsidering the 'grasp the large' initiatives

SOEs are usually heavily debt laden (Guariglia, Liu, and Song 2011; Ding, Guariglia, and Knight 2013), making a reduction in the leverage ratio a key policy reform. Many reform measures, including debt to equity swaps, equity financing, and worker layoffs, are designed to reduce leverage (debt) among SOEs. Given the scale of these reforms and that many industries SOEs successfully reduced their leverage during the period of study (see Table 3), it is fitting to expect a strong and positive marginal effect for the leverage ratio. Marginal effect estimations of corresponding quantile models are presented in panel (b) of Table 5.

The mean values of the marginal effects of the leverage ratio are small in magnitude relative to the other marginal effects and are almost always insignificant. Transportation equipment is the exception in 2007, where the mean marginal effect was significant but negative. The quantile analysis tells the same story. In almost all industry–year combinations, the marginal effect is consistently small and insignificant across the quantiles. The narrow ranges of significance for pharmaceuticals in 1999 and rubber and plastics in 2003 do not change the overall pattern. Therefore, the overall impression is one of ineffectiveness of leveraging in bridging the productivity gap between SOEs and private firms. This result echoes the findings of Chen and Gauriglia (2013), who found that difference in the leverage ratio did not contribute to productivity differentials in various samples.

[13] A potential explanation is that an increase in cash flow from privatization brings about a reduction in investment. If the investment from private firms is more efficient than the investment from SOEs then privatization reduces wasteful investment. In such cases, the reduced investment, coupled with greater investment efficiency, could produce higher productivity. However, evidence from Ding et al. (2013) shows that there is a significant positive relationship between cashflow and investment in the China manufacturing firm data, with the cashflow to investment link being stronger for private firms than SOEs. An increase in cashflow due to privatization is therefore expected to bring increased investment. Any investment effect may be proxied by looking at the change in log assets. However, the log assets measure also reflects firm size, so using the change in this variable would remove the link with size. Larger firms have preferential access to credit, and hence can invest more. An investigation into the change in size, cashflows, and investment is limited by the lack of a measure of investment efficiency. Thus we take the positive cashflow effect of privatization as increasing productivity. The investment explanation for productivity is likely, but not empirically testable.

[14] Rubber and plastics being the exception for which the marginal effect was insignificant in the lower quantiles ($\tau < 0.5$) in 1999 and ($\tau < 0.3$) in 2003).

To complete our analysis of the phase-two decomposition, we briefly discuss the marginal effects of other firm characteristics, including R&D, exports, firm age, and competition. Unlike the factors discussed above, these factors are usually not policy targets.[15] For instance, the 'grasp the large' initiative did not flag export promotion as a policy instrument targeting SOEs; instead, export promotion had been a national policy that applies to all firms ever since Deng Xiaoping's southern tour in 1992. Similarly, it is hard to imagine a policy that is designed exclusively to alter firm age. The decomposition results reinforce understanding that SOEs were older than private firms, and they faced less competition in the local market. These differences are almost always significant in the industry-year pairs. A positive marginal effect of firm age is seen in 1999, and the effect was significant for three industries, however, the significance vanished in many cases in 2003 and 2007. The only industry that demonstrates a persistent age effect is transportation equipment, where the marginal effect is strong and significant in all years and across all quantiles. Thus, the evidence suggests that any effect of firm age was limited and restricted to specific industries. The state–private gap in competition was roughly the same over the study period (Table 3), and the significance of the marginal effect vanished quickly until there were no significant marginal effects from competition in any industry in 2007. Market competition therefore appears unimportant in explaining the productivity gap between SOEs and private firms. SOEs conducted more R&D than private firms, but the marginal effects of R&D are small and insignificant. Finally, although private firms exported more than SOEs during the study period, the marginal effect of exports is rarely significant suggesting that differences in R&D and exports do not explain the productivity gap between SOEs and private firms.[16]

6. Discussion and conclusions

SOEs and private firms often have different levels of productivity which can motivate governments to choose to privatize SOEs; however, this policy option overlooks the possibility that ownership may not need to change if the SOE is marketized instead, which we define as a transformation of an SOE so that it becomes congruous with the characteristics of private enterprises without taking ownership away from the state. An underexamined alternative to privatization is to marketize SOEs by increasing the efficiency of their market operations without changing ownership (i.e. marketization).

Identifying whether privatization or marketization is preferable is a complex and debated theoretical question that requires guiding empirical evidence. Thus far the literature does not provide strong empirical evidence to support either case having considered the other, which has contributed to the belief that SOEs were less productive due to unfavourable, unobserved ownership effects. Existing literature presents results that do not untangle the connections between ownership change and marketization policies, and in this article, we sought to fill this gap in the literature by testing three hypotheses. First, we empirically assessed whether privatizing an SOE was associated with an increase in its productivity when other firm characteristics remain the same, and this effect is uniform across the productivity distribution (H01). Second, we examined if the marketizing of SOEs is associated with an increase in its productivity when there is no change in ownership, and this effect is uniform across the productivity distribution (H02). And third, we analysed if marketized firms experienced a larger increase in productivity than privatized firms across the productivity distribution (H03).

