Small and Medium Enterprise Productivity and its Determinants: Evidence from Vietnamese Manufacturing SMEs

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Abstract

There is general recognition of the importance of small and medium enterprises (SMEs) in both developed and developing economies. SMEs make considerable contributions to employment, output, exports, poverty alleviation, economic empowerment of minorities and more equitable distributions of income and wealth. Despite this, the productivity gap between small and large firms has tended to be more noticeable in developing than developed economies, and is, partly, a reflection of the sectors in which SMEs tend to operate: low value-added, labour intensive, low productivity sectors as well as limited access to resources. Analysing, understanding and addressing this productivity gap between SMEs and larger firms in developing countries is likely to generate a number of direct beneficial effects: 1) improved competitiveness of domestic SMEs; 2) expanded GDP growth; 3) expanded employment generation and opportunities; and 4) higher wages in low-wage segments of the economy, with positive and equitable distributional effects. Hence, improving SME productivity has the potential to make an important contribution to broad based, inclusive and sustainable growth.

This paper will apply a two stage productivity analysis. The first stage involves measurement of individual firm's Malmquist productivity index (MPI). A dynamic model, estimated by system-GMM, is then used to examine the relationship between MPI (and it decompositions) and various regressors which includes business environment characteristics (government assistance, sunk costs, and involvement in production networks from location in an industrial zone), firm characteristics (age, size, innovation activity, export activity, ownership type), and owner/entrepreneur characteristics (gender, age, education, experience). The research benefits from survey data available for Vietnamese manufacturing SMEs covering the period 2005 to 2013.

Keywords: SMEs, Vietnam, Malmquist productivity index, explanatory variables, policy implications.

JEL codes: C.23, D.22, D.24

1. Introduction

There is general recognition of the economic importance of small and medium enterprises (SMEs) in both developed and developing economies and in understanding how this contribution can be further improved. SMEs are a vital part of many developing economies in terms of their contribution to employment, output, exports, poverty alleviation, economic empowerment of minorities and contribution to a more equitable distribution of income and wealth (Harvie & Lee 2002; Harvie 2008). Despite this, however, larger firms tend to be more productive, and are more likely to export and pay higher wages (ITC 2015). This productivity gap between small and large firms has tended to be more noticeable in developing than developed economies, and is, partly, a reflection of the sectors in which SMEs tend to operate: low value-added, labour intensive and low productivity sectors. With lower productivity, SMEs also tend to pay lower wages and offer poorer working conditions. Analysing, understanding and addressing this productivity gap between SMEs and larger firms in developing countries is likely to generate a number of direct beneficial effects: 1) improved competitiveness of domestic SMEs; 2) expanded GDP growth; 3) expanded employment generation and opportunities; and 4) higher wages in low-wage segments of the economy, with positive and equitable distributional effects. The latter points to the inclusiveness of growth generated from a rise in SME productivity. Indeed, these effects are likely to spread beyond the direct income effect on poor households. For example, higher wages for female employees will have knock-on effects to the wider economy as women in developing countries have a higher propensity than men to invest in their families, and in the community more generally, leading to a positive impact for the country as a whole (ITC 2015). Hence, improving SME productivity has the potential to make an important contribution to broad based, inclusive and sustainable growth.

The above issues are of critical significance for Vietnam, which is still in the process of transitioning from a centrally planned to a market oriented economy. Since the introduction of economic reform, *Doi Moi,* in 1986, Vietnam has achieved impressive growth with remarkable social cohesion and equity, but maintaining this presents a major challenge to policymakers as the country undergoes further reform and structural transformation. In this context the role and participation of private sector SMEs will be critical, as indicated by the introduction in 2000 of the Enterprise Law aimed at encouraging the registration and establishment of new private sector SMEs in a wide array of economic activities (Le & Harvie 2010; 2013). By 2011, 324,691 formal companies were in operation of which over 97.6% were SMEs (General Statistics Office 2013). A recent report by Vietnam's Ministry of Planning and Investment showed that SMEs contribute 40% of the country's GDP, 51% of employment, 25% of exports and nearly 30% of the government's budgetary revenue (MPI 2015).

Vietnamese SMEs, however, face many obstacles including limited access to funds and financial facilities, inaccessibility to overseas markets, limited knowledge of production and technology, inaccessibility to information and inadequate infrastructure (Harvie 2001). In addition, labour productivity in Vietnam is among the lowest in ASEAN (Asian Productivity Organisation 2015). Vietnamese SMEs are, therefore, not in a competitive position to take full advantage of closer regional economic integration such as that arising from the establishment of the ASEAN Economic Community in 2015. Thus, there is broad appeal for research studies that focus on addressing SME productivity in Vietnam targeting improvement in their competitiveness and with the objective of achieving broad based and inclusive growth.

Research on the performance of manufacturing SMEs has generated considerable interest in the literature (see Harvie (2001; 2004; 2008); Le and Harvie (2010); Hall *et al*. (2009); Milana *et al*. (2013)). This also includes studies on the productivity of Vietnamese manufacturing SMEs (see Newman *et al*. (2009; 2015); Ha and Kiyota (2014); Hiep and Ohta (2009)), which emphasise the importance of productivity to business success. However, there are questions still to be examined regarding the productivity of SMEs: What are the sources of productivity within SMEs? What are the main factors affecting the ability of SMEs to achieve higher productivity?

