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Capital Misallocation and State Ownership Policy in Vietnam*

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This paper examines capital misallocation of manufacturing firms in Vietnam during the period 2008–17. Three sources of capital misallocation are investigated: adjustment costs, uncertainty and policy distortions. The findings reveal the modest contribution of adjustment costs to total misallocation. In contrast, policy distortions account for 81 per cent of capital misallocation in Vietnam and lead to a total factor productivity gap of 110 per cent in the manufacturing sector relative to the undistorted first-best level. The paper examines one specific type of policy distortions – preferential treatments of state-owned enterprises – and finds that these policies cause a 38 per cent loss in aggregate manufacturing productivity.

I Introduction

Productivity differences account for most of the variation in cross-country per capita income (Klenow & Rodriguez-Clare, 1997; Hall & Jones, 1999; Acemoglu & Zilibotti, 2001). The recent literature is building the case that a significant fraction of total factor productivity (TFP) gaps are due to the 'misallocation' of productive resources across firms, particularly in developing countries (Hsieh & Klenow, 2009). Misallocation refers to the dispersion in marginal revenue product of inputs, which dampens aggregate productivity. The underlying assumption is that in the undistorted first-best level, firms with higher productivity should be allocated more capital and labour to the point where their (diminishing) marginal revenue product of inputs equalises that of lower productivity firms. For developing countries, the prevalence of misallocation sows hopes that the path of becoming more productive is not out of their reach: by reallocating production inputs more efficiently, these economies can substantially raise productivity and consequently incomes.

While the literature has identified resource misallocation as a cause of aggregate productivity losses, relatively few papers have tried to pin down the severity of different sources of misallocation in a unified framework. Misallocation can be broadly attributed to three distortionary sources: adjustment costs; informational uncertainty; and other 'distortions' stemming from economic institutions and policies, for example, picking winners or providing preferential treatments to state-owned enterprises (SOEs) (David & Venkateswaran, 2019). It is hard to implement

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policies to reduce productivity losses from misallocation without knowing the nature of these losses in the first place.

For capital inputs, adjustment costs arise from investment expenditures of the firm. *Internal* adjustment costs are related to the adjustment of capital and labour *within* the firm due to the installation of new capital equipment. Alternately, *external* adjustment costs arise when the installation of new capital equipment imposes costs that do not directly involve the firm's existing factors of production. Examples include the cost of hiring experts to implement the changes, or the high initial prices of new capital assets due to the price-skimming practice of capital-supplying firms.

Informational uncertainty refers to the imperfect knowledge about business fundamentals such as future profitability or productivity. Recent research suggests that uncertainty serves as a distortion on firms' investment activities. Bloom (2009), for instance, found that uncertainty caused firms to temporarily pause their investment and hiring, which stiffened efficient input reallocation across firms and in turn slowed down aggregate productivity growth.

Capital misallocation is also the result of other distortions stemming from economic policies and other institutional features (hereafter 'policy distortions'). For example, Guner *et al*. (2008) examined government policies that imposed restrictions on the size of large firms or promoted small ones, such as Japan's restrictions on the amount of physical space that a retailer may operate or the European Union's (EU) supports for small and medium-sized enterprises. The authors concluded that policies that reduced the average firm size by 20 per cent lowered output per firm by up to 26 per cent.

This paper contributes to the literature on capital misallocation in two ways. First, it is one of the few empirical studies able to pin down the severity of different sources of misallocation in a unified framework. The usual practice in the literature has been to analyse each specific source separately, which can lead to biased assessment because misallocation data often reflect a combined influence of multiple sources. Only recently have there been studies that analyse multiple distortionary sources in combination. Song and Wu (2015) combined adjustment costs and policy distortions to investigate capital misallocation in China, ignoring the role of uncertainty. David and Venkateswaran (2019) investigated the contributions of adjustment costs, uncertainty and policy distortions to capital misallocation in the US and China. However, they did not quantify the impact of any specific policy that resulted in such distortions.

Second, this paper takes advantage of a rich firm-level dataset to examine one specific type of policy distortions in Vietnam: preferential treatments of SOEs relative to non-state firms (hereafter 'state ownership policy'). Previous studies on the misallocation effect of state ownership policy, such as Bach (2019), have mostly examined this policy in isolation and failed to account for other sources of capital misallocation such as adjustment costs or uncertainty. To the best of the present author's knowledge, this is the first paper to quantify the impact of state ownership policy distortions on aggregate TFP in the presence of other sources of misallocation.

The paper addresses the following research questions:

- To what extent is capital misallocated in the Vietnamese manufacturing sector?
- What are the contributions of adjustment costs, uncertainty and policy distortions to total capital misallocation and aggregate TFP losses?
- Among different policy distortions, how does state ownership policy contribute to capital misallocation and aggregate TFP losses?

The findings reveal modest contributions of adjustment costs to total misallocation (1.1 per cent) and aggregate TFP losses (1.5 per cent). Uncertainty is found to cause a 35.4 per cent loss in aggregate TFP, which should not be surprising given that the studied period covers the Global Financial Crisis, the 2008 oil price shock and their aftermaths. The most severe source of capital misallocation, however, comes from policy distortions, accounting for 81 per cent of capital misallocation in Vietnam and causing an aggregate TFP loss of 110 per cent relative to the undistorted first-best level. Among different policy distortions, state ownership policy alone accounts for a significant 38 per cent loss in aggregate manufacturing TFP.

