The Effect of R&D Tax Credits on Output Quality: Evidence from Firms in Chile

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Abstract

This paper studies the effect of the Research and Development (R&D) tax credits contemplated in the R&D Tax Incentive Law (Ley 20.241) on the quality of goods and services provided by companies in Chile. Exploiting survey data at the firm level, this paper employs three different ordered models to estimate the probability that firms with R&D tax credits declare improvements on goods and services provided. Results indicate no statistically significant effects on quality improvements for firms with the tax credits. In addition, results show that property rights have a positive and statistically significant effect on the probability of firms declaring high quality output improvements.

1. Introduction

The relationship between technological progress and economic development has been addressed extensively in the growth literature since Solow (1956). Romer (1986), for instance, innovates in the literature with a competitive general equilibrium model in which technological change is endogenously specified. In other words, technological change occurs as a consequence of the decision making process. In that way, researchers can derive strong aggregate empirical predictions that contribute in explaining, for instance, the productivity and income gaps among countries (Jones, 2015). Since then, the literature advanced towards the analysis of microdata (particularly at the firm level), providing answers to more specific questions such as the role of innovative firms and governments investments in promoting Research and Development (R&D) projects (Aghion and Howitt, 1992; Hall and Lerner, 2010). More specifically, this mentioned advancement in the literature allowed researchers to find links between investments in R&D and improvements in firms' products and/or ser-vices (Ioannou et al, 2020). Following this trend in the literature, this paper attempts to investigate the link between R&D tax credits and improvements in the quality of goods and/or services provided by firms in a particular case study.

The literature regarding the effects of R&D tax incentives on firms' spending and on aggregate welfare is extensive. For instance, Rao (2016) investigates the impact of the US federal R&D tax credits on corporate R&D investment, finding that a 10 % subsidy leads to a 19.8 % increase in research intensity (measured as the ratio of R&D spending to sales) in a short period of time. More recently, Agrawal, Rosell and Simcoe (2020) find that the R&D tax incentives provided by the Canadian government also had positive effects on R&D investments with larger effects on large firms that collected refunds rather than direct subsidies. This paper focuses on the link between the R&D tax incentives and goods and/or services' improvements for Chilean firms based on an existing survey of firms.

In 2008, the government of Chile issued a new law Ley 20.241 which created a tax benefit for firms that invested in R&D projects. The new law intended to build technologicalknowledge and/or innovate firms' production processes. The tax benefit consisted mainly in a 35 percent tax credit in R&D contracts between firms and third parties registered with the government entity, Production Development Corporation (CORFO) among other requirements. In 2012, Chilean authorities modified the law by relaxing some constraints such as the deadline for R&D projects (which was extended) and the top amount of the tax credit (which was almost tripled). Mardones and Madrid (2020) study the effects of Ley 20.241 and its modifications on the components of expenditure for innovation through a probit model. Their findings indicate that although Ley 20.241 had a positive and statistically significant effect on total expenditures for innovation, this effect is not economically significant. Mardones and Avila (2020) find similar results, indicating that the R&D tax credits did not affect the intensity of R&D spending. Given these scenarios, I undertake to investigate the effects of Ley 20.241 from a different angle. In other words, this paper addresses the following question:

What is the probability that the tax credit incentives created by Ley 20.241 led to an improvement in the quality of goods and/or services provided by Chilean firms given the set of firms' characteristics?

In order to answer this question, I explore the outcomes of the mentioned R&D tax credits through the use of the 10th Chilean Innovation Firm Survey data (Decima Encuesta de Innovacion de Empresas), which comprise a cross section of 5,876 firms from 38 different sectors ranging from education to pharmaceutical. More precisely, I utilize the answer to question 5.1 in Module 5 of the mentioned survey. This question asks firms to categorize their perceived improvement in the quality of the goods and/or services they provide after introducing an innovation in their production process. The answers for the question rank from 4 (High Improvement) to 1 (No Improvement). Then, the answers are linked to the answer of question 12.1 in Module 12 that asks firms if they received the R&D tax credit benefit contemplated in Ley 20.241. Moreover, the empirical estimation contemplates a number of control variables such as personnel's education and foreign ownership of firms that are explained in the data description section. In addition, I compare the results of three ordered models with distinct distribution assumptions throughout the estimation section as a robustness check.