There exists a rich literature on firm productivity and its determinants, as reviewed in Syverson (2011). Different specific aspects, including both external economic environment factors and the individual decision making of economic agents (internal factors), can influence company productivity. There are many potential factors which impact on the productivity of SMEs in the manufacturing sector. Analysing productivity and its determinants provides a better understanding of the factors which policymakers should target in order to achieve TFP growth. This study examines in more detail both internal and external factors, including firm characteristics, entrepreneur characteristics, and business environment factors, that impact upon the productivity of firms. The findings of this study provide a comprehensive analysis of the impact of potential factors on the productivity of Vietnamese manufacturing SMEs.

The purpose of this study is twofold. First, it highlights significant changes in the efficiency levels and productivity growth of Vietnamese SME manufacturing in aggregate covering the period from 2005 to 2013. Second, this research will also identify key factors impacting on productivity growth and its constituent compositions. Findings from the study will be important in identifying key factors constraining improvement in SME productivity and provide the focus of evidence based government policy formulation and international aid agency efforts. It will also be useful for policy makers in designing effective strategies to improve SMEs' readiness to capitalise on the benefits arising from Vietnam's membership of the ASEAN Economic Community, World Trade Organization, and other regional and international organisations/agreements, while enhancing the inclusiveness of these benefits.

The remainder of this paper is organised as follows. The next section briefly describes the methodology of measurement of efficiency and productivity. Section 3 describes the dataset and variables to be used in this paper. Section 4 presents the results regarding efficiency levels and TFP growth. Regression results of the major determinants are also presented in this section.

Finally, a summary of the major results and conclusions from this paper are presented in section 5.

2. Methodology

This research will apply a two-stage productivity analysis. The first stage involves the calculation of the Malmquist productivity index (MPI) and its components to obtain information on productivity changes over time. In this study, MPI is based on distance functions calculated using Data Envelopment Analysis (DEA). We also use a bootstrap method to address the statistical problems associated with DEA and will estimate the confidence intervals of deterministic parameters along with the DEA scores. This approach has been used in many studies in different fields (for example, see Arjomandi *et al*. (2011), Arjomandi and Valadkhani (2011), and Arjomandi and Seufert (2014)). The second stage is to examine the determinants of productivity change.

DEA

DEA, is a non-parametric linear programming technique developed in the work of Charnes *et al*. (1978), and is applied in this study to estimate "best practice" frontiers relative to firms' measured efficiency scores. DEA is a well-known measurement of efficiency, as evidenced in the literature (see Charnes *et al*. (1981), Golany and Roll (1989), Roll and Hayuth (1993), and Cooper *et al*. (2000), and Liu *et al*. (2013)). In this paper, we use DEA models in the manner of Färe *et al*. (1994a). One important question for a DEA assessment is whether firms are to be considered input minimisers or output maximisers, or both. Both orientations provide a similar result, just from different perspectives (Coelli *et al*. 2005). For convenience, we use the output oriented assumption.

Malmquist

The MPI developed by Caves *et al*. (1982) is based on the original work of Malmquist (1953). We use the MPI to determine whether there were productivity improvements amongst SMEs over time. The MPI may be computed by using different methods for estimation of distance functions, such as stochastic frontier functions or DEA (see, for example Färe *et al*. (1994b)). According to Grifell-Tatjé and Lovell (1996), the approach of MPI based on DEA has three main advantages. First, it does not require assumptions about profit maximisation or cost minimisation. Second, it does not require information on prices of inputs and outputs. Finally, the most important advantage of this approach is that it enables the decomposition of productivity change into two key components, technical efficiency change (i.e. change in the efficiency with which technology is applied) and technological change (i.e. change in production technology).

Bootstrapping

Once efficiency scores and productivity indices are computed, we still need to test the statistical significance of estimated distance functions or to conduct a sensitivity analysis to examine their asymptotic properties. However, results from the approach DEA do not contain random errors and have no statistical foundation (Simar & Wilson 1998; Simar & Wilson 1999; Lovell 2000; Simar & Wilson 2000). To resolve this issue, Simar and Wilson (1998; 2000) propose a statistical model, called the bootstrap simulation method, which allows analysts to examine statistical properties in relation to non-parametric estimators in multiple input/output cases. This model can evaluate confidence intervals for the DEA efficiency score. Simar and Wilson (1999) also demonstrate that the bootstrap technique has the ability to examine confidence intervals to enable calculating the value of Malmquist indices.

The idea of the bootstrapping method is to repeatedly estimate from approximated distributions by generating random samples from the population. A pseudo-sample is created to resolve the DEA model for each decision making unit (DMU) with the new data developed. By repeating this procedure many times the researcher can get a good evaluation of the true distribution. Simar and Wilson (1998) state that consistent repetition of the Data Generating Process (DGP) will determine a statistically consistent estimation of confidence intervals. In other words, the best reason for the use of bootstrapping within the implementation of frontier models is the process of repeating the DGP.

Regression of the determinants of productivity growth

After obtaining the MPIs and DEA scores, it is important to estimate the impact of potential factors on productivity. There are many internal and external factors that impact a firm's performance as identified previously. This study accomplishes this aim by means of second stage parametric regression analysis, whereby the derived productivity indices are regressed on potential explanatory variables. The directions of the impact of the environmental variables are indicated by the signs of the coefficients of these variables, and the strength of the relationships can be rendered using standard hypothesis tests. The model will be estimated by applying the system of Generalized Method of Moments (GMM), developed by Arellano and Bover (1995) and Blundell and Bond (1998), which is especially suited to dealing with empirical productivity growth models (Bond *et al*. 2001).

