Institutions and Firms' Return to Innovation

Evidence from the World Bank Enterprise Survey

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June 2014

Abstract

This paper poses a question: do firms in developing countries not innovate because they are unwilling to? The question moves away from the conventional focus on the obstacles (such as the lack of access to finance) that hinder firms' innovation ability. The World Bank's Enterprise Survey is used first to estimate the return to firms' innovation across many developing countries, in terms of sales and sales per worker. Then the return to

innovation is compared across countries with different levels of institutional quality. In countries with lower institutional quality (specifically, rule of law, regulatory quality, property and patent right protection), the return to firms' innovation is lower. This suggests that poor institutional environment lowers firms' return to innovation and hence discourages them from investing in researching and adopting new products.

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Institutions and Firms' Return to Innovation: Evidence from the World Bank Enterprise Survey

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Key words: Innovation, Institutions, Rule of Law, Property Right Protection

JEL Classification: O31, O57.

*The paper is a part of the World Bank Latin America Economic Policy Sector (LCSPE)'s project on Latin America's convergence. We thank the support from LCSPE. We thank Luis Servén, Ufuk Akcigit, Jorge Araujo, Francesco Caselli, Maya Eden, Matteo Iacoviello, Bill Maloney, Ekaterina Vostroknutova, Pluvia Zuniga for very helpful comments and feedback. We thank Maria Ivanova Reyes for her able research assistance.

1. Introduction

Firms' innovation and technology adoption is widely considered as the key driver to economic growth. Google and Apple are two prime examples in the developed world, where their innovation and new products not only contribute to the economy, but also fundamentally change the way we work, entertain and communicate. Many developing countries, via different means such as foreign direct investment, also try to encourage firms to adopt new technologies and management practices.

Yet many firms do not innovate or adopt new technology. In seeking explanations for that, the conventional focuses have been on the obstacles to firms. For example, firms might not have the ability to innovate: they might not have the know-how or access to new technologies¹. Even if they do, they might not have access to finance for the research or the adoption. [Girma et al \(2008\)](#) show that private and collectively owned firms without foreign capital participation and those with poor access to domestic bank loans innovate less than other firms do.

In this paper, we do not follow the conventional path to examine the obstacles to firms' innovation, but rather, turn our focus to firms' incentives to innovate. This angle, although more neglected, deserves more attention in our view. We argue that in many developing countries, firms might not have the incentives to innovate because the reward to innovation is small. For instance, in an environment where property rights are not well protected, a firm's new product can be easily copied². This will significantly reduce the return to innovation. [Lin et al \(2010\)](#) use the 2003 World Bank Enterprise Survey of over 2,400 firms in 18 Chinese cities to show that firms' perception about property rights protection is positively and significantly related to corporate R&D activity. Another example is that in a monopolized sector, the incumbent might not need to innovate: their products, good or bad, are the only ones available in the market.

To make our point, we will proceed in two steps. In the first step, we estimate the return to firms' innovation across many developing countries. We measure the quantitative return in terms of sales, and sales per worker. We find that the return is low, which implies that the incentive to innovate is small. In the second step, we compare the return to innovation across countries with different institutional quality. We find that in countries with lower institutional quality (in particular, rule of law, regulatory quality and property right protection), the return to firms' innovation is lower.

¹ [Burststein and Monge-Naranjo \(2009\)](#) shows that developing countries' output can grow significantly when they eliminate all barriers to foreign know-how.

² In this line, see [Branstetter et al \(2006\)](#).

Estimating the return to firms' product innovation is not entirely new. Previous studies have tried to measure the sale and employment return to firms' innovation, but mostly are limited in a single country. Earlier studies focus on the manufacturing sector in developed countries, such as Van Reene (1997) for the UK, Greenan and Guellec (2001) for France, Hall et al. (2008) for Italy, Guadalupe et al (2012) for Spain. Recent studies start to quantify the return in developing countries, Benavente and Lauterbach (2008) for Chile, Aboal et al. (2011) for Uruguay, and Crespi and Tacsir (2012) for four Latin American countries.

The main contribution of this paper is the second step, where we show the return to firms' product innovation positively correlates with countries' institutional quality. In other words, in countries with lower levels of institutional quality, the return to firms' product innovation is lower. This is an interesting result because this suggests that poor levels of institutions depress the return to innovation, and therefore discourage firms to innovate. Related to our findings, Goni and Maloney (2014) find that at the country level, the rates of return from R&D expenditures follow an inverted U: they rise with distance to the frontier and then fall thereafter, potentially turning negative for the poorest countries.

