FACTORS INFLUENCING THE FIRM'S SELF-SELECTION BEHAVOR IN THE ELECTRICITY INDUSTRY IN VIETNAM (2006 - 2010)

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Abstract

Current studies, while focusing on productivity of manufacturing firms in Vietnam, have not paid due attention to efficiency of energy enterprises. Using the data on electricity industry drawn from the Vietnamese Enterprise Census (2006-2010), this paper examines factors influencing the survival probability of firms in the industry in Vietnam. The obtained results reveal that among others, capital stock and expenditure on inputs such as materials and services were the significant determinants of firms' surviving likelihood in the market. This likelihood was also positively correlated with the age of firms, however, in an inverse fashion when the firms reached a certain age. The result also suggests that incumbents and new entrants in the industry might be in soaring demand of massive capital investments for the fixed asset expenditures (capital stocks) and maintenance costs (material and services expenditures) of large-scaled power projects, which calls for the financing not only from local but also from foreign investors.

Key words: *leadership, social enterprises, leadership style, qualitative research.*

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1. Introduction

In any country, electricity is regarded as an essential energy for the economy as blood vessels in the human body. For the case of Vietnam, enterprises in the industry not only provide electricity and related services for the daily life of more than nighty million Vietnamese citizens but also for the production of thousands of enterprises in the economy under the circumstance that demand for energy in Vietnam is soaring at 14% per year (The Economics 31st August 2013). Therefore, analysing factors that influence the efficient performance of the firms in this energy industry may give worthy implications for firm managers, investors as well as policy makers.

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Ericson and Pakes (1994) initiated the theoretical framework of the Markov Nash Perfect Equilibrium in a dynamic model of heterogeneous firms to analyse behaviour of self-selection in one industry. By applying the theory, Olley and Pakes (1996) showed that the self-selection of firms depends on the firms' characteristics and their dynamic profit maximization. Factors that cause higher probability of firm's survival also possibly increase the productivity of the firm. Recently, there have been very few empirical studies conducted for the self-selection analysis in the energy industry in Vietnam. To fill the literature gap, this paper investigates determinants that influence survival likelihood of heterogeneous enterprises in the electricity industry in Vietnam in the context of Markov Nash Perfect Equilibrium.

Our methodology mainly followed the approach of Olley and Pakes (1996) and Levinsohn and Petrin (2003). Olley and Pakes (1996) stated that firm's characteristics including investment, age, and capital stock significantly influence its survival. In an extended model, Levinsohn and Petrin (2003) replaced the investment by using values of inputs, for example: intermediate materials, energy, electricity cost since there is a large number of zero investment values observed in their data. Additionally, Yasar, Raciborsky and Poi (2008) reviewed the Olley and Pakes (1996)'s model and noted that the longer the firm stays in the market, the more adverse impact of firm's age affecting its exiting odd. In this paper, we use inputs proxied by the firm-level values of material and service variables as the alternative for the investment. The Probit model with robust standard errors is applied to calculate the marginal effects of the selected factors influencing the exiting likelihood of firms in the electricity industry in Vietnam. The results might imply that shortage of capitals for financing the enlargement of capital stocks and payments for materials and services expenditures will pose the highly risky possibility of shutting down to incumbents. Currently, for the case of State-owned enterprises, the lack of capital is financed not only by the limited government's equity, or high interest rate bank loans, but also possibly by the Initial Public Offering auction during the equitisation process.

The remaining of this paper is organized as follows. The second part summarizes general information of the electricity industry in Vietnam. The third part briefly discusses relevant literature, the forth part explains more details about the estimation methodology, the fifth part describes the data used in this research, the sixth part reports and analyses empirical results, and the last part draws our conclusions and discusses policy implications.

2. Overview of the industry

This part provides a brief overview of the electricity sector in Vietnam in terms of market structures reform, unbundling regulations and ownerships variety. Market structure in electricity sector of Vietnam has experienced a significant change since the Law of electricity came into effect on 1st July 2005. Before that milestone, only The Vietnam Electricity (EVN), which is a 100% state-owned enterprise, controlled the whole market. This sole provider was established by law due to the national energy security and the high need of government's investment for establishment and maintenance of electric grid. EVN was then restructured to be a limited liability company (LLC) since 22nd June 2006 (under the Decision No.147/QD-TTg approved by the Vietnamese President). Those domestic policy reforms aimed at gradually creating a more competitive business and investing environment in this market in response to the concerns of investors and consumers about the high charges of electricity infrastructures, unstable and inefficient supply of the monopolistic power networks. The reform has eventually opened the market for non-state stakeholders in electricity distribution and non-strategic power generation. However, electricity transmission, domestic load dispatch and large-scaled power firms are still under the monopolistic control of EVN which means high entrant barriers have still remained.