3. Data and variables

The data utilised in this study were obtained from an extensive series of surveys of small and medium enterprises (SMEs) conducted in Vietnam in 2005, 2007, 2009, 2011 and 2013. This data collection was developed with support from the Central Institute for Economic Management (CIEM) in the Ministry of Planning and Investment, the Department of Economics at the University of Copenhagen, the Royal Embassy of Denmark in Vietnam, and the Institute of Labour Science and Social Affairs (ILSSA) in the Ministry of Labour, Invalids and Social Affairs (MOLISA). Further information on the sampling used in the conduct of each survey, and general reports from each survey, are reviewed in Rand *et al*. (2007; 2008; 2010; 2012; 2014). We build panel data based on 678 non-state manufacturing SMEs for the measurement of productivity, derived from 2500 SMEs in each survey in the original data, due to some firms having incomplete or missing data, or the exiting of SMEs. Thus, given 678 SMEs over 5 two-year periods, our sample yields a panel set with 3390 observations available for efficiency assessment. For the measurement of productivity growth, this provides 2712 observations (as we consider productivity growth between two adjacent surveys).

In this research we use one output variable and three independent input variables, namely labour, capital, and intermediate input to estimate MPIs. Sales revenue will be used as a proxy for output; labour is taken as the total wages bill of the business; productive physical assets are used as the proxy for capital; and intermediate input is developed based on the total expenditure of the business, including the costs of raw materials and energy. All of these variables were collected from the financial balance sheets of sample firms at the end of the financial year, the year before the survey. Thus, they are deflated by the GDP deflator for each of these years and are calculated using the same base year. A summary of the key statistics for these variables is presented in Table 1.

Table 1. Descriptive statistics of inputs and outputs

Definitions/ Description	Mean	Std. dev.	Min.	Max.
Output				
- Real revenue from sales (million VND)	1,786.73	40,601.51	0.05	27,744.61
Inputs				
- Total value of productive physical assets (million VND)	1,430.9	3,480.6	0.1	89,657.93
- The total wages bill (million VND)	127.26	251.16	0.05	5,541.93
- The costs of raw materials and energy (million VND)	1,396.81	39,004.04	0.05	41,247.09

In order to examine the impact of potential factors on the efficiency and productivity growth of SMEs, we use a number of explanatory variables which represent firm characteristics, business environment characteristics, and owner/entrepreneur characteristics. These variables are chosen based on their relationship to firm performance as highlighted in the literature, and on their availability from the dataset. A summary of the main descriptive statistics for these variables is presented in Table 2.

Table 2. Descriptive statistics for regression variables

Variables	Description	Mean	Std. dev.
AGE	The number of years since establishment	14.46	9.19
SIZE	The number of full-time regular employees	17.75	26.92
INN	Dummy variable representing innovation if the firm did any type of innovation activities in the previous two years	0.57	0.50
EXP	Dummy variable representing if the firm directly exports	0.04	0.19
OWN	Dummy variable representing if the firm is a household enterprise	0.63	0.48
ZONE	Dummy variable representing if the firm is located in an industrial zone	0.07	0.25
FIN	Dummy variable representing if the firm received financial support	0.08	0.27
BRI	Dummy variable representing if the firm had to pay bribes	0.41	0.49
EAGE	The age of the entrepreneur	45.2	10.38
EGEN	Dummy variable representing if the entrepreneur is female	0.3	0.63
EEXP	Dummy variable representing if the entrepreneur owned/ managed other firms before establishing the present firm	0.04	0.20
EDU	Level of professional education of the entrepreneur	2.57	1.06

Source: Authors

4. Empirical results and discussion

4.1. DEA efficiency scores

This step in the analysis involves evaluating the technical efficiency of firms. Though constant returns to scale (CRS)is not described to preserve space (more details on CRS and variable returns to scale (VRS) can be found in Coelli *et al*. (2005)), we use CRS when we return to the scale of operation and when we calculate Malmquist indices. Table 3 presents a summary of the results of the bootstrapped DEA efficiency scores, and their frequency distribution for the whole of manufacturing industry.

The results for the bootstrapped efficiency scores are presented in the upper panel of Table 3. The mean efficiency score over the period 2005-2013 is 0.504. This means that the mean potential for output increasing among SMEs is about 49.6%. For individual years there are fluctuations in average scores. For example, scores rose slightly between 2005 and 2007; however, the mean scores in both years were low. In 2009, there occurred a drop in mean scores to a considerably lower level. This period could have been partly influenced by the slowdown of the Vietnamese and global economies due to the Global Financial Crisis in 2007-2008. In 2011 and 2013 the mean scores rose significantly. After 2009, a series of policies introduced by the government to support enterprises to respond to the crisis began to take effect. This may have improved the efficiency level of SMEs after the crisis.

The results from confidence intervals at the 5% level indicate that the means are within relatively large confidence intervals. This shows that there is wide variation in efficiency scores across the years. One important aspect of the confidence intervals is the assurance with which we can answer the "hypotheses" regarding whether the mean efficiency scores actually changed across years. There are significant gaps between the confidence intervals of the mean efficiency scores between the years, except between 2011 and 2013. There is an overlap between the mean efficiency scores' confidence intervals in 2011 and 2013. Thus, we cannot assert that the mean efficiency scores between these two years are different.

Looking now at the distribution of efficiency scores across individual SMEs in the whole manufacturing industry, we observe that the number of SMEs with an efficiency score under 0.6

is considerable across the years while the number of producers in the 81-100 range is low (under 12% of the total sample in most years). As a result, the mean efficiency score over the period of the study is quite low. In particular, the number of SMEs with an efficiency score under 0.6 in 2009 is high at 88.35% of the total samples.

