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Capital diversion in Vietnamese state-owned enterprises*

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Abstract

We consider the capital productivity of a panel data set of 10,200 Vietnam state-owned enterprises over the period 2010-2018, using a stochastic frontier production modelling. We discover there exists an overutilization of the physical capital and more importantly, diversion of the capital stock. This diversion may be due to a waste of capital stocks or to a special form of bribery we call "hidden overhead". The very high diversion rate, 69% on average, calls for a profound reform of the sector.

Keywords: Productivity; stochastic production frontier; hidden overhead
JEL: E20, O53, P20

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1 Introduction

When the Vietnam War ended in April 1975, Vietnam was one of the poorest country in the world. By the mid-1980s, Vietnam GDP per capita was stuck between 200 USD and 300 USD. In recent years, Vietnam is one of the important emerging economies with growth of 6-7% and a GDP per capita around $2,000$ USD in 2017. The volume of goods trade is around 200% of the GDP. This shows Vietnam economy is very open. The important question is how Vietnam economy can go further.

Nguyen Van Thang and Freeman (2009) showed there is a negative correlation between State-Owned Enterprise (SOE) growth and private sector growth. There is an evidence that SOEs are 'crowding-out' the private sector in Vietnam. Similarly, Nguyen Thu Thuy and Van Dijk (2012) found that corruption hampers the growth of Vietnam's private sector but is not detrimental for growth in the state sector. For Yoshino (2018), if the Vietnamese government has made efforts for several years to promote the reform of SOEs, this process cannot be completed since will be required the introduction of regulations and systems to correct opaque financial situation and management techniques of SOEs. Nguyen Ngoc Anh et al. (2016) showed that corruption generally has a negative effect on economic growth and that investment is the most important transmission channel. For Vietnam, the authors quantified that investment accounts for about 63% of the total effect.

Previous studies on the misallocation effect of state ownership policy in Vietnam, such as Bach Ngoc Thang (2019), modeled capital misallocation effect as the difference between actual TFP and efficient TFP (when distortions are absent). Bach Ngoc Thang (2019) found that commercial and subsidized credit can reduce a capital distortion for all firms, but awarding more commercial and subsidized credit to the SOEs, compared to private firms, mitigates this reduction effect.

In the same vein, Le Phan (2022) calculated caipital miallocation effect as the difference between actual TFP and the undistorted first-best level of aggregate TFP in the absence of all distortions. Le Phan (2022) underlined that the most severe source of capital misallocation comes from policy distortions (besides adjustment costs and uncertainty), accounting for 81% of capital misallocation in Vietnam and causing an aggregate TFP loss of 110% compared to the undistorted level. Moreover, among different policy distortions, state ownership policy accounts for 38% of loss in aggregate manufacturing TFP.

In this paper, we consider a "wasteful" use of capital in Vietnamese SOEs and model it as the distance from the actual production to the production frontier by applying the well-known literature on stochastic production frontier. Even if we do not provide explanation for this capital diversion, our paper is much in the spirit of the literature on lobbying for protection by Ngo Van Long and coauthors (Ngo Van Long and Soubeyran, 1996, Hillman et al. 2001, 2003), following that less efficient firms invest their resource to lobbying for protection measures (like tariff). In this case, we can say that part of firm capital is diverted into "political capital".

We use a census conducted over the period 2010-2018 by the General Statistics Office (GSO) of Vietnam. In this census we have the data of 10,200 SOEs concerning the values of their outputs, their capital stocks and the labor costs. The average value of the ratios [Value of the capital stock/Labor cost] is 42.07. The Vietnam average real interest rate in 2013-2018 is 5.19%.[1] If we take the capital depreciation rate equal to 0.05, the average value of the ratio [Investment cost/labor cost] is therefore

$$(0.052 + 0.05) \times 42.07 = 4.29.$$[2]

We now consider the profit rates of these SOEs. The profit rate $r(\pi)$ is defined by

$$r(\pi) = \frac{\text{value of the revenue - investment cost - labour cost}}{\text{value of the revenue}}.$$

There are $9,030$ SOEs (about 77% of observations) that made positive profit (the average profit rate is positive and equals 1.85%). Their ratio [Investment cost/labor cost] equals 25.59 on average. The mean of their capital coefficient (i.e. ratio between capital and output) is 165.41 which is quite high. The remaining 2,621 firms with a negative profit (their average profit is -11.77%) have a much higher ratio [Investment cost/labor cost]: it equals 32.78. Their average capital coefficient is impressive, 533.78.

