Firm Hierarchies and Misallocation

Shipeng Fu* and Matthias Kehrig†

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Abstract

We study how internal hierarchies affect productivity, wages, and labor shares in Chinese manufacturing firms. Using detailed information on professional titles from the 2004 Annual Survey of Industrial Production, we construct firm-level measures of hierarchical structure and compare private firms with state-owned enterprises (SOEs). Private firms operate leaner hierarchies and exhibit rising labor productivity as organizational layers expand. In contrast, SOEs adopt prematurely deep and top-heavy hierarchies associated with declining labor productivity but higher wages. As a result, labor shares are substantially higher in SOEs. Counterfactual exercises show that distortions in hiring and organizational design account for a large fraction of the labor share gap between SOEs and private firms, pointing to inefficient internal organization as an important source of aggregate misallocation.

Keywords: Firm hierarchies; Organizational structure; State-owned enterprises; Misallocation; Labor productivity; Labor share; China.
JEL classification: D24, L22, L25, O47.

*Duke University. shipeng.fu@duke.edu
†Duke University, NBER and CEPR, matthias.kehrig@gmail.com.

1 Introduction

A central challenge in organizational economics is to understand how firms structure their internal hierarchies and how these structures relate to productivity. A long tradition, beginning with the descriptive work of Mintzberg (1979) and continuing through formal theories such as Garicano (2000), argues that hierarchical design affects how knowledge is allocated, how problems are solved and ultimately how efficiently firms produce. While the relationship between firm size and organization has been studied in some economies, there is little work on the relationship between organization and productivity, especially for large developing economies.

This paper studies firm hierarchies and firm productivity in Chinese manufacturing and asks whether these theoretical predictions hold in an environment characterized by substantial institutional distortions. China provides a particularly informative setting for this analysis. Rapid growth and structural transformation have pushed firms to scale up quickly, generating wide variation in organizational form. At the same time, the coexistence of private firms and state-owned enterprises (SOEs) operating within the same industries offers a natural comparison group. While private firms typically face hard budget constraints and intense competitive pressure, SOEs operate under softer financial constraints and politically influenced personnel systems. These differences raise the possibility that hierarchy choices in SOEs are distorted, with potentially important consequences for productivity and aggregate outcomes.

Using detailed microdata from the 2004 Annual Survey of Industrial Production, which report employment by professional title, we directly measure firm hierarchies and the allocation of workers across layers. This allows us to move beyond firm size and examine internal organization explicitly. We document several new facts. First, consistent with existing theory, larger firms tend to operate more hierarchical layers and also pay higher average wages. However, when we examine productivity, the relationship between hierarchy and performance differs sharply by ownership. Among private firms, adding a top hierarchy layer is associated with higher labor productivity, consistent with efficiency-enhancing organizational deepening. Among SOEs, in contrast, labor productivity declines monotonically with hierarchical depth: three-layer SOEs are notably less productive than comparable SOEs operating only the bottom layer, and the productivity gap between SOEs and private firms widens dramatically with hierarchy.

Second, we show that these productivity patterns are closely tied to systematic differences in organizational choice. Conditional on size, SOEs are significantly more likely than private firms to operate additional layers – a pattern we refer to as premature layering. Moreover, conditional on the number of layers, SOEs employ disproportionately more workers in upper managerial ranks, resulting in much narrower spans of control. These features imply that SOEs are not simply larger versions of private firms, but are organized in a fundamentally different and less efficient way. Hierarchical complexity in SOEs expands without delivering the productivity gains predicted by standard models (Caliendo and Rossi-Hansberg, 2012).

Third, the divergence between productivity and wages across hierarchies has important implications for factor shares. While labor productivity falls with hierarchical depth in SOEs, average

wages rise sharply, reflecting strong layer-specific wage premia. As a result, SOEs exhibit substantially higher labor shares than private firms. In our data, the aggregate labor share of SOEs exceeds that of private firms by more than 13 percentage points. This pattern points to a novel channel through which organizational distortions contribute to significant aggregate effects: inefficient hierarchy choices raise labor costs relative to output, depressing aggregate labor productivity and altering the distribution of income between labor and capital.

To quantify the importance of this mechanism, we conduct counterfactual exercises that isolate the role of hierarchy choice from wage-setting behavior. We show that if SOEs were to hire and organize like private firms while maintaining their wage schedule, their aggregate labor share would fall by nearly half. In contrast, equalizing wages between SOEs and private firms while holding organizational structure fixed yields a much smaller reduction. These results imply that distorted hierarchy and employment choices, rather than wage premia alone, account for the bulk of the labor share gap between SOEs and private firms.

Our findings contribute to the literature on misallocation in China by identifying internal organization as a distinct and quantitatively important margin of distortion. Existing work has emphasized misallocation of capital Whited and Zhao (2021) and land Adamopoulos et al. (2022). The role of SOEs in the misallocation of overall resources has been studied by a large literature (see, among others, (Boyreau-Debray and Wei, 2005; Song et al., 2011; Li et al., 2017). We show that inefficient hierarchy formation within SOEs may amplify these forces by simultaneously lowering productivity and raising labor costs. This highlights the importance of a distortion to labor and its deployment in contrast to the previous literature, which has emphasized SOEs favored credit access. More broadly, the results suggest that understanding aggregate productivity requires opening the black box of the firm and accounting for how internal organizational choices interact with institutional constraints.

Literature

This paper relates to several strands of literature studying firm hierarchy, organizational structure, and productivity, with particular relevance for evidence from China and differences between private firms and SOEs. Our paper relates to previous work on firm hierarchy and organizational structure. Early contributions emphasize informational and incentive constraints within organizations. Geanakoplos and Milgrom (1991) develop a theory of hierarchies based on limited managerial attention, showing how layers arise endogenously as firms grow. Qian (1994) and Bolton and Dewatripont (1994) model the firm as a communication network, highlighting how hierarchical structures economize on communication costs but may introduce delays and distortions.

A particularly influential framework is developed by Garicano (2000) and Garicano and Rossi-Hansberg (2006), who model hierarchies as knowledge-based organizations. In these models, production involves problem solving, and hierarchy emerges as a way to allocate knowledge efficiently across workers and managers. Larger firms optimally introduce additional layers to create scope for workers sorting into tasks of different complexity, generating testable predic-

tions for the relationship between firm size, number of layers, and wage inequality. Caliendo and Rossi-Hansberg (2012) study how firms change their organization following a trade liberalization. Caliendo et al. (2015, 2020) have tested predictions of this model using data on hierarchies in French and Portugese firms, demonstrating that the number of layers increases systematically with size and that reorganizations have measurable productivity effects.

Empirical studies document that organizational structure is strongly correlated with firm performance. Within-firm organization, delegation, and monitoring practices are found to be key determinants of total factor productivity (see Bloom et al. (2012)). Bloom et al. (2014) use data to study the impact of information and communication technologies on delegation and independence of local managers. Ding et al. (2022) study the reorganization of activities inside firms, with a particular focus on design and production in U.S. manufacturing firms.