Table 3. Summary the average of bootstrapped efficiency scores

	2005	2007	2009	2011	2013	Mean
Mean	0.402	0.597	0.226	0.635	0.660	0.504
Min	0.035	0.294	0.072	0.383	0.293	0.035
Std. dev.	0.123	0.151	0.161	0.128	0.116	0.215
Confidence interval, 5%						
Lower bound	0.223	0.503	0.118	0.526	0.556	0.485
Upper bound	0.421	0.601	0.236	0.646	0.673	0.516
Distribution						
< 40	419 (61.80%)	21 (3.10%)	599 (88.35%)	2 (0.29%)	3 (0.44%)	1044 (30.80%)
41-60	218 (32.15%)	381 (56.19%)	52 (7.67%)	330 (48.67%)	226 (33.33%)	1207 (35.60%)
61-80	25 (3.69%)	200 (29.50%)	16 (2.36%)	269 (39.68%)	368 (54.28%)	878 (25.90%)
81-100	16 (2.36%)	76 (11.21%)	11 (1.62%)	77 (11.36%)	81 (11.95%)	261 (7.70%)

Source: Authors

4.2. Malmquist productivity indices

This section now turns to assessing productivity growth. A summary of the bootstrapped mean MPI and its composition, technical change (TC) and efficiency change (EC) of SMEs, as well as their distributions in the whole sample of the manufacturing industry, is presented in Table 4.

The results indicate that the total productivity growth of SMEs in manufacturing industry is a respectable 3% every two years (equivalent to 1.73% annually) over the whole period 2005-2013. The increase in productivity was mainly led by an improvement of technology by 19%, while efficiency decreased by 13%. As discussed in the previous section, the efficiency level of

SMEs in manufacturing industry for the period of the study was very low. Thus, the change in efficiency made a small contribution to productivity growth.

Period by period developments show slight fluctuations in productivity. However, its compositions, both TC and EC, show significant changes across periods. For example, in the early period from 2005 to 2007, the productivity growth rate increased by 8%. The increase in productivity in this period was caused by technical change, which improved by 73%. In the next period, 2007-2009, on the other hand, the improvement of productivity was led by a significant increase in efficiency. In the last period, the slight growth in productivity is due to small changes in both TC and EC. The changes in productivity and its composition are presented in Figure 1.

Figure 1: Changes in productivity and its composition

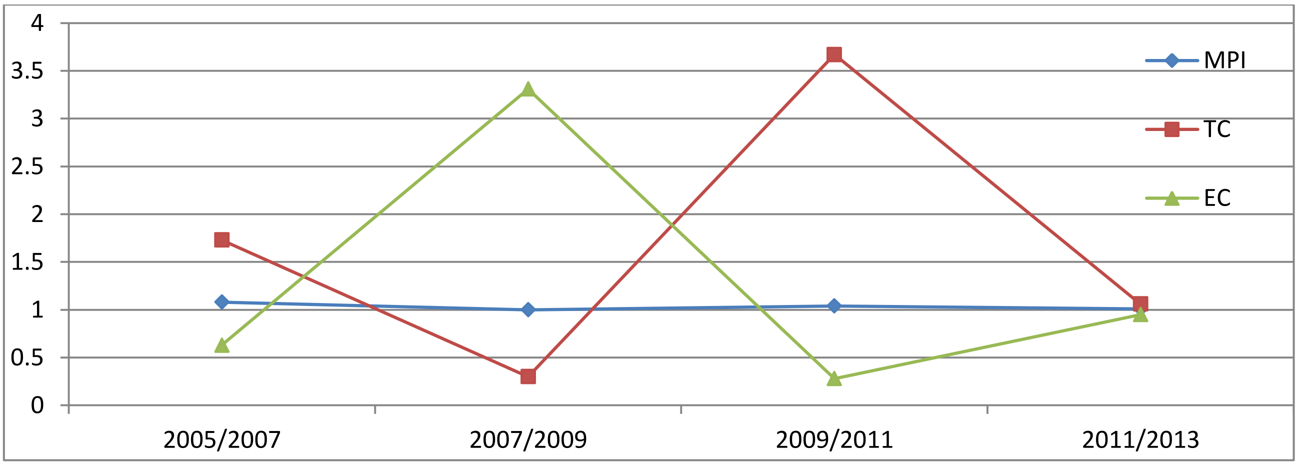

Table 4. Summary results of productivity growth of SMEs in the entire manufacturing industry