The remainder of this paper is structured as follows: Section 2 describes the econometric specification of the model, Section 3 describes the 10th Chilean Innovation Firm Survey data (Decima Encuesta de Innovacion de Empresas 2015-2016) and the dataset used for specifications, Section 4 reports the empirical findings, and finally Section 5 provides the conclusion with possible extensions for further research.

2 Econometric Model Specification

The empirical strategy used to assess the effect of Ley 20.241 on the quality of goods and/or services provided by Chilean firms is an ordered choice model. This model is characterized by a latent variable that explains the relationship

$$y_i^\star = X_i'\beta + \epsilon_i. \qquad (1)$$

In this relationship, y_i^* represents the unobservable improvement in the quality of goods and/or services after implementing a R&D innovation during the years 2015-2016 per firm. X_i, conversely, represents the exogenous determinants of the improvement contained in y_{i*} These determinants are shown in Table 1. The term ε_i represents the random term assumed to be identically and independently distributed (iid). Since y_i^* is unobserved, all that is observable by survey design are the responses for question 5.1 in Module 5 of the 10th Chilean Innovation Survey. In other words, all that is observable is the categorical variable y_i reflected on the responses of the survey. These responses categorize improvements in y_i from High Improvement (4) to No Improvement (1) with Low Improvement (2) and Medium Improvement (3) as intermediary categories. The probability of firm i falling within the interval of each of the mentioned four categories of quality improvement j is determined asfollows

$$P_{ij} = Pr(y_i = j) = P(\alpha_{j-1} \leq y_i^\star \leq \alpha_j) = F(\alpha_j - X_i'\beta) - F(\alpha_{j-1} - X_i'\beta). \qquad (2)$$

In order to generalize the results obtained in Section 4, the empirical estimation contemplates three distinct distributional assumptions for F ($X_i\beta$) in (1), which are the standard Gaussian, the Cauchy, and the Logistic, respectively. The term $_i$ in (1) represents the error term. This paper presents three ordered choice models with the mentioned distributional assumptions. I choose these distributional assumptions to compromise between the tales and degrees of freedom of each of the distributions with the Gaussian and Logistic being the extremes scenarios in the tales of the tales of the distribution and the Cauchy being the intermediary scenario in the tales.

The models for (2) given n firms and J choices are estimated via maximum likelihood. This is obtained by maximizing the following likelihood function

$$LF = \Pi_{j=1}^{J}\Pi_{i=1}^{n}P_{ij} \quad J = 1, 2, 3, 4. \qquad (3)$$

Taking logarithms and substituting for the appropriate F cumulative distribution function,(3) can be written as

$$LLF = \sum_{j=1}^{J}\sum_{i=1}^{n} ln[F(\alpha_j - X_i'\beta) - F(\alpha_{j-1} - X_i'\beta)]. \qquad (4)$$

As shown by Pratt (1981), the log-likelihood is globally concave. Hence, it can be maximized to obtain estimates of the parameter vector β. In addition, Pratt (1981) shows that the Normal (Gaussian) and Logistic distributions satisfy the stronger condition for concavity while the Cauchy distribution satisfies the weaker condition.

3 Data Description

In order to answer the research question, I use the 10th Chilean Innovation Firm Survey data (Decima Encuesta de Innovacion de Empresas 2015-2016) collected by the Innovation Division of the Chilean Ministry of the Economy, Promotion and Tourism. This survey is a cross section of 5,876 firms from 38 different sectors. The main objective of the survey is to provide information about the firms' innovation processes (inputs and results). Moreover, the survey captures the relation between the process and the strategy of firms' innovations. Furthermore, this survey also captures the factors that drive the capacity to innovate and the financial return of innovations. The question of particular interest in the survey is: "Did the innovation of products and/or services introduced in 2016 lead to an improvement in the quality of goods and services provided by the firm?". The responses range from No Improvement (1) to High Improvement (4) with Low Improvement (2) and Medium Improvement (3) as intermediary categories. All the response categories form the basis of this analysis given that the research question requires studying the effect of the R&D tax credits on the probability of firms being in one of the mentioned categories of improvement.