Currently, the electricity industry in Vietnam includes three main sub-sectors which are generation, transmission and distribution. The Vietnam Electricity directly controls the whole infrastructure and is in charge of purchasing, transmitting, and distributing of electricity. EVN is also the biggest supplier of electricity in Vietnam. In details, regarding to generation: EVN and its three subsidiaries (GENCO1, GENCO2 & GENCO3) dominate more than 50% in total of installed capacity while independent power producers (IPPs including Petro Vietnam - PVN, VINACOMIN, foreign investors and other local producers) produce the rest [see Figure1]; In terms of the transmission networks, Vietnam constructed 500 kV line, 220 kV line, and 110 kV line which are also managed by EVN and its four subsidiaries (NTP1, NTP2, NTP3, NTP4). Others lines (6kV to 35 kV) are under the control of local transmission enterprises; EVN also administers the electricity distribution via its five subsidiaries (The Northern Power Corporation, The Southern Power Corporation, The Central Power Corporation, Hanoi Power Corporation, Hochiminh City Power Corporation) [VPBS,2013,p.8].

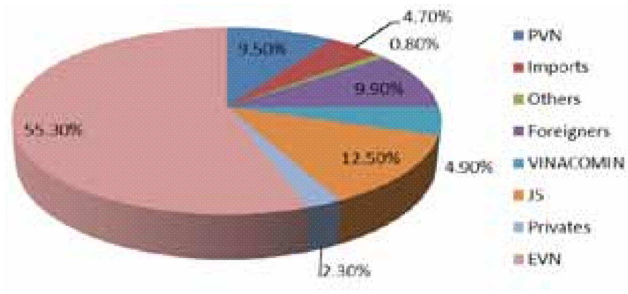

Figure 1: Installed capacity by owners in 2010

Source: *Nguyen (2011) cited from the Institute of Energy (2011)*

In addition, Table 1 briefly summarizes key information about the sector.

Table 1: Key statistics of the Electricity sector (2006-2010)

Year	2006	2007	2008	2009	2010
N (1)	2,335	2,566	2,786	1,530	1,128
HHI (2)	5.983	5.153	5.153	4.824	4.508
(3)	514.8	548.7	580.2	616.3	632.66*
(4)	11.05	10.56	9.35	9.57	10.25

Source: (1)_ N: is the number of firms are retrieved from the Vietnamese Enterprise Census (2006-2010) using 4 digits Vietnamese Standard Industrial Classification 1993. (2)_HHI, (3)_ Productivity (MWh/employees), (4)_ Transmission and distribution losses (%):Nguyen (2012); estimated.*

Table 1 demonstrates the variation in the number of firms which reflects the fact of enterprises shutting down as well as new entrants entering the market. The statistics also implied the possibility that firms could be merged or acquired. In addition, the Herfindahl-Hirschman Index (HHI) in Table 1, which is calculated by the total sum of square of each enterprise's market share, is widely used to evaluate the market power in one industry. The HHI pertained at around 4.5-6.0 reporting the high market concentration ratio in the energy industry. Nevertheless, its gradual fall in selected years could be interpreted as a dispersion of the market power. It can be explained as the result of the unbundling of EVN which began from January 2009. In the unbundling procedure, EVN as a dominant electricity supplier was split up into smaller distributors even though it still holds a large amount of shares of those firms.

3. Literature review

The analysis of firm level database has attracted more interest from researchers and policy makers since it could provide useful information in performance of firms and industries especially in the link with policy regulations.

Many papers explore database of developed as well as developing countries, and most of them investigate the total factor productivity (TFP) of manufacturers at firm level as well as at industry level. A wide range of methodologies have been applied to estimate the TFP at firm level such as: methods of para-metrics, semi-parametrics, non-parametrics, and index measurement. Of which, a well-known approach to estimate TFP was introduced by Olley & Pakes (1996) with an application of Cobb-Douglas production function. It sheds a light to control for both endogeneity and selection bias issues while estimating TFP.