The comparison of firms' return to innovation across countries in this study is made possible thanks to the World Bank's Enterprise Surveys (ES) -- a firm-level survey of a stratified representative sample of firms. It covers a large set of countries. This survey has been conducted since 2002 and typically answered by business owners and top managers. The survey covers a broad range of business environment topics, including access to finance, corruption, infrastructure, crime, competition, and performance measures³. Firms are chosen by a stratified random sampling technique, where the strata are firm size, business sector, and geographic region within a country. Firm size levels are 5-19 (small), 20-99 (medium), and 100+ employees (large-sized firms).

In our paper, we focus on product innovation. A firm is understood to innovate if it introduced a new product or service or upgraded an existing product or service. In our data, only firms in the Latin America (LAC) and Eastern Europe and Central Asia (ECA) regions are surveyed about their product innovation. We estimate the percentage change in sales per worker *within* a firm if it has introduced or upgraded the products or services in the 3 years prior to the survey. The idea is that if a firm innovates, its sales and sales per worker should increase. Ideally one should look at firms' profit as the best measure of the return. Unfortunately that is not possible in our study because data on

³ Methodological details can be found at the link below
<http://www.enterprisesurveys.org/~media/FPDKM/EnterpriseSurveys/Documents/Methodology>

reported profit are much more infrequent than data on sales, and because we are concerned about firms' profit underreporting problem.

Overall, we found that after a firm innovates, its sales per worker increase by 18%, although the significance is only at the 10% level. Obviously, without the appropriate instrument to capture the exogenous component of product innovation, the results suffer from biases. We will go back to discuss the sources of biases and how we try to mitigate them in more detail in Section 3. We will argue that if the biases are not systematically correlated with countries' institutions, the cross country comparison of the institutions' impacts -our ultimate interest- is valid.

We found that the return to innovation is higher in countries with better institutions. Overall, if a country is ranked 1 percentile higher in the world's rule of law and regulatory quality rankings, the sale return to innovation is about 1.7-1.9% higher and the sale per worker return is about 0.85-0.95% higher. This implies that in countries with better rule of law and regulatory quality, the incentive to innovate for firms is higher. We also zoom into two important components to the return to innovation: property right protection and patent right protection. We found that in countries with good property and patent right protection, the return to innovation is also higher, with about the same magnitude. We will go back to these points in greater details.

2. Data and Variables

The data are the World Bank Enterprise Survey- a rich firm-level survey database that provides information about firms' characteristics such as ownership, size, sector, region in which it is located, annual sales, capacity utilization, employment, competition etc. In order to analyze the change within a firm, we specifically select firms that appear in at least 2 surveys (i.e. we have panel data). In our sample, 6,191 firms appear in two surveys and 256 firms appear in three. There are 44 countries with 6,447 unique firms. The detailed list of countries and firms is in Table A1 in the Appendix. Note that the innovation module in the survey only exists in LAC and ECA. At the end, only LAC and ECA countries remain. The data span from 2002 to 2010.

The innovation module in Latin America is quite different to that in Eastern Europe and Central Asia. In Latin America (LAC) we use the following question to get data for innovation:

During the last three years, did this establishment introduce onto the market any new or significantly improved products? (Yes/No/ Don't know)

We define that a firm innovates when it answers Yes to this question.

In Eastern Europe and Central Asia (ECA), we use the following two questions in the survey to get data for innovation:

Q1: In the last three years, has this establishment introduced new products or services (Yes/No/Don't answer)

Q2: In the last three years, has this establishment upgraded an existing product line or service (Yes/No/Don't answer).

We define that a firm innovates when it answer Yes to either of the questions. By doing so, we can harmonize the innovation variables between LAC and ECA and hence can increase the sample size. The downside of this is that in ECA, we will mix the return of an upgraded product and that of a completely new product⁴.

Of 3,798 observations that answer, 1,855 answer Yes to one of the innovation questions. Figure 1 summarizes the profile of innovating firms by size and by regions. Large firms are more likely to innovate than small firms. Europe and Central Asia firms are more likely to innovate than Latin American firms.

Figure 1. Firms' Innovation in Emerging Markets Economies

Source: Authors' calculation based on The World Bank's Enterprise Survey.

⁴ See Akcigit and Kerr (2010) for a discussion about the innovation implications of completely new products and improve products.

