Navarra Center for International Development

Working Paper nº 10/2015

Managing Innovation under Competitive Pressure from Informal Producers

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Navarra Center for International Development WP-10/2015

Managing Innovation under Competitive Pressure from Informal Producers [*]

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November 20, 2015

Abstract

   This paper studies the impact on innovation of competition against firms in the informal sector. Using the World Bank's Enterprise Survey data from a sample of African and Latin American countries, we find that the marginal impact of informality on innovation by formal firms decreases with the intensity of competitive pressure from informal firms, consistent with an inverted-U relationship between propensity to innovate and competitive pressure from firms in the informal sector.

1   Introduction

Although so far relatively unexplored, the study of the consequences of informal economic activity arises as a new frontier in the field of Management. Indeed, most developing countries are characterized by a large informal sector, which is in some cases larger in terms of employment than the formal

sector of the economy[1]. Not being confined to developing countries, informal firms also exist in developed economies. For instance, Webb et al. (2009) shows that informal economy in developing economies account for almost 40% of the GDP and, 17% in developed economies respectively. Therefore, current management frameworks as well as firms performance analysis appear to be necessarily expanded. The inclusion of informality challenges established theoretical frameworks with empirical implications that are yet to be discussed, due precisely to the relatively recent development of the area. For instance, the presence of informal firms conditions the traditional view in business strategy regarding the building of barriers to competition, with implications toward the building of sustained competitive advantages. We contribute to the discussion by empirically searching for evidence of an impact of informal firms operations on formal firms' propensity to innovate. Our results suggest that there is an effect of informality on the likelihood of formal firms' introducing new products and processes.

While recent contributions focus on how informality affects organizational forms (firm's governance) and external compliance (legal status) (see, for instance, Godfrey (2011)), the effects on resource allocation strategies has still received little attention. Indeed, the research agenda on the implications of the existence of informality for the field of Management is still in its infancy, see McGahan (2012), Webb et al. (2013), Bruton et al. (2012), or Birkinshaw et al. (2014) for recent contributions to the discussion of this

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[1]Williams and Lansky (2013) presents the International Labour Organization's definition for the "informal economy" as "all economic activities by workers and economic units that are –in law or in practice– not covered or insufficiently covered by formal arrangements."

topic. Indeed, informal firms provide consumers in developing countries, especially those at the bottom of the pyramid –see Prahalad (2005)– with goods that might not be provided by formal firms. At the same time, informal firms put competitive pressure on firms in the formal sector, often supplying lower-quality versions of the products sold by formal firms.

Our paper contributes on the discussion of the implications of informality on formal firms' resource allocation decisions, thus focusing on the interaction between formal and informal firms. Specifically, it analyzes how competition against firms in the informal sector may affect formal firms' incentives to innovate, a factor entailed in the resource-based view as a mechanism to achieve a sustained competitive advantage. We analyze the World Bank's Enterprise Survey data to find evidence of a decreasing marginal effect on innovation of the intensity of competitive pressure from informal firms. This is in line with the influential result in Aghion et al. (2005), who find an inverted-U relationship between competitive pressure and innovation. Our empirical findings suggest that formal firms' decisions to engage in innovation activities are indeed affected by competitive pressure received from informal firms, controlling for the effect of internal determinants of innovativeness. Thus, we find that the presence of an informal sector constitutes a relevant contextual factor shaping innovation strategy, effectively altering the potential payoff from innovation and thus, formal firms' incentives to introduce new products and processes.

We view our contribution as one straddling the Management and Economics literatures. Regarding the former, we find that competitive pressure affects the choice of R&D strategy and hence the decision making process

for technological investments under this specific contextual variable. Our findings provide empirical evidence to support that the competitive pressure imposed by informal firms represents an important obstacle to the implementation of innovation strategies. Thus, a wide range of theoretical and managerial implications must be taken into account facing high competitive pressures in this setting.

In particular, the estimations reveal that at higher level of competitive pressure from the informal sector, formal firms are threatened to sustain an initial competitive position; hence, providing strong implications with the achievement of sustained competitive advantages. Indeed, the resource-based view of the firm –see for instance Penrose (1995), Wernerfelt (1984); Barney (1991)) posits that a firm's resources are the determinants of firm performance (Barney (1991)). Resources must be rare, valuable, difficult to imitate and non substitutable by other resources and, thus a competitive advantage has been created (Barney (1991)). In practice, such advantages are obtained when competitors cease efforts to duplicate a firm's configuration of resources (Barney (1991)). In our sample, informal firms activities are a strong obstacle to formal firms innovations and current innovations fail to shield formal firms' competitive strategy/position from informal firms competitive pressures. If we consider a scenario in which formal firms must continuously innovate to avoid imitation by informal firms, we find that if the initial level of differentiation is low enough, implying a strong competitive pressure from informal producers, formal firms are less likely to choose differentiation strategies to escape competition from informal firms, thus ending up in a low-differentiation equilibrium. Under these circumstances, formal

firms innovations do not seem to be a viable source of competitive advantage.

