Innovation and Productivity of Vietnamese Small and Medium Enterprises:Firm level panel data evidence

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ABSTRACT: Innovation is considered as a driver of productivity at both country and firm level. However, the researches on the relationship between innovation and firm productivity in Vietnam are rarely. Using Vietnam's SMEs survey in 2007 and 2009, this paper examines this relationship for the small and medium enterprises (SMEs). Cobb-Douglas production function and the fixed effect model are employed throughout the paper. We find that the presence of innovation has positive effects on firm productivity. In addition, this study also looks at the impact of firm size, firm location and manufacturing sector on the relationship between innovation and SMEs' productivity.

Key words: innovation, productivity, SMEs Vietnam

1. INTRODUCTION

Small and medium enterprises (*SMEs*) have played an important role in economic development. They are also an essential source of job creation, innovation, increasing the competitiveness and thus the engine of developed and developing countries. In Vietnam, with more than 300,000 registered enterprises, SMEs play a crucial role in the economy reform, not only representing the major percentage (97,6%) of businesses of the country, but also significantly contributing to Gross Domestic Product (GDP) and achieving sustainable economic development.

How could we motivate the development of this sector by enhancing SMEs' performance? Within a firm scale, it is important to foster its operational efficiency and productivity for increased competitiveness in the global market. Innovation was found to be essential for increasing productivity. The evidence in Crespi and Zuñiga (2012) shows that applying technological advances led to a more effective use of productive resources, and the transformation of new ideas into new economic solutions such as new products, processes, and services. Innovation will be the basis of sustainable competitive advantages for firms and the crucial source of permanent increases in productivity. A large amount of researches has been completed in this field for many developed and developing countries such as: Chudnovsky, López et al. (2006), Griffith, Huergo et al. (2006), Masso and Vahter (2008), Roper and Love (2002); however, firms in developing countries, especially in SMEs sector, do not always properly consider the impact of innovation on their performance. It is no surprise that there is a lack of studies on this subject in Asian countries, especially Vietnam. This paper examines the impact of innovation on firm productivity using micro data from Vietnam SMEs survey for the period from 2007 – 2009 with approximately 2500 enterprises of 10 provinces in Vietnam. The empirical study uses Cobb-Douglas production function with fixed effect model giving out some interesting results. In line with the literature we find a strong association between innovation and productivity in Vietnamese SMEs. The results have also highlighted the impacts of other influencing factors: firm size, firm location and manufacturing sector on the relationship between innovation and firm productivity.

The remainder of the paper is organized as follows: section 2 provides the literature review with both theoretical and empirical findings from previous studies. Section 3 describes the data and research methodology. Section 4 presents the research findings which are obtained from the estimation results. Last section is the conclusion.

2. LITERATURE REVIEW

Productivity is commonly defined as a ratio of a volume measure of output to a volume measure of input use (Schreyer and Pilat, 2001) or in other words, how much of output which is obtained from a given set of inputs (Syverson, 2010).

Productivity is a technical concept which measures the efficiency from the used factors of production. Higher productivity is likely to improve profitability and enhance a firm's competitiveness relative to its rivals. However, why do firms differ so much in their ability to convert the inputs to outputs? According to the theory of production (Cobb and Douglas, 1928), productivity is basically dependent on labor, capital and total factor productivity. An increase in labor, capital input or total factor productivity (TFP) will lead to an increase in output. As the results, the difference in firm's technology innovation will lead to the changes in their ability to convert the inputs to outputs.

According to Greenhalgh and Rogers (2010), innovation can be defined as the application of new ideas to the products, processes, or other aspects of the activities of a firm that lead to increased value added for the firm and also benefits to consumers or other firms. There are two important types of innovation, *production innovation and process innovation*. Product innovation is the introduction of a new product, new type or design of good, service, or it could be a significantly qualitative change in an existing product. While, process innovation is developed to introduce the new process, new techniques for making or delivering good and service.