We use the following two proxies for firms' performance: real sales, and real sales per worker. They are admittedly not ideal measures. The ideal measure should be firms' profit. We do not use firms' profit here because the data on profit are much spottier,⁵ and because firms' profit might be under-reported in many developing countries.

Sales can go up or down with a new product. A new product may cannibalize the business and the profits made from producing the old products when the new products replace and drive out the old products from the market. On the other hand, the new product on the market may compliment the old product. In any case, a successful introduction of a new or upgraded product should increase sales. Between the two measures of sales, in our view, sales per worker is a more precise measure of return to innovation than total sales. A sharper increase in sales per worker implies higher return.

Note that a firm can answer Yes to these questions even if the firm just slightly modifies its product, or adopts the new product from overseas. It could also simply copy the product from another domestic firm. As long as the product is new or improved to that firm, the firm can answer Yes to the questions. In that sense, the understanding of "Innovation" is broader than one usually would think, but the implication to the return to innovation is unchanged: in an environment where a firm can freely copy a product and claim it as a new innovating product, the return to its "innovation" is not likely high. The return is not high for those that originally come up with the products and nor for those that copy it.

Choosing control variables is not straight-forward, we need to find factors that potentially affect firm sales. Besides the change of manager, we found two variables in the questionnaire: whether a firm becomes an exporter between the two waves of the survey, and whether the number of a firm's competitors increases or decreases. We expect that becoming an exporter will boost firms' sales and employment, and an increase of competitors will reduce sales and employment. We also include firm

⁵ In the dataset, a third of firms do not report labor costs, and 60% firms do not report costs on intermediate input and raw material. The vast majority of firms do not report costs on fuel, electricity and water, and rented buildings and equipment. For 438 firms in Brazil, Guatemala and Ecuador that report costs on labor, intermediate inputs and fuel and electricity, the calculated change in real profit is highly correlated with the change in real sales (the correlation=0.96). This suggests that sales measures are acceptable substitutes for profit.

size, industry, and country*time fixed effects. The detailed rational and data sources of these variables are discussed in the next section.

We use Rule of Law and Regulatory quality to proxy for institutional quality. Rule of law reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Regulatory quality reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. The data are from the Worldwide Governance Indicators (WGI). It is a research data set summarizing the views on the quality of governance provided by a large number of enterprises, citizen and expert survey respondents in industrial and developing countries (Kaufmann, Kraay and Mastruzzi, 2010). We use the property right index by the Heritage Foundation⁶ to proxy for property right protection. Property right protection assesses the extent to which private economic activity is facilitated by an effective legal system and rule-based governance structure in which property and contract rights are reliably respected and enforced. For the patent right protection, we use the patent right index from Park (2008).

3. Model

3.1 Model setup

The baseline weighted regression is the following:

$$\Delta y_{ijt} = \alpha + \delta D_{ijt}^{innov} + \beta X_{ijt} + \mu_{jt}(f_j \cdot f_t) + \mu_s(f_s) + \varepsilon_{it}$$

where $\Delta y_{ijt} = \ln(y_{ijt}) - \ln(y_{ijt-1})$ is the dependent variable, and y_{ijt} are sales and sales per worker of firm i in country j at time t respectively. D_{ijt}^{innov} equals 1 if firm i in country j innovates between time t and time $t-1$. The interactive dummy $f_j \cdot f_t$ captures the macroeconomic conditions for country j at time t . The dummy f_s captures the sector fixed effects. X_{ijt} are different firm-level control variables.

The extended regression (to interact with various institution variables) is the following:

$$\Delta y_{ijt} = \alpha + \delta D_{ijt}^{innov} + \mu(D_{ijt}^{innov} \cdot Ins_j) + \beta X_{ijt} + \mu_{jt}(f_j \cdot f_t) + \mu_s(f_s) + \varepsilon_{it}$$

where Ins_j is the institutional variable for country j . Note that institutional variables here are time-invariant. Since the surveys are typically very close together, the institutional quality rarely changes.

⁶ <http://www.heritage.org/index/property-rights>

$D_{ijt}^{innov} \cdot Ins_j$ is the interaction between a country's institutional variables and a firm's innovation.

We ultimately are interested in μ .

Note that since the data are collected by the stratified random sampling method, all the regressions are weighted accordingly to restore representativeness. In addition, we cluster the standard errors at the country level to capture potential correlations between the error terms, and allow for heteroscedasticity (i.e. having robust standard errors).

