Innovation in Small Firms: The Effects of In-firm Formal Training

Evidence From Enterprise Survey Data in Cambodia

Author: Vanlik Tan *

Thesis Advisor: Daichi Shimamoto

Abstract

This paper examines factors that might be associated with innovation activities for small and medium enterprises in Cambodia. While innovation literature for small and medium enterprises in developing countries is still limited due to the lack of data and other constraints, I use micro data from the World Bank to offer some rather new insights. I found that in-firm training program significantly increase the probability of firms being innovative by as much as 30% even after controlling for potential confounders.

1 Introduction

Innovation is a key to technology adoption and creation, and studying the determinants of innovation is a crucial first step in understanding how firms catch up to the technology frontier and for designing policies to enhance growth and development. While numerous of studies has been done to investigate the determinants of firms' innovation, little is clearly understood of what are the factors that might affect innovation activities of the firms, especially firms in developing countries. Cohen (2010) put together innovation literature over the past 5 decades and devoted one section to the discussion of contrasting empirical results that possibly relates firm size and market structure to firms' innovation. de Mel et al. (2009) offers another

*Shimamoto Zemi(Development Economics seminar), Kindai University class of 2020. All mistakes are my own. vanlik.tan@gmail.com

perspectives using survey data of 2865 micro- and medium-size firms in Sri-lanka over the effects of rather *firm's owner characteristics* onto firm innovation process. The authors claimed significant result, suggesting that owner ability, personality traits, and ethnicity have significant impact on the likelihood of firm innovation. In addition, study from Ayyagari et al. (2011), which used firm micro-data from developing countries, also provides a fresh insight into the relationship between accessing to external finance could help boost firm innovation. However, little do we know exactly the direct effects of formal training program over firm innovation activities.

Recently, many economists have utilized the randomized controlled trials (RCTs) experiments to examined the factors that might possibly induce innovation dynamic into firms. As management capability plays a very essential role in helping firms grow, survive, productive, adopting proper management practices has been shown to be significantly impactful regarding these group of outcomes (Bloom et al. (2013); Higuchi et al. (2019)). What is interesting is that the effects of basic business training persists 2 to 3 years as shown in Higuchi et al. (2019) when authors conducted RCTs experiment in Tanzania.

However, these existing results are not always satisfying. Karlan and Valdivia (2011) observes little or no evidence per se when introducing business training program to female microentrepreneurs in Peru, though found positive effects (an increase in client retention rate) for microfinance institution. As argued in McKenzie and Woodruff (2014), the existing results usually suffer from small sample sizes, measure impacts only within a year of training, and experience problems with survey attrition and measurement that limit the conclusions one can draw. Higuchi et al. (2015), for instance, concludes their findings with no significant results on the effects of general business training on performance, claiming that that depends on the intensity of training. Hence, mixed results are still overwhelming.

Knowledge may generally come from both internal and external sources. Before entering labor market, people seek skills by undertaking some year-long education through primary to secondary, or some even until tertiary education (i.e.college/university). These formal education play a very essential role in producing long-term growth (Hanushek and Woessmann, 2008).

On the other hand, skills also can be attained after entering into labor market, such as in-firm training. A classic Arrow (1962), for instance, pointed out that many skills can be acquired on the job, theoretically. As a matter of fact, it is true due to changing environment of recent world in which human capital derived from formal education– such as schooling

vocational– depreciates quickly, learning by doing, in the form of in-firm training, may be an additional way to continue to accumulate knowledge (Bauernschuster et al., 2009). This is indeed the focus of this paper.

The relationship between training (both formal and informal)– or learning by doing in general– and innovation[1] has been accessed over years of literature. Acemoglu and S.Pischke. (1998) discusses over the incentive mechanism why firms offer training and its returns, though not necessarily associated to innovation but wages compensation. A rather recent literature by Gallié and Legros (2012) offers an empirical result from French firms suggesting that firm employee training has a positive impact on technological innovation. Dostie (2018) goes further to examine the positive effects of different types of training: classroom and on-job, on innovation.