To control the selection bias, the important preliminary step of the TFP estimation by Olley and Pakes (1996) is to predict the survival probability of firms using non-linear models such as Probit or Logit. In particular, Olley and Pakes (1996) demonstrate that each firm maximizes their profit dynamically under the algorithm of rational expectation in the Bellman equation. According to them, the firm's current profit is the function of state variables including current productivity, age of firm, and capital stocks, while the cost of the firm is the value of present investment to capital (buildings and equipment). Furthermore, they comment that decision of each firm to continue their business is conditional on the comparison between the "sell-off" values of its assets and the "expected discounted returns" of prolonging their production.

To program a convenient command of Olley and Pakes (1996)'s TFP estimation for Stata users, Yasar, Raciborsky and Poi (2008) use the framework of Olley and Pakes (1996), and add more arguments on the firm's age by considering the square of age and other interaction terms in their estimation. They basically use the Probit with robust standard errors to estimate the firm's shutdown likelihood, not the survival probability. Intuitively, the probability of exiting is equal to one minus the probability of staying in the industry. Neither Olley and Pakes (1996) nor Yasar, Rarciborsky and Poi (2008) pay attention to the size of effects interpreted from the marginal effects of the Probit model.

One important assumption in the model of Olley and Pakes (1996) is the increasing monotonicity of marginal capital in productivity. Besides, investment must be strictly non-negative to be invertible. In practice, researchers experience the fact that values of investment flows in their database can be zero or negative at a high frequency (i.e: due to missing values, or firms do not invest in capital stock annually). Levinsohn and Petrin (2003) solve the problem by using alternative non-zero valued variables (e.g: values of inputs such as expenditures on materials, electricity, intermediate inputs) as the proxies for unobservable productivity. They also introduce tests to check for the assumptions of monotonicity and consistent estimations for different choices of proxies.

Recently, Vietnamese firm level database has also been used to analyse the impacts of trade flows, foreign directed investment, market concentration, ownership, learning by doing effects on TFP of manufactures[1]. However, until now there have been few papers working on neither the efficient performance of firms nor the self-selection analysis in the Vietnamese electricity sector. Several reports of the industry released by the research department of local banks merely provide general information and statistics for the industry[2]. Nguyen (2012) summarizes related information of electricity market, and focused on the market restructuring. However, the author does not provide any empirical evidence to analyse enter and exit scenario in the market.

Applying the extension model of Levinsohn and Petrin (2003), Thangavelu et al (2010) confirms the positive correlation between foreign ownership and the TFP, and a minor negative impact of financial constraints on TFP in the manufacturing sectors in Vietnam (2002-2008). However, they did not report any information about the shutdown likelihood, the roles of capital, firm's age, or inputs (material and services) in these industries. Most recently, Ha and Kiyota (2014) address the dynamic entry and exit pattern of manufacturing firms in Vietnam in the context of international trade (2000-2009) by using the sub-sample of agents who hire more than twenty workers. However, neither Ha and Kiyota (2014) nor Thangavelu et al (2010) pay due attention to the selection bias in their research.

Trung et al (2009) uses the Logit framework to analyse the shutdown decision of the Vietnamese small and medium enterprises in exporting activities. However, they did not consider the impacts of firm's characteristics such as the capital stock accumulation, firm's age, input investment. Besides, Vu et al (2012) confirm the significant causal link between self-selection in export market and productivity of Vietnamese small and medium manufacturing enterprises with the results of pooled and dynamic Probit model. Similar to Trung et al (2009), Vu et al (2012) ignore the role of government owned capital and the increase of input usage in their test of self-selection hypothesis.