A closely related strand of the literature studies productivity differences between state-owned and private firms in China and the aggregate consequences of ownership-related distortions. Hsieh and Song (2015) document large and persistent productivity gaps between SOEs and private firms and show that misallocation induced by preferential policies toward SOEs accounts for a substantial share of aggregate productivity losses. Brandt et al. (2012) and Chen et al. (2021) provide complementary evidence that ownership reform and privatization lead to significant productivity improvements, particularly in competitive sectors, underscoring the efficiency costs associated with state ownership.

An important insight from this literature is that misallocation arises not only because resources are allocated to the "wrong" firms, but also because distorted incentives within SOEs affect how inputs are used. Hsieh and Klenow (2009) show that dispersion in marginal products across firms in Chinese manufacturing implies large potential TFP gains from improved allocation. While their analysis is silent on organizational structure, it provides a benchmark for thinking about wedges between marginal products and factor payments that may stem from policy distortions. Our results suggest that inefficient internal hierarchies are one mechanism through which such wedges can emerge within SOEs.

Relatedly, Huang et al. (2017) show that decentralization reforms in Chinese SOEs improve firm performance by allowing managerial decisions to better reflect local information. Their findings highlight the importance of internal organizational design for productivity and suggest that centralized, rigid hierarchies can be a source of inefficiency, even when firm size and industry are held constant. We complement this work by providing direct evidence on how SOEs structure their hierarchies and by showing that excessive layering and narrow spans of control are systematically associated with lower labor productivity.

By linking ownership, internal organization, and factor shares, our paper contributes a new perspective to the SOE reform and misallocation literature. We show that distorted hierarchy choices in SOEs simultaneously depress productivity and raise labor costs, leading to markedly high labor shares. This mechanism operates within firms and therefore complements existing evidence on misallocation across firms. Taken together, these results suggest that reforms aimed

at improving aggregate efficiency may benefit not only from reallocating resources toward more productive firms, but also from addressing inefficiencies in internal organizational design within SOEs.

2 Data and institutional background

2.1 Data description

We use data from the 2004 Annual Survey of Industrial Production (ASIP), which covers approximately 270,000 firms in manufacturing, mining, and utilities. It provides detailed information on employment, output, capital inputs, financial indicators, and other firm characteristics. Private firms are sampled above a threshold of five million RMB in sales, a sampling rule absent for SOEs. While they tend to be larger than private firms, we drop the few small SOEs below the sampling threshold for private firms to obtain a set of firms that is consistently sampled. Next, we drop observations with negative reported values for output, employment, wage bill, capital, and value added.[1] Last, we drop observations in the 0.1% tails of employment, value added, average wage, value added per worker, and capital intensity by 3-digit industry. All this leaves us with a sample of just under 250,000 firm observations.

A distinctive feature of the 2004 data is a supplement reporting the employment by "professional title" – entry-level, junior, intermediate, and senior[2] – categories that jointly reflect workers' skill, experience, and responsibilities. More senior titles typically involve broader supervisory duties over lower-ranked employees and are indicative of accumulated experience and higher labor quality.

Professional titles in China are governed by industry-specific regulatory frameworks designed by political-administrative bodies. These regulations determine qualification criteria, promotion rules, and the permissible distribution of titles within occupations and firms. As such, the observed hierarchy within a firm is shaped both by market forces and by institutional constraints on title assignment. The richness of the ASIP data therefore allows us to infer organizational structure by mapping professional titles into hierarchical layers and by measuring the distribution of employees across these layers.

The dataset has several advantages for studying hierarchies. It covers the majority of the manufacturing sector, includes both SOEs and private firms, and provides enough granularity to identify distinct organizational patterns. Because this professional title system is explicitly designed to reflect a worker's professional rank, it speaks more directly to a firm's hierarchy than a classification based solely on occupations as in most of the literature. Our data report labor compensation, however, only for the entire firm and the data are cross-sectional, preventing direct analysis of dynamic adjustments of a given firm. We are working to incorporate the China

[1] Negative value added may occur in reality per se, but it seems negligible in absolute magnitude here making up 0.7% of aggregate value added.

[2] In practice, there are only three titles: junior, intermediate, and senior. We refer to employment without any title as entry-level.

Employer-Employee Survey (CEES), a smaller but longitudinal dataset that can be also matched to worker-level records, which will allow us to investigate employment and wage dynamics within firms.

To construct our hierarchy measures, we define layers based on professional title categories and compute both the number of layers present in each firm and the share of the workforce allocated to each. Because the distinction between entry-level and junior employees is ambiguous, we combine them into one bottom layer, while intermediate workers make up the middle layer and seniors the top layer. This construction aligns with theoretical models that emphasize the mapping of knowledge, supervision, and task complexity into layers.

2.2 Summary statistics

Tables 1-2 summarize firm characteristics by the number of hierarchical layers and the size distribution across different layers. We display summary statistics for private firms and SOEs separately.

Table 1: Average firm statistics by number of layers and ownership status

		Average firm				
Layer	No. obs	Employment	Value Added	Sales	Profits	Wage
A. Full Panel						
1	105,166	141	7,951	34,281	1,527	12.7
2	76,459	185	10,066	42,952	1,769	12.9
3	68,283	460	42,731	162,329	11,207	15.1
All	249,908	242	18,101	71,921	4,246	13.4
B. Private Firms						
1	103,676	141	7,883	34,258	1,526	12.7
2	72,696	181	9,881	42,825	1,806	12.8
3	61,270	368	35,484	139,280	10,152	14.8
All	237,642	212	15,611	63,956	3,836	13.3
C. State-Owned Enterprises						
1	1,490	181	12,668	35,871	1,538	13.4
2	3,763	266	13,640	45,406	1,038	14.6
3	7,013	1269	106,040	363,706	20,429	18.1
All	12,266	829	66,351	226,234	12,185	16.4

Note: This table reports summary statistics for the average firm in the 2004 ASIP. Average firm employment is measured in number of employees, while value added, sales, profits, and the average worker wage is expressed in thousand RMBs. Panels B. and C. report the analogues for the sample of privately owned firms as well as state owned enterprises.

Table 1 shows that employment, value added, sales, profits, and wages increase noticeably with the number of layers. Firms with three layers, for example, employ about twice as many workers and produce four times as much the sales and value added as firms with two layers.

This pattern holds for both private firms and SOEs, though the scale differences are magnified among SOEs. In general, SOEs are about four times as large on average as their private counter-

parts. The size difference among SOEs with different number of layers is more pronounced than that across private firms. Private 3-layer firms employ about twice as many workers as two layer firms, while that ratio for SOEs is five. The relative size difference of outputs is even larger than that of employment, especially among SOEs. These striking size differences reflect the historically large footprint of SOEs in heavy industries and capital-intensive sectors.