Dependent variables:

- *Log of real sales* (i.e. sales divided by country's price level)
- *Log of real sales per full-time employee*

Explanatory variables:

- *Innovation*: whether a firm introduced products or services or upgraded its product or services in the last 3 years. This is problematic for our regressions if the two rounds of survey are less than 3 years apart. For this reason, we only keep countries that have surveys more than 3 years apart.
- *Changing manager*: if a firm changed its manager between the two waves of the survey. This is to capture potential other restructuring activities besides innovation. There is no direct way to know if a firm changes its manager. We indirectly guess by using the manager's years of experience (as the firms are asked about the manager's experience). We identify if a firm changed its managers by comparing the change in the experience years of the managers and the years between the two surveys. If the change in the experience years is different to the change in years, we conclude that the firm changes its manager. For example, at the first round of the survey in 2005, a firm's manager has 10 years of experience; at the second round of survey in 2009, the firm's manager has 20 years of experience. Since $\Delta \text{year}_{\text{EXPERIENCE}}$ is greater than $\Delta \text{year}_{\text{SURVEY}}$, we conclude that the firm must have changed its manager between the two rounds of the survey. We acknowledge that there is a possibility that the manager might not remember exactly his or her years of experience. As a robustness check we allow for that possibility by loosening the restriction: only when $\text{year}_{\text{EXPERIENCE}}$ is greater than $\text{year}_{\text{SURVEY}}+1$ or smaller than $\text{year}_{\text{SURVEY}}-1$ we can conclude the firm changes its manager. The variable is quite robust: if we follow the original criteria, we find that 3,495 out of 6,447 (54.2%) firms change their managers; if we follow the less restrictive criteria, we

find that 2,616 (40.5%) firms change their managers. In the regression we use the original criteria.

- *Becoming an exporter*: this dummy variable equals 1 if a firm becomes an exporter between the two waves of the survey, it equals 0 otherwise.
- *Change in the number of competitors*: this dummy variable equals 1 if the number of a firm's competitors increases between the two waves of the survey, it equals 0 otherwise.
- *Firm size*: small (0-20 full-time employees), medium (21-100 employees) and large (more than 100 employees).
- *Rule of law*: percentile rank of the country. We calculate the ranking from the entire population of countries provided by the Governance Indicators. The rank is 100 for the highest ranked countries, and 1 for the lowest ranked. The detailed ranking of countries for Rule of Law and other institutional variables are shown at Table A2 in the Appendix.
- *Regulatory quality*: percentile rank of the country. We calculate the ranking from the entire population of countries provided by the Governance Indicators. The rank is 100 for the highest ranked countries, and 1 for the lowest ranked.
- *Property right*: percentile rank of the country. We calculate the ranking from the entire population of countries provided by the Heritage Foundation. The rank is 100 for the highest ranked countries, and 1 for the lowest ranked.
- *Patent protection*: percentile rank of the country (by our own calculation from the entire population of countries). The rank is 100 for the highest ranked countries, and 1 for the lowest ranked. The data is a proxy for how well a patent is protected in a country. The data are from Park (2008). It is the sum of five separate scores for: coverage (inventions that are patentable); membership in international treaties; duration of protection; enforcement mechanisms; and restrictions (Park, 2008).
- *Sector fixed effects*: 2-digit ISIC revision 3. This is to capture industry specific characteristics that may affect the return to innovation. For example, one might argue that a new product in electronics is likely to have better sales than a new line of shoes.
- *Country*time fixed effect*: to capture a country's macroeconomic effect.

3.2 Discussion about potential estimation biases

It is difficult to isolate and capture exogenous sources of innovation. There are several issues when it comes to measuring the impact of innovation. First is a concern that inherently good firms in general

will do better than bad firms in sales, and at the same time more likely to innovate. In other words, the correlation between innovation and firms' performance might be driven by unobserved characteristics of the firms. We address that issue by using panel data: we only consider the change of sales within the same firm, not across firms. By looking for the change within a firm, we effectively control for firms' time-invariant characteristics.

The second issue is the omitted variable problem. We will not be able to capture any unobserved change in firms' characteristics between the two waves of the survey. For example, a firm might go through a restructuring and at the same time introduce a new product. The observed change in sales could then be the results of both innovation and the restructuring. In our regression, we try our best to capture unobserved changes by controlling for the change of the top manager. Specifically, we include a dummy which equals 1 if the firm changes the manager between the two waves of the survey. Many changes in a firm's structure, management style or marketing strategies come from a new manager (see [Bloom and Van Reenen, 2010](#)).