However, these literature results, if observed carefully, may be overstated. Obvious reason would be these studies have been done with firm data from developed countries where formal education are generally high. Problems are school education and in-firm training is indeed correlated, and the selection of who gets trained attributes to some amount of biases (Pischke, 2005).

In this paper, I take advantage of the World Bank Enterprise Survey (ES data) to examine the effects of formal training in Cambodian's small and medium enterprises (SMEs). It is worth noting, though, that this paper does not attempt to suggest causal relationship between training and innovation due to the small sample size and randomized tools; rather it may offer an interesting insight that innovation can be learnt and trained from within. In particular, I found that in-firm formal training program significantly affects the firm innovation after controlling firm location and industry and other potential confounding variables.

This paper proceeds as follows. In Section 2, I explain the ES data and variables used in the analysis; section 3 presents model equations used and noticeable results from the analysis, while section 4 discusses some limitations of the results and needs for further research. Lastly, section 5 concludes my argument and includes my personal remarks on policy recommendation for Cambodia.

[1] Becker (1964) examined the incentive of firms investing in the form of training on the expectation of having higher workers' productivity.

2 Data and Variables Specification

I use the World Bank Enterprise Survey data (ES data) which covers Cambodia in the period of 2013 and 2016. The ES currently cover over 155,000 firms in 148 countries, of which 139 have been surveyed following the standard methodology. This allows for better comparisons across countries and across time. Data are used to create statistically significant business environment indicators that are comparable across countries. The ES are also used to build a panel of enterprise data that will make it possible to track changes in the business environment over time and allow, for example, impact assessments of reforms.

The survey was conducted in three separate years: 2007, 2013-2016, covering a whole details of information about SMEs business in Cambodia. Those standard factors include firm characteristics, gender participation, access to finance, annual sales, costs of inputs/labor, workforce composition, bribery, licensing, infrastructure, trade, crime, competition, capacity utilization, land and permits, taxation, informality, business-government relations, innovation and technology, and performance measures (WorldBank, 2016).[2]. This paper, however, focuses on only 2016.

2.1 Descriptive Statistics

ES data Cambodia 2016 comprise of 373 firms. The samples were selected using stratified random sampling where industry, location and establishment's firm size are the levels of stratification. Industry stratification was designed in the way that follows: the universe was stratified into one manufacturing industry and two services industries- Manufacturing (ISIC 3.1 codes 15 - 37), Retail (ISIC code 52), and Other Services (ISIC codes 45, 50, 51, 55, 60-64, and 72). The regions are Phnom Penh, Plains, Mountains, Coastal and Tonle Sap.

The data consists of more than 50% that are small firms and roughly 16% that are large (see figure 1).[3] Moreover, there are only about 6% of firms in the sample are somehow affiliated with large firms and around 50% of firms are owned by female. Notice that while the distribution of proportion of skilled labor in each firms are right-skewed, that of those who completed high school is bimodal at the end of each edge (see figure 2). This basically

[2]Technical note is available here

[3]As far as firm size is concerned, I follow the Cambodian government official definition where firms that have number of employees of less than 50 are considered small; less than 100 is medium. See document here.

Table 1: Descriptive Statistics on Selected Variables (ES data 2016)

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
number of labor	373	136.992	525.876	4	6	35	7,000
formal training(last3y)	373	0.276	0.448	0	0	1	1
foreign technology(last3y)	373	0.139	0.347	0	0	0	1
product innovation(last3y)	373	0.265	0.442	0	0	1	1
process innovation(last3y)	373	0.214	0.411	0	0	0	1
marketing innovation(last3y)	373	0.228	0.420	0	0	0	1
R&D investment(last3y)	373	0.105	0.306	0	0	0	1
female executive	373	0.531	0.500	0	0	1	1
part of large firm	373	0.067	0.250	0	0	0	1
number of skilled labors	373	9.544	24.400	0	0	6	300
number of highschool grad	373	47.902	200.132	0.000	1.250	21.000	2,375.000

Note: variables with (last3y) at the end refers to during the period of 3 years prior to 2016, has the firm been doing each particular innovation.

means that despite the fact that firms might have many workers holding a high school diploma, most are still less skilled.