We now turn to the hierarchical structure of firms. In principle, firms with one layer may only employ intermediate or senior workers instead of workers at the lowest hierarchy level as posited by most theories. Likewise, firms with more than one layer may resemble a "pyramid" where they employ most workers in the bottom junior layer and fewer workers higher up in the hierarchy. Employment here is consecutively and monotonically[3] ordered in the sense that it declines with hierarchy level. Such hierarchies are consistent with the knowledge models based on Garicano (2000). Alternatives to pyramid-like organizations are worker allocations that involve a considerable number of senior employees managing a large pool of juniors without the aid of significant intermediate employees. In that case, employment is not monotonically decreasing in hierarchy layer and the firm organization exhibits a missing or lean middle. Such "stamp" structures have been studied empirically by Mintzberg (1979). Last, alternative hierarchy structures could be heavy at the top ("inverse pyramids") – likely organizations that provide management services only – or organizations that employ most workers in the intermediate middle layer ("urns"). In the following analysis, we will focus on the standard pyramid-like hierarchy structures, which are consistent with an employment allocation that declines the higher the hierarchy layer.

Table 2 displays the distribution of firms by layer and their organizational shape. As one can see, about 95% of all firms accord with the standard pyramid shape. The remaining 5% comprise other shapes, such as stamps, urns, and inverse pyramids, which we will ignore for our analysis given their small share of the sample. Data from other countries show much higher prevalence of non-pyramid-like structures.[4]

Most of the firms are 1-layer firms (42.1%) with all their employment in the junior bottom layer, while 2-layer firms are slightly more prevalent with 28.1% than 3-layer firms with 24.7% of the sample. The last, however, reflect the lion share of economic activity in terms of overall employment and value added.

Interestingly, the hierarchy distribution for SOEs exhibits the opposite pattern of that of private firms: most SOEs are 3-layer firms (55% of SOEs), while 2-layer firms make up 29% of SOEs. Only 12% of SOEs are one-layer firms. Almost 90% of the economic activity of SOEs is accounted for by SOEs with 3 layers. This pattern confirms that SOEs are predominantly large enterprises as seen in Table 1.

[3] In Caliendo et al. (2015), they refer to "consecutively ordered layers" as firm has only layer 1, layers 1-2, or layers 1-3, but it does not necessary have pyramid-like shape.

[4] Table 5 in Caliendo et al. (2015) shows that 14% of 2-layer firms, 36% of 3-layer firms and 43% of 4-layer firms in France do not display a pyramid-like hierarchy.

Table 2: Distribution of firms by organization

Layer	No. obs.	Share of observations	Share of employment	Share of value added
A. Full Panel				
1 (bottom)	105,151	42.1%	24.6%	18.5%
2 (pyramids)	70,275	28.1%	21.9%	15.7%
3 (pyramids)	61,607	24.7%	49.8 %	61.0%
Rest	12,875	5.2%	3.7%	4.9%
All	249,908	100%	100%	100%
B. Private Firms				
1 (bottom)	103,662	41.5%	24.1%	18.1%
2 (pyramids)	66,663	26.7%	20.3%	14.6%
3 (pyramids)	54,909	22.0%	35.2%	44.7%
Rest	12,408	5.0%	3.5%	4.6%
All	237,642	95.1%	83.2%	82.0%
C. State-Owned Enterprises				
1 (bottom)	1,489	0.6%	0.4%	0.4%
2 (pyramids)	3,612	1.5%	1.6%	1.1%
3 (pyramids)	6,698	2.7%	14.6%	16.2%
Rest	467	0.2%	0.2%	0.3%
All	12,266	4.9%	16.8%	18.0%

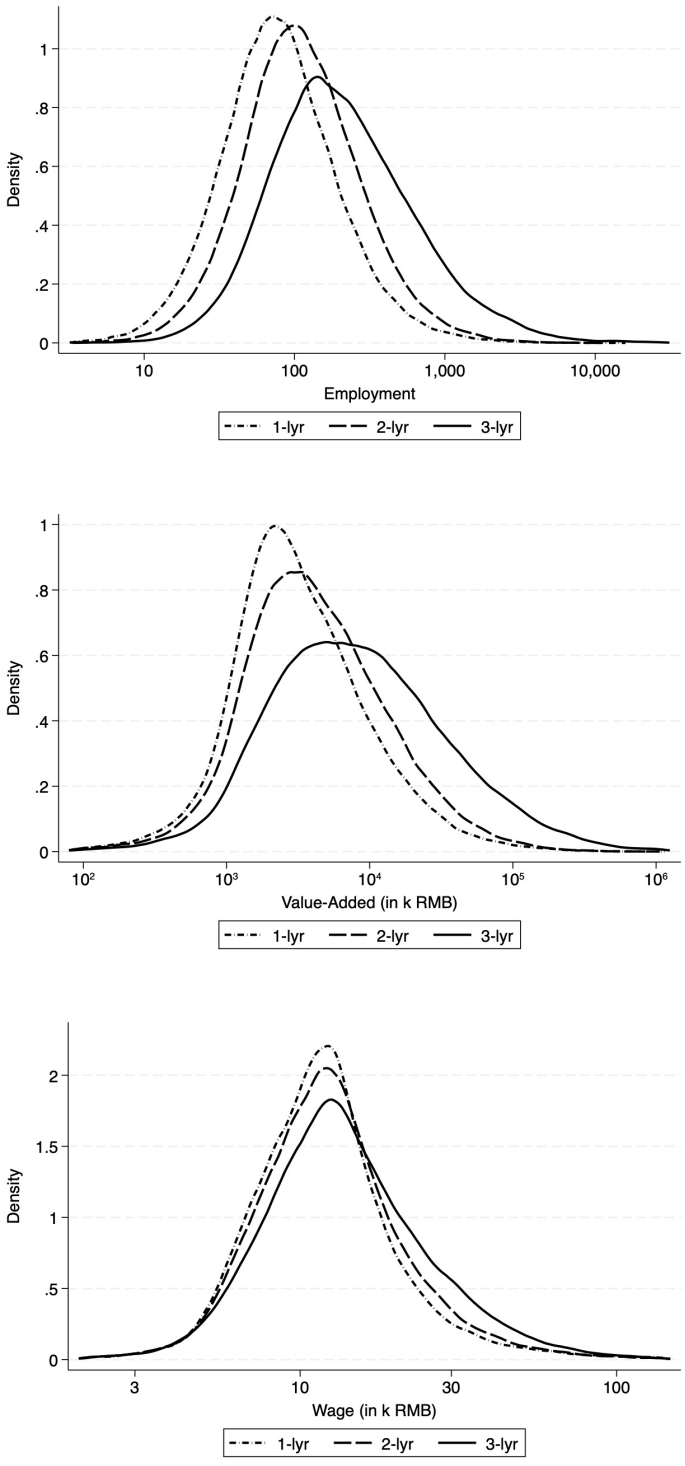
3 Empirics

3.1 Firms with different layers are different

To examine how firm characteristics vary with hierarchical depth, we compare SOEs and private firms along employment, value added, and wages, controlling for industry fixed effects. These controls account for systematic differences in technology or production structure across industries. We do not, at this stage, include capital controls as their relationship to hierarchy is ambiguous and may itself reflect organizational choices. We first assess if the size and wage distributions differ by the number of layers a firm operates.