	2005-2007			2007-2009			2009-2011			2011-2013			2005-2013		
	MPI	TC	EC	MPI	TC	EC	MPI	TC	EC	MPI	TC	EC	MPI	TC	EC
Mean	1.08	1.73	0.63	1.00	0.30	3.31	1.04	3.67	0.28	1.01	1.06	0.95	1.03	1.19	0.87
Min	0.08	0.42	0.17	0.26	0.84	0.08	0.06	0.21	0.16	0.27	0.65	0.42	0.06	0.21	0.08
Max	8.32	0.92	12.84	33.21	5.16	12.34	4.32	0.88	8.52	3.52	1.55	2.80	33.21	5.16	12.84
Std. dev.	0.48	0.07	0.70	1.72	0.87	0.60	0.50	0.11	1.52	0.28	0.06	0.27	0.75	0.28	0.77
Confidence interval, 5%															
Lower bound	1.03	1.60	0.57	0.94	0.27	2.96	0.98	3.34	0.25	0.97	1.00	0.89	0.98	1.10	0.78
Upper bound	1.15	1.88	0.69	1.06	0.33	3.73	1.11	4.06	0.32	1.05	1.12	1.02	1.09	1.30	0.96
Distribution															
< 60	13	0	278	78	650	1	41	0	606	3	0	6	135	650	891
	1.95%	0.00%	41.62%	11.68%	97.31%	0.15%	6.14%	0.00%	90.72%	0.45%	0.00%	0.90%	5.05%	24.33%	33.35%
61-80	63	0	253	108	11	5	128	0	32	60	2	109	359	13	399
	9.43%	0.00%	37.87%	16.17%	1.65%	0.75%	19.16%	0.00%	4.79%	8.98%	0.30%	16.32%	13.44%	0.49%	14.93%
81-100	161	0	105	142	6	14	151	1	20	251	139	289	705	146	428
	24.10%	0.00%	15.72%	21.26%	0.90%	2.10%	22.60%	0.15%	2.99%	37.57%	20.81%	43.26%	26.38%	5.46%	16.02%
101-120	213	3	25	124	1	13	127	1	5	250	514	191	714	519	234
	31.89%	0.45%	3.74%	18.56%	0.15%	1.95%	19.01%	0.15%	0.75%	37.43%	76.95%	28.59%	26.72%	19.42%	8.76%
121-140	123	42	4	68	0	17	77	3	3	75	11	57	343	56	81
	18.41%	6.29%	0.60%	10.18%	0.00%	2.54%	11.53%	0.45%	0.45%	11.23%	1.65%	8.53%	12.84%	2.10%	3.03%
141-160	53	203	2	50	0	11	58	5	2	22	0	14	183	208	29
	7.93%	30.39%	0.30%	7.49%	0.00%	1.65%	8.68%	0.75%	0.30%	3.29%	0.00%	2.10%	6.85%	7.78%	1.09%
>161	42	420	1	98	0	607	86	658	0	7	2	2	233	1080	610
	6.29%	62.87%	0.15%	14.67%	0.00%	90.87%	12.87%	98.50%	0.00%	1.05%	0.30%	0.30%	8.72%	40.42%	22.83%

The confidence intervals of the bootstrapped results offer further insight into the results. Most of the means of MPI across the periods of study are within relatively large confidence intervals at the 5% significant level. The interpretation of the confidence interval, as presented in Simar and Wilson (1999), is straightforward. If unity is contained in the confidence interval, it is impossible to assert whether there is regress or progress. For example, the results show significant progress of MPI during the period 2005-2007, of TC in most of the periods except 2007-2009, and of EC in 2007-2009. It also shows significant regress of TC in the period 2007-2009, and of EC in 2005-2007 and 2009-2011.

The distribution of productivity indices across individual firms in the lower panel of Table 4 also partly explains the change in the mean of MPI, TC, and EC as described above. We observe that the number of firms with an MPI in the 0.81-1% interval and the 1.01-1.2% interval represent the majority, by 20% to 30%, of the total samples for each interval across the periods. Thus, the mean MPI oscillates around unity. The number of high rates of TC, and EC (in the interval more than 1.61%), is distributed differently in the period 2007-2009, and 2009-2011. These led the significant change in TC and EC in these periods.

4.3. Determinants of productivity growth

To further investigate the determinants of productivity growth of SMEs, we hypothesise a set of influential factors based on previous literature. We regress productivity change (MPI) and its compositions, the TC index and the EC index, on several explanatory variables which are presented in Section 3. In addition, growth of productivity should be conditional on the background of the initial efficiency level. Thus, it is important to calculate the effect of the initial efficiency level on productivity change and compositions of productivity change.

Furthermore, each sub-manufacturing sector or group of SMEs may apply different technology. They may create their best practice frontiers differently. Thus, we also estimate separately regressions for sub-manufacturing sectors, and by groups of firm size. SMEs in this research will be classified by manufacturing sub-sectors based on the International Standard Industrial Classification (ISIC) codes. The ISIC codes, their descriptions, and the distribution of observations for each ISIC group are summarised in Appendix A. However, it is important to note that some firms switch their main business to other sub-sectors in the manufacturing industry, or that firms in the group termed micro firms many get larger and join the group of small firms. Thus, for estimation of the DEA score and the MPI of firms in a specific group of SMEs, to avoid bias when comparing across groups, this study estimates the frontier of the groups based on the samples which stay in their group for the whole period 2005-2013. Thus, the total sample in the panel data of all groups is less than the samples in the original panel for the whole manufacturing industry.

The results of the regressions are presented in Table 8 and Table 9 for the whole manufacturing industry and for some key sub-sectors.

The initial efficiency level (EFF) is significantly correlated with MPI and its compositions in most regressions. The results indicate that those firms with a greater initial efficiency level attain a larger increase in their MPI. However, the results for TC and EC are mixed, with the exception of the regressions for ISIC-17, ISIC-20, ISIC-25, ISIC-28, and ISIC-36, and the frontier shift (TC) decomposition is higher for firms with a lower initial efficiency level. This implies that firms with a lower initial efficiency level try to improve their technology or innovation. However, the initial efficiency level has a positive coefficient with the EC index. This implies that firms with a greater initial efficiency level have a tendency to experience a larger improvement. This could be an obstacle to the improvement in productivity of firms with a low initial efficiency level.