This paper focuses on the step controlling for selection bias in Olley and Pakes (1996)'s estimation, and evaluates the size effects in the Probit model drawn from the characteristics of enterprises that influence the firm's self-selection. In addition to factors such as firm's age, capital stock (Olley and Pakes,1996), we introduce additional variables which are inputs (Levinsohn and Petrin, 2003) and square of age. We do not use intermediate inputs as Levinsohn and Petrin (2003) but input in terms of materials and services. The

[1] See Thangavelu et al (2010), Ramstetter & Ngoc (2011); Yang & Huang (2012), Vu et al (2012); and Ha & Kyota (2014)

[2] See: The report on Vietnamese Electricity Industry by VPBS (2013), PhugiaSC, Annual report by EVN

projection is that firms in electricity industry often require a large start-up cost, such as investment in fixed assets (e.g: generators, buildings, equipment, gridlines), hence the periodical investments for capital stocks are volatile. Besides, annual firm-level cost on materials and services (as the complements of capital stocks) in the electricity industry are non-volatile. In fact, the extracted data contains large number of zero/missing values in investment flows (See Table 2), while firms' materials and services expenditure recorded more non-missing observations. Further details in the techniques and the variable construction would be referred in the part of methodology and data descriptions.

4. Methodology

In this part, we present our methodology which basically applies the framework of Olley and Pakes (1996) in self-selection analysis. Moreover, we assume the inputs (materials and services) can be the proxy for unobservable productivity instead of investment flows. As discussed briefly above, in the electricity market, the yearly firm-level investment flows are at the high fluctuation, and the firms have to invest heavily for fixed assets when starting up. Annual expenditure for maintenance and operation (e.g: expenditure on maintenance services, or cost on energy usage) are eventually more stable for enterprises in the industry. Yearly consumption of inputs for firm's production therefore is the function of the capital stocks (fixed assets), the inputs (as the complements of the fixed assets), and the maturity of firms.

We assume that firms in the market have a homogenous Cobb-Douglas production function. They maximize their profit using the Bellman equation as follows (Olley and Pakes 1996):

$$(1)\quad V_{it}(k_{it},a_{it},\omega_{it})=Max[\Phi,Sup_{msit\geq 0}\prod_{it}(k_{it},a_{it},\omega_{it}) - C(ms_{it})+\beta E\{V_{i,t+1}(k_{i,t+1},a_{i,t+1},\omega_{i,t+1})|J_{it}\}]$$

Where:

$V(k_{it},a_{it},\omega_{it})$ is the value of the firm.

Φ is the liquidation value that firm can be compensated when leaving the market.

$\prod_{it}(k_{it},a_{it},\omega_{it})$ is the profit function of firm i at year t.

k_{it}, a_{it} respectively are log of capital stocks and age of firm (K_{it}), which are state variables of the profit function. As noted by Olley and Pakes (1996), marginal productivity of K_{it} is increasing in ω_{it}. k_{it} follows the Markov process while $a_{it} = a_{i,t-1} + 1$.

ω_{it} is the unobservable productivity of firm (unobservable to researchers but observable to firms).

$C(ms_{it})$ is the cost function of firm.

ms_{it} is the log of total materials and services used by firm (MS_{it}).

$E[.|J_{it}]$ is the expectation of future discounted firm's value which is conditional on information set J_t at time t (The information is assumed to be the productivity which is observed by firms).

A remarkable assumption is that all firms in the industry face the same input prices.

We also assume that: $\omega_{it} = \omega(ms_{it}, k_{it}, a_{it})$

In equation [2], ω_{it} follows the Markov process, and it is a function of state variables: ms_{it}, k_{it}, a_{it}.

As discussed the reasons above, this paper modifies models of Olley and Pakes (1996) and Levinsohn & Petrin (2003) by choosing ms_{it} to be the alternative proxy for productivity instead of investment flows. Recall that Olley and

Pakes (1996) defines $i_{it} = i(\omega_{it}, k_{it}, a_{it})$ where i_{it} is the log value of I_{it}, and follow the Markov prefect Nash Equilibrium. i_{it} is the function of parameters in equilibrium. Alternatively, this paper specifies $ms_{it} = ms(\omega_{it}, k_{it}, a_{it})$ where ms_{it} is also assumed to follow the Markov prefect Nash Equilibrium.

Recall that the Markov-Perfect Nash Equilibrium, which was first introduced by Ericson and Pakes (1994), was applied by Olley and Pakes (1996) to empirically explain the self-selection in the United State telecommunication equipment market influenced by the technology advance and policy deregulation. As stated by Ericson and Pakes (1994), this dynamic model showed the profit maximization of heterogeneous firms under the idiosyncratic shocks (e.g: shocks from the government policies). Therefore, it can be fully applied in the monopolistic electricity market in Vietnam in which agents are heterogeneous, especially after the domestic liberalization in this industry in 2006.