Figure 1 illustrates these relationships using kernel density estimates for employment, value added, and wages across one-, two-, and three-layer firms. Employment and value added shift markedly to the right with additional layers, while wages display more muted but still visible differences. Overall, these results are consistent with the theory developed and refined in Garicano (2000), Garicano and Rossi-Hansberg (2006), and Caliendo and Rossi-Hansberg (2012) that predicts non-overlapping size distributions across organizational forms. However, the distribution of wages by layer is theoretically more nuanced: supervision and expertise may command higher wages at upper layers, but wages in the bottom layer of a multi-layer firm reflect comparatively low productivity of a large workforce tasked with simple jobs. Firm adding layers at the top will

Figure 1: Size and wage distribution by layer



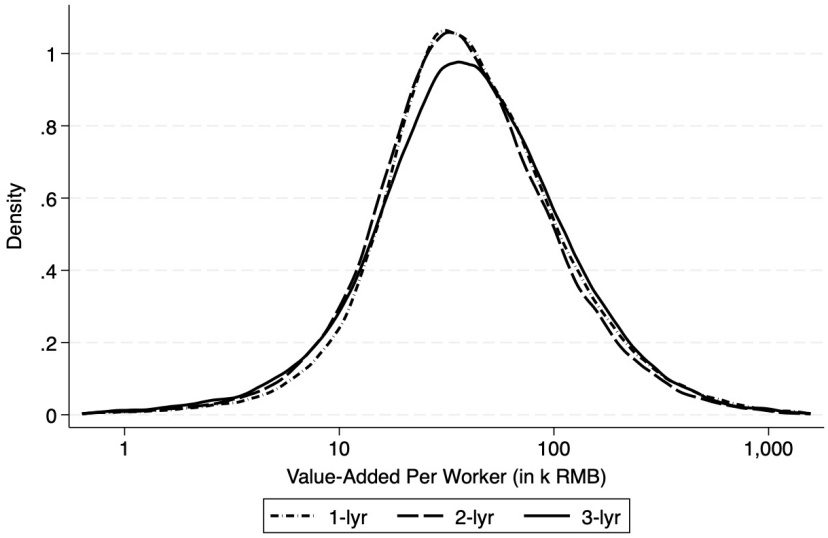
Note: This figure displays the distribution of employment (top panel), value added (middle panel), and wages (bottom panel) across firms with different layers. We first remove industry fixed effects from each variable by estimating $\log x_i = \alpha + \sum_{L=1}^{3} \beta^L L\text{-layer}_i + \sum_s \delta^s s_i + \varepsilon_i$, where $x_i \in \{\text{employment, value added, wages}\}$; $L\text{-layer}_i$ and s_i are sets of dummies for layers and four-digit industries of firm i, respectively. The residualized value is then $\log \hat{x}_i = m + \sum_{L=1}^{3} \hat{\beta}^L L\text{-layers}_i + \hat{\varepsilon}_i$ where m is the average value for firms with one layer. We then compute the kernel density estimates of the distribution of $\log \hat{x}_i$ grouping firms by their number of layers.

pay those workers a hefty premium, while workers remaining in the bottom layers see their wages fall. Higher wages at the top layer and lower ones at the bottom layer counteract each other and make the average firm wage varies less clearly with layer than firm size.[5]

3.2 Productivity and firm hierarchy

Next, we explore the relationship between productivity and firm hierarchy. We focus on labor productivity as it is a straightforward concept, easy to measure and free from making further assumptions about technologies that would be necessary to asses total factor productivity, with organization being one such factor. The central tenet of firm hierarchies is that it reflects knowledge; more hierarchy layers mean therefore more scope to solve complicated problems, thus allowing the firm to grow and more efficiently sort worker into different tasks. Value added per worker should hence increase in the number of layers.

Figure 2: Value added per worker and layer



Note: This figure displays the distribution of value added per worker across firms with different layers. For details, see notes to Figure 1.

Figure 2 plots value added per worker across firms with different numbers of layers. Surprisingly, productivity differences across one-, two- and three-layer firms are indiscernible. Even when that is possible, firms with one layer appear to be more productive than those with two layers, while 3-layer firms are sometimes more, sometimes less productive than 1-layer firms. In other words, the relationship between productivity and firm hierarchy looks ambiguous. This

[5]Theoretically, there is no prediction on average wages. The empirical evidence is mixed. Caliendo et al. (2015) (Table 3) report that one-layer firms have greatest average wages, and wages are increasing in number of layers for two- to four-layer firms in France. Caliendo et al. (2020) (Appendix) report average wages increase with hierarchical depth for Portuguese firms.

finding contrasts with the evidence on wages, which do increase with layers. Since value added per worker is closest to the average revenue product of labor, one would expect that it is closest to the wage that those firms pay. These findings raise an important question: if increasing hierarchical depth is theoretically associated with improved coordination or knowledge utilization, why do we not observe corresponding productivity gains?

One possibility is that firms expand hierarchies for reasons other than to enhance efficiency. Political pressure or lack of competition may lead to over-layering where additional managerial positions do not translate into productivity improvements. Such an argument seems plausible for SOEs, which face more political demands about their employment and compensation (Bai et al., 2006). These observations motivate the deeper analysis in subsequent sections comparing SOEs and private firms at comparable scales and examining whether organizational complexity is associated with productivity differences conditional on size. Because this analysis will have to account for more real-world factors that do not show up in the theoretic model, we present this evidence as regressions, which control for several factors not directly related to firm hierarchy and the organization of firm's workforce. In particular, we run the following regressions:

$$\ln(VA/N)_i = \alpha + \beta D_i^{SOE} + \sum_{L=1}^{3} \gamma^L D_i^L + \sum_{L=1}^{3} \delta^L D_i^{SOE} \times D_i^L + X_i + \varepsilon_i \tag{1}$$

where D_i^{SOE} is a dummy indicating that firm i is a state-owned firm and D_i^L is a dummy indicating that firm i operates L layers. The γ^Ls will inform us about the productivity patterns along layers in general, while the δ^Ls will tell us if they differ for SOEs. X_i is a set of control variables including size, capital per worker, and industry fixed effects.