The essential effect of production and process innovation is cost reduction in production, thus enhances the firm's competitiveness in the global market. This is understood as the innovation process. The innovation process normally starts from the research and development activity such as market survey, demand analysis, developing the new idea, testing it with assessment, designing the new product.

Chudnovsky, López et al. (2006) considered a firm was innovative when it introduced new or radically modified products and/or processes during the period of 1992-1996. Lööf and Heshmati (2006) defined innovative firm is when its innovation investment and innovative sales are positive. Mohnen, Mairesse et al. (2006) considered innovation as the residual of innovation production function.

At micro level, innovation influences the firm's productivity with direct and indirect impact. Chudnovsky, López et al. (2006) strongly suggested that innovators attain higher productivity levels than non-innovators in the study of Argentine manufacturing firms' behaviors during 1992–2001. Specifically, the estimation results had suggested that the labor productivity of innovators is 14.1% higher than non-innovators, which was a significant direct impact to the firm's productivity. The former performed better than the latter group in terms of labor productivity.

Griffith, Huergo et al. (2006) found that product innovation was associated with higher productivity in France, Spain, and the UK, but not in Germany. Similarly, Masso and Vahter (2008) suggested that firms, who have more resources to invest in innovative activities and a higher ability to undertake R&D will get the improvement in productivity. They have also found the effect of innovation on productivity not only on the productivity in the last year of the innovation survey, but one and two years after the survey.

Another strong relationship between innovation (both product and process innovation) has been asserted by Hall, Lotti et al. (2009) with a significant impact of innovation outputs on manufacturing firm's productivity in Italy covering the period from 1995 - 2003. They show that product innovation has positive impact on labor productivity, while process innovation has larger effect via associated capital investment.

However, for a less developed country like Chile, Miguel Benavente (2006) was not be able to find any significant impact from innovation on the sales and productivity in the short-run in 1995-1998. This could be explained that the innovation would need sometimes to wait for market's responses or really impact on the firm's productivity, especially in the long-run period. The study also found the significant effect of labor skills on the estimation of productivity instead.

Firm size is classified based on number of employees or invested capital amount. It is one of the important factors, which directly affects the firm's productivity. With innovative activities, Masso and Vahter (2008) found that the larger firms are more likely to engage in innovation than small firms. Firm size has an insignificant impact on product innovation but positive impact on the process innovation. More specifically, Chudnovsky, López et al. (2006) suggested that large firms have a higher probability of engaging in innovation activities and becoming innovators. However, the largest firms have a significantly higher probability of being innovative (68%) than small or medium-sized ones (30%), which was found in (Baldwin and Branch 2000). And no significant difference was found between small and medium-sized firms in terms of their likelihood of being innovative.

The impact of location on firm's efficiency is also considered in Vu (2003), Glancey (1998), Devereux, Griffith, and Simpson (2007) and many other studies. Audretsch and Feldman (1996) found that industry localization increased the innovative activity. Baptista and Swann (1998) used data of 248 manufacturing firms in UK and concluded that *"a firm is considerably more likely to innovate if own-sector employment in its home region is strong"*, which means affirms located in strong clusters; they were more likely to innovate than other firms. It was explained that the strong clusters tended to attract more new entrants and also grow faster than other groups. On the other hand, CIEM (2010) has found a strong evidence of higher labor productivity of firms located in the urban area or the big cities than rural area and smaller cities, and of course the innovation rates of these firms are also higher. However, most of their innovation activities are implemented to satisfy their customer's requests rather than response's to the market's demands.

Manufacturing sector is one of the key determinants of innovation because it is much related to the technology and production process. There are many investigations for different industries. In a research of German industry, Fritsch and Meschede (2001) presented that low-technology manufacturing firms lag behind their medium and high-technology counterparts in product innovation performance, but they appears to perform well and even better in process innovation. For Italy manufacturing firms, Hall, Lotti et al. (2009) found that the impact of product innovation on productivity was positive and slightly stronger for firms in high-tech industry than low-tech sector. However, the larger and older firms seemed to be less productive than smaller firms, *ceteris paribus*.