The remainder of the paper is structured as follows. Section II reviews the related literature on misallocation in general and state ownership policy distortions in particular. Section III provides a background of state ownership policy in

Vietnam. Section IV presents the theoretical motivation of the paper. Section V explains the identification strategy and parameterisation. Section VI describes the dataset and variable selection. Section VII discusses the results and robustness checks. Section VIII concludes.

II Related Literature

This paper relates to a growing body of literature on measuring the impacts of resource misallocation. The earliest works include Restuccia and Rogerson (2008) and Hsieh and Klenow (2009), who sought to quantify the overall effects of resource misallocation without analysing its different sources.

Another strand of the misallocation literature includes studies that examine a single source of misallocation. On adjustment costs, Cooper and Haltiwanger (2006) explained the observed non-linear correlation between investment and profitability found in plant-level data by developing a model that combines both convex and non-convex adjustment costs. Asker *et al.* (2014) studied intra-industry capital misallocation for 40 countries by using a standard investment model with adjustment costs. They found that industries with greater variability in productivity have a larger dispersion of the marginal revenue product of capital.

Regarding uncertainty, Bloom (2009) showed that this factor led to a temporary pause of firms' investment and hiring, which stalled efficient input reallocation across firms and thereby slowed down aggregate TFP growth. Bachmann and Elstner (2015) found that manufacturing firms systematically over- or under-predicted their production growth by a quarter. Larger and exporting firms were likely to have more realistic expectations while more leveraged firms were likely to have more optimistic expectations.

On policy distortions, Buera *et al.* (2013) demonstrated that well-intended policy interventions often had large negative long-term effects on aggregate productivity and output because they were difficult to change once in place. Buera and Fattal-Jaef (2018) found that policies on removing barriers to firm entry led to a persistent growth in TFP and a decrease in average firm size, while policies on addressing resource misallocation brought about more protracted TFP paths and a rise in average firm size.

Recent research has begun to shift attention towards analysing a combination of distortionary sources. Song and Wu (2015) investigated capital misallocation in China by combining adjustment costs and policy distortions, without accounting for the role of uncertainty. David and Venkateswaran (2019) investigated the role of adjustment costs, uncertainty and policy distortions on capital misallocation in the US and China, neglecting specific policies that may contribute to such distortions.

Further, the paper relates to the literature on state ownership policy distortions. Song *et al.* (2011) found that a key source of productivity losses was the misallocation of resources in manufacturing between private and SOEs in China. Bach (2019) used the general framework of Hsieh and Klenow (2009) to examine SOEs and capital misallocation in Vietnam, assuming away the presence of adjustment costs, uncertainty and other policy distortions.

III State Ownership Policy in Vietnam

SOEs have long been present in the Vietnamese economy. This enterprise form first appeared in Ordinance 104 in 1948 under the term 'national enterprise', which was defined as an enterprise owned and controlled by the nation. National enterprises were the main engine of the Vietnamese economy during the Vietnam War and were divided into state-owned farms and forest enterprises (in agriculture), SOEs (in the industry sector) and state-owned shops (in the service sector).

Later, SOEs continued to be given important roles during Vietnam's transition from a centrally planned economy to a 'socialist-oriented' market economy. In 1994, the state general corporations (GCs) were first established, with inspiration from the Japanese *keiretsus* and South Korean *chaebols*. In 1995, the first Law on SOE was introduced, which defined SOE as an economic organisation set up and managed by the state and whose business operations aimed at fulfilling the socio-economic objectives assigned by the state. According to this law, SOEs were to serve as the leading force of the economy.

In 2005, the government piloted the conversion of several strategic GCs into state economic groups (SEGs) with the aim of creating powerful domestic firms capable of competing with multinational enterprises (MNEs), in anticipation of the accession to the World Trade Organisation (WTO) in 2007.[1] By 2020, among the 10 largest enterprises in Vietnam by revenues, six are SEGs operating in the resources, utilities and information and communication technology (ICT) sectors (Thanh, 2019).

While viewing SOEs as the leading force of the economy, Vietnam has also been experimenting with the equitisation of these firms for the past three decades. The term 'equitisation' is adopted in legal documents and refers to both *minor* privatisation, in which the state owns the majority of shares in privatised SOEs, and *majority* privatisation, in which the state owns minor or no share in the privatised firms.

The equitisation of SOEs in Vietnam can be divided into three periods:

- Period 1 (1992–98) was the *experimenting* stage, with the government carrying out a pilot equitisation programme for small and medium-sized SOEs meeting the following criteria: (1) having profits; (2) non-strategic, meaning that the state did not need to own 100 per cent of charter capital; and (3) voluntary participation by the firms. The pilot programme lasted from 1992 to 1996 and aimed to equitise smaller, non-strategic SOEs before moving on to larger and more strategic firms. Due to its voluntary nature, the programme was able to equitise only five SOEs. From 1996 to early 1998, the government tried to expand the pilot equitisation programme; yet again the results were modest with only 28 firms being equitised among nearly 6000 existing SOEs at the time.
- Period 2 (1998–2007) was the *accelerating* stage, marked by the introduction of Decree 44/1998 on the transformation of SOEs into shareholding companies. This Decree removed the voluntary nature of previous equitisation programmes and classified SOEs into three groups based on their strategic importance to the state. The first group included SOEs of strategic importance over which the state retained full ownership and control. The second group contained strategic SOEs in which the state retained dominant or special shares after equitisation. The third group included the remaining non-strategic SOEs which were the main subjects of equitisation (see Appendix S1 in the additional supporting information for a more detailed list of key equitisation policies in this period). As a result, more than 80 per cent of the total number of SOEs were equitised during Period 2. Yet, these equitised firms altogether accounted for less than 10 per cent of total state-owned capital (Doan, 2011).
- Period 3 (2008–present) is the *backsliding* stage, with a marked decline in the number of equitised firms. Only 692 SOEs were equitised between 2008 and 2017, less than 18 per cent of the number of equitisation in Period 2 (Nguyen & Trinh, 2019). This was because while the first 15 years of equitisation dealt mostly with small-scale and non-strategic SOEs, equitisation in Period 3 involved large and strategic SOEs with multiple lines of business and in which the state decided to retain dominant or special shares after equitisation. The valuation of these SOEs was often prolonged due to disagreement between the firms' board of directors and the valuation organisations (Le *et al.*, 2020). Further, as the majority of profitable SOEs had been equitised in previous periods, the remaining loss-making SOEs found it hard to attract investors interested in their initial public offerings.