Another concern is the issue of reverse causality between the change in sales and innovation. Specifically, one could argue that perhaps changes in sales also affect innovation. For example, when a firm witnesses a decline in sales and market share, it might want to introduce a new product or service to halt the declines. In this case, the correlation between innovation and the change in sales would tend to be negative (i.e. a negative change in sales leads to a positive change in innovation). The OLS results would then underestimate the true impacts of innovation on sale and employment. The reverse causality is more severe if the innovation process is quick, for example, when the sales decline, the decision to innovate and the introduction of a new product all take place in the same period. The reverse causality is less severe if the innovation process takes time. If there is a "time-to-build" period between when the innovation decision is made and a new product is introduced, the introduction of a new or improved product is likely too late for, and hence uncorrelated with the sale declines.

None of the variables available in the survey can serve as a good instrument variable for innovation.

An ideal instrument should capture firms' perception about *intellectual* right protection.

Unfortunately the variable is not available. The best two candidates for the instrument that we can find are (1) firms' concern about competition practice of the informal sector and (2) the amount of R&D a firm invested in the previous wave of survey. They are still flawed because they still violate the exclusion restriction. Regarding (1), although a large part of the concern about informal sector has to do with intellectual property right infringement, the concern can also be about the labor or tax

practices, which can affect the firm's non-innovation investment activities. Regarding (2), it is not a good instrument if the decision to do R&D is also connected to other non-innovation activities of the firm.

Having discussed all the drawbacks of the estimation, it is important to note that we are not interested in the precision of the return per se. We are instead interested in the comparison of the return across countries. To the extent that the biases are not systematically correlated with countries' institutional characteristics, the comparison across countries is valid.

4. Regression Results

4.1 Return to innovation

Table 1. Return to Innovation

Variables	$\Delta \ln(\text{sales})$		$\Delta \ln(\text{sales/labor})$	
Innovation	0.242 (0.146)	0.147 (0.149)	0.198* (0.109)	0.183* (0.0967)
New Top Manager		-1.308*** (0.328)		-1.475*** (0.366)
Exporter		0.0550 (0.101)		0.0274 (0.166)
More Competitors		-0.902*** (0.169)		-0.697*** (0.0990)
Small Size		-1.483*** (0.324)		-0.541** (0.215)
Medium Size		-1.136*** (0.170)		-0.555*** (0.160)
Constant	1.355 (1.202)	4.142*** (1.365)	-0.0582 (0.109)	1.959*** (0.568)
Year*Country FE	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes
No of Obs	1,879	1,874	1,870	1,870
R-Squared	0.456	0.493	0.450	0.462

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

Clustered robust standard errors by country in parentheses

Table 1 presents the overall results when we pool all countries in ECA and LAC together, for a total of 1,879 unique firms. Overall, only sales per worker are marginally significant at 10% level: an innovating firm sees its sales per worker increase by 18.3%. Since there are biases, it is safer to

consider this as an association, not causation. The dummy variables “More Competitors” and “Firm Size” are significant and have expected signs. Firms that have more competitors between the two surveys see weaker growth in sales than those that have fewer competitors. In addition, small and medium firms see significantly weaker growth in sales than large firms do. This is counter-intuitive if one would think firms should converge to an optimal size. Our conjecture is that in developing countries, many obstacles (such as connection to politicians) prevent small firms to growth as fast as larger ones. The dummy “New Top Manager” is significant and negative. This could reflect adjustment costs to the restructuring associated with the new managers.⁷

Table 2. Returns to Innovation for Monopolists

Variables	$\Delta \ln(\text{sales})$		$\Delta \ln(\text{sales/labor})$	
Innovation	0.111 (0.288)	-0.00814 (0.323)	-0.0483 (0.252)	-0.0451 (0.283)
Monopolist*Innovation	-2.819* (1.434)	-2.463 (1.561)	-2.472** (1.043)	-2.376** (1.076)
Monopolist	1.614 (1.357)	1.258 (1.526)	1.005 (0.892)	0.848 (0.969)
New Top Manager		-1.497*** (0.337)		-1.710*** (0.383)
Exporter		0.0163 (0.129)		-0.125 (0.112)
More Competitors		-1.029*** (0.0971)		-0.826*** (0.0555)
Small Size		-1.569*** (0.445)		-0.656** (0.250)
Medium Size		-1.151*** (0.0891)		-0.584*** (0.0707)
Constant	-0.0967 (0.288)	-1.497 (1.255)	0.188 (0.252)	2.604*** (0.432)
Year*Country FE	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes
No of Obs	970	969	965	965
R-Squared	0.261	0.317	0.248	0.270

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

Clustered robust standard errors by country in parentheses

⁷ Alternatively, reverse causality might be at play: firms with declining performance hire new managers.