Table 3 shows the evidence of value added per worker and wages. Column (1) confirms a well-known result about SOEs: they are less productive than their private peers in the same industry. In 2004, we quantify this productivity difference to be 37 log points, a sizable discount. Column (2) considers the difference of value added per worker by organizational form. There is no significant difference between 1- and 2-layer firms as seen in Figure 2, but 3-layer firms indeed are about 10% more productive than their 1- or 2-layer peers. In column (3) of the table, we study the different productivity patterns for private firms and SOEs along different layers. Private 3-layer firms still show a productivity premium over their private peers (about 11.6%), while SOEs are less productive than private firms in general. Surprisingly, SOEs tend to be *less* productive the more layers they operate. The productivity gap of 20.4% between private and state owned 1-layer firms grows to over 55% for 3-layer firms! These patterns suggest that private firms do become more productive as they add layers, while SOEs become *less* productive. The evidence for SOEs is clearly at odds with the main theory that postulated more layers are associated with a better division of labor and tasks. Given that 3-layer SOEs account for such a sizable portion of economic activity, this may indicate a serious shortfall in aggregate productivity.

We also study a version of equation (1) with wages on the left hand side. This is motivated by the fact that value added per worker reflects the average revenue product of labor, ARPL, and is

Table 3: Productivity and wage patterns

	(1) $\ln VA/N$	(2) $\ln VA/N$	(3) $\ln VA/N$	(4) $\ln w$	(5) $\ln w$	(6) $\ln w$
SOE	-0.369***		-0.204***	0.188***		0.106***
	(0.023)		(0.031)	(0.017)		(0.024)
2-Lyr		-0.009	-0.003		0.054***	0.053***
		(0.007)	(0.006)		(0.005)	(0.005)
3-Lyr		0.095***	0.116***		0.136***	0.125***
		(0.010)	(0.010)		(0.007)	(0.007)
2-Lyr × SOE			-0.158***			0.030
			(0.029)			(0.024)
3-Lyr × SOE			-0.238***			0.107***
			(0.050)			(0.028)
Obs.	237,033	237,033	237,033	237,033	237,033	237,033
Adj. R-sqr	0.263	0.260	0.265	0.183	0.185	0.188
Industry FEs	4-digit	4-digit	4-digit	4-digit	4-digit	4-digit

Note: This table displays regression coefficients of versions of equation (1). Columns (1)-(3) consider value added per worker on the left hand side, columns (4)-(6) consider average wages. Controls on the right hand side include industry fixed effects, capital intensity, and linear-quadratic terms of employment (all in logs).

closest to the marginal product of labor which should equal the wage rate. Average wages are in fact strongly related to layers as the results in column (5) show: 2-layer firms pay a premium of about 5% compared to similarly sized 1-layer firms. This layer premium rises to 13.6% for 3-layer firms. Column (6) repeats the analysis for both private firms and SOEs. SOEs do pay higher wages in general: 1-layer SOEs pay about 10.6% higher wages than their private peers. Interestingly, the layer premium is stronger in SOEs than in private firms. A private 3-layer firm pays 12.5% more than its 1-layer counterpart. A 3-layer SOE, on the other hand, pays 33.8% more than a 1-layer private firm.

The labor productivity and wage profile of SOEs diverge quite a bit: while productivity *falls* with higher layers in SOEs, their average wages *rise*. This implies that the labor share of SOEs, the ratio of wages and average revenue product of labor, is strongly higher for SOEs with more hierarchy layers. We will explore these labor share patterns in greater detail in Section 4.

3.3 How do SOEs organize differently?

SOEs have relatively more hierarchy layers As shown in Table 2, SOEs tend to organize more into 3-layer firms than 1- or 2-layer firms. Given the productivity decline with hierarchy level in SOEs, this raises the question if part of the well-known productivity gap between SOEs and private firms stems from firm hierarchies.

In this section, we focus on a novel dimension of SOE inefficiency: the design and deployment of internal hierarchies. Standard theoretical models predict that firms endogenously add layers

only when doing so enhances problem-solving capacity and managerial efficiency, thereby increasing productivity. However, a large empirical literature in corporate management documents numerous frictions and inefficiencies in organizational design. Research on the "diversification discount" as well as extensive evidence on managerial empire building highlights how firms may expand organizational structures even when doing so does not improve performance (Lang and Stulz, 1994). These forces may be particularly pronounced in SOEs, which operate under softer budget constraints and weaker competitive pressures than private firms, potentially making them more susceptible to entrenchment and political motivations.

Against this background, it is plausible that SOEs expand their hierarchies for reasons unrelated to efficiency. Such distortions may manifest along two margins. First, SOEs may engage in "premature layering," adding hierarchical tiers even when their scale does not warrant such complexity. Second, conditional on the number of layers, SOEs may allocate disproportionately more workers to upper managerial ranks, resulting in inflated top layers relative to private firms. The following empirical analysis examines both the extensive margin (the number of layers) and the intensive margin (the staffing of upper layers) to assess whether SOE organizational choices deviate systematically from efficient benchmarks. Crucially, we have to be mindful of the fact that SOEs are larger than private firms, which will naturally lead them to organize into more layers. Therefore, we examine if SOEs choose more layers *conditional on size* by regressing the number of layers on a SOE dummy and size controls.

Table 4: Number of layers in SOEs and Private firms

	(1)	(2)	(3)
	No. of Layers		
SOE	0.399***	0.245***	0.258***
	(0.021)	(0.019)	(0.018)
$\ln VA$	0.158***		0.053***
	(0.004)		(0.003)
$\ln N$		0.252***	0.210***
		(0.007)	(0.008)
Obs.	237,033	237,033	237,033
Adj. R-sqr	0.194	0.232	0.236
Industry FEs	4-digit	4-digit	4-digit

Note: This table displays regression coefficients of the number of layers on a SOE dummy and controls for firm size (employment and value added) and industry.

Table 4 displays the results. Conditional on value added produced, SOEs operate 0.4 more layers on average than their private peers, a sizable difference given we only consider three hierarchy layers. Conditional on employment size, they still operate a quarter layers more than their private peers. This shows that in order to produce the same output and/or to produce with the same employee pool, SOEs tend to organize their workforce into more hierarchy layers.