The significant and negative results of the firm age variable (AGE) in the regression for MPI in the sample for the whole manufacturing industry, the sample of micro firms and ISIC-28 indicate that younger firms have a higher rate of productivity growth than older firms in these samples. Overall, younger firms have to catch up in order to be competitive. Thus, it is to be expected that the productivity growth rate of younger firms is higher than the growth rate of existing firms' productivity. There is a negatively correlated relationship between productivity growth rate and firm age in the early stages of a firm's life, because of the innovation and learning process (Huergo & Jaumandreu 2004). However, the positive relationship between firm age and productivity growth could be explained by the "learning by doing" hypothesis and/or the "selection effects" hypothesis (Jensen *et al*. 2001; Foster *et al*. 2008; Syverson 2011; Arkolakis *et al*. 2015), such as for the case of ISIC-25, and the group of small firms. The significant and positive results in the MPI regressions of these groups of SMEs indicate that older firms have a higher rate of productivity growth than new firms. The result of the relationship between firm age and the compositions of productivity growth show that, overall, older firms in the manufacturing industry and, in particular, for sub-sectors such as ISIC-15, ISIC-20, and ISIC-25, have a tendency to improve their technology. However, the significant and negative results of most regressions for EC indicate that older firms have a low rate of efficiency change.

The significant and positive coefficient for the firm size variable (SIZE) in the regression of MPI and TC of the sample of the whole manufacturing industry, indicates that larger firms have a higher rate of productivity growth and technology change. This result is similar to the findings of Urata and Kawai (2002) for the case of the Japanese manufacturing sector, and Aw (2002) for the Taiwan manufacturing sector. These researchers emphasised the role of technological and scale factors in affecting the TFP levels of firms.

The household ownership (OWN) variable gives an unclear result for MPI in most regressions. The significant and negative result in ISIC-15 indicates that household enterprises have a lower rate of productivity growth than other types of ownership in this sub-sector. In the data survey samples used in this study, household enterprises are individual business establishments that do not satisfy the conditions stated in the Law on Enterprises of Viet Nam. These are informal enterprises, which are not registered with the provincial authorities; however, they may have tax codes provided by district authorities. Thus, they have more disadvantages in term of access to public facilities, financial resources, sub-contracting, or high skilled labour. Thus, household enterprises lack resources to increase their productivity. Becoming officially registered could lead to an increase in productivity. There is an unanticipated positive and significant association (at the 10% level) between the household ownership variable and EC for the entire manufacturing industry and for the group of small firms.

As discussed in the introduction section, Vietnam is in the process of economic integration through its participation in the AEC. This brings more opportunities to engage in exporting activities for Vietnamese manufacturing SMEs. The significant and positive coefficient for the export activities variable (EXPORT) in the MPI and TC regressions for the entire manufacturing industry and some sub-sectors, in particular ISIC-28 and ISIC-36, indicates that exporting is positively correlated with the productivity growth of manufacturing SMEs. There are two hypotheses usually applied to explain the link between export density and productivity growth. The first is the self-selection hypothesis which suggests that only highly productive firms will self-select into the export market (Bernard & Jensen 1999). The "learning by exporting" hypothesis argues that export participation is positively correlated with productivity growth (Van Biesebroeck 2005). A more detailed study is needed to examine the impact of exporting on the productivity growth of Vietnamese manufacturing SMEs.

Results for the industrial zone variable (ZONE) show a significant and positive correlation in the MPI and TC regression for the whole manufacturing industry, and the ISIC-15 ISIC-36 sub-sectors. This implies that firms located inside industrial zones have a higher rate of productivity growth and technology change in the overall manufacturing industry, and in particular in the ISIC-15, ISIC-36 sectors. Firms operating in industrial zones may have many opportunities to join a cluster and receive access to information and knowledge, government incentives, better infrastructure and access to skilled labour. However, the high cost of industrial zones, as well as other legal constraints such as environmental protections, could represent barriers for SMEs. The significant and negative coefficient in EC for ISIC-17 indicates that SMEs in this sub-sector, located inside industrial zones, remain farther away from the technical efficiency frontier.

The result for financial support from the government and state banks (FIN), and the result of paying bribes (BRI), do not appear to have a significant impact on the MPI, TC, and EC for most regressions. Only the financial support variable gives a negative coefficient in the TC regression of the small firms sample, and in the MPI regression of the ISIC-28 sample; however, it is significant at the 10% level. This indicates that government support programs have been ineffective, or that SMEs have to pay a high cost to access the support programs. In addition, government financial assistance could be simply propping up inefficient and lower productivity SMEs.

The relationship between the personal characteristics of entrepreneurs and the productivity of firms has been the focus of many studies in the literature, such as Martin *et al*. (2013), Van der Sluis *et al*. (2008) and Peake and Marshall (2009). In this study, we consider the impact of the personal characteristics of entrepreneurs (age, gender, education, experience) on the productivity growth of SMEs. The significant and negative coefficient of the gender variable (EGEN) in the MPI and TC regressions for the whole manufacturing industry, and the sample of ISIC-15, implies that SMEs with female entrepreneurs have a lower rate of productivity growth and technical change than SMEs with male entrepreneurs in the overall manufacturing industry, and in particular the ISIC-15 sector. However, SMEs with female entrepreneurs have higher productivity growth in the ISIC-28 sector, and in the group of micro firms. Micro firms are, as usual, family enterprises. They tend to use family labour, and female entrepreneurs, in this case, tend to combine work and family better than men (World Bank 2012). Mead and Liedholm (1998) and Nichter and Goldmark (2009) also state that there are strong linkages between female ownership, wage employment conditions, time and mobility, access to resources, markets and social networks, and the willingness of SME owners to take risks.

