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Assessing the Effects of Simple and Complex Innovation Strategies on the Performance of Firms in the Philippines

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Abstract

Innovation is the synergistic use of resources, technology, capital, and information to achieve growth at different levels of the economy. Many studies abroad have already supported the hypothesis that innovation leads to a good firm performance and long-term economic growth. In the Philippines, some studies already analyze the effects of simple innovations on firm performance. However, emerging literature shows that complex innovation strategies have bigger impacts than simple ones. In line with this strand of research, this paper analyzes the effects of simple and complex innovations on labor productivity and employment growth. Results show that there is no single best innovation strategy that a firm must undertake. However, if firms are constrained by their budget, a simple innovation will help in improving labor productivity and to some extent, employment growth. Firms that do not face cost issues can benefit more from adopting a complex innovation strategy. In addition, several specific types of complex innovation strategies can be adapted depending on whether the firm aims to increase its employment or to boost its labor productivity.

Keywords: labor productivity, employment growth, simple innovation, complex innovation

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Connie Bayudan-Dacuycuy and Lora Kryz C. Baje*

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1. Introduction

Innovation is the synergistic use of resources, technology, capital, and information to achieve growth at different levels of the economy. At the macro level, innovation is perceived as a driver of economic growth, productivity and competitiveness (Solow 1956; More and Jain 2013). At the firm level, it is a means for firms to differentiate themselves (Tavassoli and Karlsson 2015), increase their profitability, reduce their production and distribution costs, and/or increase the willingness of customers to buy and pay for their products (Jiménez and Sanz-Valle 2011).

The Philippine government has emphasized the integral role innovation plays in its economy's long-term and inclusive growth. The Philippine Development Plan 2017–2022, which highlights the role of innovation in improving the sectoral productivity, has reiterated the benefits of technology adoption for local firms. Despite this, the Philippines still has a long way to go to in its innovation efforts. Based on the 2018 Global Innovation Index (GII)[1], the Philippines ranked 73rd out of the 126 countries. Compared with the ranking in the 2017 GII, the country has remained in the same spot while its ASEAN neighbors have improved. Nevertheless, the Philippines is still ahead of Indonesia (85th) and Cambodia (98th) although it is far behind Singapore (5th), Malaysia (35th), Thailand (44th), and Vietnam (45th).

Considering the Philippines' lackluster performance in innovation, there is a need for an innovative business environment through tailoring policies that will accommodate innovative endeavors to boost productivity and growth. While several studies have been done to analyze the factors affecting innovation in the country, the literature that systematically analyzes the impact of innovation on firm performance is wanting.

To our knowledge, Llanto and del Prado (2015) is one of the few studies that analyzes the impact of a simple innovation on firm performance in the Philippines. However, innovation strategies can be simple or complex. It is simple when one type of innovation (product, services, process innovation, or marketing innovation) is adopted and complex when a combination of these innovations are implemented. There is an emerging literature that complex innovation strategies have bigger impacts than simple ones (Polder et. al 2010; Tavassoli and Karlsson 2015). Given this, there is a need to further analyze the effects of innovation on firms' performance in the Philippines. Doing this is important because it provides directions on what types of innovations can be pursued given limited resources. It can also provide directions on policies to support innovative strategies**.**

This paper aims to establish the effects of innovation on firm performance, which is done by addressing the potential bias arising from endogeneity and causality. It is related to (Goedhuys and Veugelers 2012; Abazi-Alili 2014), who have used an instrumental variable technique. The paper uses research and development (R&D) and obstacles to operations as instruments and as such closely follows Wakelin (2001), Saridakis, et.al (2015), and Goedhuys, et.al (2016). In addition, this paper looks into the effects of both simple and complex innovations and is related to Karlsson and Tavassoli (2015) and Goedhuys and Veugelers (2012) who have investigated the effects of complex innovation strategies on firm performance in Sweden and Brazil, respectively.

[1]The Global Innovation Index is co-published by Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO). It aims to capture the multi-dimensional facets of innovation through its seven pillars: institutions, human capital, research, infrastructure, market sophistication, business sophistication, knowledge and technology outputs and creative outputs.

Using the 2015 World Bank Enterprise Survey (WBES), results indicate that there is no single best innovation strategy that a firm should undertake. However, if firms are constrained by their budget, a simple innovation will help in boosting labor productivity and to some extent, employment growth. Firms that do not face cost issues can benefit more from adopting a complex innovation. In addition, several specific types of complex innovation strategies are identified depending on whether the firm aims to increase its employment or to boost its labor productivity.

This paper is organized as follows: Section 2 provides the review of related literature, section 3 discusses the empirical strategy, data source, and key variables, section 4 provides the profiles of firms surveyed in the dataset, section 5 discusses the results, and section 6 summarizes and concludes.

2. Review of related literature

While some literature on the theory of firm emphasize the transitory effect of innovation on firm performance (Knight 1921), others highlight its longer-term impact. The latter is based on evolutionary economics, in which economies are systems not in constant equilibrium but as systems that evolve through ideas that undergo the process of testing, rejection, and regeneration (Veblen 1898; Schumpeter 1934; Nelson and Winter 2009). This process leads to the accumulation of knowledge that eventually pushes the boundaries of the production frontier.[2]

Schumpeter (1934) defines innovation as carrying out new strategies that include the introduction of new good, new method of production, opening of new market, the conquest of new source of supply or raw materials, and the carrying out of the new organization of any industry. This has been the basis of succeeding literature to classify innovation into product innovation, process innovation, organizational innovation and marketing innovation.[3]

The relationship between innovation and firm performance goes back to growth theory that attempts to explain long-run growth. In particular, the endogenous growth theory pioneered by Romer (1986) recognizes that technological progress is endogenous[4]. Since labor productivity is an explicit outcome of the model, it has become one of the factors investigated within the broader context of firm performance.

In the literature, proxies for innovation include research and development expenditure (Wakelin 2001), intermediate output such as the number of inventions patented (Ghapar et.al 2014), and direct measure of innovative output such as a new product or new process (Chaney and Devinney 1992). Among these common measures, R&D expenditure or intensity has been the most widely used (Damijan et.al 2008; Fukao, et al. 2017). However, it has several disadvantages. One, it is an input measure and do not include other critical elements in innovation such as learning-by-doing and investments in physical and human capital (Tavassoli and Karlsson 2015). Two, it

[2] While Schumpeter was primarily interested in changes in the production functions of the technological leaders or the innovating firms because of the growth forces set into motion by the adoption of new methods of production (Ruttan, 1959), he also highlighted the idea of creative destruction where new structures are destroyed that replace old ones to aid in the pursuit of growth.