It is instructive to examine this relationship between firm size and organizational hierarchy in

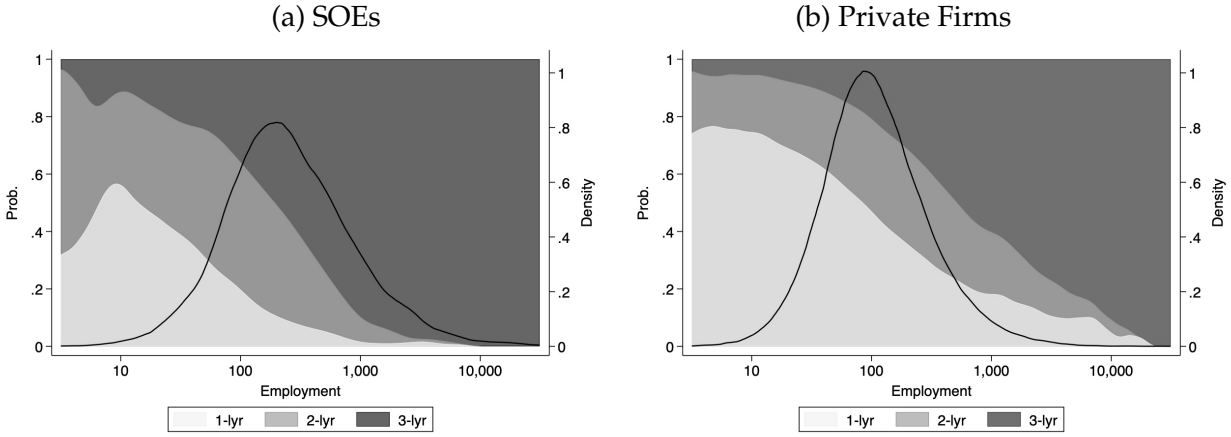
greater detail. The size distributions by hierarchical layer reported in Figure 1 imply that, for any given firm size, there exists a well-defined probability that the firm is organized as a one-, two-, or three-layer organization. Formally, this object of interest is the conditional probability $\Pr(L|N)$, where L denotes the number of layers and N employment size. By Bayes' law, this probability can be expressed as

$$\Pr(L|N) = \frac{\Pr(N|L)\Pr(L)}{\Pr(N)}. \tag{2}$$

The term $\Pr(N|L)$ corresponds directly to the conditional size distributions shown in the top panel of Figure 1. For the remaining components, $\Pr(L)$ captures the unconditional distribution of one-, two-, and three-layer firms in the population, while $\Pr(N)$ represents the unconditional firm size distribution.

In what follows, we compute $\Pr(L|N)$ separately for private firms and SOEs in order to assess whether the size-hierarchy relationship differs systematically across ownership types.

Figure 3: Probability of layers by firm size

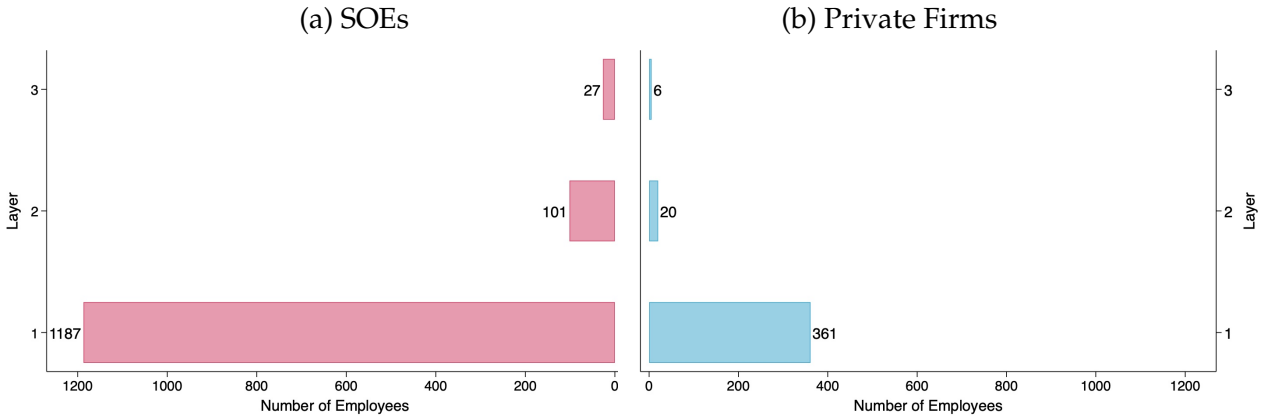


Note: This figure displays the probability of SOEs (left panel) and private firms (right panel) to organize into $L = 1, 2, 3$ layers given a particular firm employment size. This object is computed using equation (2) and the estimated size distributions from Figure 1. The areas shaded light fray represent the probabilities to organize as a 1-layer firm, the areas shaded medium gray that to organize into a 2-layer firm and the areas shaded dark gray that to organize into a 3-layer firm. The thin black lines plot the unconditional employment size distributions.

Figure 3 displays the conditional probabilities of layers conditional on firm employment for private firms and SOEs along with their size distributions. As is clearly visible, at any size, SOEs are much more likely to organize into 2- or 3-layer firms than private firms. A private firm with 100 employees will have a 50% likelihood of being a 1-layer firm, about a 30% likelihood of being a 2-layer firm, and a 20% likelihood of being a 3-layer firm. These number are 20%, 42%, and 48%, respectively for SOEs. That is to say, compared to private counterparts, SOEs always tend to engage in "premature layering."

SOEs have relatively steep hierarchies Next, we ask if the relative employment distribution across layers in SOEs is similar to that in private firms for a given number of layers operated in a firm. Figure 4 shows the average employment in each layer of a 3-layer firm. Not only are SOEs larger in general, but they also employ more workers in relatively higher positions.

Figure 4: Relative size of 3-layer SOEs and private firms



Note: This figure displays the average employment in a 3-layer SOE (left panel) and a private firm (right panel) by layer. SOEs clearly employ (i) absolutely more workers in each layer (ii) relatively more workers in the middle and top layers given bottom layer employment.

Another way to formalize this insight is to look at the span of control in 2-layer and 3-layer firms, i.e. how many bottom junior employees can a higher echelon manage? We compute those numbers and report them in Table 5.

Table 5: Span of control by number of layers and firm ownership

Layer	State-owned	Private
2	89.2	176.6
3	17.1	43.9

Note: This table displays the average employment-weighted span of control, defined as the ratio of bottom employment to employment in middle and top layers.

Overall, the span of control in private firms is more than twice as large as in SOEs. A typical manager (intermediate or senior) in a 2-layer SOE only directs about 89 junior workers, while that number is almost 177 in private 2-layer firms. In 3-layer firms that difference is even greater with a typical manager directing 17 junior workers in SOEs and 44 in private firms.

In summary, these results reveal a clear pattern: as SOEs expand, they add hierarchical layers, yet their productivity systematically declines. Two mechanisms help explain this divergence. First, SOEs appear to engage in premature layering, establishing more hierarchical tiers at any scale than comparable private firms. Second, conditional on the number of layers, SOEs disproportionately hire more personnel into upper managerial ranks, resulting in narrower spans of

control. Both features point to organizational over-complexity that is not matched by corresponding productivity gains.

4 Firm Hierarchies and Labor Shares

The organizational patterns documented in the previous sections have direct implications for aggregate economic outcomes. This follows from the fact that both wages and labor productivity vary systematically with firms' hierarchical structures. Differences in hierarchy choice therefore do not merely affect firm-level outcomes, but also shape aggregate labor productivity and the distribution of income between labor and capital.