2.2 Variables specification

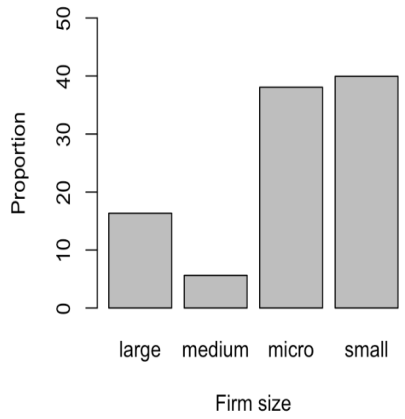
Innovation used in this paper includes product, process, marketing and R&D spending. These are themselves yes/no variables, and coded into an integrate dummy variable *inno.prox*. Firms that have done either one of the above activities are considered as *engaging in innovation activity*, and therefore being innovative.[4]

In addition, it is worth noting that last3y variables (prior to 2016) are often used including the innovation proxy variables. For instance, variable $formal.train$ represents whether or not firms had been investing in training their employees in the past 3 years. The sample question in the survey is as following:

> During the last three years did this establishment provide **formal training** to any of its employees specifically for the development and/or introduction of new or significantly improved products or services and processes?

[4]The reason is partly due to firms barely invest in such activities in developing countries especially Cambodia, and if they do, they must be somehow affiliated with foreign company.

Figure 1: Frequency of Firm Size (ES 2016)



Therefore, this analysis establishes the cross-sectional relationship (of year 2016) of the variables that might influence innovation during the 3-year period.

3 Models and Results

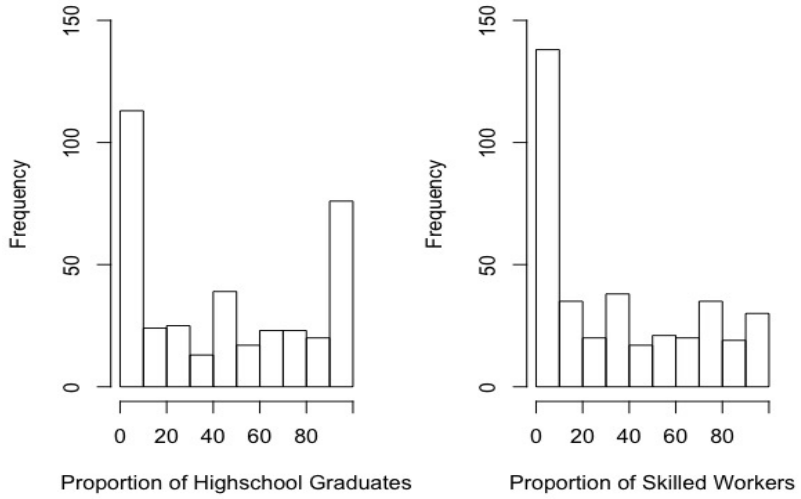
3.1 Models Specification

There may be different ways to approach firm innovation econometrically. In Hall et al. (2009), the authors consider innovation by measuring firms R&D intensity against innovation output. The so-called CDM model, which dubbed behind Crépon et al. (1998), was applied in order to investigate innovation in SMEs in Italy. The model proceeds in 3 steps: first, to correspond to firm decisions whether to engage in R&D; second, to use knowledge production function, which relates innovation output to innovation input and other factors; third, to process innovation to firm productivity. In this paper, however, CDM model is not followed as RD expenditure data are mostly not available.[5]. Alternatively, I apply the linear probability model (LPM) approach on binary dependent variable in the cross-sectional ES 2016. The regression equation is:

$$inno.prox_i = \beta_1 formal.train_i + \beta_2 \mathbf{X}_i + u_i \tag{1}$$

[5]As the readers may reckon, firms in Cambodia are prone to either not keeping record nor investing in R&D

Figure 2: Distribution of Prop. of Skilled workers(right) and highschool graduates(left)



where the innovation proxy variable $inno.prox_i$ is a yes or no dummy variable and $formal.train$ refers to whether or not firms had been offering in in-firm formal training program in the last 3 years. $\mathbf{X}_i$ is a set of control variables such as firm characteristics.