An important exercise is to examine the return to innovation for monopolist. It is usually argued that monopolist have little incentives to innovate: their product, good or bad, is the only one available in the market and they have already captured the market anyway. For example, if a bad flight service is the only option available for travelers, an improved flight service will not generate much return to an airline monopolist because they will not bring in many new passengers. Table 2 shows the return to innovation to Monopolists compared to non-monopolists. We define monopolist as those that have zero competitor. We show that the conventional wisdom is correct: after a monopolist innovates, its sales per worker percentage increase is 90% (i.e. $\exp(-2.37)$) lower than the percentage increase of non-monopolist. We expect the result to be stronger if we consider “upgraded products” alone, as we think that an improved product does not likely improve monopolist’s profit, whereas a completely new product might.

4.2 Return to Innovation with Institution Quality

In this section we focus on the question if the return to innovation is higher in countries with better institution quality. The argument is that in a better institutional environment, where property rights are protected, the courts are reliable, and regulatory uncertainty is small, etc., firms’ investment in bringing new products and services to the market will yield a good return. On the contrary, in an environment where a new product can be easily copied with little enforceable punishment or the government policy is highly volatile, the return to innovation will likely be small. We proxy for institutional quality by Rule of Law and Regulatory Quality. Rule of law reflects “*perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence*”. Regulatory quality reflects “*perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development*”. These two variables are highly correlated, and are commonly used to capture institutional quality.

We show that in general, in a country with better rule of law, the return to innovation is higher. Table 3 shows that if a country is placed 1 percentile higher in the world’s rule of law ranking (i.e. better rule of law), the sale return to an a new or improved product is 1.91% higher, and the sale per worker return -our focus- is 0.97% higher. Similarly, if a country is placed 1 percentile higher in the world’s regulatory quality ranking, the employment return to innovation is 1.7% higher, and the sale per worker return is 0.86% higher (Table 4).

The coefficients for “Innovation” become either negative or insignificant. Note that the summation of the coefficient for “Innovation” and the one for the interacted variable captures the return to innovation for the lowest ranked country (the one that ranks 1). Similar considerations apply to other tables. The summations for Tables 3 and 4 show that the sale per worker return to innovation for the lowest ranked country in rule of law and regulatory quality is essentially zero.

Table 3: Returns to Innovation with Rule of Law

Variables	$\Delta \ln(\text{sales})$		$\Delta \ln(\text{sales/labor})$	
Innovation	-0.778*	-0.865**	-0.315	-0.330
	(0.443)	(0.407)	(0.256)	(0.234)
RuleofLaw*Innovation	0.0192**	0.0191***	0.00965**	0.00967**
	(0.00723)	(0.00682)	(0.00421)	(0.00388)
New Top Manager		-1.274***		-1.457***
		(0.371)		(0.389)
Exporter		0.0381		0.0187
		(0.0989)		(0.161)
More Competitors		-0.902***		-0.697***
		(0.170)		(0.0991)
Small Size		-1.480***		-0.540**
		(0.322)		(0.214)
Medium Size		-1.139***		-0.557***
		(0.167)		(0.158)
Constant	1.716*	4.463***	1.714	3.720***
	(0.946)	(1.180)	(1.033)	(1.283)
Year*Country FE	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes
No of Obs	1,879	1,874	1,870	1,870
R-Squared	0.458	0.495	0.450	0.462

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

Clustered robust standard errors by country in parentheses

Table 4: Returns to Innovation with Regulatory Quality

Variables	$\Delta \ln(\text{sales})$		$\Delta \ln(\text{sales}/\text{labor})$	
Innovation	-0.848 (0.621)	-0.975* (0.572)	-0.339 (0.348)	-0.360 (0.312)
RegQual*Innovation	0.0172* (0.00865)	0.0177** (0.00802)	0.00846 (0.00521)	0.00857* (0.00472)
New Top Manager		-1.222*** (0.424)		-1.432*** (0.414)
Exporter		0.0445 (0.0975)		0.0222 (0.162)
More Competitors		-0.903*** (0.170)		-0.697*** (0.0991)
Small Size		-1.485*** (0.320)		-0.542** (0.214)
Medium Size		-1.141*** (0.166)		-0.558*** (0.158)
Constant	1.746* (0.941)	4.461*** (1.203)	1.725 (1.027)	3.711*** (1.295)
Year*Country FE	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes
No of Obs	1,879	1,874	1,870	1,870
R-Squared	0.458	0.495	0.450	0.462