The control covariates of interest in the dataset include firms' personnel level of education (total number of workers with secondary education and higher education), percent of firm's equity owned by foreign organizations and the level of total exports. Additionally, I construct a dichotomous variable, AppropriationDummy. This variable measures the effectiveness of legal mechanisms of protection of innovations introduced by firms. This effectiveness measure attempts to capture the ability for firms to seize the benefits of knowledge and "spillover effects"(Cassiman and Veugelers, 2012; Reyes Islas 2018). In a few words, this variable can be used as a proxy for well enforced property rights. More importantly, the key explanatory variable of interest related to the R&D tax credits is the dichotomous variable TaxRDummy. This variable attempt to capture a differential effect between firms which received the R&D tax credits and those which did not receive the mentioned credits. All the variables in the dataset reflect survey responses in the year of 2016 at the firm level. The completedescription and summary statistics of the variables used can be found in Table 1 and Table 2, respectively.

4 Estimation and Results

4.1 Estimation and Findings

Estimating the model given by (2) with the categories of quality improvement reported in the survey as a function of the indicator variable distinguishing firms that received the R&D tax credits while controlling for covariates, yields results in Table 3. Moreover, this table shows the estimates under the three already mentioned distributions assumptions (Nor-mal, Cauchy, and Logistic, respectively). Standard errors reported are robust to violations of constant variance (i.e., heteroskedasticity). As demonstrated by Yatchew and Griliches (1985), assuming standard errors with constant variance without verifying the data can be problematic since the parameter estimates obtained can be biased and not only inefficient as in the typical Ordinary Least Squares (OLS) scenario.

Results in Table 3 indicate that the dichotomous variable that differentiates firms which received the R&D tax credit from firms which did not (TaxRDummy) is not statistically significant in the three specifications. Moreover, the coefficient of variable TaxRDummy is negative under the three specifications.

These findings support the results found by Mar-dones and Madrid (2020) and Mardones and Avila (2020). As stated before, Mardones and Madrid (2020) did not find economically significant effects of Ley 20.241 on innovation expenditures. Results in Table 3 also reinforce this finding by showing that there is no statistically significant effect of the R&D tax credits on output quality improvement. In addition, results in Table 3 also complement Mardones and Avila (2020). Mardones and Avila (2020) find that the R&D tax credit has a

statistically significant and positive effect on the probability of performing R&D innovations. Nevertheless, they also do not find economically significant increases in R&D spending attributable to Ley 20.241. Hence, since firms did notincrease their R&D spending substantially, their output quality did not change substantially as results in Table 3 indicate.

Removing the coefficient for the variable TaxRDummy from the estimation in Table 3 results in a higher log-likelihood function for the Probit, Cauchit, and Logit specifications. The likelihood ratio statistic

$$\lambda = -2(LLF_{restricted} - LLF_{unrestricted}) \quad (5)$$

can be used to test the significance of TaxRDummy. From Table 4, it is possible to observe that calculated values of the mentioned statistic (λ) with 2 degrees of freedom are 0.13, 0.50, and 0.14, respectively. These results reinforce the findings in Table 3 where the coefficients associated with TaxRDummy are not statistically significant in all three specifications.