3.2 Results

Table 2 shows the LPM regression results of equation (1).[6] Column (1) represents the effects of formal training without control variables; that *significantly* increases the probability of being innovative by 40%. However, after accounting for potential controls, the effects drop, still significant, to roughly 30%. This means that firms that offered in-firm formal training program have a high likelihood of doing innovation activities. Interestingly

[6]Robust standard errors are applied in this analysis to avoid heteroskedasticity issue of the error term u_i (White, 1980)

enough, number of employee barely affects innovation at all.[7]

This particular result offers couple of interesting things. First, given that fact that majority of Cambodian workers receive relatively low education(MoEYS, 2018), in-firm training is an important alternative to formal education (Wei and Nishimoto, 2015) in term of acquiring skills. Thus, in-firm training program somehow plays an essential role in boosting firms innovation. Second, to my surprise, having female executive and skilled labor do not make any differences. This is subjected to further investigation as there might be a lot of missing values in the data.

4 Discussion

The results above are limited several ways in terms of methodology (how to accurately measure training) and validity (application). For instance, in his comment article, Pischke (2005) raises some difficulties is accessing the true returns to formal training. The author pointed out three external effects on training such as the ability to learn of workers, future managerial changes, and spillover from other firms. Moreover, the author stressed out an important fact that formal training is a more important source of skills in larger firms. However, this is at least partially offset by informal training being more important in small firms.

Despite all these, this paper did its best to demonstrate, to some extend, that in-firm formal training programs are essential for both firms (in term of achieving innovation) and workers (in term of accumulating skills). Had the data specifically defined the training program and offered less missing values, I could have made rather robust results as far as training and innovation is concerned.

5 Conclusion

This paper has shown that formal training in firms has significant impacts on the probability of innovation performance such as product, process, and R&D. Low skilled Cambodian workers, either facing difficulties seeking

[7] This comes with no surprise since, regardless of the size, most firms in Cambodia are still in an infant stage and lacking a lot of capabilities such as how to properly apply technology used in the production process, for instance, in order to build up the potentials against regional competitors. According to OECD (Organization for Economic Cooperation and Development) report, Cambodian SMEs scored below the ASEAN average (OECD, 2018).

required skills in formal education or not able to receive it education at all, lead firms to offer on-job training in order to achieve innovation. Firm size, however, does not affect at all on firm innovation probability.

Despite some limitations, which I leave for future research, the results are vividly convincing especially in the context developing country like Cambodia. Therefore, as a policy recommendation, Cambodian government should shift the focus from firm size tax incentive[8] to *incentivize* firms to start offering the program for their employees. The long term benefits of this is so huge as firms would see their labors' productivity, innovation, and more importantly regional competitiveness all grow higher. Then, the economy would enjoy high growth with dynamic and competitive business environment.

References

Acemoglu, D. and S.Pischke., J. (1998). Why do firms train? theory and evidence. *Quarterly Journal of Economics*, 113(1):79–119.

Arrow, K. J. (1962). The economic implications of learning by doing. *The Review of Economic Studies*, 29(3):155–173.

Ayyagari, M., Demirgüç-Kunt, A., and Maksimovic, V. (2011). Firm innovation in emerging markets: The role of finance, governance, and competition. *The Journal of Financial and Quantitative Analysis*, 46(6):1545–1580.

Bauernschuster, S., Falck, O., and Heblich, S. (2009). Training and innovation. *Journal of Human Capital*, 3(4):323–353.

Becker, G. S. (1964). *Human Capital*. University Chicago Press, Chicago.