Results for the entrepreneur age variable (EAGE) gives a significant and positive coefficient only in the MPI regression of for the ISIC-15 sample. This implies that firms with older entrepreneurs have a higher rate of productivity growth than firms with younger entrepreneurs in the ISIC-15 sector. However, the significant negative coefficient in the EC regression of the ISIC-17 sector means that firms with younger entrepreneurs, in this sub-sector, have a higher rate of efficiency change than firms with older entrepreneurs.

The education level and the previous experience of the entrepreneur are considered to have a positive influence on both the performance and the survival of the business (Pittaway & Cope 2007; Woldie *et al*. 2008; Simpeh 2011). However, the empirical results in our study for professional education level (EDU) and experience in ownership/management of other firms before establishing the present firm (EEXP) are considerably different across regressions. In particular, these two variables give significant and negative coefficients in EC regressions of the samples for the whole manufacturing industry, in the groups of micro firms, ISIC-15 and ISIC-17, and in the TC regression of the ISIC-28 sample.

These empirical results have various implications related to the productivity growth of SMEs in the manufacturing industry. Our study finds that the effects of various factors on productivity growth and its composition across sub-manufacturing sectors and groups by firm size are not always consistent, but also sometimes generate unanticipated results. This finding means that we need to develop specific support policies for different groups of SMEs in order to achieve better productivity performance.

Table 6: Determinants of productivity growth of SMEs in the whole of manufacturing industry and by firm size groups

	Whole of manufacturing industry			Micro			Small		
	MPI	TC	EC	MPI	TC	EC	MPI	TC	EC
EFF	0.684***	-2.422***	6.757***	1.447***	-0.373***	2.140***	1.344***	-0.254**	2.291***
AGE	-0.017**	0.672***	-0.609***	-0.013***	-0.026***	-0.008**	0.021***	-0.011	-0.050***
SIZE	0.001*	0.002*	-0.003	-	-	-	-	-	-
OWN	-0.112	-0.009	0.353*	-0.034	0.021	-0.046	-0.058	-0.067	0.145*
EXP	0.015*	0.269**	0.035	-	-	-	0.090	0.047	0.010
INN	0.036	0.002	0.057	0.014	0.011	0.004	-0.015	-0.053	0.018
ZONE	0.127*	0.172	0.013	-0.039	0.021	-0.017	-0.032	-0.006	-0.016
FIN	0.110	0.088	-0.020	-0.035	-0.046	0.034	0.026	-0.116*	0.068
BRI	0.025	-0.069	0.045	-0.005	-0.016	0.008	-0.032	-0.033	0.022
EGEN	-0.161***	-0.083**	0.059	0.037***	0.063***	-0.055***	-0.021	0.126***	-0.041**
EAGE	0.001	0.004	-0.000	0.001	-0.000	0.000	0.002	-0.000	0.001
EDU	-0.000	0.004	-0.074**	0.005	-0.001	-0.005	-0.009	-0.010	-0.005
EEXP	0.003	-0.004	-0.006	0.009*	0.013***	-0.009*	-0.014	-0.011	0.003
Constant	1.629***	-5.851***	7.540***	0.075	1.903***	-0.324***	0.077	1.668***	-0.088
Observations	2004	2004	2004	789	789	789	474	474	474

(Note: *, **, *** indicate significance at 10%, 5%, and 1% level, respectively)

Table 7: Determinants of productivity growth of SMEs across sub-manufacturing sectors

	ISIC-15			ISIC-17			ISIC-20		
	MPI	TC	EC	MPI	TC	EC	MPI	TC	EC
EFF	0.670***	-1.876***	8.846***	2.307*	0.494	1.316***	1.202***	-0.257	3.215***
AGE	-0.017	0.617***	-0.320***	-0.061	-0.057	0.002	0.004	0.092***	-0.033**
SIZE	0.002	0.001	0.000	-0.001	0.003	-0.001	0.000	-0.000	-0.001
OWN	-0.634***	-0.168	-1.131	-0.029	-0.118	-0.096	0.009	-0.068	0.210
EXP	-0.475	-0.414	1.401	-	-	-	0.007	0.026	0.034
INN	0.089	0.101	0.298	-0.091	-0.006	0.012	0.031	0.012	0.013
ZONE	0.474**	0.655**	-0.297	-0.092	-0.016	-0.112**	-0.041	-0.012	-0.013
FIN	0.134	-0.139	0.589	0.387	0.228	0.051	0.071	-0.071	0.108
BRI	0.037	-0.136	0.277	0.181	0.122	0.018	-0.037	-0.081	-0.045
EGEN	-0.245***	-0.173*	0.344	0.064	0.068	-0.003	-0.078	-0.068*	0.097**
EAGE	0.012**	0.011	0.004	-0.005	-0.004	-0.007*	-0.008	-0.004	-0.010
EDU	0.024	-0.019	-0.149	0.038	0.074	-0.018	-0.022	-0.007	0.033
EEXP	-0.031	0.013	-0.153*	-0.044	0.001	-0.019*	-0.005	-0.002	0.007
Constant	1.518***	-6.649***	2.559	-0.193	1.459	0.185	0.748	0.959***	-1.304**
Observations	360	360	360	42	42	42	144	144	144

(Note: *, **, *** indicate significance at 10%, 5%, and 1% level, respectively)

Table 8: Determinants of productivity growth of SMEs across sub-manufacturing sector (continued)