These considerations are particularly relevant in the context of state-owned enterprises. If SOEs operate with more hierarchical layers than private firms of comparable size ("premature layering"), then organizational choices will mechanically affect aggregate outcomes through two channels. First, additional layers are associated with higher wages due to layer-specific wage premia. Second, as shown in Table 3, higher hierarchical complexity in SOEs is accompanied by lower labor productivity. Taken together, these patterns imply that organizational choices by SOEs are likely to raise labor costs relative to output, thereby increasing labor shares at both the firm and aggregate level.

This observation connects naturally to the broader literature documenting the productivity discount of SOEs and the aggregate gains from reallocating resources toward more efficient private firms through competition, deregulation, or privatization. Our analysis highlights an additional mechanism through which SOEs may affect aggregate performance: internal organizational structure. By shaping wages and productivity simultaneously, hierarchy choice influences not only aggregate labor productivity but also overall wage levels and wage inequality.

In this section, we focus on a new implication of hierarchy choice that follows directly from these considerations, namely its consequences for the labor share. Because SOEs offer higher wages while exhibiting lower labor productivity, both particularly pronounced in more complex hierarchies, their labor share should be substantially higher than that of private firms. Indeed, in the 2004 ASIP data, the aggregate labor share of SOEs exceeds that of private firms by a substantial 13 percentage points (36.4 percent versus 23.4 percent). This large gap raises a natural and quantitatively important question: to what extent does organizational choice contribute to the observed difference in labor shares between SOEs and private firms? We therefore discipline two counterfactual exercises that isolate the role of hierarchy choice versus wage-setting behavior: first, we ask how aggregate labor shares would change if SOEs organized like private firms conditional on size, and second, how they would change if SOEs paid the same wages as private firms holding organizational structure fixed. These exercises quantify the extent to which internal organization contributes to observed differences in labor shares and, by extension, to aggregate labor productivity.

4.1 How hierarchies impact aggregate labor income

In this section, we will compute a statistical counterfactual labor shares that alter the organizational choice and the wages that come with it. Specifically, we will modify the wage bill of the SOEs, which is the numerator of the labor share, while keeping value added in the denominator unchanged. The way we modify the SOEs' wage bill will tell which component is most relevant in affecting the aggregate labor share of SOEs.

First, we operationalize the formula for the aggregate wage bill in a way that makes it easy to compute some counterfactual magnitudes. In particular, we leverage the information of layers conditional on size. To fix ideas and make counterfactuals possible, we will consider the organization into up to three hierarchy layers. We assume that firms of a given hierarchy layer pay the same average wage though wages may well differ for firms of different layers. Then we can write the aggregate wage bill as follows:

$$\begin{aligned} WB^j &= \int_{i \in I^j} w_i N_i di = \int w^j(y) N^j(y)\ dF_y^j \\ &= \int \sum_{L=1}^{3} \Pr{}^j(L|N) w^j(L) N^j(y)\ dF_y^j, \end{aligned}$$

where $j \in \{SOE, Prv\}$, I^j is the set of SOEs or private firms. The first line rewrites the simple sum as an integral conditional on output (value added) size and $w(y)$ is a non-parametric functions dictated by the joint density of wages and value added; $N(y)$ is the analogue for employment. The second line assumes that wages are the same among firms with the same number of layers, hence w only depends on L. The term $\Pr(L|N)$ captures into how many layers a firm of employment size N will organize. Because average wages differ across 1-, 2-, and 3-layer firms, different employment size will mean different wages via different organizational structure. The term $N(y)$ captures how many workers a firm decides to hire given a certain output level to be produced. While this captures "over-hiring" of SOEs compared to private firms, it has organizational implications as different sizes mean different layers, which in turn mean different wages.

Since wages are assumed to depend only on the number of layers a firm operates, we can use $\Pr(L|N)$ from equation (2) and the layer-specific wage premia estimated in Table 3 to compute an average expected wage that only depends on size via the implied organizational structure chosen at that size: $\tilde{w}(N) = \sum_{L=1}^{3} \Pr(L|N) w(L)$. Only this average expected wage and employment will then matter for the aggregate wage bill:

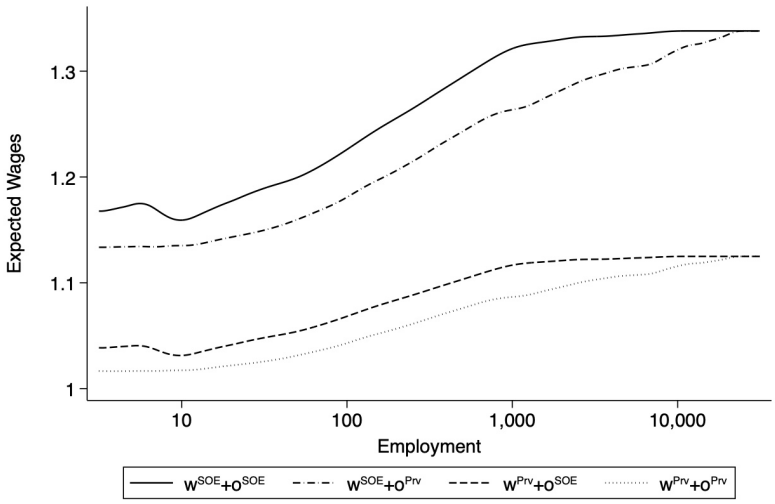
$$WB = \int \sum_{L=1}^{3} \Pr(L|N) w(L) N(y)\ dF_y = \int \tilde{w}(N) N(y)\ dF_y. \tag{3}$$

This equation illustrates the counterfactuals we will carry out to study how the wage bill of SOEs may change: first, bringing employment and organizational choice to the level of private firms means that overall employment size, $N^{SOE}(y)$, and the resulting organizational choice prob-

abilities, $\Pr^{SOE}(L|N)$, will change to those of private firms, that is, $N^{Prv}(y)$ and $\Pr^{Prv}(L|N)$. Second, we will change the wage premia SOEs pay, $w^{SOE}(L)$, to that of the privates, $w^{Prv}(L)$, while holding their size and organization fixed.

To inform the reader about the implied average expected wage, we plot the $\tilde{w}(N)$ in Figure 5, once for private firms and once for the SOEs. There are two counterfactual average expected wages we compute, which will entail the relative wages of SOEs multiplied by the organizational choices of private firms and vice versa. These will be useful in our two main counterfactuals below when we vary either the wage menu firms pay (conditional on size and organizational choice) or the organizational choice holding the wage menu fixed.

Figure 5: Average wage $\tilde{w}$ across the size/organization distribution



Note: This figure displays the average expected wage of a firm given its organizational structure it chooses for its size. Wages are assumed to be the same for a firm with a certain number of layers ($L = 1, 2, 3$) and legal status (private and SOE). Wage of 1-layer private firms is normalized to 1, and wage premia by layer and legal status are estimated in Table 3.
$w^{SOE} + o^{SOE}$ refers to the actual average expected wage of a SOE assuming that it chooses its organization structure as an SOE and pays the typical wages of a SOE. $w^{Prv} + o^{Prv}$ denotes the actual analogue for private firms.
$w^{SOE} + o^{Prv}$ depicts the counterfactual average expected wage of a firm that organizes like a private firm, but pays SOE wages. $w^{Prv} + o^{SOE}$ denotes the counterfactual average expected wage of a firm that organizes like a SOE but pays wages like a private firm.