Bloom, N., Eifert, B., Mahajan, A., McKenzie, D., and Roberts, J. (2013). Does management matter? evidence from india. *The Quarterly Journal of Economics*, 128(1):1–51.

Cohen, W. M. (2010). Fifty years of empirical studies of innovation and performance. *Handbooks in Economics*, 1(4):129–198.

Crépon, B., Duguet, E., and Mairesse, J. (1998). Research, innovation and productivity: An econometric analysis at the firm level. *Economics of Innovation and New Technology,*, 7(2):115–158.

[8]The Cambodian government has offered several tax incentive packages to SMEs according to their size. See here for more details.

de Mel, S., McKenzie, D., and Woodruff, C. (2009). Innovative firms or innovative owners? determinants of innovation in micro, small, and medium enterprises. *The World Bank Development Research Group Policy Research Working Paper*, (4934).

Dostie, B. (2018). The impact of training on innovation. *Industrial and Labor Relations Review*, 71(1):64–87.

Gallié, E. P. and Legros, D. (2012). Firms' human capital, rd and innovation: A study on french firms. *Empirical Economics*, 43(2):581–96.

Hall, B. H., Lotti, F., and Mairesse, J. (2009). Innovation and productivity in smes: empirical evidence for italy. *Small Business Economics*, 33:13–33.

Hanushek, E. and Woessmann, L. (2008). The role of cognitive skills in economic development. *Journal of Economic Literature*, 46(3):607–68.

Higuchi, Y., HoangNam, V., and TetsushiSonobe (2015). Sustained impacts of kaizen training. *Journal of Economic Behavior & Organization*, 120:189–206.

Higuchi, Y., Mhede, E. P., and TetsushiSonobec (2019). Short- and medium-run impacts of management training: An experiment in tanzania. *World Development*, 114:220–236.

Karlan, D. and Valdivia, M. (2011). Teaching entrepreneurship: Impact of business training on microfinance clients and institutions. *Review of Economics and Statistics*, 93(2):510–527.

McKenzie, D. and Woodruff, C. (2014). What are we learning from business training and entrepreneurship evaluations around the developing world? *The World Bank Research Observer*, 29(1):48–82.

MoEYS (2018). Education in cambodia: Findings from cambodia's experience in pisa for development. Technical report, Ministry of Education Youth and Sports, Phnom Penh: Author.

OECD (2018). "cambodia", in sme policy index: Asean 2018: Boosting competitiveness and inclusive growth. Technical report, OECD Publishing, https://doi.org/10.1787/9789264305328-17-en., Paris.

Pischke, J.-S. (June, 2005). Comments on "workplace training in europe" by bassanini et al. prepared for the conference education and training in europe. *London School of Economics*.

Wei, S.-J. and Nishimoto, T. (2015). Cambodia: Addressing the skills gap employment diagnostic study. Technical report, ADB and ILO.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica*, 48(4):817–838.

WorldBank (2016). Cambodia enterprise survey (es). Ref. khm_2016_es_v01_m, The World Bank.

Table 2: Innovation and Formal Training: The Linear Probability Model approach

	Innovation	
	(1)	(2)
formal training(last3y)	0.396***	0.297***
	(0.052)	(0.062)
part of large firm		0.104
		(0.097)
female executive		-0.006
		(0.051)
number of skilled labors		0.001
		(0.001)
total number of labors		-0.0001**
		(0.0001)
number of highschool grad		0.0004**
		(0.0002)
samp_industryManufacturing		0.462***
		(0.070)
samp_industryRetail Services		0.497***
		(0.072)
samp_industryOther Services		0.529***
		(0.070)
samp_regionPlains		-0.158**
		(0.077)
samp_regionMountains		-0.293***
		(0.078)
samp_regionCoastal		-0.237***
		(0.074)
samp_regionTonle Sap		-0.161**
		(0.073)
Constant	0.352***	
	(0.029)	

Note: *p<0.1; **p<0.05; ***p<0.01
Coefficients and their standard errors are shown.
The standard errors are robust to heteroskedasticity.