Overall, three points should be noted about state ownership policy in Vietnam:

- The government has never given up on the idea that SOEs should play a 'leading role' in the economy. The incessant faith in SOEs was reflected in the fact that after three decades of equitisation and market-oriented reforms, just over 10 per cent of total state-owned capital in these enterprises was replaced with private investment.
- With their mission to become the leading force of the economy, SOEs have been granted preferential treatment over domestic private firms. In 2017, SOEs made up 0.5 per cent of the total number of firms, employed 9 per cent of the labour force, but held 29 per cent of total assets in the economy (Tu, 2019). Compared with domestic private firms, SOEs have preferential access to credit and foreign currencies

[1] There are six criteria that a GC must meet to become an SEG: (1) having profits for three consecutive years preceding the year when it is selected; (2) having its financial status assessed by the firm's owner as being at a safe level; (3) having a higher labour productivity than the average levels of other enterprises in the same sector; (4) possessing advanced equipment and technologies and having sound management practices; (5) effectively managing its shares and capital contributions in other enterprises; and (6) having international operations.

from the Vietnam Development Bank and the four state-owned commercial banks, which are the largest financial institutions in the country. The state also allocated or leased out prime-location land to these corporations at much lower prices than the prevailing market price, which SOEs could in turn use as collateral to obtain even more bank loans.

- Different from domestic private firms, SOEs do not see profit maximisation as the ultimate objective. In periods of high inflation, for example, the government often attempts to reduce the sale prices of essential commodities such as electricity and petroleum below their marginal costs via its guidance of the Vietnam Electricity (EVN) and the Vietnam National Petroleum Group (Petrolimex). In addition, to maintain social equality, the government directs SOEs to invest in poor, remote or mountainous areas despite the high costs and low profit expectations.

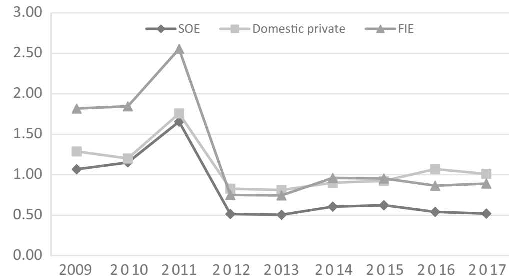
The above points mean that state ownership policy is a potential source of capital misallocation. This can be seen in Figure 1, which shows that SOEs' average revenue product of capital is about half the values for domestic private firms and FIEs in recent years, while the average capital stock per firm is the highest among the three ownership forms. The following section therefore introduces a theoretical framework to examine the impact of Vietnam's state ownership policy on the country's aggregate manufacturing TFP during Period 3 of equitisation, taking into account other sources of capital misallocation.

IV *Theoretical Framework*

The framework for examining state ownership policy and other sources of capital misallocation is an extension of the main model in David and Venkateswaran (2019). The framework allows for both capital distortions and labour distortions of the same nature to be present in the firm's optimal investment problem. Further, different from David and Venkateswaran, who did not look into any specific policy distortion driving the misallocation of capital, this paper quantifies the distortionary impacts of state ownership policy in Vietnam, taking into account other sources of misallocation.

The model features a discrete-time, infinite-horizon economy populated by a representative household and a continuum of firms of fixed measure one that produce intermediate goods

FIGURE 1
Average Revenue Product of Capital by Ownership Forms.



Source: Author's compilation from the Vietnam Enterprise Surveys (VES) 2009–17.

using capital and labour according to a Cobb–Douglas technology:

$$Y_{it} = K_{it}^{\hat{\alpha_1}} N_{it}^{\hat{\alpha_2}}, \ \hat{\alpha_1} + \hat{\alpha_2} \leq 1 \tag{1}$$

Intermediate goods are used to produce a single final good according to the constant elasticity of substitution (CES) aggregator:

$$Y_t = \left(\int \hat{A}_{it} Y_{it}^{\frac{\theta-1}{\theta}} di \right)^{\frac{\theta}{\theta-1}}, \tag{2}$$

where $\theta \in (1, \infty)$ is the elasticity of substitution between intermediate goods; and $\hat{A}_{it}$ represents a firm-specific idiosyncratic component in production/demand. $\hat{A}_{it}$ is assumed to be the source of *uncertainty* in the economy.