Another important finding in Table 3 is that the constructed dichotomous variable AppropriationDummy is statistically significant at the 5 percent level in the Probit and Logit specifications and at the 10 percent level in the Cauchit specification. This indicates that this variable plays a non negligible role in defining output quality improvements. As stated in Table 1, this variable distinguishes firms that had any form of legal protection for the innovations introduced (e.g Patents or Licenses) from firms which did not possess those mechanisms to protect their innovations. Results in Table 3 also show that the coefficient of the variable AppropriationDummy is positive in the three specifications, indicating that firms which had access to patents, for instance, had a higher probability of improving their goods and/or services than firms that did not. Namely, firms with legal mechanisms of protection for their innovations have the appropriate incentives to improve their output and bear the costs of investing more in R&D, for example. This is due to the fact that the bene-fits of that improvement and its costs are guaranteed to be retained by these firms given the law protection provided. There is extensive evidence favoring this hypothesis in the existing literature (See, for instance, Hausman et al (1984) and Cincera (1997)).Removing the coefficient for the variable AppropriationDummy from the estimation in Table 3 yields a lower log-likelihood for the three specifications. By using the likelihood ratio statistic as in (5) to test the significance of AppropriationDummy, it is possible to see from Table 5 that the calculated values for the test statistic (λ) are 5.30, 4.48, and 5.48, respectively. These values are statistically significant at the 5 percent level in all three specifications, reinforcing the findings that indicate the importance of legal protection of innovations for Chilean firms.

4.2 R&D Tax Credits for Firms with Legal Protection

In order to verify any differential effect of the R&D tax credits on firms that had any le-gal protection for their innovations, I interact both dichotomous variables TaxRDummy and AppropriationDummy to generate variable AppTaxRDummy. Results in Table 6 show that firms with legal protection and the R&D tax credits have a lower probability of declaring High Improvement (4) in their goods and/or services relative to those firms which did not have both. This interaction is statistically significant at the 5 percent level in all three specifications. This finding raises the possibility that the mentioned tax credits had detrimental effects on the probability of improving output quality for firms with legal protection.

4.3 Marginal Effects

Given that the estimated coefficients in Table 3 do not provide the change in the probability of a specified category of improvement due to a unit change in the relevant explanatory variables, I estimate these probabilities through the marginal effects for both the ordered probit and logit.The marginal effect on the probability of firm i declaring improvement j when covariate x_{ri} changes is given by the partial derivative of (2) with respect to x_{ri}:

$$\frac{\partial Pr(y_i = j)}{\partial x_{ri}} = [F'(\alpha_{j-1} - x_i'\beta) - F'(\alpha_j - x_i'\beta)]\beta_r \quad (6)$$

Given the scope of the analysis, I focus on the marginal effects of the variables TaxRDummy and Appropriation Dummy of declaring No Improvement (1) and High Improvement (4) in their goods and/or services. These results are presented in Table 6 and 7 for both ordered probit and logit, respectively. In the two specifications, the marginal effects of firms with the R&D tax credits are statistically insignificant. This indicates that there is no statistical evidence that the R&D tax credits have an effect on output quality improvements. Also, from results in Table 7, it is possible to observe that firms that had any legal protection (AppropriationDummy) for their innovations were approximately 4.57 percent less likely to declare No Improvement (1) relative to their counterparts in the Probit specification. In the Ordered Logit specification, firms with legal protection for their innovations were approximately 4.14 percent less likely to declare No Improvement (1) relative to those firms which did not have a legal protection for their innovations. Both marginal effects are statistically at the 5 percent level.

Regarding the marginal effects of declaring High Improvement (4), the coefficients associated with TaxRDummy are statistically insignificant in both specifications as it is possible to observe in Table 8. These findings reinforce the evidence that firms that had the advantage of the R&D tax credits did not improve the quality of their output. In the other hand, firms that possessed any legal protection for their innovations had statistically significant marginal effects. In the Ordered Probit case, firms with legal protection were approximately 8.9 per-cent more likely to declare high improvement in output quality relative to firms with no legal protection. In the Ordered Logit specification, firms with legal protection were approximately 9.41 percent more likely to declare High Improvement (4) than firms with no legal protection. Both marginal effects are statistically significant at the 5 percent level. These findings indicate the importance of institutional variables, particularly property rights, for output quality improvements.