[3] OECD's Oslo Manual (2005) has provided a definition for each innovation type. Product innovation is "the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses and it includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics." Meanwhile, process innovation is the "implementation of a new or significantly improved production or delivery method, including significant changes in techniques, equipment and/or software." On the other hand, marketing innovation means the "implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing." Organizational innovation involves "new methods in the firms' business practices, workplace organization or external relations."

[4] In contrast to the exogenous growth models where long-run growth rate is exogenously determined by savings (Harrod-Domar model) and rate or technical progress (Solow model).

gives very little information about the innovation process per se as well as the firms' choices of innovation strategies (Kemp, et al. 2003).

Innovation strategies can be either simple or complex. It is simple when one type of innovation (product, services, process innovation, or marketing innovation) is adopted. It is complex when a combination of these innovations are implemented. Simple innovations have varying impacts on firm performance. For example, Damijan et.al (2014) use four waves of Community Innovation Survey data from 2004-2010 for 23 European countries and conclude that product, organizational, or marketing innovation, each implemented on its own, has a positive effect on employment for manufacturing and service industries. Process innovation has labor displacement effects for manufacturing, however.

While there is no consensus on which of these simple innovations produce a greater effect on firm performance, there is an emerging literature that complex innovation strategies have bigger impacts than simple ones. For example, Polder et. al (2010) find in Netherlands that product and process innovations lead to higher productivity only when combined with organizational innovation. Tavassoli and Karlsson (2015) find that firms with complex innovation strategy have higher productivity than non-innovators and firms with simple innovation strategy.

The story of innovation in developing countries is different from developed ones, with the former's technological advancements occurring through the absorption and adaption of pre-existing technologies rather than through the creation of new ones (Goedhuys and Veugelers 2012). In addition, many developing countries have business environments that limit their innovative potentials. Among these barriers are heavy regulatory burden on closed economies, poor quality of institutions and limited access to finance, inadequately educated workforce, political instability, high tax rates and inefficiency of tax incentives, crime, corruption, and difficulty in the acquisition of business permit and license.

Several studies in developing countries, such as in Vietnam (Tuan et. al 2016), Turkey (Atalay, et.al 2013) and Latin America (Crespi and Tacsir 2012), have been done to analyze the effects of innovation on the firm performance. In general, results suggest that product and process innovations have positive effects on firm performance. In the Philippines, there are many studies that provide an in-depth analysis of profiles of firms and their innovative activities (Macapanpan 1999; Albert et. al. 2011) and that conduct econometric analysis related to innovation (Llanto and del Prado 2015; Albert et. al 2017). In general, their findings suggest that product and process innovations are common in the country. These studies emphasize the need to address factors such as lack of government support and weak linkages between R&D institutions and industries to encourage firms to innovate.

Among these studies, however, Llanto and del Prado (2015) are one of the few who provide an in-depth and systematic inquiry that tackles the effects of innovation on the performance of firms in the country. Llanto and del Prado (2015) examine the determinants of innovation and the probability that product and process innovation would lead to higher sales and improved productivity. Using the 2013 Survey on Production Process for Manufacturing Establishments, which covers manufacturing firms in Cavite, Laguna, Batangas, Rizal, and Quezon (CALABARZON), the paper shows that either product or process, lead to an increase in sales and productivity.

3. Empirical Strategy, data source, and key variables

Innovation is embedded in the endogenous growth theory pioneered by Romer (1986). In this model, the production function of firm *i* is $Y_i = A_t F(K_i, L_i)$ where *Y* is the output of firm *i*, *k* is capital, *l* is labor input and *A* is technological change. Knowledge determines productivity via technological change. Assuming a Cobb-Douglas production function, $Y_i = AK_i^{\alpha} L_i^{1-\alpha}$ and normalizing L, labor productivity is given by $y_i = Ak_i^{\alpha}$ where k is capital per labor. As an empirical strategy, several studies use innovation to proxy for *A* (Griffith 2006; Lööf and Heshmati 2006)[5]. Later, labor productivity and employment growth (see for example, Brouwer et. al 1993) have become common outcomes investigated within the broader context of firm performance.

There are at least two modeling strategies used to analyze innovation and firm performance. One, there are studies that model innovation in different stages (Crépon, Duguet, and Mairesse 1998; Lööf and Heshmati 2006), which aims to consistently estimate the causal effect of innovation investment on innovation output and the causal effect of innovation output on productivity. The four-equation model explains the firms' decision to invest in innovation, the intensity of innovation investment, the knowledge production function linking innovation intensity and innovation outcomes, and the output production function (Alvarez et. al 2015).

Two, there are studies that employ the single-equation approach. The earlier version of this strategy treats innovation as exogenous (see for example Kemp, et al. 2003). This strategy raises some important issues. One, estimates are potentially biased due to the correlation of unobservable attributes with innovation and firm performance. For example, management aspirations will likely boost the firms' labor productivity and this will likely drive firms to invest in innovative strategies. In this case, estimates are bias upward. Two, there is a problem of causality. This can happen when efforts to innovate and performance feedback on each other. Innovation can improve labor productivity and employment growth, which in turn enhance innovation. Recent studies (Abazi-Alili 2014; Abazi-Alili et.al 2016) recognize the endogeneity of innovation and use the instrumental variable technique to correct for it. Both have used R&D investment and direct exports as instruments for innovation. These studies point to the enhanced firm performance due to innovation.

Following the literature that treats innovation as endogenous, we use an instrumental variable technique and in the context of innovation, the relevant set-up becomes

$$innovation = f(IV, firm\ attributes; e) \quad 1a$$
$$performance_j = f(innovation, firm\ attributes; u) \quad 1b$$

where *IV* is the instrument; and *performance* is employment growth and labor productivity. For *IV* to become a valid instrument, it should satisfy relevance and exclusion requirements. An instrument is relevant if it induces changes in performance while it satisfies exclusion restriction if it affects performance only through innovation. In this paper, we use obstacles to operations and research and development as instruments to innovation. The effects of obstacles to operation on innovation are widely established (Girma et. al 2008; Saridakis et.al 2015; Mukherjee et.al

[5] This strategy has its roots from the works of Schumpeter where innovation denotes the application of new ideas to the production process. Schumpeter's term "innovation" as well as Fellner's "technological-organizational change" and Solow's "technical change" all refer to the same phenomenon, namely, a shift in the production function (Schweitzer, 1961).

2017). Similarly, the effects of research and development on innovation are widely documented (Crépon, Duguet, and Mairesse 1998; Abazi-Alili 2014).

