Understanding Firm-Level Innovation and Productivity in Mexico using Logit Regression

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Abstract - The objective of this paper is to explore the nature of firm-level innovation and investments in knowledge capital in Mexico and the link between innovation activities and productivity and employment.

Keywords - *Determinants, regression, logit model.*

I. INTRODUCTION

Topics like Prevalence of firm-level innovation in Mexico, type of firms that innovate, main types of knowledge capital investments that firms implement, main determinants and barriers to firm-level innovation and links between innovation activities and productivity or employment are discussed. The data has been collected from World Bank Enterprise Survey.

II. FINDINGS

	(1)	(2)	(3)	(4)
	R&D per worker	Research per worker	R&D	Research
Two-way traders	0.4795***	-0.0432***	0.1661	-0.0206
Demand(-)	0.5025***	0.6001***	0.1688	0.2101
Share(t-3)	-0.0303***	-0.0070***	-0.0091	-0.0025
Lack Finance	0.0228***	-0.0535***	-0.0046	-0.0173
Telecom_obstacle	-0.0089***	-0.1480***	0.0024	-0.0522
Government_obstacle	0.1092***	0.0249***	0.0367	0.0079
Trade cost-obstacle	-0.0598***	0.0596***	-0.0211	0.0214
Foreign	-1.231***	-0.1179***	-0.4007	-0.0418
Age	-0.0049***	0.0108***	-0.0016	0.0037
Medium	-0.4836***	0.0715***	-0.1529	0.0284
Large	0.3877***	0.3159***	0.1479	0.1149
Constant	9.4470***	9.196***	-2.6571	-3.1717
Observations	181	181	181	181

TABLE 1. KNOWLEDGE INTENSITY FUNCTION

Table 1 shows the results for knowledge regression over various factors. The following logit model was used for the regression:

$\ln\{E(ki)\} = xi\beta$ $\quad\quad$ k ~ Poisson

Where ki is the knowledge intensity function for firm i, xi is a vector of determinants of knowledge intensity and β is a vector of estimated coefficients. In columns (1) and (2) knowledge intensity has been tested using the logit model. Columns (3) and (4) have been tested with a probit model for robustness.

From table 1 it can be concluded the most important determinant of knowledge investment is decreasing demand. A firm facing decreasing demand of its product would invest more in research to improve its product or introduce a new one. The three types of obstacles (finance, government and trade) do not have a significant impact on the decision to invest in research. The firms with higher foreign ownership tend to invest less in research. This could be due them investing in research in their home country and then exporting that knowledge to their subsidiaries to minimize costs. The age of the firm or past three year market share do not have an impact on the knowledge investment decision of firms. Large firms tend to invest more in research the medium sized firms.

	(1)	(2)	(3)	(4)
	Sales per worker – R&D	Sales per worker – R&D	Sales per worker – Research	Sales per worker – Research
Log(K/L)	0.196695 (4.97E-06)	0.194843 (5.6E-06)	0.136293 (0.0018)	0.135766 (0.001824)
Log(L)	0.232127 (3.65E-08)	0.230707 (3.91E-08)	0.233972 (6.94E-09)	0.232312 (8.16E-09)
Product Innovation	-0.12759 (0.40203)	0.082084 (0.068546)	-0.07993 (0.058529)	0.098441 (0.061386)
Process Innovation	-0.28076 (0.033088)	0.081105 (0.076077)	-0.31992 (0.011997)	-0.01071 (0.096676)
Product*Process		-0.4754 (0.120634)		-0.40527 (0.168862)
Intercept	8.717196 (1.17E-33)	8.609737 (6.08E-33)	8.085849 (2.5E-30)	8.009494 (7.97E-30)
No. of Observation	173	173	173	173
R - Squared	0.363322	0.372522	0.412265	0.41895

Table 2

Table 2 regresses the sales per worker using R&D intensity as knowledge input to predict innovation and research, training and equipment for innovation intensity to explain innovation with capital per labour, capital production and process innovation. The following equation is used to regress:-

$$\log(Y_i / L_i) = \delta_0 + \delta_1 \mathrm{Pr}od_i + \delta_2 \mathrm{Pr}oc_i + \delta_3 organ_i + \delta_4 \log(K / L_i) + \delta_5 \log(L_i) + \delta_2 X_i + \varepsilon_i$$

Columns (1) to (2) uses R&D intensity as knowledge input to predict innovation, while columns (3) to (4) uses the instruments of innovation estimated using research, training and equipment for innovation intensity to explain innovation. The coefficients of innovation are not significant. Thus we conclude that innovation does not affect in increasing productivity of Mexican establishments.

	(1)	(2)	(3)
Sales growth	-0.0006		
Sales growth old products		0.2051	0.2292
Sales growth new products		-0.0018	-0.0032
Process_inno2		-15.6718	-25.9000
Age	0.0912		0.0086
Two_way traders	24.4300		23.8900
Foreign	32.7700		35.4500
Medium	19.9500		19.0500
Large	-53.7900*		-58.1600*
Constant	-37.4300		0.0028
Observations	181	181	181
R-squared	0.0771	0.010	0.0875

Table 3. Employment and Innovation

Table 3 gives the OLS estimates for the equation:

$$\Delta L_1 = \alpha_0 + \alpha_1 old_i + \alpha_2 new_i + \alpha_3 process_i + \beta X_i + e_i$$

The model estimates the change in employment over the last three years. In column (1) of table 3 we consider sales growth as a determinant of change in employment along with other factors. In column (2) and (3) we divide the sales growth into two components: sales growth due to (i) old product and (ii) new product.

The results of table 3 show that growth in sales of old product significantly impacts employment. Process innovation significantly impacts employment but in a negative way. This could be because new processes often involve automation which requires less workforce. Two way traders and foreign firms tend to employ more workers. Medium sized firms tend to increase their workforce while large firms tend to do the opposite

III. CONCLUSIONS

1. Employment is heavily influenced by process innovation and sales growth of old products.
2. The innovation function tells us that inadequately educated workforce is a significant factor in determining probability of product and process innovations. Size, Knowledge intensity, improvement in Research intensity and investment in R&D do not affect innovation probability in Mexican firms. Historically, the economic activity in Mexico was mainly based on exploiting its abundant natural resources with oil production holding a large share of GDP. Its economy as closed and heavily regulated. Hence, Mexican firms have had little incentive to innovate followed by little need to invest in R&D.
3. Innovation does not affect in increasing productivity of Mexican establishments.

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