Applying the cost minimisation condition and Shephard's Lemma to (2) yields the demand function for intermediate good i:[2]

$$Y_{it} = P_{it}^{-\theta} \hat{A}_{it}^{\theta} Y_t$$

$$P_{it} = \left(\frac{Y_{it}}{Y_t} \right)^{-\frac{1}{\theta}} \hat{A}_{it} \tag{3}$$

[2] Appendix S2 in the additional supporting information contains the proof.

where P_{it} means the relative price of good i in terms of the numeraire final good. From (1) and (3), we have the revenues for firm i at time t:

$$P_{it}Y_{it} = Y_t^{\frac{1}{\theta}}\hat{A}_{it}Y_{it}^{1-\frac{1}{\theta}} = Y_t^{\frac{1}{\theta}}\hat{A}_{it}K_{it}^{\alpha_1}N_{it}^{\alpha_2}, \quad (4)$$

where:

$$\alpha_j = \left(1 - \frac{1}{\theta}\right)\hat{\alpha}_j,\ j = 1, 2.$$

(i) Input Choices

At the end of each period, firms choose investment in new capital, which becomes available for production in the following period. Gross investment is given by $I_{it} = K_{it+1} - (1-\delta)K_{it}$, where δ denotes depreciation rate. Investment is also subject to quadratic *adjustment costs* – the costs associating with the level of newly installed capital:

$$\phi(K_{it+1}, K_{it}) = \frac{\hat{\xi}}{2}\frac{I_{it}^2}{K_{it}} = \frac{\hat{\xi}}{2}\left(\frac{K_{it+1}}{K_{it}} - (1-\delta)\right)^2 K_{it},$$

where $\hat{\xi}$ represents the severity of adjustment costs. The underlying idea is that abrupt changes in the level of newly installed capital create disproportionately higher costs of adjustment for businesses.

Labour is assumed to experience the same distortion as capital. Firms hire labour period by period in a spot market at a competitive wage W. Gross payment to hire incremental labour is given by:

$$M_{it} = WN_{it+1} - (1-\delta)WN_{it},$$

where δ denotes the employee turnover rate. Labour investment is subject to quadratic adjustment costs similar to capital investment:

$$W\phi(N_{it+1}, N_{it}) = \frac{\hat{\xi}}{2}\frac{M_{it}^2}{WN_{it}} = \frac{\hat{\xi}}{2}W\left(\frac{N_{it+1}}{N_{it}} - (1-\delta)\right)^2 N_{it},$$

where $\hat{\xi}$ represents the severity of adjustment costs; and WN_{it} indicates gross wages. The underlying idea is that abrupt changes in the amount of labour cause disproportionately higher costs of adjustment, for example, the costs of training new employees or changing corporate governance structure.

Besides adjustment costs and uncertainty, investment decisions are also affected by policy distortions such as taxes, size-restriction regulations, or preferential treatments to certain regions or firm ownership forms. Following Hsieh and Klenow (2009), these distortions are modelled as firm-specific proportional taxes on the flow cost of capital and labour, denoted T_{it+1}. The firm's dynamic optimisation problem in a stationary equilibrium can be represented in recursive form as:

$$\begin{aligned} F(K_{it}, N_{it}, \aleph_{it}) = \max_{K_{it+1}, N_{it+1}} & E_{it}[Y_t^{\frac{1}{\theta}}\hat{A}_{it}K_{it}^{\alpha_1}N_{it}^{\alpha_2}] \\ & - E_{it}[T_{it+1}K_{it+1}(1-\beta(1-\delta)) + \phi(K_{it+1}, K_{it})] \\ & - E_{it}[T_{it+1}WN_{it+1}(1-\beta(1-\delta)) + W\phi(N_{it+1}, N_{it})] \\ & + E_{it}[\beta F(K_{it+1}, N_{it+1}, \aleph_{it+1})] \end{aligned} \quad (5)$$

where E_{it} [.] denotes the firm's expectations, conditional on its information set at the time of making period t investment choices, denoted $\aleph_{it}$; β is the discount rate; and βW is the present discounted value of wages. Since the wedge T_{it+1} distorts both capital and labour investment, it affects the stock of capital and labour but not the capital-to-labour ratio.[3]

Using the conjecture method with $N_{it+1} = \eta K_{it+1}$, the firm's dynamic optimisation problem can be rewritten as:

$$\begin{aligned} \tilde{F}(K_{it}, \aleph_{it}) = \max_{K_{it+1}} & E_{it}[GA_{it}K_{it}^{\alpha} \\ & - T_{it+1}K_{it+1}(1-\beta(1-\delta)) \\ & - \phi(K_{it+1}, K_{it})] + \beta E_{it}\left[\tilde{F}(K_{it+1}, \aleph_{it+1})\right] \end{aligned} \quad (6)$$

where $\alpha = \alpha_1 + \alpha_2$ is the curvature of operating profits (value-added net of wages); $A_{it} = \hat{A}_{it}$ represents firm productivity;

$$G = \frac{\eta^{\alpha_2}Y^{\frac{1}{\theta}}}{1 + W\eta}$$

[3] For robustness check, the paper considers a simpler model with only capital distortions, in which case T_{it+1} affects both the level of capital and the capital-to-labour ratio.

captures the effects of aggregate variables, with:[4]

$$\eta = \frac{\alpha_2}{W\alpha_1}$$

(ii) Stationary Equilibrium

Solving for the stationary equilibrium in this economy entails identifying: (1) a set of value and policy functions, $F(K_{it}, \aleph_{it})$, $N_{it}(K_{it}, I_{it})$, $K_{it+1}(K_{it}, I_{it})$; (2) a wage W; and (3) a joint distribution over (K_{it}, I_{it}) such that (a) taking as given wage W and I_{it}, the value and policy functions solve the firm's optimisation problem; and (b) the labour market clears.