3. RESEARCH METHODOLOGY AND DATA

We start off with the Cobb-Douglas production function:

$$\mathbf{Y = F(K,L,M) = A\,K^{\alpha}\,L^{\beta}\,M^{\gamma}}$$

Where Y is total outputs in a given year; L is labor input or the total number of person worked for the firm a given year; K is capital input or the real value of total physical assets; M is total material inputs; A is total factor productivity. In this equation α, β and γ are the output elasticity of capital, labor and materials respectively.

Productivity can be calculated as the ratio of output to a specific factor or to all relevant factors of production. In this paper, the author applies the non-parametric measure of productivity – labor productivity as it gives a simple and full meaning of firm productivity performance. By dividing both sides by L, we have the new productivity function:

$$\frac{Y}{L} = A\left(\frac{K}{L}\right)^{\alpha}\left(\frac{M}{L}\right)^{\gamma} L^{(\alpha+\beta+\gamma-1)}$$

Taking logarithm of both sides, we have

$$\ln\frac{Y}{L} = \ln A + \alpha\ln\frac{K}{L} + \gamma\ln\frac{M}{L} + (\alpha+\beta+\gamma-1)\ln L$$

We will have the main model (1) below, which is going to test the relationship between technology innovation and firm productivity.

Model 1 – Innovation

$$\ln(Y_{it}/L_{it}) = \ln A + \alpha\ln(K_{it}/L_{it}) + \gamma\ln(M_{it}/L_{it}) + (\alpha+\beta+\gamma-1)\ln(L_{it}) + \delta I_{it} + \varepsilon_{it} \qquad (1)$$

Where:

$Ln(Y_{it}/L_{it})$ is the log of productivity (total outputs per employee) of firm i in year 2007, 2009

I_{it}: Innovation of firm i in 2007 and 2009 (proxied by the investment in the new product or new production technology or improvement of existing products – dummy variable)

$ln(K_{it}/L_{it})$ is log of physical capital per employee

$ln(M_i/L_i)$ is log of total inputs per employee

$ln(L_i)$ is log of number of employees

ε_{it} is error terms or presenting the unobserved variables in the models in 2007 and 2009

α, β, γ are the productivity elasticity of capital, labor and materials respectively.

$(\alpha+\beta+\gamma-1)$ is the coeffient for $\ln L_{it}$, measures the deviation from constant returns to scale

δ is the productivity elasticity of innovation

Furthermore, for testing the impacts of firm size, firm location and manufacturing sector on the relationship of innovation and productivity, we are going to have following models:

Model 2 - Firm size

$$\mathbf{\ln(Y_{it}/L_{it}) = \ln A + \alpha \ln(K_{it}/L_{it}) + \gamma \ln(M_{it}/L_{it}) + (\alpha+\beta+\gamma-1) \ln(L_{it}) + \delta I_{it} + \delta_1 I_{it}*dLsize + \varepsilon_{it}} \quad (2)$$

where

dLsize is dummy variable for medium-sized firms by employee. *dLsize=1* if the firm size has less than or equals to 10 employees.

δ_1 is the productivity elasticity of innovation of firms less than or equals to 10 employees

$\delta+\delta_1$ is the productivity elasticity of innovation

Model 3 - Firm location

$$\mathbf{\ln(Y_{it}/L_{it}) = \ln A + \alpha \ln(K_{it}/L_{it}) + \gamma \ln(M_{it}/L_{it}) + (\alpha+\beta+\gamma-1) \ln(L_{it}) + \delta I_{it} + \delta_1 I_{it}*dlocation + \varepsilon_{it}} \quad (3)$$

where

dlocation is dummy variable for the big cities. *dlocation=1* if the firm is located in Ha Noi or Ho Chi Minh City.

δ_1 is the productivity elasticity of innovation of firms in the big cities

$\delta+\delta_1$ is the productivity elasticity of innovation

Model 4 –Manufacturing sector

$$\mathbf{\ln(Y_{it}/L_{it}) = \ln A + \alpha \ln(K_{it}/L_{it}) + \gamma \ln(M_{it}/L_{it}) + (\alpha+\beta+\gamma-1) \ln(L_{it}) + \delta I_{it} + \delta_1 I_{it}*In\_High + \varepsilon_{it}} \quad (4)$$

where

In_High is dummy variable for High-tech industry. *In_High=1* if the firm is high-tech industry.