The Bellman equation in (1) indicates that firm will compare its current values of liquidation and future discounted return while deciding to continue their business or not. More specifically, the indicator function χ_t presents the exiting rule:

$$(2) \quad \chi_t = 1 \ if \quad \omega_{it} < \varpi_{it}(ms_{it}, k_{it}, a_{it})$$

$$\text{and} \quad \chi_t = 0 \quad otherwise$$

where $\varpi_{it}(ms_{it}, k_{it}, a_{it})$ is the threshold of productivity depending on k_{it}, a_{it}, ms_{it}. χ_t is equal to one if firm exits the market in the next year (at time t+1), and equal to zero if firm stays in the market in the next year. In other words, firms that are less efficient than $\varpi_{it}(ms_{it}, k_{it}, a_{it})$ will choose to exit the market in the next year. The probability of exiting the market at year (t+1) can be written as:

$$\begin{aligned} Pr\{\chi_{i,t+1} = 1 | \varpi_{i,t+1}(ms_{i,t+1}, k_{i,t+1}, a_{i,t+1}),\ J_{i,t}\} \\ = Pr\{\omega_{i,t+1} < \varpi_{i,t+1}(ms_{i,t+1}, a_{i,t+1}, k_{i,t+1}) \\ | \varpi_{i,t+1}(ms_{i,t+1}, k_{i,t+1}, a_{i,t+1}),\ \omega_{i,t}\} \\ = \Phi\{\varpi_{i,t+1}(ms_{i,t+1}, a_{i,t+1}, k_{i,t+1}),\ \omega_{it}\} \\ \text{(by definition)} \end{aligned}$$

$$\begin{aligned} (4) \quad Pr\{\chi_{i,t+1} &= 1 | \varpi_{i,t+1}(.), \omega_{it}\} \\ &= \Phi\{ms_{i,t}, a_{i,t}, k_{i,t}\} \end{aligned}$$

Equation (4) ends up with function of variables at year t since $ms_{i,t+1}, a_{i,t+1}, k_{i,t+1}$ can be derived respectively from their lagged variables. In this paper, Probit model with robust standard errors and fixed effects is applied to estimate the equation (4). We applied the the model to analyse the self-selection behaviour as a binary dependent variable which is impossible to be estimated by the ordinary least square. As noted by Green (2000), probit model possibly gives the similar result as the logit model. In addition, while the algorithm of these two non-linear models constraint the predicted likelihood to be between zero and one, linear probability model does not provide the correct estimated range (Green 2000, p.813). For this reason, the linear probability model is not selected. To provide the correction for the standard errors, we used robustness probit model which is implemented by the "probit" command with the "robust" option in Stata13. The algorithm of the Probit model is presented as follow:

$$Pr\,(Y_{it} = 1 | X_{it}) = \Phi(X'\beta_k)$$

where $\Phi(.)$ is the cumulative distribution function of the standard normal distribution.

The marginal effects of Probit model is expressed as:

$$\partial P(Y_i = 1 | X_{ki}) / \partial X_{ki} = \beta_k \varphi(X'\beta_k)$$

where $\varphi(.)$ is the standard normal probability density function.

The selection of independents (X_{ki}), such as natural logarithm of real capital stocks, natural logarithm of real investment, or natural logarithm of inputs, and age, square of age, follows the literature from Olley and Pakes (1996), Levinsohn and Petrin (2003), and Yasar, Raciborski and Poi (2008). Obviously, there were shocks that could influence the self-selection behaviour, for instant: the economic downturn or the adjustment of the government policies, which are probably captured by the year trend variable.

To prevent the problem of endogeneity, the independent variables were lagged one period of time. In particular, the behaviour of exiting the market at time t+1 is causally explained by the lagged regressors (of capital stocks, investment, or inputs) at time t-1. In details, we estimate two Probit models with robust standard errors to make the comparison of the results. The first model excludes the variable investment $i_{i,t-1}$, but includes the variable inputs $ms_{i,t-1}$. The second is vice versa. Both models include the same variables $k_{i,t-1}$, $age_{i,t-1}$, $age^2_{i,t-1}$, and a dummy variable controlled for time fixed effect: $year_{i,t-1}$.