(iii) Adjustment Costs

The presence of quadratic adjustment costs means that there is no exact solution. The model is solved using a perturbation method. The log-linearised Euler equation of investment has the following form:

$$k_{it+1}((1+\beta)\xi + 1 - \alpha) = E_{it}[a_{it+1} + \tau_{it+1}] + \beta\xi E_{it}[k_{it+2}] + \xi k_{it}, \tag{7}$$

where lowercase variables denote natural logs of the corresponding uppercase variables, for example, $k_{it+1} = lnK_{it+1}$. ξ and $\tau$are rescaled and natural-log versions of the *adjustment cost* parameter, $\hat{\xi}$, and the distortion, T_{it+1}, respectively.

(iv) Policy Distortions

The distortion τ_{it} is assumed to be jointly normal with the natural logs of productivity, a_{it}. As common in the literature on firms' investment dynamics, firm-specific productivity A_{it} is assumed to follow an AR(1) process with normally distributed i.i.d innovations σ_μ^2 :

$$a_{it} = \rho a_{it-1} + \mu_{it}, \quad \mu_{it} \sim N(0, \sigma_\mu^2) \tag{8}$$

Distortion has the following representation:

$$\tau_{it} = \gamma a_{it} + \varepsilon_{it} + \chi_i, \quad \varepsilon_{it} \sim N\left(0, \sigma_\varepsilon^2\right), \chi_i \sim N\left(0, \sigma_\chi^2\right)$$

where γ indexes the extent to which distortion is correlated with firm productivity (correlated distortion), while ε_{it} andχ_i are uncorrelated with $a_{it}.t$. If $\gamma < 0$, the distortion discourages (encourages) investment by more (less) productive firms – arguably, the empirically relevant case. The opposite is true if $\gamma > 0$. ε_{it} captures transitory distortion, while χ_i is firm-specific distortion that is uncorrelated with productivity. For the purpose of measuring the distortionary impacts of state ownership policy, χ_i is the main factor of interest. The severity of correlated, transitory and permanent distortions is summarised by three parameters: $(\gamma, \boldsymbol{\sigma}_\varepsilon^2, \boldsymbol{\sigma}_\chi^2)$.

(v) Uncertainty

The information set $\aleph_{it}$ of the firm at the time of choosing period t investment includes the history of past productivity up to period t. Since productivity is assumed to follow an AR(1) process, this history can be summarised by the most recent observation a_{it}. The firm also observes a noisy signal of future productivity/demand:

$$s_{it+1} = \mu_{it+1} + e_{it+1}, \quad e_{it+1} \sim N(0, \sigma_e^2)$$

where e_{it+1} is an i.i.d, mean zero and normally distributed 'news shock' that contains information about the following period's productivity/demand. Finally, firms are assumed to be able to observe the transitory distortions ε_{it+1} and the fixed component χ_i at the time of choosing period t investment.

The firm's information set is given by $\aleph_{it} = (a_{it}, s_{it+1}, \varepsilon_{it+1}, \chi_i)$. Applying Bayes' rule to obtain the conditional expectation of future productivity a_{it+1} :

$$a_{it+1}|\aleph_{it} \sim N(E_{it}[a_{it+1}], V)$$

where

$$E_{it}[a_{it+1}] = \rho a_{it} + \frac{V}{\sigma_e^2} s_{it+1}; \; V = \left(\frac{1}{\sigma_u^2} + \frac{1}{\sigma_e^2}\right)^{-1}$$

The measure of *uncertainty*, V, has a one-to-one mapping with the quality of future news about productivity/demand. In the absence of any useful news, that is, $\sigma_e^2 \to \infty$, $V = \sigma_u^2$, or the firm has no idea about future shocks to productivity/demand. On the contrary, with full information ($\sigma_e^2 \to 0$), $V = 0$ and the firm is perfectly informed about μ_{it+1} and $E_{it}[a_{it+1}] = a_{it+1}$.

(vi) Aggregation

Aggregate output can be expressed as:

$$\log Y = y = a + \alpha_1 k + \alpha_2 n,$$

[4] Appendix S3 in the additional supporting information contains the detailed proof.

where k and n represent the logs of aggregate stock of capital and labour inputs, respectively.

In addition, the firm's optimisation problem shown in (5) can be rewritten into (6), which is essentially the optimisation problem in the main model of David and Venkateswaran (2019), but with different conjecture and parameter values:

$$N_{it} = \eta K_{it},\ \eta = \frac{\alpha_2}{\alpha_1 W}$$

Applying their results to the model in this paper using $N_{it} = \eta K_{it}$ and $\eta = \frac{\alpha_2}{\alpha_1 W}$, one can obtain aggregate TFP, denoted a:

$$a = a^* - \frac{1}{2}\theta\sigma^2_{arpk},\ \frac{da}{d\sigma^2_{arpk}} = -\frac{\theta}{2}$$

where a^* is the undistorted first-best level of aggregate TFP in the absence of all distortions; that is, $\sigma^2_{arpk} = 0$.[5]

V Identification Strategy

The paper explores the sources of capital misallocation, measured as average revenue product of capital (*arpk*) dispersion, within a unified framework combining adjustment costs, uncertainty and policy distortions. The strategy follows insights from David and Venkateswaran (2019), which matched the unobserved five distortionary sources (adjustment costs, uncertainty, correlated, transitory and permanent policy distortions) with the five observed statistical moments: (1) investment variance; (2) investment autocorrelation; (3) the correlation of investment with past productivity; (4) the covariance of *arpk* with productivity; and (5) the variance of *arpk*. The underlying idea is that while each moment is influenced by multiple distortionary sources, these sources do not have similar effects on *all* moments. For example, although increases in adjustment costs and correlated policy distortions both lower investment variance (moment (1)), an increase in the former raises investment autocorrelation while more severe correlated distortions dampen investment autocorrelation (moment (2)). The use of multiple moments therefore allows for more precise measure of the impacts of different sources of misallocation than that of single moment as in most previous studies.