This paper uses the 2015 WBES-Philippines, which compiles information on a broad range of business aspects such as access to finance, corruption, infrastructure, crime, and competition and performance measures. The Philippines' dataset has been collected between November 2014 and May 2016. The sample was selected using a stratified random sampling[6]. Three levels of stratification were used: industry (seven manufacturing industries and two services industries namely Food and Beverages, Garments, Chemicals, Rubber and Plastics, Fabricated Metal, Electronic Products, Other Manufacturing, Retail and Other Services), establishment size (small: 5 to 19 employees, medium: 20 to 99 employees, and large: 100 or more employees), and region (Metro Manila, NCR excluding Manila, Metro Cebu, Central Luzon, and CALABARZON).

The 2015 WBES-Philippines compiles information on the obstacles to firm's operation using the following question: *Using the response options on the card; To what degree is [____] an obstacle to the current operations of this establishment?* This question is asked in reference to crime, business licensing and permits, access to finance, inadequately educated workforce, corruption, tax rates, and political instability. Firms, then, choose from the following responses: 0 for no obstacle, 1 for minor obstacle, 2 for moderate obstacle, 3 for major obstacle, and 4 for very severe obstacle. Based on this information, binary data are created such that it is equal to 1 if the response is 0 and 1 (no obstacle); and 0 if the response is either 2, 3, or 4 (presence of obstacles). A principal component analysis (PCA) is then used to reduce the dimension of the data. The overall Kaiser-Meyer-Olkin (KMO)[7] measure of sampling adequacy is around 0.84, which indicates that these assets contain enough similar information to warrant the factor analysis.

To ascertain the relevance of the obstacles to operation and research and development as instruments, we run probit regressions on proxies for innovation against the instruments. Results show that the proposed instruments induce variations in the innovation proxies. However, obstacles to operation and research and development can also affect firm performance. To investigate this, an OLS is used to determine the direct effect of obstacles on employment growth and labor productivity. Results[8] show that research and development and obstacles to operation are not significant predictors of any of the proxies for firm performance. To some extent this provides evidence on the validity of the proposed instruments.

Formal tests to ascertain the validity of instruments, such as underidentification and overidentification tests, are provided together with the results. The former tests the null hypothesis that $cov(instrument, endogenous\ variable) \neq 0$. Rejection of the null implies that the instruments are relevant; that is, the instrument induces a change in the endogenous variable. The latter tests the null hypothesis that the instruments are uncorrelated with the error term, $cov(instrument, error\ term) = 0$ and that the excluded instruments are correctly excluded from the estimated equation. Non-rejection of the null implies that the instruments are valid.

[6] World Bank. (2017). Description of Philippines 2015 Implementation. Washington, DC: The World Bank Group. h*ttp://microdata.worldbank.org/ index.php/catalog/2800/download/39772* (accessed on July 29, 2017).

[7] The KMO statistic is a test if the data are suited for factor analysis by measuring the sampling adequacy for each variable and for the complete model (Kaiser, 1970). This statistic is a summary of how small the partial correlations are relative to the original correlations. If the variables share common factor/s, then the partial correlations should be small and the KMO should be close to 1 (http://www-01.ibm.com/support/).

[8] Not shown but available from the authors upon request.

The available proxies for innovation are binary indicators and the typical 2SLS does not apply.[9] Following the procedure outlined in Angrist and Pischke (2009), the following set-up is used:

$$innovation = f(IV, innovation\_p, firm\ attributes; e) \quad 2a$$
$$performance_j = f(innovation, firm\ attributes; u) \quad 2b$$

where *innovation_p* is the predicted innovation from $\Pr(innovation) = f(IV, firm\ attributes)$. In this alternative strategy, the non-linear fitted values are also used as instruments and equations 2a and 2b are then estimated using the usual 2SLS routine in Stata.

To operationalize firm performance, we use labor productivity and employment growth as indicators. Labor productivity is the ratio of the real sales and the number of employees at the end of the last fiscal year. Meanwhile, employment growth is the difference between the firms' number of employees at the end of the last fiscal year (in logarithm) and the firms' number of employees three fiscal years ago (in logarithm).

This paper looks into four types of innovations: product, process, organization, and marketing. From the WBES questionnaire, the types of innovations are culled from the following questions:

For product innovation:

> *During the last three years, has this establishment introduced new or significantly improved products or services?*

For process innovation:

> *During the last three years, has this establishment introduced new or significantly improved methods of manufacturing products or offering services?*
> *During the last three years, has this establishment introduced new or significantly improved logistics, delivery or distribution methods for inputs, products or services?*
>
> *During the last three years, has this establishment introduced new or significantly improved supporting services for your processes, such as maintenance systems or operations for purchasing, accounting, or computing?*

For organizational innovation:

> *During the last three years, has this establishment introduced new or significantly improved organizational structures or management practices?*
>
> *During the last three years, did the establishment make any changes in its organizational structure in any of the following ways: create a new unit or department, dissolve any units or department; or merge any units or department*

For marketing innovation:

> *During the last three years, has this establishment introduced new or significantly improved marketing methods?*

[9] Plugging in the fitted values from a probit regression into equation 1b is a "forbidden regression" since only OLS estimation involving equation 1a is guaranteed to produce first-stage results that are uncorrelated with fitted values and covariates (Angrist and Pischke, 2009).

Based on these data, innovation variables are created for simple innovation such that:

$$\mathbf{y_{simple}} = \begin{cases} 0 \text{ if non-innovator} \\ 1 \text{ if simple innovator} \end{cases}$$

where $simple$ is either product, process, organization, or marketing.

Following Tavassoli and Karlsson (2015) who document that firms undertake complex innovation strategies, the following innovation strategies are defined:

$$\mathbf{y_{complex}} = \begin{cases} 0 \text{ if non-innovator} \\ 1 \text{ if complex innovator} \end{cases}$$

where $complex$ is defined for two, three, and four innovators based on the combinations of the product, process, organization, and marketing innovations.

Other explanatory variables include the firm's characteristics such as establishment size (small, medium, and large), sector of the firms (manufacturing, retail, and other services), domestic ownership, and firm's age. In addition, dummy variables for firms located in the National Capital Region and main business city are included. Following the literature that analyzes the effects of gender on the performance of microbusinesses (Elizabeth and Baines 1998) and startups (Bosma, et.al. 2004), a dummy of female ownership is also included. Minimum wage, sourced from the National Wages and Productivity Commission in different industries per region, is also included in the list of explanatory variables.