δ_1 is the productivity elasticity of innovation of firms in high-tech industry

$\delta+\delta_1$ is the productivity elasticity of innovation

It will consider alternative regression models associated with collected panel data: the random effect regression model (RE model) and the fixed effect regression model (FE model). By running the Hauman test, the results would allow us to select the better and more appropriate regression model for this research.

Following hypotheses are determined basing on the theoretical and empirical reviews which are discussed in above.

(i) **Hypothesis 1**: innovation influences positively in firm's productivity

(ii) **Hypothesis 2**: the higher firm size, innovation has more impact on the productivity

(iii) **Hypothesis 3**: impact of innovation on productivity in the big cities is higher than other area.

(iv) **Hypothesis 4**: innovation in the high-tech sector has higher impact on the productivity than the other sector

4. DATA, VARIABLES AND SUMMARY STATISTICS

This study used data from the SME Survey in Vietnam for 2007 and 2009 with repeated enterprises in manufacturing sector. These surveys were conducted by the Vietnamese Institute for Labor Sciences and Social Affairs (ILSSA), Ministry of Labor, Invalids and Social Affairs (MOLISA) with the partnership from University of Copenhagen, Denmark. Data has approximately surveyed 2500 enterprises (with nearly 2100 repeated firms) in 10 provinces in Vietnam. They are: Ha Noi, Hai Phong, Ha Tay, Phu Tho, Quang Nam, Nghe An, Khanh Hoa, Lam Dong, Ho Chi Minh City and Long An. Within the scope of this research, we have divided firms of manufacturing sectors into two groups: big and small cities for considering the impact of firm location, high technology and low technology based on the OECD technological intensity classification for considering the technological factor.

Table 4.1: Definitions & Measurement of Variables and Expected Sign of Coefficients

Variables	Definitions	Measurement	Unit	Expected sign of coefficients	Acronym in Stata
Dependent variable					
Productivity (Q)	Value of outputs produced per employee in a fiscal year	Total production outputs per employee deflated by the industrial production price index (logarithm form)	thousand VND		lnOAperL
Independent Variables					
Capital (K)	Value of physical capital used in production process per employee in a fiscal year	Total physical assets per employee at the end of a fiscal year (logarithm form) *Physical assets contain value of land, buildings, equipment/machinery, transport equipment*	thousand VND	positive (+)	lnKAperL
Labor (L)	Number of labors in a fiscal year	Total number of full-time employees at the end of a fiscal year (logarithm form)	persons	positive (+/-)	lnL
Material (M)	Value of raw material used in production process per employee in a fiscal year	Total value of raw material used per employee at the end of a fiscal year (logarithm form)	thousand VND	positive (+)	lnMAperL
Innovation (I)	Dummy variable for innovation measure	Dummy=1 if the firm has an investment in introducing new product *or* new production technology *or* improve the existing products in the last two year Dummy=0 if the firm has no investment in introducing new product *and* new production technology *and* improve the existing products in the last two year		positive (+)	innovation

Control Variables				
Firm location	Dummy variable for big cities	Dummy=1 if the firm is located in the big cities (Ha Noi, Ho Chi Minh City) Dummy=0 if the firm is located in smaller cities and otherwise	positive (+)	dlocation
Innovation*dlocation	Dummy variable for Innovation of big cities	Dummy = Innovation*dlocation	positive (+)	InLocation
Employee Size	Dummy variable for small-sized firms by employee	Dummy=1 if the firm size has less than or equals to 10 employees Dummy=0 otherwise	positive (+)	dLsize
Innovation*dLsize	Dummy variable for Innovation of small-sized firms	Dummy = Innovation*dLsize	positive (+)	InLsize
Hightech Industry	Dummy variable for high technology industry	Dummy=1 if the firm is high-tech industry *(ISIC OECD classification)* Dummy=0 otherwise	positive (+)	hightech
Innovation*Hightech	Dummy variable for Innovation of high-tech industry	Dummy = Innovation*hightech	positive (+)	In_High

Source: Authors' analysis

Table 4.1 describes the definitions of variables and concepts in the models and expected signs basing on the research hypotheses.