Model 1

$$Prob\,(Exit_{it} = 1|ms_{i,t-1}, k_{i,t-1}, age_{i,t-1}, age^2_{i,t-1}, year_t) = \Phi\,(\beta_{cons}constant + \beta_k k_{i,t-1} + \beta_{ms} ms_{i,t-1} + \beta_a age_{i,t-1} + \beta_{aa} age^2_{i,t-1} + \beta_y year_t + \varepsilon_{it})$$

Model 2

$$Prob(Exit_{it} = 1|i_{i,t-1}, k_{i,t-1}, age_{i,t-1}, age^2_{i,t-1}, year_t) = \Phi\,(\beta_{cons}constant + \beta_k k_{i,t-1} + \beta_i i_{i,t-1} + \beta_a age_{i,t-1} + \beta_{aa} age^2_{i,t-1} + \beta_y year_t + \varepsilon_{it})$$

From Probit results of Model 1, Model 2 we then calculate the marginal effects of each model to analyse the size of effects.

5. Data description

This paper uses the data of Electricity sector in Vietnam drawn from the Vietnamese Enterprise Census database (2006-2010) which conducted by the General Statistics Office of Vietnam. The census provides rich information at firm level in terms of establishment years, type of firms, total revenues, total fixed assets, ratio of state-owned capitals, total number of labours, total wages. The selected industry was filtered from the database using the four digits Vietnamese Standard Industrial Classification 1993 (VSIC 1993, industry code = 4010). Each enterprise is coded with a unique key and pooled in an unbalanced panel of five years (2006-2010). The years before 2006 are dropped due to the monopolistic market where the market power is highly concentrated in only several numbers of state owned enterprises.

Similar to the literature (Ha & Kyota, 2014), we used the booked value of total fixed asset in the beginning of year t as the proxy for the capital stock variable K_{it} because the physical capital stock at year t is not observable, then we derived $k_{it} = \log(K_{it})$.

The investment flow at year t is expressed as: $i_{it} = \log(I_{it}) = \log(K_{i,t+1} - (1\text{-}\sigma)\ K_{i,t})$ (Deloecker 2007). We calculated investment using capital stock since the investment flows are unobservable in the data. We assume $K_{i,t+1} = (1\text{-}\sigma)K_{i,t} + I_{it}$ where $K_{i,t+1}$ is the total booked value of fixed asset at the beginning of year t+1 (equal to total fixed asset at the end of year t), and the depreciation ratio (σ) is chosen to be equal to 5%. For some firms which are reported missing booked values of total fixed assets ($K_{i,t}$) in the end of year t, the author replaced those missing values with the booked values of total fixed assets at the beginning of the next year (year t+1). Similarly, the missing values of total fixed assets at the beginning of year t were replaced by the total fixed assets at the end of year t-1. As the result, 192 and 372 real changes were made respectively.

Since we could not observe the physical number of inputs (materials and services), the values of total expenditure on these inputs (MS_{it}) were used as the proxy. MS_{it} was calculated by using values of total revenues, total profits before taxes, annual investment flow for fixed capital stocks, and total expenditure on wages. We specify $ms_{it} = \log(MS_{it})$.

Nominal capital stocks were deflated using the deflators calculated from the gross fixed capital formation[1]. The annual real investment flows were obtained by dividing the nominal values by the deflators calculated from the gross domestic investment[2]. The deflator for the nominal expenditure in materials and services is the GDP deflator calculated by the authors from the real and normal values GDP of Vietnam[3]. All these deflators have the base year 2000.

The age of enterprises (Age_{it}) was observed by subtracting the year when the enterprise starts its business from year t and plus one additional year (i.e: firms which only stay in the market for one year will have the age of one). For several firms which were recorded with inconsistent information of the establishment year (e.g : different establishment years), we choose the year with the highest frequency of records. At year t, the dummy variable for exiting ($Exit_{it}$) has value of one if the firm is no longer recorded in the data in the next year (year t+1), and has value of zero if the firm shows its appearance. Observations with missing values (assumed to be randomly missing) of key variables were dropped at the rate approximately 10-15%. The enterprises which had duplicates in id key were also dropped (<3%).