5. Conclusion

This paper shows that there is no statistical evidence that the R&D tax credits contemplated in Ley 20.241 increased the probability of output quality improvements for Chilean firms. This finding is robust across three different specifications under different distribution assumptions. In addition, this paper shows that there is statistically significant evidence that property rights play an important role in defining output quality. Firms that had legal protection for their innovations had a higher probability in declaring High Improvement and a lower probability in declaring No Improvement. This finding is also robust across the three specifications. More interestingly, this paper shows that firms that took advantage of the R&D tax credits and the legal protection had a lower probability of declaring High Improvement. Further work could evaluate a more specific causal relationship between the two mentioned variables given this apparent contradiction in the findings. Furthermore, the results in this paper serve as a source of evidence which policymakers could use to evaluate the costs of tax credits given that the R&D tax credits represent a major revenue sacrifice for the Chilean national government. The evidence shown suggests that the loss in revenue is not being offset by alleged improvements in the delivery of goods and services. Potential recommendations pending on further research would involve verifying how the R&D tax credits in Ley 20.241 affect firms' incentives to innovate and improve their output. Incentives matter as the old saying states in economics. This case is not an exception.

6. References

Aghion, P. and Howitt, P. (1992).A Model of Growth Through Creative Destruction.Econometrica, 60(2), 323-351 DOI:10.3386/w3223.

Agrawal, A., Rosell, C. and Simcoe, T. (2020). Tax Credits and Small Firm RD Spending.

American Economic Journal: Economic Policy, 12(2), 1–21 https://doi.org/10.1257/pol.20140467.

Cassiman, B. and Veugelers, R. (2002). R&D Cooperation and Spillovers: Some Empirical Evidence from Belgium. American Economic Review, 92(4), 1169–1184.

Cincera, M. (1997). Patents R&D, and Technological Spillovers at the Firm Level: Some Evidence from Econometric Count Models for Panel Data. Journal of Applied Econometrics, 12(3), 265–280. https://ideas.repec.org/a/jae/japmet/v12y1997i3p265-80.html.

Hall, B and Lerner, J. (2010). Handbook of the Economics of Innovation (1st ed., Vol. 1). NorthHoland. https://doi.org/10.1016/S0169-7218(10)01014-2

Hausman, J., Hall, B. H. and Griliches, Z. (1984). Econometric Models for Count Data with an Application to the Patents-R&D Relationship. Econometrica, 52(4), 909.

Ioannou, C., Makris, M. and Ornaghi, C. (in press). R&D Productivity And The Nexus Between Product Di erentiation And Innovation: Theory And Experimental Evidence. Manuscript.

Jones, C. I. (2015). The Facts of Economic Growth. National Bureau of Economic Research, Working Paper 21142, 1–60. https://doi.org/10.3386/w21142.

Mardones, C. and Avila, F. (2020). Effect of R&D subsidies and tax credits on the innovative processes of Chilean firms. Academia RevistaLatinoamericana de Administraci´on, C23(03), 15–40. https://doi.org/10.1108/ARLA-08-2020-0181.

Mardones, C., and Madrid, N. (2020). Ex-Post Evaluation of the R&D Tax Incentive Law in Chile. Academia RevistaLatinoamericana de Administraci´on, C24(O7), 30–54. doi.org/10.1108/ARLA-03-2019-0092.

Pratt, J. W. (1981). Concavity of the Log Likelihood. Journal of the American Statistical Association, 77(380), 954. https://doi.org/10.2307/2287361.

Rao, N. (2016). Do Tax Credits stimulate R&D Spending? The e ect of the RD tax credit in its first decade. Journal of Public Economics, 140, 1–12. https://doi.org/10.1016/j.jpubeco.2016.05.003.

Reyes Islas, M. B. (2018). Obst´aculosen la Innovaci´on de las Peque˜nas y MedianasEmpresas (PyMes) en Chile: Falta de Informaci´onSobreTecnolog´ıa (Master's Thesis). Universidad de Chile. http://repositorio.uchile.cl/handle/2250/149521.

Romer, P. (1986). Increasing Returns and Long-Run Growth. Journal of Political Economy, 94(5), 1002–1037. https://www.jstor.org/stable/1833190?seq=1metadata$_i$nf o$_t$ab$_c$ontents.