As one would expect, $\tilde{w}(N)$ increase in size because firms that produce more will hire more, firms that hire more tend to operate more layers, and firms with more layers pay a premium. Fixing a wage menu but assuming a firm chooses an organization like a private firm rather than an SOE yields lower average expected wages because private firms tend to organize into fewer layers and thus pay lower layer premia: $E[w^j|\Pr^{Prv}(L|N)] < E[w^j|\Pr^{SOE}(L|N)]\ \forall j \in \{Prv, SOE\}$. Likewise, fixing an organizational policy but assuming a firm pays wages like a private firm rather than an SOE yields a lower average expected wage because private firms pay less given any size and organizational structure: $E[w^{Prv}|\Pr^j(L|N)] < E[w^{SOE}|\Pr^j(L|N)]\ \forall j \in \{Prv, SOE\}$.

4.2 Counterfactual labor shares

What if SOEs organized like private firms? With our estimated objects of equation (3) at hand, we can compute the aggregate labor share changes under the assumption that SOEs produce the same output but hire and organize like private firms. The choice to hire and organize like a private firm is represented by computing the aggregate wage bill of SOEs using $N(y)$ and $Pr(L|N)$ of the private firms while keeping the relatively high wage level of SOEs.

Conversely, we compute the counterfactual labor share of private firms that hire and organize like SOEs, i.e. computing the wage bill of private firms using $N(y)$ and $Pr(L|N)$ of SOEs while maintaining the relatively low wage level of private firms.

These two counterfactuals will tell us how much the labor share of SOEs would fall/that of private firms would rise due to hierarchy choices.

Table 6: Labor shares by hierarchy layer: Actual and counterfactuals

Choices		Labor Share	
Hiring and hierarchy	Wages	SOE	Private
SOE	SOE	**36.4%**	50.9%
Private	SOE	18.5%	26.8%
SOE	Private	31.0%	43.6%
Private	Private	16.0%	**23.4%**

Note: This table displays the actual and counterfactual labor shares assuming differential hiring/hierarchy and wage choices for the subsamples of private firms and SOEs. The actual labors share are in bold for the respective subsamples.

Table 6 displays the result of these two counterfactuals. The actual labor share for SOEs is 36.4%. Counterfactually, imposing the private hiring and hierarchy choices would bring down their labor share to 18.5% – nearly halving their labor share! The converse impact of counterfactually giving private firms SOE hiring and hierarchy practices would bring their labor share from 23.4% to 43.6% – nearly doubling their labor share.

What if SOEs paid the same wages as private firms? Next, we consider the effect of the wage differentials between SOEs and private firms given a particular size and organizational structure. These counterfactuals maintain the hiring and hierarchy of SOEs but remove the wage premium paid by SOEs. The results can also be seen in Table 6. Just giving SOEs the wages of private firms means reducing the labor share from 36.4% to 31.0%. This is a reduction by 1/7th of their labor share, which is considerable, but a far cry from the reduction by 1/2 induced by the hiring/hierarchy counterfactual.

Likewise, calculating the labor share of private firms under the assumption of they paying SOE wages means increasing their labor share from 23.4% to 26.8%, which is an increase by 1/8th. Again, this pales in comparison to the previous labor share increase induced by the hiring/hierarchy choices, which doubled their labor share.

5 Conclusion and Outlook

This paper studies how internal organizational structure shapes productivity, wages, and factor shares in Chinese manufacturing firms. Using detailed data on professional titles from the 2004 Annual Survey of Industrial Production, we directly measure firm hierarchies and compare organizational choices between private firms and state-owned enterprises. Our analysis yields a stark contrast: private firms behave in line with standard theories of hierarchy – as firms grow, they add layers, and additional layers are associated with higher labor productivity and higher wages. In SOEs, by contrast, deeper hierarchies are systematically associated with lower labor productivity, despite substantially higher wages.

We document that this divergence is not driven merely by differences in scale or industry composition. Conditional on size, SOEs operate significantly more hierarchical layers than private firms and allocate disproportionately more workers to upper managerial ranks, resulting in narrower spans of control. We refer to these patterns as "premature layering" and "top-heavy layering," respectively. While hierarchical deepening in private firms appears to facilitate specialization, supervision, and knowledge utilization, additional layers in SOEs fail to deliver productivity gains and instead raise labor costs. As a result, the productivity gap between SOEs and private firms widens sharply with hierarchical depth.

These organizational distortions have important aggregate implications. Because wages rise with hierarchical complexity in SOEs while labor productivity falls, SOEs exhibit substantially higher labor shares than private firms. Our counterfactual exercises show that organizational choices account for the bulk of this gap: if SOEs were to hire and organize like private firms while maintaining their wage schedule, their aggregate labor share would fall by nearly half. In contrast, equalizing wages alone yields a much smaller effect. This evidence highlights internal organization as a quantitatively important and previously underexplored source of misallocation, complementing existing work on capital misallocation, ownership wedges, and size distortions in China.

More broadly, our findings suggest that the productivity consequences of hierarchy depend critically on the institutional environment in which firms operate. Theories that view hierarchies as an efficiency-enhancing response to scale implicitly assume profit-maximizing behavior and hard budget constraints. In settings where political objectives, soft financing, or personnel rules weaken these forces, hierarchical expansion may instead reflect bureaucratic incentives or managerial entrenchment, leading to organizational over-complexity and declining efficiency. Opening the "black box" of the firm is therefore essential for understanding both micro-level performance and aggregate productivity differences across ownership types.

Several avenues for future research emerge from this analysis. First, extending the analysis to a dynamic setting would shed light on how firms adjust hierarchies over time in response to shocks such as privatization, competition, or regulatory reform. Linked employer-employee data would allow researchers to study promotions, wage dynamics, and the reallocation of workers across layers. Second, integrating organizational choice into quantitative models of misalloca-

tion could improve our understanding of how internal distortions interact with external policy wedges. Third, it would be informative to examine whether similar patterns arise in other institutional contexts to assess the external validity of our findings – for instance, sectors that are close to government or tightly regulated (e.g., utilities and healthcare).

Overall, this paper shows that hierarchy is not merely a passive reflection of firm size but an active margin of distortion. In the case of Chinese SOEs, inefficient organizational design simultaneously depresses productivity and raises labor costs, contributing to high labor shares and aggregate inefficiency. Policies aimed at improving economic performance may therefore benefit not only from reallocating resources across firms, but also from reshaping incentives and organizational practices within firms.

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