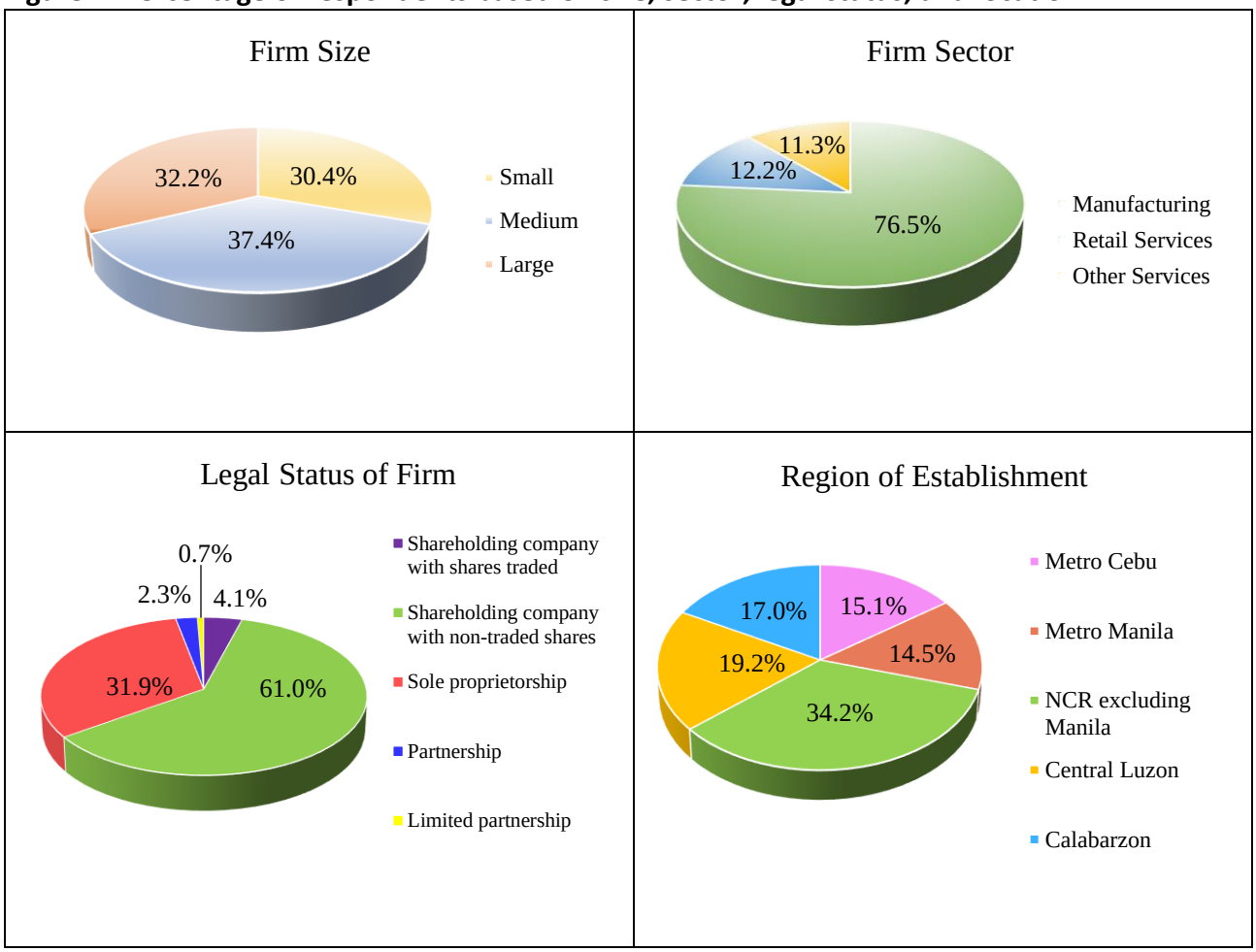
4. Profile of firms

Figure 1 shows the percentage of respondents according to their size, sector, legal status, and location. Medium firms comprise the largest portion of the pie at 37%, while small and large firms are at 30% and 32%, respectively. In addition, a large portion of the firms belong to the manufacturing sector (77%) and are companies with non-traded shares (61%). Geographically, respondents are mostly from firms located in the NCR excluding Manila (34%). Those located in Metro Cebu and Metro Manila constitute 15% of the sample respectively.

From figure 2, firms in the services sector are mostly dominated by retail or wholesale, while firms in the manufacturing sector are mostly engaged in electronics, fabricated metal products, plastic and rubber, refined petroleum or chemicals, textile, garments or leather, and food industries. Looking at figure 3, around 30% of large firms have invested in research and development. This is around 10 and 15 percentage points higher than the percentage of medium and small firms, respectively.

Firms are asked to identify obstacles in their current operation and the information is presented in figure 4. Firms, regardless of size, identify the practices of competitors in the informal sector as the biggest hurdle in their operations. In addition, many small firms identify delays in electricity installation and power outages, and access to finance as obstacles. Many medium firms also indicate informal sector practices, high tax rates, and access to finance while several large firms determine customs, trade regulations, and high tax rates as barriers to their operations.

Figure 1. Percentage of respondents based on size, sector, legal status, and location