This shows that the Vietnamese SOEs are very capital intensive. Some of them are extremely capital intensive. In developed countries, the ratio [Investment cost/labor cost] is 0.5. So, is there maybe a waste of physical capital for Vietnamese SOEs? It is well known that when a Vietnamese SOE asks for say 1 billion of VND for its purchase of capital, it will receive (1-λ) billion. But it has to declare receiving 1 billion, λ billion VND have been diverted. The number λ is called by us "hidden overhead". Our purpose is to estimate λ. Note that the period of study covers some most important anti-corruption trials concerning som big SOEs in Vietnam, such as the shipbuilding conglomerate Vinashin, the national shipping company Vinalines, the petroleum conglomerate PetroVietnam, and the PetroVietnam Construction Joint-Stock Cor-

[1] See the link https://data.worldbank.org/indicator/FR.INR.RINR?locations=VN&most_recent_year_desc=true

[2] Let qK be the value of the capital, and wN the value of total wages. q, w are respectively the price of the capital and labour wages. If r is the real interest rate and δ is the capital depreciation rate, then the ratio [Investment cost/labor cost] is $\frac{(r+\delta)qK}{wN}$

poration PVC, etc. (Malesky and Phan, 2019).

The main findings of our paper are

- Using a census conducted by GSO in 2010-2018 for 10,200 Vietnam SOEs, we found that they are very capital intensive.
- 9,030 SOEs make profit, the average profit rate is around 1.85% whereas 2621 SOEs make losses with the average profit rate of -11.77%
- Regarding the issue of "hidden overhead", we found that the average rate of hidden overhead (λ above) is 69% for the whole sample. If we consider the $9,030$ SOEs which make profits (20804 observations), the average value hidden overhead is relatively the same (68%). However, for the $2,621$ SOEs who make losses (3689), it rises up to 74%.

The rest of the paper is organized as follows. Section 2 presents a simple model to deal with the capital diversion issue on Vietnamese SOEs. Section 3 presents the data. Section 4 discusses estimation results and show there exists an over utilization of the physical capital. We also question the issue of diversion of the capital in these SOEs. This diversion may be due to a waste of capital stocks or to a special form of bribery we call "hidden overhead". Section 5 concludes the papers with several remarks.

2 A simple modelling of capital diversion

We check the diversion issue. Let λ_{it} denote the rate of waste (or bribery) in terms of physical capital of firm i at year t. The effective production function of firm i at period t is actually

$$Y_{it} = A[(1-\lambda_{it})K_{it}]^{\alpha} N_{it}^{\beta} e^{\varepsilon_{it}} \tag{1}$$

which includes a white noise disturbance (ε_{it}).

Taking the logarithm of equation (1) gives

$$\ln Y_{it} = \alpha_0 + \alpha_K \ln K_{it} + \alpha_N \ln N_{it} + \varepsilon_{it} - \underbrace{[-\alpha_K \ln(1-\lambda_{it})]}_{u_{it}}, \tag{2}$$

where $\alpha_0 \equiv \ln A$. The new residual term corresponds to $\varepsilon_{it} - u_{it}$. Remark that $u_{it} \geq 0$ because $0 \leq \lambda_{it} \leq 1$.

Following the literature on stochastic frontier production (e.g. Kumbhakar and Lovell, 2003), u_{it} corresponds to the well-known stochastic technical inefficiency. Besides the normal distribution assumption for ε_{it}, we need an additional assumption about the distribution of u_i

in order to calculate the maximum likelihood estimator of the model. For instance, we assume that u_{it} follows a truncated normal distribution $N^+(\mu, \sigma_u^2)$ with truncation point at 0. We note that $\mu = z'_{it}\psi$ corresponding to exogenous determinants (included in z_{it}) of inefficiency (or capital diversion). Thus, our model corresponds to the inefficiency effects models of Battese and Coelli (1995) and its estimation can be performed by maximum likelihood.

The technical inefficiency u_{it} can be estimated by $\hat{u}_{it} = E(u_{it} \mid \varepsilon_{it} - u_{it})$ (following Jondrow et al., 1982).

$$\hat{u}_{it} = E(u_{it} \mid \varepsilon_{it} - u_{it}) = \tilde{\mu_{it}} + \tilde{\sigma} \left[\frac{\phi(-\tilde{\mu_{it}}/\tilde{\sigma})}{\Phi(-\tilde{\mu_{it}}/\tilde{\sigma})} \right], \tag{3}$$

where $\tilde{\mu}_{it} = \left[-(\varepsilon_{it} - u_{it})\sigma_u^2 + \mu\sigma_\varepsilon^2 \right] / \sigma_s^2$, $\tilde{\sigma} = \sigma_\varepsilon\sigma_u/\sigma_s$, $\sigma_s = (\sigma_\varepsilon^2 + \sigma_u^2)^{1/2}$. Note that $\phi(.)$ and $\Phi(.)$ are respectively the density and the cumulative distribution function of the standard normal distribution.