(i) State Ownership Policy

Permanent policy distortions often include policies that favour certain ownership forms, regions or priority sectors. One should note that the term 'permanent' is used with respect to the time period of the study, in this case 2008–17. Without a time frame, it is most likely that no policy can be considered permanent.

Since permanent distortions are matched with the variance of *arpk* (σ^2_{mrpk}), the contribution of state ownership policy to overall permanent distortions can be proxied by the contribution of state ownership status to σ^2_{mrpk}. In other words, if *arpk* is expressed as a function of state ownership status, denoted *ownership*, and remaining terms, $\boldsymbol{X}$:

$$arpk_{it} = \alpha ownership_i + \boldsymbol{X}$$

The variance σ^2_{arpk} can then be expressed as:

$$\sigma^2_{arpk} = \left[\alpha^2\sigma^2_{ownership} + 2\alpha Cov(ownership, \boldsymbol{X})\right] + \sigma^2_X$$

or

$$1 = \frac{\left[\alpha^2\sigma^2_{ownership} + 2\alpha Cov(ownership, \boldsymbol{X})\right]}{\sigma^2_{arpk}} + \frac{\sigma^2_X}{\sigma^2_{arpk}}$$

The first term on the righthand side is the contribution of state ownership status in σ^2_{mrpk}, and can be measured as:

$$\frac{\left[\alpha^2\sigma^2_{ownership} + 2\alpha Cov(ownership, \boldsymbol{X})\right]}{\sigma^2_{arpk}} = 1 - \frac{\sigma^2_X}{\sigma^2_{arpk}}$$

While it is difficult to measure the lefthand term directly, the righthand term can be easily captured through regressing *arpk* on ownership status and obtaining the variance of the residual (σ^2_X). Since σ^2_{arpk} is observable from the dataset,

$$1 - \frac{\sigma^2_X}{\sigma^2_{arpk}}$$

can be measured and used as the proxy for the contribution of state ownership policy to overall permanent distortions.

[5] *arpk* denotes average revenue product of capital. Under a Cobb–Douglas production assumption, *arpk* is proportional to the marginal revenue product of capital.

(ii) Parameterisation

The paper sets a period length of one year because the data arrive annually and assume a constant discount factor $\beta = 0.95$ and an annual depreciation rate $\delta = 0.10$ as standard in the misallocation literature (Hsieh & Klenow, 2009). The capital depreciation rate and employee turnover rate are assumed to be the same to facilitate the transition from a dynamic optimisation problem with two variables K and N in Equation (5) to a more tractable problem with only variable K in Equation (6). In the main model, the elasticity of substitution is set at $\theta = 3$, similar to what was used for China and India by Hsieh and Klenow (2009). For robustness checks, the paper also uses $\theta = 6$, as in David and Venkateswaran (2019).

In addition, the labour's share of payments to factors of production is measured as the average share of total labour compensation in total manufacturing value-added during the period 2008–17 and equals $\hat{\alpha}_2 = 0.60$. Capital's share is calculated as the residual of labour's share,$\hat{\alpha}_1 = 1 - \hat{\alpha}_2 = 0.40$, as in Bai *et al.* (2006).

The persistence of productivity, ρ, and the volatility of productivity shocks, σ_μ^2, are estimated from the autoregressive Equation (8), controlling for industry-year fixed effects. The log of firm-level productivity can be directly computed as $a_{it} = va_{it} - \alpha k_{it}$.

To estimate adjustment costs ($\hat{\xi}$), uncertainty (V), correlated distortions (γ), transitory distortions (σ_ε^2) and permanent distortions (σ_χ^2), the paper targets the five moments as described in the previous section: (1) investment variance; (2) investment autocorrelation; (3) the correlation of investment with past productivity; (4) the covariance of *arpk* with productivity; and (5) the variance of *arpk*. Since unobserved firm-level fixed effects have been shown to affect firm-level investment data, investment *growth* rates are used instead of levels in the empirical analysis.

The impact of state ownership policy on aggregate productivity is estimated in several steps: (1) regressing *arpk* on an ownership dummy using a random-effect regression to extract the residual; (2) calculating the variance of the residual; (3) the proportional impact of state ownership policy in permanent distortions is calculated as 1 minus the ratio of residual variance over *arpk* variance; and (4) multiplying the proportional impact of state ownership policy in permanent distortions with the impact of permanent distortions on aggregate productivity.

The parameters are estimated via the moment matching technique (MM) developed by McFadden (1989). MM uses simulations to find moments as a function of model parameters, instead of trying to solve the moment conditions analytically as does the classical method of moments. For this paper, MM is selected because there is no analytical mapping from moments to parameters in the model. The strategy is to search over the parameter vector (ξ, V, γ, σ_ε^2, σ_χ^2) to minimise the equally weighted distance between the simulated values and observed values for the targeted moments.