Before we could obtain results relating to these three hypotheses, we needed to overcome a number of empirical challenges. The lack of randomness between ownership change and

[15] For brevity results for these characteristics are reserved for the Supplementary material.

[16] Supplementary materials highlight that these conclusions are robust to the inclusion of foreign-owned firms and when replacing labour productivity for productivity.

marketization and the need to appreciate these issues across the productivity continuum mean that standard panel methods are not sufficient to identify effective answers to this industrial reform conundrum and to tackle this endogeneity problem. Meanwhile, important characteristic differences between SOEs and private firms, including size, age, and major financial variables (Ding, Guariglia, and Knight 2013) also contribute to observed differences in productivity. Thus, the policy choice between privatization and marketization first requires the disentangling of the effects on productivity of privatization and marketization and we do so through application of the Rothe (2015) approach rather than employing a difference-in-difference approach; this is the first article to fill this gap in the literature. By drawing on data from across Chinese manufacturing sectors during their industrial reform period of 1999–2007 and using a counterfactual distribution approach following the work of Rothe (2015), we isolated the ownership effect from the contributions of differences in characteristics between SOEs and private firms, and hence analysed separately the effects of true privatization from policies that sought to close the gap in characteristics between SOEs and non-SOEs, aka marketization.

This article makes a series of contributions to the literature. First, it identified the structural effect on productivity of privatizing an SOE into an otherwise comparable private firm that shares the same characteristics, thereby providing empirical support for H01. Second, it assessed the composition effect on productivity of marketization that aligns characteristics of an SOE with those of a private firm without ownership change, thereby providing empirical support for H02. Third, it evaluated whether privatization is superior to marketization in terms of productivity gains for economies transitioning to a market economy, thereby providing empirical support for H03. Thus, this article makes a crucial contribution to the understanding of government economic policy regarding whether to privatize SOEs to enhance the rate of development.

Our analysis demonstrates that the 'grasp the large and let go of the small' policy was successful in reducing the divide between SOEs and their private counterparts. Evidence lies in the narrowing productivity gap over time. We found that the average productivity gains from privatization were comparable in size to that of marketization if the characteristics of SOEs were fully aligned to those of private firms. However, a distinct feature of the privatization policy appears to be that the benefit was much stronger for the least productive firms such that, in extreme cases, privatization of the most productive SOEs could be harmful to their productivity.

SOEs were observed to be less productive than their domestically owned private counterparts, both on average and across all quantiles. By understanding the distributional decomposition of these industrial policy effects, this article reveals for the first time the effectiveness of the Chinese government's 'let go of the small' policy that aimed to bring the least productive end of the SOEs distribution towards that of the private sector. By aligning SOEs' characteristics to those of private firms, the 'grasp the large' policy was a potent measure that boosted productivity among existing SOEs.

The decomposition analysis offers a unique opportunity to assess the marginal effects of individual marketization policies. These results demonstrate that the consolidation of state assets enabled SOEs to maintain a productivity advantage over their private counterparts. Results reveal that SOEs generally benefited from higher cash flows and that reforms that closed the gap in inventory control were successful in reducing the productivity advantage of private firms. The challenges of local policy and differential access to finance are possible causes, amongst others, of differences across the productivity distribution, and future research could explore these aspects in further details by building on the work of Poncet, Steingress, and Vandenbussche (2010) and Berkowitz, Ma, and Nishioka (2017). In summary, we find that the Chinese 'grasp the large' industrial policy had greater benefits than the 'let go of the small' practice, because marketization was effective throughout the period of study, whereas the effect of privatization became insignificant at the later stage of these

reforms. Nonetheless, we also find that not all marketization policies delivered the expected outcome: increasing assets and cash flow and reducing inventory were helpful but reducing SOE leverage yielded no meaningful productivity benefits to SOEs.

Our study has limitations. The performance of SOEs and private firms is compared on the grounds of TFP, but TFP may not fully capture the performance of SOEs that usually also possess additional social responsibilities. Omission of social welfare concerns into our performance measure means that we may have underestimated the efficiency of SOEs and overestimated the efficiency of private firms. Other limitations may relate to well-understood issues of data quality and variations in sample selection processes across ownership types. Despite these limitations, our results cast important new light on the evolution of Chinese manufacturing and the effectiveness of Chinese industrial policy, offering far more insight into individual policies than analyses based on panel data average effects might suggest. Although our empirical results are specific to China, our approach demonstrates how transitional economies may obtain greater success industrial reform strategies.

Supplementary material

Supplementary material is available at the *Oxford Economic Papers* Journal online. These are the replication files and the online appendices. The data used in this paper are available from www.resset.com. Data may also be acquired through the Chinese National Bureau of Statistics (https://www.stats.gov.cn/english/).

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