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

Clustered robust standard errors by country in parentheses

4.3 Return to Innovation with property right protection

Since rule of law and regulatory quality are still too general to have specific policy recommendations, this section zooms in one particular component of institutions that we think are more obvious in affecting the return to innovation. It is property right protection. For our analysis, we use the property right index by the Heritage Foundation to proxy for property right protection. Property right protection assesses the extent to which private economic activity is facilitated by an effective legal system and rule-based governance structure in which property and contract rights are reliably respected and enforced.

The property rights here include both intellectual property rights (IPR) and more general property rights. While IPR laws and enforcements provide necessary protection to the fruits of R&D (patent, copyrights, trademarks, etc.), broader property rights protection and contract enforcements protect

investments that are complementary to R&D expenditures, especially during the post-R&D stage, and hence help realize the commercial values of R&D. In a country where property right is not well protected, a new product or service when deemed profitable will be easily copied, thus the return to the innovating firm is reduced. On the other hand, if property right is well protected, the firm can extract good return from its new products or services.

Table 5 presents the overall results across countries. Overall, if a country is placed 1 percentile higher in the ranking, the sale per worker return to innovation for an innovating firm will be 0.91% higher, and the sale return is 1.5% higher. Overall, the magnitude of the impact here is similar to that from the regulatory quality and rule of law regressions.

Table 5: Return to Innovation with property right protection

Variables	$\Delta \ln(\text{sales})$		$\Delta \ln(\text{sales/labor})$	
Innovation	-0.635 (0.466)	-0.676 (0.445)	-0.307 (0.274)	-0.305 (0.249)
PRP*Innovation	0.0163** (0.00748)	0.0153** (0.00728)	0.00937** (0.00428)	0.00909** (0.00396)
New Top Manager		-1.274*** (0.368)		-1.454*** (0.391)
Exporter		0.0406 (0.101)		0.0188 (0.163)
More Competitors		-0.901*** (0.170)		-0.696*** (0.0990)
Small Size		-1.477*** (0.325)		-0.538** (0.215)
Medium Size		-1.137*** (0.169)		-0.556*** (0.159)
Constant	1.643 (0.996)	4.372*** (1.226)	1.698 (1.042)	3.694*** (1.294)
Year*Country FE	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes
No of Obs	1,879	1,874	1,870	1,870
R-Squared	0.458	0.495	0.450	0.462

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

Clustered robust standard errors by country in parentheses

4.4 Return to Innovation with patent right protection

In this section we squarely focus on the most arguably relevant factor that affects innovation: patent protection. The index is provided in Park (2008). It is “*the unweighted sum of five separate scores for: coverage (inventions that are patentable); membership in international treaties; duration of protection; enforcement mechanisms; and restrictions (for example, compulsory licensing in the event that a patented invention is not sufficiently exploited)*” (Park, 2008).

Table 6. Returns to Innovation with Patent right protection

Variables	$\Delta \ln(\text{sales})$		$\Delta \ln(\text{sales/labor})$	
Innovation	-2.266 (1.389)	-2.584* (1.329)	0.0674 (1.071)	0.0140 (1.027)
PatentsRights*Innovation	0.0320 (0.0183)	0.0349* (0.0172)	0.00197 (0.0148)	0.00253 (0.0141)
New Top Manager		-1.484*** (0.194)		-1.700*** (0.184)
Exporter		0.0407 (0.112)		-0.0374 (0.169)
More Competitors		-0.918*** (0.167)		-0.709*** (0.0961)
Small Size		-1.597*** (0.355)		-0.598** (0.222)
Medium Size		-1.209*** (0.123)		-0.598*** (0.127)
Constant	1.575 (1.057)	3.014*** (0.377)	1.535 (1.186)	3.841** (1.294)
Year*Country FE	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes
No of Obs	1,198	1,193	1,189	1,189
R-Squared	0.306	0.359	0.262	0.280