When an estimation of technical inefficiency (u_{it}) and output elasticity of capital (α_K) are available, one can recover an estimate for the hidden overhead (λ_{it}):

$$\hat{\lambda}_{it} = 1 - \exp\left(-\frac{\hat{u}_{it}}{\hat{\alpha_K}} \right). \tag{4}$$

In the following, we only discuss the Cobb-Douglas production case.[3] It is important to note that the source of inefficiency may also come from a "low effort" in labor in the sense that the production function could be $Y_{it} = AK_{it}^{\alpha}[(1-\gamma_{it})N_{it}]^{\beta}e^{\varepsilon_{it}}$ instead of (1). However, Mauro (1995) found that corruption lower private investment but does not deter public investment, suggesting that public investment has a different purpose than returns to capital. Our observation above about the very high capital intensity of Vietnamese SOEs seems to be consistent with Mauro's finding, therefore supporting our capital diversion-based modelling.

3 Data

We observe that Vietnamese SOEs are very heterogeneous and that this heterogeneity has to be accounted in estimations. We deal with this issue in several ways. Firstly, the proposed modelling is a panel inefficiency model of Battese and Coelli (1995) with takes into account the

[3] In case of *translog* production function, the regression equation becomes

$$\begin{aligned} \ln Y_{it} &= \beta_0 + \beta_K \ln K_{it} + \beta_N \ln N_{it} + \beta_{KK}(\ln K_{it})^2 + \beta_{NN}(\ln N_{it})^2 + \beta_{KN} \ln K_{it} \ln N_{it} + \varepsilon_{it} \\ &\quad - \underbrace{\left\{ -(\beta_K + 2\beta_{KK} \ln K_{it} + \beta_{KN} \ln N_{it}) \ln(1-\lambda_{it}) - \beta_{KK} \left[\ln(1-\lambda_{it})\right]^2 \right\}}_{u_{it}}, \end{aligned} \tag{5}$$

This specification implies the endogeneity of $\ln K_{it}$ and $\ln N_{it}$ as $E(\ln K_{it}u_{it}) \neq 0$ and $E(\ln N_{it}u_{it}) \neq 0$. Hence, alternative methods would be more appropriate to estimate this specification but this will completely change the nature of our paper (see Van Beveren, 2012). Indeed, while the methods advocated by Olley and Pakes (1996), Levinsohn and Petrin (2003), and Wooldridge (2009) can allow to estimate the TFP (represented by β_0) derived from this production function, it seems that the hidden overhead parameter cannot be easily identified.

panel dimensions. Secondly, exogenous determinants of inefficiency correspond to some firm heterogeneities related to their export activities, scale, sectoral and year dummies. Finally, the analysis is also performed on different subsamples based on capital-output ratio.

Table 1 around here

Table 1 reports main descriptive statistics for firm production Y, capital stock K, labor L. We also calculate the ratio of capital in production K/Y. Data on these variables are in values (i.e. in monetary terms): we employ capital costs, labor costs, and revenue for K, L and Y respectively. As a result, the ratio K/Y represents the share of capital value in revenue. We observe a very large heterogeneity in the sample as the ratio K/Y can vary from 0.0001 to 1.368×10^6 with a mean of 220.82. To have a more detailed view on this heterogeneity, we consider two subsamples: one with $K/Y \leq 20$ and another with $K/Y > 20$. The first subsample includes 9,726 firms with a quite reasonable average K/Y (2.29) while the second subsample only contains 787 firms with a very high average K/Y (4141.96) (see Tables 2 and 3).[4] Tables 4 and 5 report the distribution of firms by sector and the distribution of firm size, respectively. Note that in order to avoid a too small sector, we define two dummies "Agriculture, Forestry, Fishing, and Mining & Quarrying", on the one hand, and "Electricity, Gas, Water Supply, and Construction", on the other hand, as two aggregate sectors (the former is the reference category) which are comparable to Manufacturing (3,821 and 5,304 observations versus 5,304 observations). The largest group is the remaining sectors with 10,455 observations. Finally, we define "Small and very small firms" dummy for firms with fewer than 200 employees (reference category), "Medium firms" for firms having between 200 and 300 employees, and "Large firms" for firms with more than 300 employees. Following this definition, the small and large firm groups are of similar size (10,490 and 10,253 observations).