Productivity is *total value of production / manufactured output per employee*.

Total physical assets of the firm are used as a proxy for total capital. It contains the value of land, buildings, factory, equipment/machinery, transport equipment..

Total materials take the value of raw materials used in the production.

In SME survey, total outputs, physical capital and materials are nominal market value, thus all value need to be deflated and converted to the real value by using Production Price Index (PPI) of 2007 and 2009.

Labor as an input of production function, it is the total number of full-time workers of the firm at the end of the surveyed year.

Innovation is the dummy variable. If the firm has an investment in introducing new product (at 4 digit ISIC level) or new production technology or improves the existing products in the last two year, then it is said to be innovative. If there is no investment in all of these mentioned above, they become non-innovative. The main reasons of innovation activities are for meeting the requests from purchasing customers and for increasing the competitive advantage to other producers or competitors

Firm size in this research is classified by groups of dummy variables based on the employee size, which are in compliance with Decree 56/ND-CP. However, due to the data availability and making it simpler in the research, I have divided into 2 groups. Micro firms have no more than 10 employees and small and medium group has more than 10 employees.

Firm location is divided into two groups: big cities concludes Ha Noi and HCMC, smaller cities consist of Hai Phong, Ha Tay, Phu Tho, Quang Nam, Nghe An, Khanh Hoa, Lam Dong and Long An.

The manufacturing industries have been classified into categories based on R&D intensities (ISIC Rev. 2 OECD Technology Intensity Classification – *Appendix 1*). According to that, chemicals, machinery, transportation equipment are high-tech industries, while foods & beverages, tobacco, publishing, textiles, furniture, fabricated metal products and others are belong to the low-tech group.

Table 4.2: Descriptive Statistic of Variables

Fiscal Year	Variable		Obs	Mean	Std. Dev.	Min	Max
2007	Total outputs per employee	OAperL	2,110	130,392.8	220,250.3	3,077.3	4,900,000.0
	Total physical assets per employee	KAperL	2,110	208,076.7	376,516.5	1,500.0	7,300,000.0
	Total materials per employee	MAperL	2,110	88,431.3	184,283.2	0.0	3,775,000.0
	Logarithm of total outputs per employee	lnOAperL	2,110	11.3	1.0	8.0	15.4
	Logarithm of total physical assets per employee	lnKAperL	2,110	11.5	1.2	7.3	15.8
	Logarithm of total materials per employee	lnMAperL	2,094	10.6	1.3	3.1	15.1
	Logarithm of total employee	lnL	2,110	1.9	1.1	0.0	5.5
	Total number of employee	employee	2,111	14.6	26.4	0.0	250.0
	Innovation	innovation	2,111	0.5	0.5	0.0	1.0
2009	Total outputs per employee	OAperL	2,110	153,000.0	280,338.7	2,866.9	6,956,979.0
	Total physical assets per employee	KAperL	2,110	238,599.8	434,895.5	254.8	10,600,000.0
	Total materials per employee	MAperL	2,110	106,975.3	237,202.4	0.0	6,472,794.0
	Logarithm of total outputs per employee	lnOAperL	2,110	11.4	0.9	8.0	15.8
	Logarithm of total physical assets per employee	lnKAperL	2,110	11.6	1.3	5.5	16.2
	Logarithm of total materials per employee	lnMAperL	2,092	10.9	1.2	5.5	15.7
	Logarithm of total employee	lnL	2,110	1.8	1.1	0.0	6.2
	Total number of employee	employee	2,111	14.0	28.8	0.0	500.0
	Innovation	innovation	2,111	0.4	0.5	0.0	1.0

Source: Authors' calculation

5. Data Analysis

The first research hypothesis can be supported by the estimation results of the first model. As shown in *Table 5.1* (estimation results), all of the regression coefficients are significant at p-value less than 5%. The estimated coefficient of innovation is 2.9%, it implies that innovation can improve the firm's productivity, given all other things equal, if the firm is innovative, which means it has investment in the new product or new technology or improvement in the existing product in the last two years, its productivity will be 2.9% higher than non-innovative firms.