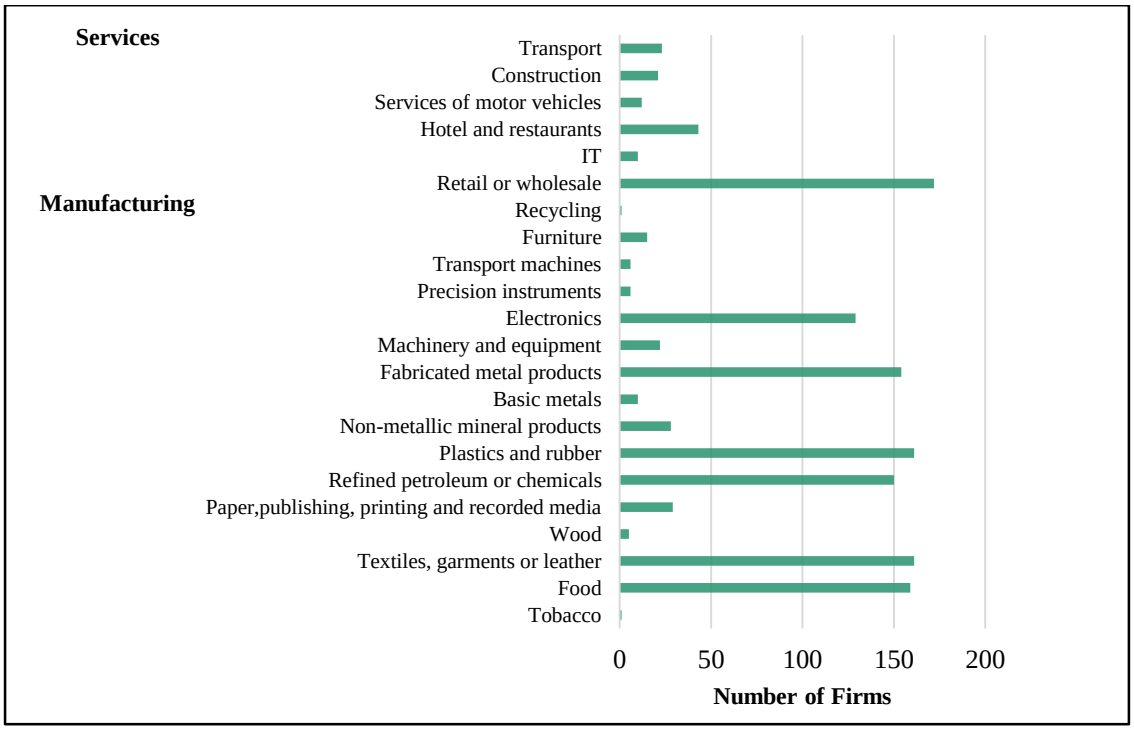


Source: Authors' computations based on the 2015 World Bank Enterprise Survey

From figure 5, around 40% (499 out of the 1251 surveyed firms) are non-innovators. In particular, small(large) firms have the highest(lowest) number of non-innovators. Among those that implemented one innovation, many firms, regardless of size, have implemented process innovations. This is consistent with Albert et.al (2017), who document that most innovations done by firms in the Philippines is process innovation and with Goedhuy and Veugelers (2012) and Karlsson and Tavassoli (2015), who document similar profiles abroad.

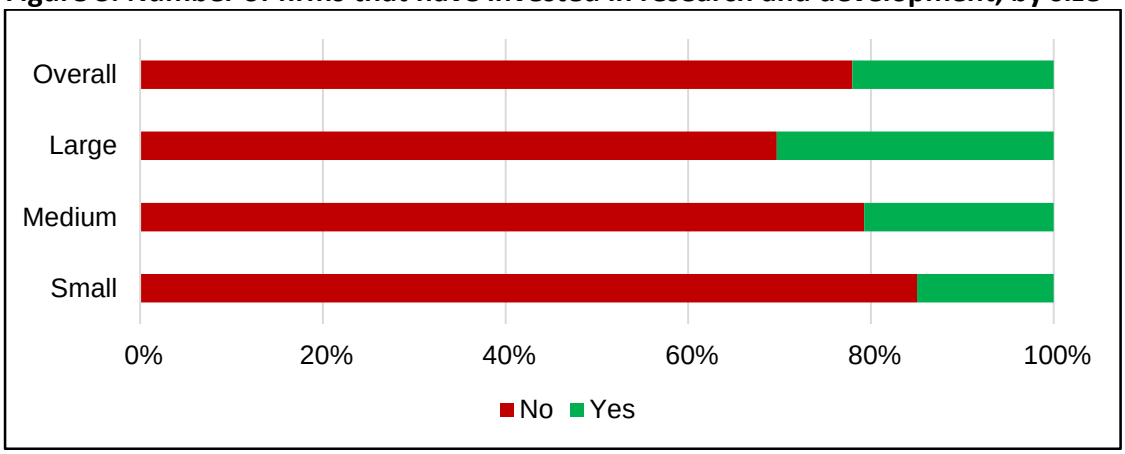
Figure 6 presents information on firms that have implemented complex innovation strategies. Among complex innovators, firms that did all four innovations are higher than those that did two or three. No more than 25 firms (small, medium, and large) have invested in three innovations. Among complex innovators, many large firms have implemented product, process, and organizational innovations. Medium firms have the highest number among those that did process, marketing, and organizational innovations. Among two-innovators, the number of large firms that did product and market innovations is similar to those in medium firms. However, the number of large firms that implemented process and organizational innovations is higher than the number of medium firms.

Figure 2. Industry of firms



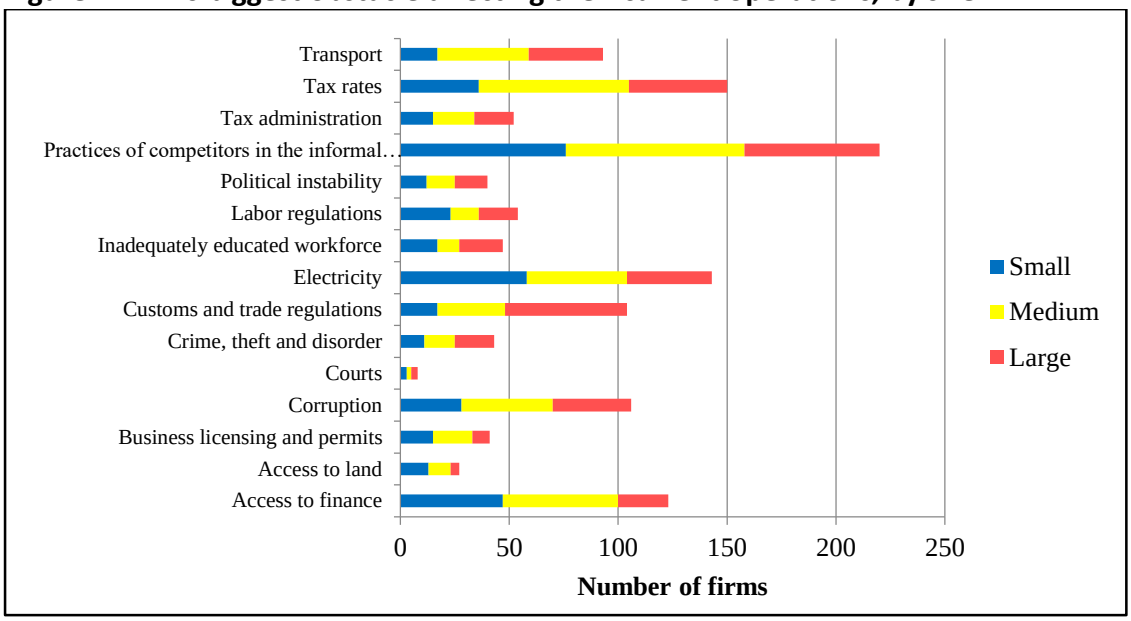
Source: Authors' computations based on the 2015 World Bank Enterprise Survey

Figure 3. Number of firms that have invested in research and development, by size