Solow, R. M. (1956). A Contribution to the Theory of Economic Growth. The Quarterly Journal of Economics, 70(1), 65. https://doi.org/10.2307/1884513.

Yatchew, A. and Griliches, Y. (1985). Specification Error in Probit Models. The Review of Economics and Statistics, 67(1), 134–139. https://doi.org/10.2307/1928444.

Table 1: Description of Variables

Variable Name	Variable Description
Qual	Quality Improvement in goods and/or services provided in 2016
Sales	Firm Total Sales in national currency in 2016
TaxRDummy	=1 If firm had R&D tax credits approved and used them for fiscal year 2016
Secondary	Firm's number of workers with secondary school education in 2016
Bachelors	Firm's number of workers with a bachelors degree education only in 2016
Masters	Firm's number of workers with a master's degree only in 2016
PhD	Firm's number of workers with a doctoral degree in 2016
ForeignShare	Percent of Firms' Shares owned by a foreign organization in 2016
Exports	Firm's level of total exports in 2016 in national currency
AppropriationDummy	=1 If firm had any legal protection for their innovation such as a Patent in 2016

Table 2: Summary Statistics

Variable Name	N	Mean	Min	Max	Standard Deviation
Qual	1055	3.095735	1	4	1.020348
Sales	5876	3.01e+07	0	2.81e+10	4.15e+08
TaxRDummy	5876	0.0098707	0	1	0.0988681
Secondary	5876	82.72158	0	11076	410.4189
Bachelors	5876	41.516	0	14730	295.5547
Masters	5876	4.282165	0	3113	64.54387
PhD	5876	1.125425	0	1674	27.08814
ForeignShare	5,876	0.0556231	0	1	0.2207511
Exports	5876	5882036	0	7.03e+09	1.20e+08
AppropriationDummy	5876	0.0359088	0	1	0.1860786

Table 3: Estimation Results

	Ordered Probit	Ordered Cauchit	Ordered Logit
Sales	-2.14e-10	-3.29e-10	-3.78e-10*
	(1.36e-10)	(2.83e-10)	(2.25e-10)
TaxRDummy	-0.0646	-0.202	-0.113
	(0.177)	(0.344)	(0.298)
SecondarySchool	-0.000123	-0.0000595	-0.000186
	(0.000104)	(0.000204)	(0.000203)
Bachelors	0.000579***	0.000720	0.000921***
	(0.000182)	(0.000675)	(0.000302)
Masters	-0.00124**	-0.00179	-0.00202***
	(0.000485)	(0.00117)	(0.000765)
PhD	0.000122	0.000905	0.000305
	(0.000856)	(0.00404)	(0.00158)
ForeignShare	-0.384***	-0.490	-0.644***
	(0.140)	(0.325)	(0.243)
Exports	1.62e-10	-6.89e-11	2.91e-10
	(4.06e-10)	(2.16e-09)	(8.66e-10)
AppropriationDummy	0.228**	0.314*	0.388**
	(0.101)	(0.185)	(0.170)

cut1			
_cons	-1.164***	-2.407***	-1.970***
	(0.0544)	(0.234)	(0.101)
cut2			
_cons	-0.726***	-1.091***	-1.187***
	(0.0477)	(0.0979)	(0.0816)
cut3			
_cons	0.142***	0.198***	0.230***
	(0.0443)	(0.0663)	(0.0721)
Observations	1055	1055	1055
Log-Likelihood	-1277.9587	-1281.4642	-1278.3317

Robust standard errors in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

Table 4: Likelihood Ratio Test Values for Variable TaxRDummy

	Ordered Probit	Ordered Cauchit	Ordered Logit
LRchi2	0.13	0.50	0.14
Prob>chi2	0.7205	0.4780	0.7081

Table 5: Likelihood Ratio Test Values for Variable Appropriation Dummy

	Ordered Probit	Ordered Cauchit	Ordered Logit
LRchi2	5.30	4.48	5.48
Prob>chi2	0.0213	0.0344	0.0192