The sum of three inputs' coefficients: capital, labor and materials are approximately closed to 1 *(0.04+0.61+0.26),* which means the constant returns to scale is observed in production function in the manufacturing industries.

Table 5.1: Regression results

Variable lnOAperL	**Fixed-effect model**			**Random-effect model**		
lnKAperL	0.0404	*(0.0075)*	***	0.0753	*(0.0047)*	***
lnMAperL	0.6120	*(0.0068)*	***	0.6412	*(0.0046)*	***
lnL	-0.0935	*(0.0149)*	***	0.0713	*(0.0055)*	***
innovation	0.0290	*(0.0136)*	**	0.0186	*(0.0108)*	*
_cons	4.4803	*(0.1143)*	***	3.4595	*(0.0598)*	***
R-squared	*0.82*			*0.81*		
Number of observation	*4186*			*4186*		

the figures in parentheses are standard errors
(***), (**), (*) denote significant level of 1%, 5%, 10%, respectively

Source: Authors' calculation

It is important to choose the most appropriate panel-data regression models. The choice of the most appropriate panel-data regression models strongly depends on the results of Hausman test. There are two regression models mentioned above, fixed effect model and random effect model *(Table 5.2)*. Hausman test: p-value < 0.05 then we should reject the null hypothesis and select the fixed effect model as a more effective and appropriate approach.

Table 5.2: Hausman Test Results

lnOAperL	Fixed	Random	Difference	S.E.
lnKAperL	0.0404	0.0753	-0.0350	0.0058
lnMAperL	0.6120	0.6412	-0.0292	0.0049
lnL	-0.0935	0.0713	-0.1648	0.0138
innovation	0.0290	0.0186	0.0103	0.0083
Chi-squared	154.75			
Prob>chi2	0.0000			

Source: Authors' calculation

Firm size

Table 5.3 has shown that there is no significant difference in the impact of innovation on productivity between the firms who have more than 10 employees and firms who have less than 10 employees. Even p-value of firm size is not significant but the innovation still has positive impact on firm's productivity at 4.7%. Hausman Test result has rejected the null hypothesis as p-value is less than 5%, which means it FE model is more appropriate.

Table 5.3: Regression results with regards to employee size

Variable lnOAperL	Fixed-effect model			Random-effect model		
lnKAperL	0.0403	*(0.0075)*	***	0.0753	*(0.0047)*	***
lnMAperL	0.6120	*(0.0068)*	***	0.6412	*(0.0046)*	***
lnL	-0.0973	*(0.0153)*	***	0.0754	*(0.0064)*	***
innovation	0.0474	*(0.0218)*	**	0.0025	*(0.0172)*	
InLsize	-0.0268	*(0.0247)*		0.0227	*(0.0190)*	
_cons	4.4866	*(0.1144)*	***	3.4538	*(0.0599)*	***

the figures in parentheses are standard errors

(***), (**), (*) denote significant level of 1%, 5%, 10%, respectively

Source: Authors' calculation

Firm location

As shown in *Table 5.4*, the innovation coefficients of the innovation of firms located in Ha Noi and HCMC is -2.0% *(0.05-0.07)* and the significant level is at 5%, which means the impact of innovation on firm's productivity in Ha Noi and HCMC is lower 7.0% than other cities. Even the labor productivity of firms in Ha Noi and HCMC is higher than other regions (CIEM 2010), but they are facing the higher technology investment costs, greater labor costs and other operational expenditures, thus the production outputs will be affected and seem to be lower than firms in smaller cities.