Tables 2-5 around here

4 Estimation results

Table 6 reports estimation results of model (2) using maximum likelihood and firm-level clustered standard errors. We observe that output elasticities of capital and labor are respectively 0.47 and 0.55, corresponding to a constant returns to scale (CRS) production function (the z-statistic for the CRS hypothesis equals 1.62 with the p-value = 0.11).

[4] It is normal that the two subsamples give a number of firms (9726+787 = 10513) exceeding the total number of available firms in our sample (10200) because the ratio K/Y can vary and crosses the threshold of 20 over the period of study.

Table 1: Descriptive statistics on SOEs.

Variable	Obs	Mean	Std. Dev.	Min	Max
K	24,493	1894.285	25357.08	.001	1282304
L	24,493	51.459	297.079	.004	16600.17
Y	24,493	944.976	6135.086	.0001	275040.9
K/Y	24,493	220.821	12903.76	.0001	1367856

Notes. Data on 10,200 SOEs over the 2010-2018 period. K, L, and Y are in billion VND. Source: Data from GSO Enterprise Census, table by the authors.

Table 2: Descriptive statistics on SOEs, subsample with $K/Y \leq 20$.

Variable	Obs	Mean	Std. Dev.	Min	Max
K	23,200	1766.011	25353.74	.001	1282304
L	23,200	53.466	305.003	.008	16600.17
Y	23,200	994.927	6299.463	.033	275040.9
K/Y	23,200	2.295	3.102	.0001	19.99

Notes. Data on 9,726 SOEs over the 2010-2018 period. K, L, and Y are in billion VND. Source: Data from GSO Enterprise Census, table by the authors.

Table 3: Descriptive statistics on SOEs, subsample with $K/Y > 20$.

Variable	Obs	Mean	Std. Dev.	Min	Max
K	1,293	4113.539	25070.44	.278	418665.3
L	1,293	17.025	65.103	.004	976.456
Y	1,293	81.547	738.807	.0001	19100.97
K/Y	1,293	4141.962	56036.1	20.003	1367856

Notes. Data on 787 SOEs over the 2010-2018 period. K, L, and Y are in billion VND. Source: Data from GSO Enterprise Census, table by the authors.

Table 4: Distribution of firms over different sectors.

Sectoral dummies	Frequency	Percentage
Agriculture, Forestry, Fishing, Mining & Quarrying	3,821	15.60
Manufacturing	4,913	20.06
Electricity, Gas, Water Supply, Construction	5,304	21.66
Others	10,455	42.69
Total	24,493	100.00

Notes. Data on 10,200 SOEs over the 2010-2018 period. Source: Data from GSO Enterprise Census, table by the authors.

Table 5: Firm size.

Size dummies	Definition	Frequency	Percentage
Small	Small and very small firms	10,490	42.83
Medium	Medium firms	3,750	15.31
Large	Large firms	10,253	41.86
Total		24,493	100.00

Notes. Data on 10,200 SOEs over the 2010-2018 period. Source: Data from GSO Enterprise Census, table by the authors.

Table 6 around here

It is also shown that technical inefficiency depends on several variables like export activity, sectoral dummies, firm size, and year dummies. Export dummy has a negative and significant (at the 5% level) coefficient, indicating that exporting firms are more efficient than non-exporting firms. This is rather intuitive as exporting firms should be sufficiently competitive in order to entry and stay in international markets. We also obtain the negative impacts of sectoral dummies on technical inefficiency. It means that firms operated in all economic sectors are more efficient than the reference group (Agriculture, Forestry, Fishing, Mining and Quarrying sector). Moreover, medium-size and large-size firms are more efficient than small and very small firms (as both firm size dummies are negative and significant). Finally, all the year dummies coefficients are positive and significant, except 2014 and 2015, representing the deterioration of firm technical efficiency over the period of study compared to the reference year 2010.

Figure 1 presents the distribution of λ_i for the full sample, over a range between 0.24 and a value close to 1. The average inefficiency value is 0.690 (also very close to the median, 0.692) indicates a vary high rate of capital diversion for the Vietnamese SOEs. The most "efficient" (or rather the least inefficient) firms has a hidden overhead of 0.24 (minimum value of λ) which is still a high amount. The figure also shows the existence of an important group of firms (more than 10% of observations) that have a λ very close to 1, meaning that these SOEs wasted almost all their capital during 2010-2018.