VI Data

The data on Vietnamese manufacturing firms are from the annual Vietnam Enterprise Surveys (VES) conducted by the General Statistics Office (GSO). The paper uses data spanning the period 2008–17, which corresponds to Period 3 of SOE equitisation in Vietnam. In this period, the remaining SOEs were mostly large in size and operated in what the state deemed as strategic sectors. Therefore, the state often exerted dominant influence over these firms even after majority privatisation.

The VES provides the most comprehensive and authoritative firm-level survey in Vietnam, covering all SOEs and FIEs as well as domestic private firms exceeding certain employment thresholds. For domestic private firms below the employment thresholds, a subsample is selected based on stratified random sampling across sectors and provinces (see Appendix S4 in the additional supporting information). All registered firms, if selected, are required to participate in the VES according to Statistics Law 2015.

The paper measures nominal firm-level capital stock in each period as the year-end value of physical assets, for example, buildings, tools and machinery. The real value of capital stock is calculated as nominal capital divided by capital deflators. Capital deflators are computed by dividing the value of gross fixed capital formation at current prices by that at 2010 constant prices.

Real value-added is measured as the difference between real output and real intermediate inputs. Under the double-deflator method, gross output and intermediate inputs are deflated using different deflators. Real output is computed through deflating gross outputs by the 2010 baseline producer price index of industrial products at the two-digit Vietnam Standard Industrial

Classification (VSIC) level from the GSO. Following Athukorala and Nguyen (2021), the deflator for each sector's intermediate inputs is computed as the weighted shares of the deflators of products used as intermediate inputs in that sector. The weighted shares are calculated using the 2012 Input–Output table, where the 164 sectors are aggregated.

Under a Cobb–Douglas production assumption, the marginal revenue product of capital is measured by subtracting the log of real capital inputs from the log of real value-added and adding the log of the constant term α. Net investment growth and productivity growth are computed by first differencing the log of real capital and the log of TFP, respectively. In addition, the paper extracts the industry-by-year fixed effects from net investment growth and productivity growth and use the residuals of each series. This is equivalent to the assumption that all firms within a five-digit manufacturing industry operate identifiable production technologies and have identical mark-ups.

Further, firms with missing or negative data on value-added, capital or labour inputs are excluded from the sample. The paper also removes duplicate observations and outliers, which includes eliminating firms with annual investment growth rate of more than 100 per cent in absolute values and trimming the 3 per cent tails of *arpk* series. The final sample contains 76,988 firm-year observations.

VII Results

(i) Main Results

The main results are shown in Table 1. The top panel displays the parameter estimates. The second panel reports the contribution of each distortionary source to dispersion in *arpk*, denoted $\Delta\sigma^2_{arpk}$. The third panel expresses the contribution as a percentage of the total *arpk* dispersion measured in the data, denoted:

$$\frac{\Delta\sigma^2_{arpk}}{\sigma^2_{arpk}}.$$

Because of the approximation method and possible measurement error, these relative contributions do not necessarily sum to 1. Finally, the bottom panel of Table 1 computes the implied losses in aggregate TFP stemming from each factor relative to the undistorted first-best level ($\Delta a = a^* - a$).

Overall, distortions create a productivity gap of 147 per cent relative to the undistorted first-best level, meaning that productivity can more than double the current level if capital is efficiently allocated. Among the difference sources of misallocation, adjustment costs and transitory policy distortions play a relatively modest role, accounting for 1.1 per cent and 0 per cent of total capital misallocation. This translates to a negligible TFP loss of 1.5 per cent and 0 per cent relative to the first-best level. Uncertainty makes up 26.1 per cent of capital misallocation and causes a TFP loss of 35.4 per cent. This is not surprising as the studied period covers the Global Financial Crisis, the 2008 oil shock and their aftermaths.

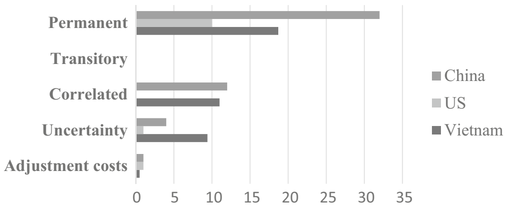
The largest source of capital misallocation in Vietnam comes from policy distortions, particularly correlated and permanent distortions. The former account for 36.9 per cent of total

TABLE 1
Sources of Capital Misallocation

			Distortions			
	Adjustment costs	Uncertainty	Correlated	Transitory	Permanent	State ownership policy
Parameters	ξ	V	γ	σ^2_ε	σ^2_χ	$\frac{\sigma^2_{ownership}}{\sigma^2_\chi}$
	0.07	0.24	–0.64	0.00	0.40	0.64
$f\Delta\sigma^2_{arpk}$	0.01	0.24	0.33	0.00	0.40	
$\frac{\Delta\sigma^2_{arpk}}{\sigma^2_{arpk}}$	1.1%	26.1%	36.9%	0.0%	43.9%	
$\boldsymbol{\Delta a}$	1.5%	35.4%	50.2%	0.0%	59.7%	38.2%

Source: Author's compilation.

Figure 2
Comparisons of Total Factor Productivity (TFP) Losses from Misallocation (%).



Source: Author's compilation.

misallocation and generate a TFP gap of 50.2 per cent relative to the first-best level. Permanent distortions are even worse, making up 43.9 per cent of total misallocation and causing a TFP loss of 59.7 per cent. These figures should be alarming to Vietnamese policymakers.

Further, among many possible policy distortions, state ownership policy alone makes up 64 per cent of permanent distortions and accounts for 38.2 per cent loss of manufacturing TFP relative to the first-best level. This indicates the urgency of reforming SOEs and letting these firms operate according to market principles.