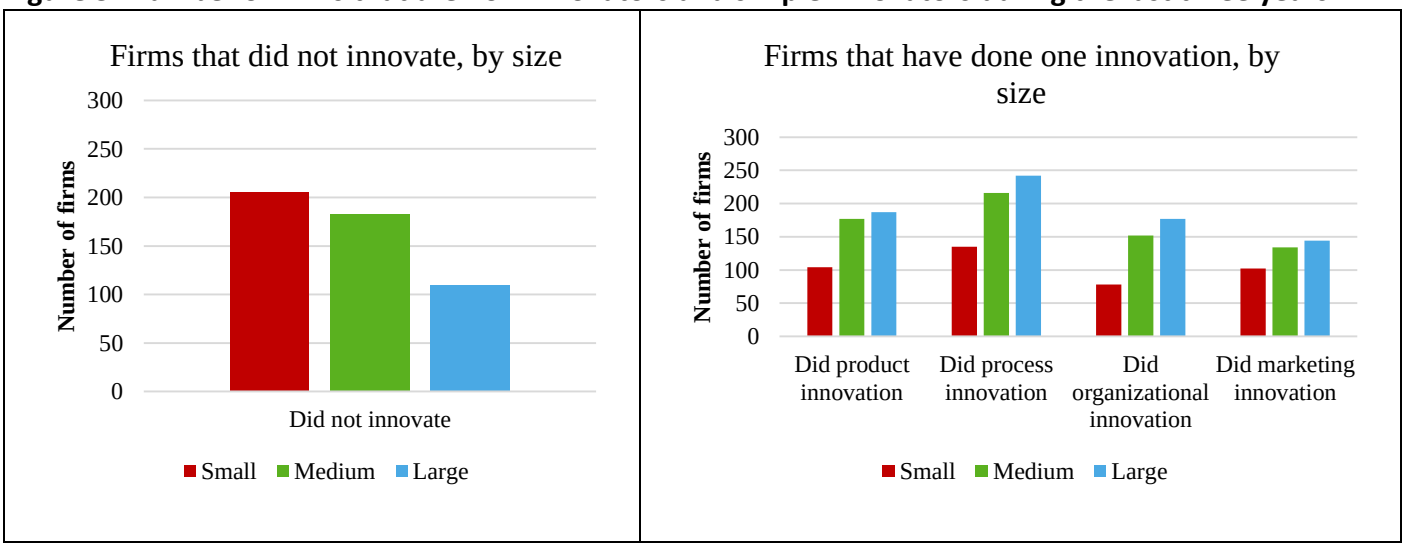
Source: Authors' computations based on the 2015 World Bank Enterprise Survey

Figure 4. Firms biggest obstacle affecting their current operations, by size



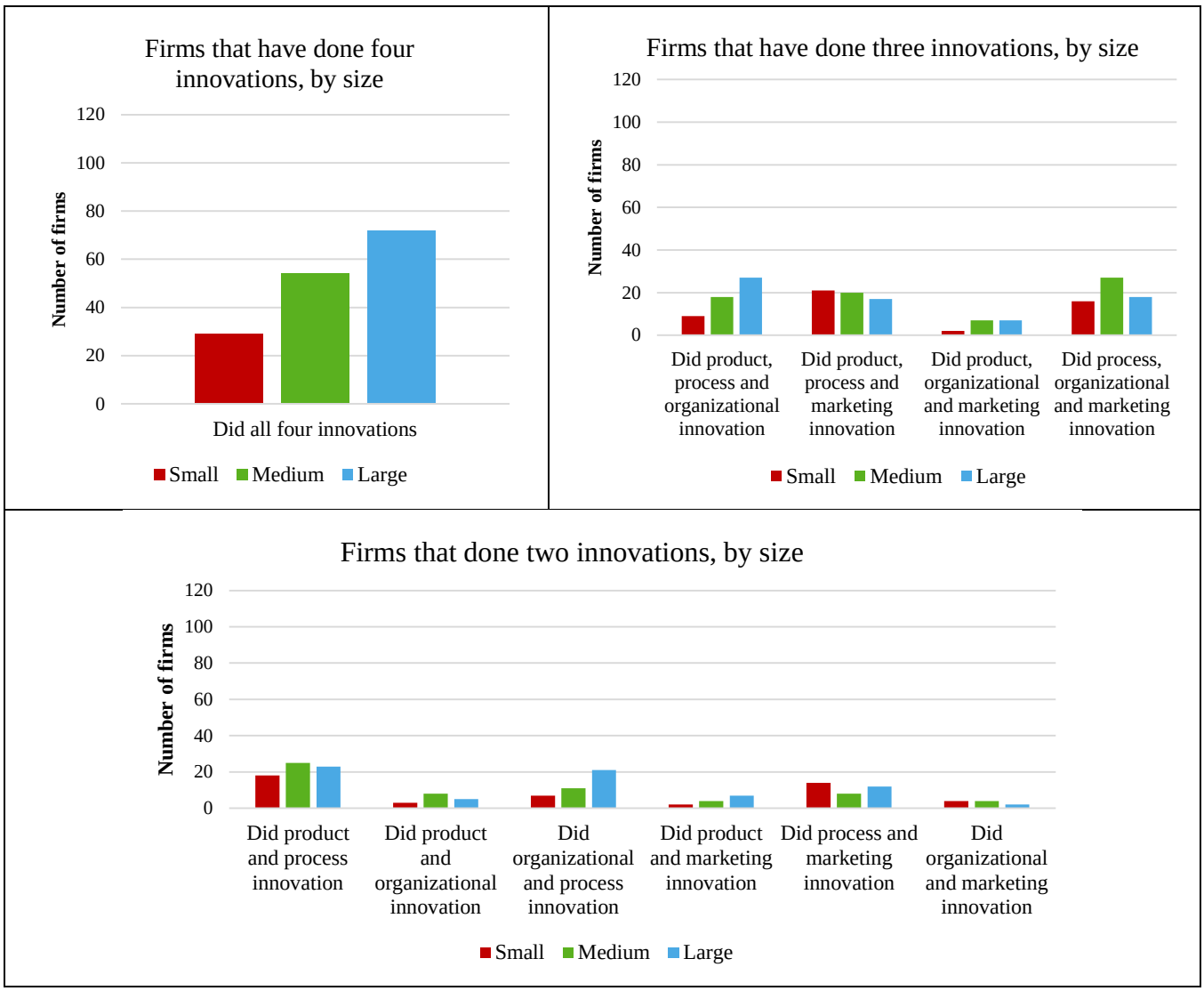
Source: Authors' computations based on the 2015 World Bank Enterprise Survey

Figure 5. Number of firms that are non-innovators and simple innovators during the last three years



Source: Authors' computations based on the 2015 World Bank Enterprise Survey

Figure 6. Number of firms that have done complex innovation strategies during the last three years, by size



Source: Authors' computations based on the 2015 World Bank Enterprise Survey

5. Discussion of results

5.1. Labor productivity

From table 1, results show that relative to non-innovators, simple innovators have higher labor productivity. Firms that are process innovators have labor productivity that is 110% higher than firms that are non-innovators. Product, marketing, and organizational innovators have labor productivity that is 103%, 93%, and 80% higher than non-innovators, respectively.