	ISIC-25			ISIC-28			ISIC-36		
	MPI	TC	EC	MPI	TC	EC	MPI	TC	EC
EFF	1.195***	0.400	1.998***	0.839***	-0.066	1.452***	1.574***	0.271	1.596***
AGE	0.061***	0.071***	0.000	-0.027***	-0.065***	0.021***	0.002	-0.017*	0.013*
SIZE	0.001	0.001	0.000	-0.001	-0.006***	-0.002	0.001	-0.001	0.002**
OWN	0.089	-0.833**	0.221	-0.065	0.067	-0.064	-0.169	-0.109	-0.080
EXP	0.118	0.154	-0.132	0.162	0.484**	0.141	0.484*	0.559**	0.080
INN	0.041	0.029	0.013	0.002	0.039*	-0.007	-0.038	0.013	-0.043
ZONE	0.071	0.047	-0.006	0.072	-0.030	0.030	0.180**	0.002	0.144**
FIN	0.094	0.100	-0.032	-0.093*	-0.025	-0.027	0.009	0.046	0.010
BRI	-0.040	-0.015	-0.004	-0.036	-0.019	-0.015	-0.014	0.015	-0.040
EGEN	-0.006	0.041	-0.025	0.061***	-0.004	-0.013	-0.010	-0.008	-0.005
EAGE	0.009	-0.002	0.004	0.000	-0.003	0.001	0.004	0.007	-0.011
EDU	0.003	0.039*	-0.023	-0.011	-0.039***	0.008	-0.024	-0.000	-0.004
EEXP	0.007	0.005	-0.002	0.008	0.008	-0.006	-0.017	-0.001	-0.008
Constant	-1.075*	0.112	-1.219**	1.046***	2.900***	-0.499***	-0.192	0.834**	-0.054
Observations	96	96	96	288	288	288	99	99	99

(Note: *, **, *** indicate significance at 10%, 5%, and 1% level, respectively)

5. Conclusions

In this paper, we calculate the efficiency level, productivity growth and the components of productivity growth, and then examine the relationships between productivity growth and its components with various environmental variables for Vietnamese non-state manufacturing SMEs covering the period 2005-2013. From the results of a bootstrapped DEA, we found that the efficiency level of Vietnamese non-state manufacturing SMEs was very low, especially during the period of the economic crisis from 2007-2009. The mean potential for output increase among SMEs was approximately 49.6%. We measured productivity growth by means of a bootstrapped DEA Malmquist index. From 2005 to 2013 the average Vietnamese non-state manufacturing SME had an encouraging productivity increase of around 3% every two years (approximately 1.73% per year). This increase in productivity is mainly due to technical improvement among SMEs, rather than improvements in efficiency.

In addition, we examined factors that determine productivity growth and its composition across different groups of observations. The findings of this study provide policy makers with a clear insight into what aspects need to change in order to improve the productivity the Vietnamese manufacturing industry overall, and of particular sub-manufacturing sectors, and groups of micro firms and small firms. We emphasise the importance of export activity, location in industry zones, formalisation of household enterprises, professional education for entrepreneurs and other factors on TFP, TC, and EC.

To summarise, we view this paper as providing a more comprehensive assessment of the efficiency and productivity growth of Vietnamese non-state manufacturing SMEs, as well as the determinants of that performance. Our analysis therefore contributes to knowledge about efficiency and productivity across different groups of SMEs in manufacturing in the Vietnamese economy.

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Appendix A. ISIC code and distribution of observations by subsector and firm size in 2013

ISIC-	Subsector	Micro	Small	Total
15	Food products and beverages	100 (76.92%)	30 (23.08%)	130 (19.17%)
17	Textiles	12 (46.15%)	14 (53.85%)	26 (3.83%)
18	Wearing apparel etc.	6 (37.5%)	10 (62.5%)	16 (2.36%)
19	Tanning and dressing leather	6 (60%)	4 (40%)	10 (1.47%)
20	Wood and wood products	58 (63.74%)	33 (36.26%)	91 (13.42%)
21	Paper and paper products	6 (28.57%)	15 (71.43%)	21 (3.1%)
22	Publishing, printing, etc.	6 (40%)	9 (60%)	15 (2.21%)
23	Refined petroleum, etc.	1 (50%)	1 (50%)	2 (0.29%)
24	Chemical products, etc.	3 (30%)	7 (70%)	10 (1.47%)
25	Rubber and plastic products	23 (47.92%)	25 (52.08%)	48 (7.08%)
26	Non-metallic mineral products	24 (48.98%)	25 (51.08%)	50 (7.08%)
27	Basic metals	9 (69.23%)	4 (30.77%)	13 (1.92%)
28	Fabricated metal products	106 (75.71%)	34 (24.29%)	140 (20.65%)
29-32	Machinery (inc office, electrical)	12 (50%)	12 (50%)	24 (3.54%)
34	Motor vehicles, etc.	2 (50%)	2 (50%)	4 (0.59%)
35	Other transport equipment	2 (50%)	2 (50%)	4 (0.59%)
36	Furnitures	56 (74.67%)	19 (25.33%)	75 (11.06%)
	Total	432 (63.72%)	245 (36.28%)	678 (100%)

Source: Author's summary based on the created panel data

Note:

- Figures are in number of firms and below, for each sub-sector, is the share of firms in each size category (percentages in parenthesis), and share of this sub-sector in total manufacturing industry.
- Micro: 1-9 employees; Small: 10-199 employees; Medium: 200-399 employees (based on the definition in Government Decree No. 56/2009/ND-CP).