(ii) International Benchmarking

To ensure that the results remain robust to different specifications, the paper estimates the model with only capital distortion and elasticity of substitution $\theta = 6$ as in David and Venkateswaran (2019). Further, outcomes for Vietnam are benchmarked against the results for China and the US from their study (Fig. 2). It should be noted that the time period for China and the US is from 1998 to 2009, while that for Vietnam is from 2008 to 2017.

From Figure 2 it is clear that assuming away distortions in the labour market greatly reduces the magnitude of misallocation sources. For example, with distortions in the labour market, correlated and permanent distortions cause TFP losses of 50.2 per cent and 59.7 per cent, respectively, in Vietnam. In Figure 2, however, these two distortionary sources generate respective TFP losses of 11 per cent and 18.7 per cent relative to the first-best level.

Among the three countries, China incurs the highest TFP losses from capital misallocation. Its largest source of misallocation comes from permanent policy distortions, suggesting that China's state ownership policy and its picking-winner industrial policy distort the efficient allocation of capital. In contrast, the US is the most efficient economy in the benchmarking group, with TFP loss from permanent policy distortions less than a third that of China.

For Vietnam, while the magnitudes of distortions differ from those in Table 1, the implications stay the same. Adjustment costs and transitory distortions cause a negligible TFP losses of 0.5 per cent and 0 per cent, respectively. The largest source of capital misallocation comes from policy distortions, which altogether account for 80 per cent of capital misallocation and leads to a 28.7 per cent loss of aggregate manufacturing TFP. In addition, Vietnam has higher TFP loss from informational uncertainty than China and the US, suggesting the presence of higher barriers to information for firms in Vietnam.

(iii) Correcting for Measurement Error

The book-value measure of capital and the Cobb–Douglas assumption for calculating *arpk* indicate potential measurement error in the main results of this paper. To address this issue, the paper follows Bils *et al.* (2021) in estimating the following model:

$$\Delta rva_{it} = \phi mrpk_{it} + \psi \Delta k_{it} - \psi(1-\lambda) mrpk_{it}.\Delta k_{it} + D_{jt} + \varepsilon_{it}$$

where Δva_{it} and Δk_{it} represent respective changes in log real value-added and log real capital; D_{jt} indicates industry-year fixed effects; and $mrpk_{it}$ is the log of the marginal revenue product of capital. In this model, λ represents the ratio of the true σ^2_{mrpk} to the observed σ^2_{mrpk}. Estimation result shows that $\lambda = 0.82$ in Vietnam, suggesting that 18 per cent of the observed σ^2_{mrpk} can be accounted for by additive measurement error. Therefore, the lower bound for state ownership policy distortion is 0.82*0.382 = 31.3 per cent loss of aggregate TFP relative to the first-best level.

VIII Conclusions

This paper has examined the misallocation of capital among manufacturing firms in Vietnam during the period 2008–17 and how state ownership policy contributed to such misallocation. The findings reveal that capital is significantly misallocated in Vietnam's manufacturing sector. Altogether, distortions create a TFP gap of 147 per cent relative to the undistorted first-best level, meaning that productivity can more than double the current level if capital is efficiently allocated. Among the difference sources of misallocation, policy distortions play a major role, accounting for 81 per cent of capital misallocation in Vietnam and a TFP gap of 110 per cent relative to the first-best level. State ownership policy alone accounts for a 38 per cent loss of aggregate productivity in the country's manufacturing sector. While it is unlikely that the first-best level can ever be achieved, the severity of TFP losses due to state ownership policy highlights the urgency of reforming current SOEs and ensuring a level-playing field regardless of ownership forms.

The paper seeks to contribute to the literature on capital misallocation in two ways. First, it is one of the few empirical studies able to pin down the severity of different sources of misallocation in a unified framework. Second, the paper, to the best of the author's knowledge, provides the first study to quantify the impact of state ownership policy distortions on aggregate productivity in the presence other distortionary sources.

Furthermore, this paper leaves ample room for future research. A potential direction is to improve upon the current theoretical framework. For example, to turn the dynamic optimisation problem with two variables K and N in Equation (5) into a more tractable problem with only variable K in Equation (6), this paper assumes the capital depreciation rate and employee turnover rate to be the same. In reality, these two rates are different, and future papers can try to relax this rather strict assumption. In addition, the AR(1) assumption of productivity processes in this paper imply that persistence ρ and shock variability σ_μ^2 do not depend on past values and are identical across firms. A better approach is to model productivity dynamics to be non-linear and non-Gaussian as in Fella *et al*. (2021). Regarding SOEs, future research can try to model these firms explicitly pursuing other targets other than profit maximisation, thereby creating resource misallocation.

Another promising direction is to investigate how labour market rigidity leads to labour misallocation and aggregate productivity losses. For example, India's 1947 Industrial Disputes Act required companies to seek government approval to fire employees or to shut down – a bureaucratic process that often takes years and disincentivises entrepreneurs to formally register new firms and hire additional workers. In 2021, the Indonesian government introduced the Jobs Creation Law aiming to reduce labour market rigidity, which created a nationwide protest from students and labour unions. To what extent such policies affect aggregate productivity is an important question for policymakers and academics alike, and is a promising avenue for future research.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Key policies on SOE equitisation in Vietnam.

Appendix S2. Derivation of demand function.

Appendix S3. Solution to the firm's dynamic optimisation problem.

Appendix S4. Coverage of the VES during 2008-2017.

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