In addition, firms that are product-process innovators have labor productivity that is 137% higher than non-innovators. However, among the possible combinations, only product-process innovations have significant effects on labor productivity. Process innovation in the WBES includes innovation on methods of manufacturing products or offering services; logistics, delivery or distribution innovations; and innovation on supporting activities such as maintenance systems or operations for purchasing, accounting or computing. We further look into how the types of process innovation, when combined with product innovation, affect labor productivity.

From table 2, results show that product-methods innovators have labor productivity that is 150% higher than non-innovators.

For firms that implemented three and four innovations, results in table 1 show that the implementation of all four innovations does not significantly affect labor productivity. However, firms that are three-innovators have labor productivity that is 210% higher than non-innovators. Looking into the detailed combination of innovations, product-process-marketing innovations affect labor productivity. In particular, innovators using this combination have labor productivity that is 136% higher than non-innovators.[10] Among the types of process innovations (shown in Table 2), the combinations of product-marketing with changes in methods and maintenance appear to have positive and significant effects on labor productivity.

Table 1 – Effects of innovation on labor productivity

Simple Innovation Strategy	**Estimate/[SE]**	**Obs**	**Underid test§**	**Overid test§§**
Did product	0.93** / [0.40]	732	0	0.24
Did process	1.10***/ [0.35]	726	0	0.15
Did organizational	0.80** / [0.36]	732	0	0.09
Did marketing	1.03*** / [0.37]	728	0	0.63
Complex Innovation Strategy				
Two innovations				
Did product/process	1.37** / [0.65]	284	0	0.32
Did product/organizational	0.5 / [1.20]	247	0	0.85
Did product/marketing	-0.51 / [1.41]	247	0	0.95
Did process/organizational	1.08 / [0.67]	264	0	0.48
Did process/marketing	-0.34 / [0.88]	257	0	0.9
Did organizational/marketing	0.81 / [1.49]	152	0	0.43
Three and four innovations				
Did any three innovations	2.10*** / [0.75]	735	0	0.62
Did product/process/organizational	0.34 / [0.53]	268	0	0.58
Did product/process/marketing	1.36** / [0.59]	283	0	0.9
Did product/organizational/marketing	0.56 / [0.64]	228	0	0.61
Did all four innovations	0.48 / [0.31]	350	0	0.81

Note: Explanatory variables include log of firms' age, female ownership of firm, domestic ownership and minimum wage, location of the firm, sector, and industry. */**/*** Significant at 10/5/1% level. Figures in [ ] are standard errors.

§Tests the hull hypothesis that the equation is under-identified, $cov(instrument, endogenous\ variable) = 0$. Rejection of the null implies that the instruments are relevant; that is, the instrument induces change in the endogenous variable.

§§Tests the null hypothesis that the instruments are uncorrelated with the error term, $cov(instrument, error\ term) = 0$ and that the excluded instruments are correctly excluded from the estimated equation. Non-Rejection of the null implies that the instruments are valid.

[10] We attempted to look into how product-marketing innovations combined with different types of process innovations affect labor productivity. However, observations are few and the estimation encountered convergence problems.

Table 2 - Effects of product-marketing-(specific)process innovations on labor productivity

Product and specific process innovation	Estimate /[SE]	Obs	Underid Test§	Overid test§§
Did product/logistics	1.83 / [1.49]	207	0	0.52
Did product/method	1.50** / [0.69]	275	0	0.4
Did product/maintenance	0.14 / [0.93]	215	0	0.32
Product, marketing and specific process innovations				
Did product/marketing/method	1.33** / [0.58]	279	0	0.93
Did product/marketing/logistics	1.08 / [0.76]	262	0	0.54
Did product/marketing/maintenance	1.27** / [0.61]	269	0	0.94

Note: Explanatory variables include log of firms' age, female ownership of firm, domestic ownership and minimum wage, location of the firm, sector, and industry. */**/*** Significant at 10/5/1% level. Figures in [ ] are standard errors.

§Tests the hull hypothesis that the equation is under-identified, $cov(instrument, endogenous\ variable) = 0$. Rejection of the null implies that the instruments are relevant; that is, the instrument induces change in the endogenous variable.

§§Tests the null hypothesis that the instruments are uncorrelated with the error term, $cov(instrument, error\ term) = 0$ and that the excluded instruments are correctly excluded from the estimated equation. Non-Rejection of the null implies that the instruments are valid.

5.1. Employment Growth

Employment growth is also used within the broader context of firm performance. For simple innovators, results in table 3 indicate that all innovation types have positive and significant effects on employment growth. Of the four simple innovation strategies, product innovation and organizational innovation have higher effects on employment growth (around 28%). Both marketing innovators and process innovators have employment growth that is around 23% higher than non-innovators.

For two-innovators, organizational-process innovators have employment growth that is 21% higher than non-innovators.[11] Looking at the combination of organization innovation with different types of process innovation, results show that firms that implemented organization-logistics innovations have employment growth that is 29% higher than non-innovators while those that implemented a combination of organizational-method innovations have employment growth that is 21% higher.

For firms that implemented three and four innovations, results indicate that firms that did all four innovations have employment growth that is 13% higher than non-innovators. This is lower compared to those that did any three innovations (around 43% higher), however. Looking into the combination of innovations for three-innovators, results show that product-organizational-process and product-organizational-marketing innovations affect employment growth. In particular, firms implementing the former have employment growth that is 24% higher than non-innovators. Those implementing the latter have employment growth that is 27% higher than non-innovators.

Organizational innovation in the WBES includes changes in the organizational structure such as creating a new unit or department, dissolving any units or department, and merging any units or department. We look into how each of this, when combined with product-process innovations,

[11] While marketing-process innovations have a positive and significant effect, the Sargan statistic indicates that the instruments did not satisfy the overidentification test and therefore the results are not interpreted here.

affects employment productivity. From table 4, merging and creation of units have similar effects on employment growth (around 38%). Furthermore, product-organizational-maintenance innovations have positive effects on employment growth (around 23%).