Table 5.4: Regression results with regards to firm location

Variable lnOAperL	Fixed-effect model			Random-effect model		
lnKAperL	0.0401	*(0.0074)*	***	0.0738	*(0.0047)*	***
lnMAperL	0.6120	*(0.0067)*	***	0.6407	*(0.0046)*	***
lnL	-0.0943	*(0.0149)*	***	0.0689	*(0.0055)*	***
innovation	0.0556	*(0.0172)*	***	-0.0017	*(0.0123)*	
InLocation	-0.0706	*(0.0279)*	**	0.0588	*(0.0173)*	***
_cons	4.4844	*(0.1141)*	***	3.4862	*(0.0602)*	***
R-squared	*0.82*			*0.81*		
Number of observation	*4186*			*4186*		

the figures in parentheses are standard errors
(***), (**), (*) denote significant level of 1%, 5%, 10%, respectively
Source: Authors' calculation

Manufacturing sector

Basing on OECD classification of manufacturing industries, firms are divided into two groups: high-tech sector *(chemicals, machinery, transportation equipment)* and low-tech sector *(foods & beverages, tobacco, publishing, textiles, furniture, fabricated metal products and others*). The empirical results have shown that there is no significant difference between the impact of innovation on productivity of high-tech industry and low-tech industry. As observed from previous statisitcs, most of the surveyed enterprises are micro and low-tech manufacturing sector. Specially, only few enterprises have improvement or invested in new technology. Therefore, we could not be able to find a strong evidence supporting for the innovation impact in high-tech sector.

Table 5.5: Regression results with regards to manufacturing sector

Variable lnOAperL	Fixed-effect model			Random-effect model		
lnKAperL	0.0401	*(0.0075)*	***	0.0753	*(0.0047)*	***
lnMAperL	0.6119	*(0.0068)*	***	0.6412	*(0.0046)*	***
lnL	-0.0939	*(0.0149)*	***	0.0712	*(0.0055)*	***

innovation	0.0507	*(0.0267)*	**	0.0269	*(0.0194)*	
In_High	-0.0261	*(0.0275)*		-0.0101	*(0.0198)*	
_cons	4.4851	*(0.1144)*	***	3.4593	*(0.0598)*	***
R-squared	*0.82*			*0.81*		
Number of observation	*4186*			*4186*		

the figures in parentheses are standard errors

(***), (**), (*) denote significant level of 1%, 5%, 10%, respectively

Source: Authors' calculation

SECTION REMARK

This section uses the collected data to test for four hypotheses on the innovation and productivity interrelationship for the SMEs in Vietnam. It firstly introduces some figures about SMEs in Vietnam by performing the descriptive statistics as well as the model specification. Next, this study chooses the most appropriate regression model consistent with the collected panel data by operating Hausman test. The result of Hausman test is the choice of the FE model. The research results indicate that innovation has positive impact on firm's productivity. However, this relationship is not affected by the firm size or manufacturing sector but it will be impacted by the firm location. The firms located in the bigger cities like Ha Noi and HCMC will receive lower labor productivity if they engage in innovation activities than other area of the country. The next section will come up with the concluding remarks and the policy recommendations of this thesis.

6. CONCLUSIONS

In summary, this paper has produced the evidence on theimportance of innovation on the firm's productivity by using Cobb-Douglas production function. Innovation stimulates manufacturing firm's productivity at both national and regional levels. Given all other things equal, if the firm is innovative, its productivity will be *2.9%* higher than non-innovative firms. We find that the fixed effect method the more effective and appropriate model for this estimation from Hausman test results. This study suggests that the impact of innovation on productivity depends on the firm's location. Firms located in Vietnam's smaller cities have advantages in obtaining higher innovation impacts on their productivity, compared with the firms located in bigger cities such as Ha Noi and HCMC. This is understood that innovation expenditures and operational costs in the big cities are higher than those in smaller cities, given the fact that labor productivity in the smaller cities is usually lower than bigger regions (CIEM 2010). However, there is no difference between the impact of innovation on productivity of micro firms, who have less than 10 employees and larger firms, who have more than 10 employees; and more interestingly, innovation in high-tech intensive sectors have no noticeable impact on productivity, compared with the low-tech and other sectors.