Table 6: Estimation Results with Interaction Variable

	Ordered Probit	Ordered Cauchit	Ordered Logit
Sales	-2.71e-10**	-4.33e-10	-4.72e-10**
	(1.32e-10)	(2.67e-10)	(2.16e-10)
TaxRDummy	0.282	0.351	0.457
	(0.234)	(0.373)	(0.401)
SecondarySchool	-0.000117	-0.0000444	-0.000177
	(0.000104)	(0.000194)	(0.000205)
Bachelors	0.000604***	0.000842	0.000981***
	(0.000188)	(0.000570)	(0.000320)
Masters	-0.00132***	-0.00203*	-0.00220***
	(0.000493)	(0.00116)	(0.000783)
PhD	0.0000807	0.000683	0.000224
	(0.000870)	(0.00401)	(0.00164)
ForeignShare	-0.373***	-0.498*	-0.627**
	(0.140)	(0.297)	(0.244)
Exports	1.87e-10	-1.29e-10	3.29e-10
	(4.15e-10)	(1.28e-09)	(9.25e-10)
AppropriationDummy	0.295***	0.413**	0.502***
	(0.108)	(0.180)	(0.182)
AppTaxRDummy	-0.792**	-1.116**	-1.315**
	(0.351)	(0.496)	(0.583)
cut1 _cons	-1.157***	-2.398***	-1.958***
	(0.0546)	(0.230)	(0.101)
cut2 _cons	-0.718***	-1.082***	-1.173***
	(0.0479)	(0.0975)	(0.0820)
cut3 _cons	0.152***	0.216***	0.248***
	(0.0447)	(0.0644)	(0.0729)
Observations	1055	1055	1055
Log-Likelihood	-1275.6223	-1279.1668	-1275.9796

Robust standard errors in parentheses

* p< 0.1, ** p< 0.05, *** p<0.01

Table 7: Marginal effects on the probabilities of firms declaring No Improvement in Quality

	Ordered Probit	Ordered Logit
Sales	4.28e-11***	4.03e-11***
	(1.27e-11)	(1.42e-11)
TaxRDummy	0.0129	0.0120
	(0.0354)	(0.0318)
SecondarySchool	0.0000247	0.0000198
	(0.0000209)	(0.0000218)
Bachelors	-0.000116***	-0.0000984***
	(0.0000371)	(0.0000331)
Masters	0.000248**	0.000216***
	(0.0000981)	(0.0000830)
PhD	-0.0000243	-0.0000326
	(0.000171)	(0.000169)
ForeignShare	0.0769***	0.0688***
	(0.0282)	(0.0265)
Exports	-3.24e-11	-3.11e-11
	(7.33e-11)	(8.49e-11)
AppropriationDummy	-0.0457**	-0.0414**
	(0.0203)	(0.0184)
Observations	1055	1055

Robust standard errors in parentheses

* p< 0.1, ** p<0.05, *** p<0.01

Table 8: Marginal effects on the probabilities of firms declaring High Improvement in Quality

	Ordered Probit	Ordered Logit
Sales	-8.33e-11***	-9.17e-11***
	(1.80e-11)	(2.25e-11)
TaxRDummy	-0.0252	-0.0273
	(0.0690)	(0.0724)
SecondarySchool	-0.0000481	-0.0000451
	(0.0000403)	(0.0000491)
Bachelors	0.000226***	0.000224***
	(0.0000702)	(0.0000726)
Masters	-0.000482**	-0.000491***
	(0.000188)	(0.000185)
PhD	0.0000474	0.0000741
	(0.000334)	(0.000385)
ForeignShare	-0.150***	-0.156***
	(0.0539)	(0.0582)
Exports	6.31e-11	7.07e-11
	(1.41e-10)	(1.90e-10)
AppropriationDummy	0.0890**	0.0941**
	(0.0391)	(0.0409)
Observations	1055	1055

Robust standard errors in parentheses

* p<0.1, ** p<0.05, *** p<0.01