The descriptive table below summarizes information of key variables of firms in the Electricity sector in Vietnam (2006-2010):

Table 2. Descriptive summary for Electricity sector

Variable	Obs = .	Obs ≠ .	Mean	Std.Dev
TR_{it}	53	10,292	80,453	1,856,925
TC_{it}	887	9,458	81,320	1,875,419
K_{it}	787	9,559	139,592	3,943,675
I_{it} 2495 obs <= 0	1043	9,302	21,796	896,370
MS_{it} 946 obs <=0	1604	8,741	62,270	1,269,849
W_{it}	5	10,345	3,130	70,6
L_{it}	0	10,345	66.22	1.732
Age_{it}	0	10,345	5.2	

Source: Vietnamese Enterprise Census, 2006-2010, www.gso.gov.vn.[TR: total revenue, TC: total cost, K: total capital, I: investment flows, MS: expenditure of materials and services, W: total wages, L: total employees, Age: age of firm. The values of mean and standard deviation of TR, TC, K, I, MS, and W are in Million VND. Those values of L are in persons, of Age are in years]

[1, 2] Source: data.worldbank.org

[3] Source: World Economic Outlook database at www.imf.org

6. Empirical result

In part 5, we run a Probit model using data of Vietnamese electricity sector drawn from the Vietnamese Enterprise Census (2006-2010) which their marginal effects are shown in Table 3. It is reported that there were identical negative signs in marginal coefficients of lagged variables in the log of capital stocks (percentage change), age, and year are two models the selected period.

Firstly, it can be interpreted that, on average, the enlargement in the capital stocks in the previous year could lower the probability of firm exiting the market in the next year (other things equal), which is consistent with the literature (See: Olley and Pakes, 1996; & Yasar, Raciborski, and Poi, 2008). Although the signs are similar, only result in Model 1 is significant. The reason might be because of volatile investment flows in the industry (i.e: the high frequency of missing values in investment flows in the data).

Secondly, the firms, which were older, experienced less likelihood to leave the industry. According to the marginal coefficients of age and square of age variables, after staying in the market at a certain age, the maturity of firm no longer increased its survival chances. Last but not least, spending more on materials and services, the enterprises were less likely to be shut down (Model 1). In Model 2, the rise in the annual investment could eliminate firm's exiting probability.

In short, because the enlargement of capital stocks implies for the extension of firm's size, we might conclude that the firm with larger scale was less likely to go bankruptcy in the electricity industry, but only in the context of investing more in material and services. The maturity of firms (firm's age) in the market provides the implication for its rich experience of the business. However, age of firms determined the self-selection process with decrease fashion at a certain level as both shown in two models. The variable ms_{it} shows its strong impact in the process of firm's liquidation (in Model 1), and reveals the similar sign of impact on exit probability as investment (in Model 2). It should be noted that, Model 1 keeps more observations than Model 2 due to the missing values of investment flows recorded in the data (See: Number of observations in Table 3). Hence, we suggest using ms_{it} in further analysis of firm's self-selection and TFP estimation in this industry.

Table 3. Marginal effects after Probit

	Model 1	*Model 2*
Exit		
$ms_{i,t-1}$	-0.037** (0.005)	
$k_{i,t-1}$	-0.022*** (0.006)	-0.014 (0.009)
$age_{i,t-1}$	-0.030*** (0.004)	-0.033*** (0 .004)
$age^2_{i,t-1}$	0.001*** (0.000)	0.001*** (0.000)
$year_{i,t}$	0.065*** (0.007)	0.056*** (0.007)
$i_{i,t-1}$		-0.040*** (0.006)
Observations	5134	4342
Marginal effects; Standard errors in parentheses		
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$		

Conclusion

We use the marginal coefficients of the Probit estimation with robust standard errors to explain for factors influencing self-selection in the Vietnam electricity industry. Our empirical results suggest that firm's characteristics including the growth rate in capital stocks, firm's maturity, percentage change in materials and services (inputs), were dominant factors in the decision of firms for liquidation in the industry during the selected period. The negative sign of marginal effects (in capital stocks growth rate, age, and time fixed effect) after the Probit estimation is significant and similar to the literature (Olley and Pakes, 1996; & Yasar, Raciborsky and Poi, 2008). The negative impact on shutdown likelihood caused by an increase in materials and services is identical to the sign of impacts caused by investment flows growth rate.