The main policy implication is that: firms are suggested to upgrade their innovation activities for enhancing their productivity performance. Individual firms need to take action to enhance their growth, starting with reconsidering their current practices in investments, determining the needs, development strategies and gaps for more balanced innovation activities. This helps to enhance their sustainable development and innovation capability for the firm itself and for national economic growth in general.

References

Audretsch, D. B. and M. P. Feldman (1996). "R&D spillovers and the geography of innovation and production." The American Economic Review **86**(3): 630-640.

Baldwin, J. R. and S. C. A. S. Branch (2000). Determinants of innovative activity in Canadian manufacturing firms: the role of intellectual property rights, Citeseer.

Baptista, R. and P. Swann (1998). "Do firms in clusters innovate more?" Research Policy **27**(5): 525-540.

Chudnovsky, D., et al. (2006). "Innovation and productivity in developing countries: A study of Argentine manufacturing firms' behavior (1992–2001)." Research Policy **35**(2): 266-288.

CIEM (2008). Characteristics of the Vietnamese business environment: evidence from an SME survey in 2007, Copenhagen and Hanoi: CIEM/University of Copenhagen.

CIEM (2010). Characteristics of the Vietnamese Business Environment: Evidence from a SME Survey in 2009, Central Institute for Economic Management, CIEM.

Cobb, C. W. and P. H. Douglas (1928). "A theory of production." The American Economic Review **18**(1): 139-165.

Crepon, B., et al. (1998). "Research, Innovation And Productivity: An Econometric Analysis At The Firm Level." Economics of Innovation and New Technology **7**(2): 115-158.

Crespi, G. and P. Zuñiga (2012). "Innovation and productivity: evidence from six Latin American countries." World Development **40**(2): 273-290.

Europeia, U. (2005). The new SME definition: User guide and model declaration.

Fritsch, M. and M. Meschede (2001). "Product innovation, process innovation, and size." Review of Industrial Organization **19**(3): 335-350.

Greenhalgh, C. and M. Rogers (2010). Innovation, intellectual property, and economic growth, Princeton University Press.

Griffith, R., et al. (2006). "Innovation and productivity across four European countries." Oxford Review of Economic Policy **22**(4): 483-498.

Hall, B. H., et al. (2009). "Innovation and productivity in SMEs: empirical evidence for Italy." Small Business Economics **33**(1): 13-33.

Lang, T. M., et al. (2012). "Mediate effect of technology innovation capabilities investment capability and firm performance in Vietnam." Procedia-Social and Behavioral Sciences **40**: 817-829.

Lööf, H. and A. Heshmati (2002). "Knowledge capital and performance heterogeneity:: A firm-level innovation study." International Journal of Production Economics **76**(1): 61-85.

Lööf, H. and A. Heshmati (2006). "On the relationship between innovation and performance: a sensitivity analysis." Economics of Innovation and New Technology **15**(4-5): 317-344.

Masso, J. and P. Vahter (2008). "Technological innovation and productivity in late-transition Estonia: econometric evidence from innovation surveys." The European Journal of Development Research **20**(2): 240-261.

Miguel Benavente, J. (2006). "The role of research and innovation in promoting productivity in Chile." Economics of Innovation and New Technology **15**(4-5): 301-315.

Mohnen, P., et al. (2006). "Innovativity: A comparison across seven European countries." Economics of Innovation and New Technology **15**(4-5): 391-413.

Nguyen, A. N., et al. (2008). "Innovation and exports in Vietnam's SME sector." The European Journal of Development Research **20**(2): 262-280.

Roper, S. and J. H. Love (2002). "Innovation and export performance: evidence from the UK and German manufacturing plants." Research Policy **31**(7): 1087-1102.

Schreyer, P. and D. Pilat (2001). "Measuring productivity." OECD Economic studies **33**(2001/2): 127-170.

Syverson, C. (2010). What determines productivity?, National Bureau of Economic Research.