Table 3 - Effects of innovations on employment growth

Simple Innovation Strategy	**Estimate / [SE]**	**Obs**	**Underid test§**	**Overid test§§**
Did product	0.28*** / [0.09]	738	0	0.93
Did process	0.22*** / [0.08]	733	0	0.39
Did organizational	0.27*** / [0.08]	737	0	0.97
Did marketing	0.23*** / [0.07]	733	0	0.51
Complex Innovation Strategy				
Two innovations				
Did product/process	0.12 / [0.09]	297	0	0.7
Did product/organizational	0.38 / [0.27]	259	0	0.85
Did product/marketing	-0.13 / [0.36]	257	0	0.94
Did process/organizational	0.21** / [0.10]	276	0	0.86
Did process/marketing	0.41*** / [0.15]	268	0	0.09
Did organizational/marketing	0.34 / [0.22]	164	0	0.92
Three innovations				
Did any three innovations	0.43*** / [0.14]	740	0	0.78
Did product/process/organizational	0.24*** / [0.08]	279	0	0.58
Did product/process/marketing	0.1 / [0.08]	295	0	0.36
Did product/organizational/marketing	0.27** / [0.10]	235	0	0.57
Did all four innovations	0.13** / [0.06]	358	0	0.14

Note: Explanatory variables include log of firms' age, female ownership of firm, domestic ownership and minimum wage, location of the firm, sector, and industry. */**/*** Significant at 10/5/1% level. Figures in [ ] are standard errors.
§Tests the hull hypothesis that the equation is under-identified, $cov(instrument, endogenous\ variable) = 0$. Rejection of the null implies that the instruments are relevant; that is, the instrument induces change in the endogenous variable.
§§Tests the null hypothesis that the instruments are uncorrelated with the error term, $cov(instrument, error\ term) = 0$ and that the excluded instruments are correctly excluded from the estimated equation. Non-Rejection of the null implies that the instruments are valid.

Table 4 - Effects of specific innovations (organizational and process) on labor productivity

Details on organizational and process innovation	**Estimate /[SE]**	**Obs**	**Underid test§**	**Overid test§§**
Did organizational/logistics	0.29* / [0.15]	262	0	0.8
Did organizational/method	0.21** / [0.10]	268	0	0.8
Did organizational/maintenance	0.18 / [0.14]	228	0	0.92
Detailed organizational innovations (with product-process)				
Did product/process/dissolved units	-0.19 / [0.19]	227	0	0.48
Did product/process/merged units	0.38***/ [0.12]	234	0	0.68
Did product/process/created new units	0.37***/ [0.10]	270	0	0.96
Detailed process innovations (with product-organization)				
Did product/organizational/method	0.08 / [0.10]	245	0	0.13
Did product/organizational/logistics	0.11 / [0.12]	263	0	0.23

Did product/organizational/maintenance	0.23*** / [0.08]	270	0	0.46

Note: Explanatory variables include log of firms' age, female ownership of firm, domestic ownership and minimum wage, location of the firm, sector, and industry. */**/*** Significant at 10/5/1% level. Figures in [ ] are standard errors.

§Tests the hull hypothesis that the equation is under-identified, $cov(instrument, endogenous\ variable) = 0$. Rejection of the null implies that the instruments are relevant; that is, the instrument induces change in the endogenous variable.

§§Tests the null hypothesis that the instruments are uncorrelated with the error term, $cov(instrument, error\ term) = 0$ and that the excluded instruments are correctly excluded from the estimated equation. Non-Rejection of the null implies that the instruments are valid.

5.2. Summary of results

Several salient results are noted. *One*, innovation has a positive impact on both labor productivity and employment growth. For simple innovations, process and product innovations have the highest effects on labor productivity while product and organizational innovations have the highest effects on employment growth.

Two, complex innovation strategies have higher effects on labor productivity and employment growth than simple innovations. Among complex innovators, three-innovators appear to benefit the most from their innovation strategies. Their labor productivity is positively affected by their strategies (whereas that of the two- and four-innovators is not) and their employment growth is the highest as well.

Three, process innovation appears to be one of the staple strategies for two-innovators. On one hand, innovations involving methods and product innovations positively affect labor productivity. On the other hand, organizational innovation, combined with either logistics or methods innovation, positively affects employment growth.

Four, for three-innovators, combining other types of innovation with product and process innovations appears to be a more superior strategy. Combined with marketing innovation, product-process innovations enhance labor productivity while combined with organizational innovation, product-process innovations increase employment growth.

6. Summary and conclusions

There are many studies that establish the effects of innovation on good firm performance but few systematically analyze such issue in the Philippines. In light of emerging evidence that complex innovations have bigger impacts than simple ones, this paper has analyzed the effects of these two strategies on the employment growth and labor productivity of firms in the country using an instrumental variable technique. While the instruments used in the paper have passed the overidentification and underidentification tests, the paper has not rigorously established the effects of the instruments on other factors that can potentially affect the firm performance. Bearing in mind this caveat, we discuss below some general directions on what types of innovations can be pursued.

Innovation has a positive effect on firms' performance and estimation results indicate that there is no single strategy that can be considered superior. Choosing one strategy over the other involves several considerations. One, implementing innovations entails costs, which are the most important barriers to innovation especially for Micro, Small and Medium Enterprises (MSMEs).

Two, adopting a specific strategy can also be dictated by the kind of performance firms wish to enhance.

Both simple and complex innovations are beneficial to labor productivity and employment growth. Firms that are limited in resources can implement one innovation and benefit from it. In particular, marketing or process innovation appears to yield the highest benefit for firms that aim to increase labor productivity. On the other hand, product or organizational innovation can be pursued by firms with constraints in their budget but aim to increase employment growth.

Complex innovation is a better strategy for firms that have more resources and that aim to increase labor productivity. Specifically, product-process innovation mix appears to be a good combination for firms that can afford two innovations. This mix can be further combined with marketing for those that can afford three innovations. For firms that aim for employment growth, product-process innovation appears to be a good strategy. This mix can be further combined with organizational innovation for firms that can afford three innovations.

How can these results potentially feed into the government's innovation policies? Relative to large firms, MSMEs face more challenges due to their limited technical know-how and budget. Notwithstanding these challenges, MSMEs have important roles on output and export growth, poverty alleviation, and economic empowerment. If the Philippines is to keep up with a resilient, people-oriented, and people-centered ASEAN community, the country needs to strengthen innovation programs that support MSMEs. To do this, there is a need to look into how different product and/or process innovations can fit into the broader business strategies of MSMEs. A thorough assessment of how these innovations can fit into the unique needs of MSMEs is needed so that technical assistance and capacity-building can be customized to cater to these unique needs.

While the paper has not investigated MSMEs in greater detail, results of the paper can still provide some general directions on how innovation-related policies can further help MSMEs. One, once product and/or process innovative capacities are integrated into the MSMEs' conduct of business, sustaining and scaling-up of enterprises are key elements to MSMEs' contribution to skills, productivity, and value creation. At this stage, policies can therefore address the importance of building capacities to sustain and scale-up operation. One area that can be explored include the provision of subsidies to innovative enterprises that have consistently performed well on value adding and employment growth. Two, provision of subsidies to improve and upscale marketing innovations can be explored. To complement these efforts, infrastructure support such as fast and affordable access to information technology should be improved to help the MSMEs become more visible in the local and global markets.

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