A remarkable note is one may consider choosing inputs variable to replace investment variable in the analysis of self-selection because inputs typically showed more non-volatile pattern than capital investment flows in the industry. Interestingly, the results may suggest that the likelihood of being merged or acquired in the electricity industry was also influenced by those selected factors. Similar to the exiting behaviour, merge and acquisition also reflects the reallocation of resources among firms in the market.

In addition, the findings of this paper could also be regarded as a preliminary step for further study in dynamic TFP of electricity industry in Vietnam or in other countries because factors create higher probability of surviving may positively influences on productivity of the firms.

Apart from the suggestions for econometrics practice, the results draw further implications for the firm managers, investors and policy makers in terms of how to finance the soaring needs to increase the capital stocks and to afford essential expenditures on inputs for costly energy projects. Recently, regarding to state-owned enterprises in this industry, equitisation and Initial Public Offer auction have been implemented. Other resources such as bank loans and stock issuances to domestic and foreign investors are possibly financial sources for both state-owned and private joint-stock companies. The former is costly with high interest rate while the latter appears to be more attractive to both managers and investors.❑

References

1. De Loecker., J.D, 2007, "Do exports generate higher productivity? Evidence from Slovenia". *Journal of International Economics,* 73, 69-98.
2. Doan Thi Thanh Ha, D.T.T., & Kiyota, K, 2014, "Firm-level evidence on productivity differentials and turnover in Vietnamese manufacturing". *The Japanese Economic Review*, 66 (1), 51-86. doi:10.1111/jere.12032

3. Levinsohn, J. A. and A. Petrin, 2003, "Estimating Production Functions Using Inputs to Control for Unobservables", *Review of Economic Studies*, 70 (2), 317–340.
4. Nguyen A.T, 2012, "A Case Study on Power Sector Restructuring in Vietnam". Pacific Energy Summit. www.nbr.org.
5. Olley, S. G., & A. Pakes,1996, "The Dynamics of Productivity in the Telecommunications Equipment Industry", *Econometrica*, 64 (6), 1263–1297.
6. Ramstetter, E.D., & Ngoc, P.M, 2011, "Productivity, Ownership, and Producer Concentration in Transition: Further Evidencefrom Vietnamese Manufacturing". *ESRI Discussion Paper Series No. 278*.
7. Thangavelu, S.M., Findlay, C., & Chongvilaivan, A, 2010, "FDI, Financial Constraints, and Productivity: Firm Level Study in Vietnam, in Findlay, C., Parulian, F., & Corbett (ed.), Linkages between Real and Financial Aspects of Economics Integration in East Asia". *ERIA Research Project Report 2009-1*, Jakarta: ERIA, 316-343.
8. Trung, T.Q., Tung. N.T., Dong, T.D., & Duong, P.H, 2008, "Performance of export-oriented small and medium sized manufacturing enterprises in Vietnam", *Asia-Pacific Research and Training Network on Trade Working Paper Series, No.54*.
9. Yang, C.H., & Huang, C.H, 2012, "Ownership Reform, Trade Liberalization, and Productivity in Transition: Firm-level evidence from Vietnam", paper presented at the 13th International Convention of the East Asian Economic Association, Singapore, October 2012.
10. Vu, H., Lim, S., & Holmes, M, 2012, "Higher productivity in Exporters: Self-selection, Learning by exporting or both? Evidence from Vietnamese Manufacturing SMEs", *MPRA Paper series*, 40708. http://mpra.ub.uni-muenchen.de
11. Yasar, M., & Raciborski, R, 2008, "Production function estimation in Stata using the Olley and Pakes method", *The Stata Journal*, 8(2), 221-231.
12. Report on Electricity Industries, PhugiaSC, https://www.phugiasc.vn/Portals/0/UploadedFiles/PHUGIASC/BCVM/Bao_Cao_Nghien_Cuu_Nganh_Dien.pdf[In Vietnamese]
13. Industrial Analysis Report. https://vpbs.com.vn/Reports/1866/bao-cao-nganh-dien-viet-nam.aspx [In Vietnamese]
14. Anual reports, Vietnam Electricity: http://www.evn.com.vn/Portals/0/userfiles/vuthuhong/2012/4/BaoCao2010_2011.pdf [In Vietnamese]
15. Electricity in Vietnam: A Heavy load. *The Economist, 31st August 2013*. Available at:

http://www.economist.com/news/asia/21584374-vietnams-power-grid-under-strain-all-kinds-fuses-may-blow-heavy-load