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

Clustered robust standard errors by country in parentheses

Table 6 shows the relationship between the return to innovation and patent right ranking (where 1 is for the lowest ranked country, and 100 is for the highest ranked). We can see that the sale return for innovating firms is significantly smaller for countries with lower patent right protection: if a country is 1 rank lower, the sale return is 3.4% lower. The magnitude is relatively large, compared to findings for other institutional variables. However, the return in terms of sale per worker is not significantly correlated with the patent right ranking, although the sign is correct. It is possible that measurement errors inflate the standard errors, making the coefficient insignificant. It is also possible that patent right protection indeed has a smaller impact on the return than other components of property right protection. For example, if firms in developing countries do not habitually file for patent protection, the index would be irrelevant.

5. Conclusion

Why firms do not innovate or adopt new technologies remains an important and interesting question. In this paper we do not go to the usual routes of examining the obstacles to firms' innovation, but focus on firms' incentives to innovate. We do that by estimating the return to innovation across countries, and comparing the return in countries with different levels of institutional quality. We found that in general, in countries with lower level of institution quality, the return of innovation (in terms of sales per worker) for firms is lower. This means that in developing countries, a large part of the lack of innovation is due to firms' unwillingness to innovate: bad institutional environments discourage firms from investing researching new products.

The magnitude of the estimated gain is large. If a country were placed 10 ranks higher in the world percentile ranking, the return to innovation in terms of sales per worker for firms in that country could be 8 to 10% higher. This finding calls for policies that go beyond addressing obstacles to firms' ability to innovate. They have to also place a strong focus on institutional factors (such as property right protection) in order to address firms' incentive problem.

Appendix

Table A1: List of countries

Country Name	Number of Unique Firms	Percent (%)
Latin American Countries	1,229	32.73
Brazil	426	11.34
Ecuador	142	3.78
Guatemala	210	5.59
Honduras	194	5.17
Nicaragua	213	5.67
Venezuela	44	1.17
Europe & Central Asia Countries	2,526	67.27
Albania	48	1.28
Belarus	77	2.05
Georgia	68	1.81
Tajikistan	55	1.46
Turkey	391	10.41
Ukraine	173	4.61
Uzbekistan	93	2.48
Russian Federation	61	1.62
Poland	114	3.04
Romania	95	2.53
Serbia	90	2.40
Kazakhstan	86	2.29
Moldova	114	3.04
Bosnia and Herzegovina	51	1.36
Azerbaijan	107	2.85
Macedonia, FYR	88	2.34
Armenia	107	2.85
Estonia	87	2.32
Czech Republic	40	1.07
Hungary	75	2.00
Latvia	53	1.41
Lithuania	58	1.54
Slovak Republic	35	0.93
Slovenia	80	2.13
Bulgaria	131	3.49
Croatia	72	1.92
Montenegro	4	0.11
Kyrgyz Republic	73	1.94
Total	3,755	100.00

Table A2: Percentile Ranking by Country for Different Variables

Country	Rule of Law	Regulatory Quality	Property Right Protection	Patent Right Protection
Brazil	56	56	67	60
Ecuador	14	16	17	64
Guatemala	15	48	37	44
Honduras	20	50	37	34
Nicaragua	30	40	10	34
Venezuela	2	7	1	48
Albania	38	59	37	-
Belarus	15	10	88	-
Georgia	51	74	62	-
Tajikistan	11	19	17	-
Turkey	58	66	67	71
Ukraine	23	32	37	62
Uzbekistan	6	4	10	-
Russian Federation	26	39	23	62
Poland	72	80	75	78
Romania	57	75	56	75
Serbia	47	53	56	-
Kazakhstan	32	43	49	-
Moldova	45	51	56	-
Bosnia and Herzegovina	46	52	17	-
Azerbaijan	22	38	23	-
Macedonia, FYR	49	60	49	-
Armenia	43	59	37	-
Estonia	86	91	89	-
Czech Republic	81	86	82	83
Hungary	73	82	78	88
Latvia	74	80	67	-
Lithuania	73	79	75	70
Slovak Republic	69	81	67	78
Slovenia	84	73	75	-
Bulgaria	52	71	37	90
Croatia	61	70	56	-
Montenegro	56	52	56	-
Kyrgyz Republic	10	45	17	-

Sources: The World Governance Indicators (for Rule of Law and Regulatory Quality), our own calculation based on the Heritage Foundation (for Property Right Protection), and is Park (2008) (for Patent right protection).

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