Figure 1 around here

5 Concluding remarks

This paper estimates the technical inefficiency of Vietnam SOEs during the period 2010-2018. The result is indicative of a very high "hidden overhead" in physical capital, 69% on average. Thus, even without a comparison with private firms, this astonishing finding suggests the need

Table 6: Estimation results of the Cobb-Douglas production frontier

Variable	Coefficient	Robust Std.Err.
Production function		
ln Capital	0.471**	0.012
ln Labor	0.544**	0.017
Intercept	1.446**	0.099
Inefficiency determinants		
Export	-33.351**	12.244
Sectoral dummies		
Manufacturing	-72.646**	26.862
Electricity, Gas, Water, Construction	-33.775**	12.250
Others	-44.183**	16.149
Firm size dummies		
Medium	-34.105*	13.787
Large	-26.354**	9.903
Year dummies		
2011	26.715**	10.055
2012	33.853**	12.302
2013	7.877*	3.925
2014	5.597	4.233
2015	3.496	3.747
2016	9.850**	4.923
2017	16.882**	6.338
2018	14.707**	5.559
Intercept	-44.765*	17.903
σ_ε	1.009**	0.012
σ_u	7.967**	1.512
Log-likelihood	-39470	
Number of firms	10200	
Number of observations	24493	

Notes. Estimation performed by maximum likelihood with firm-clustered standard errors. Reference group for sectoral dummies is 'Agriculture, forestry, fishing, mining & quarrying' sector. Reference group for year dummies is 2010. Reference group for firm size is 'Small & very small firms'. Significance level: $*p < 0.05$, $**p < 0.01$. Source: table by the authors.

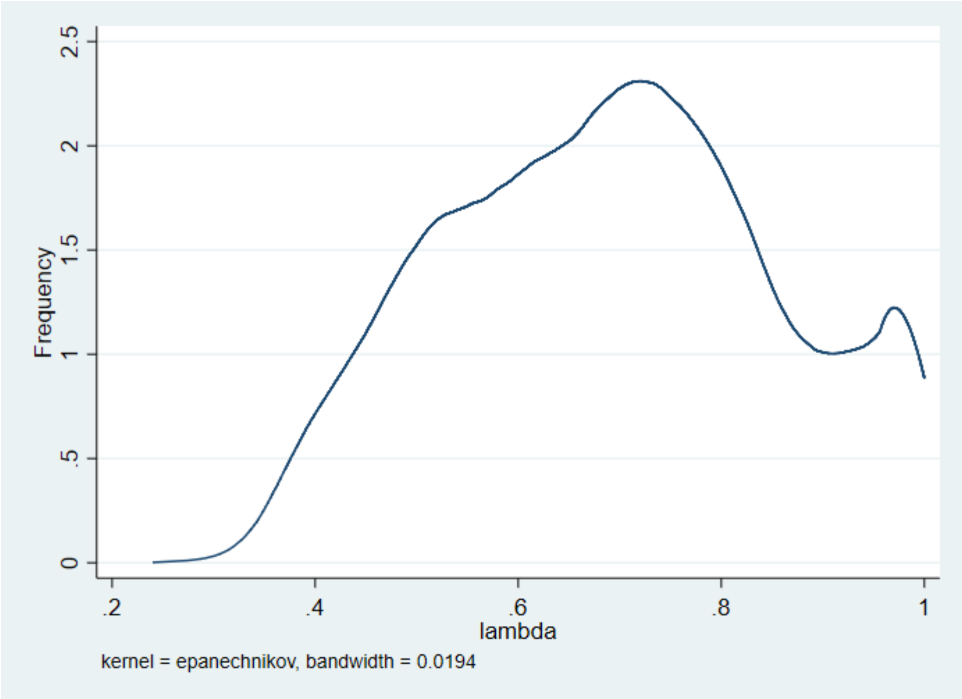

Figure 1: Distribution of $\hat{\lambda}_i$. Source: figure by the authors.

for an urgent and profound reform of the Vietnam SOEs in order to reduce their wasteful use of capital.

Some further investigations are necessary in order to deliver a more precise calculation of hidden overhead. One the one hand, an alternative production function such as the CES function would be more general than the Cobb-Douglas one considered here. In this regard, some more advanced econometric techniques could be employed to avoid the endogeneity of input variables (similarly to the TFP estimation literature). On the other hand, a similar exercise can be applied to private firms in order to have a comparison between public and private sectors. This analysis could tell us, other things being equal, whether a campaign to privatize state-owned companies would be appropriate in Vietnam.

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