Our results also suggest a set of hypothetical considerations that potentially affect the management of innovations. Contemplating the impact of competitive pressures from informal firms in this study, first, it is important to highlight that many of the innovations in emerging markets arise from firms informally organized, see Bhattacharyya et al. (2010) or Radjou et al. (2012). Second, the study of innovation behavior and resources allocation strategies is fragmented and has been conducted within different disciplines with relatively little interaction. Therefore, this study contributes by establishing the connection with the field of Industrial Organization. Third, business strategy has typically induced firms to develop defensible positions against the forces of competition initiatives such as the case of open innovation. Hence, informal sectors push firms to face the challenges to retain their ability to sustain themselves over time, see Chesbrough (2003) or Chesbrough and Appleyard (2007). Forth, the fact that the informal firms constitute a threat to formal firms means that their products have market acceptance, especially in developing countries. Therefore, formal firms must confront strategic challenges related to the role of customers and technological change at least. In this regard, early contribution in Christensen (1997) face the following management choice dilemma: i) to take risky and disruptive innovative perspective, or ii) taking the less risky innovative path. Then, while the results in this paper do not allow us to determine the how the dynamic of competition between formal and informal firms affect the degree of innovation, parallel innovations as strategic responses and/or more sophisticated innovations should be taken into account regarding competitive pressure.

Lately, intellectual property issue requires to be analyzed in depth because of informality characterize most developing economies. Certainly, the database used in this study does not allow us to cross patent rights with the degree of competition.

Regarding the Economics literature, we contribute to the discussion of the effect of competitive pressure on innovation, as well as to the broader study of informality and its impact on productivity. Mendi (2015) proposes a recent theoretical analysis of the interplay between competitive pressure and incentives to innovate that gives rise to empirical implications consistent with our results. The model, which features a single formal firm and a competitive fringe that could be assimilated to the informal sector, assumes vertical product differentiation, as in Shaked and Sutton (1982). This vertical differentiation component is justified by the fact that firms in the informal sector typically produce product with a lower quality level than firms in the formal sector, see Banerji and Jain (2007). In the model, competitive pressure is measured by the degree of product differentiation. Competitive pressure on the one hand induces the firm to further differentiate, what we can refer to as escape competition effect. However, on the other hand, it reduces the return from innovation, or rent-dissipation effect. The theoretical analysis in Mendi (2015) finds that for low levels of competitive pressure, the former effect dominates the latter, and the opposite occurs for high-enough levels of competitive pressure.

In fact, the question of the effect of competitive pressure from rivals –not necessarily in the informal sector- on firms' incentives to innovate has received attention in the Economics literature, both from a theoretical as well

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as from an empirical perspective. A number of studies suggest that competition among producers decreases incentives to innovate, see for instance, Aghion and Howitt (2003), Grossman and Helpman (1993), Spulber (2013). At the same time, other contributions find a positive effect of competition on innovation and productivity, for instance Blundell et al. (1999), Symeonidis (2002), or Galdón-Sánchez and Schmitz (2002). Meanwhile, the comparison between the formal and informal sectors has been the object of study in a number of recent contributions to the economic literature, but less attention in the management literature , see Bruton et al. (2012). For instance, La Porta and Shleifer (2008) find that firms in the informal sector are much less productive than small formal firms, in terms of sales per worker. La Porta and Shleifer (2011) presents a similar study focusing on African countries. Also, most formal firms, approximately 90% began as formal. In another recent contribution, de Paula and Scheinkman (2011) discuss the relevance of the informal sector in Brazil.

The study of the interaction between the formal and informal sectors is also related with the literature on the determinants of firm productivity, see Acemoglu et al. (2007), as well as with the literature on misallocation and productivity, see for instance Hsieh and Klenow (2009), Bartelsman et al. (2013), or Restuccia and Rogerson (2013). Since differences in total factor productivity explain a large proportion of differences in output per capita, this strand of the literature studies how the way factors are allocated across heterogeneous firms explain differences in total factor productivity. In this line, D'Erasmo et al. (2013) analyze the role of institutions on the size of the informal sector, the stock of human capital and measured productivity.

They argue that the informal sector firms are small, relatively unproductive and young. This gives rise to a bimodal distribution of firm in terms of size, with a missing middle. It is argued that this missing middle is responsible for the positive correlation between total factor productivity and income per capita. Funkhouser (1996) finds that the mean education level in the formal sector is substantially higher than in the informal sector. Amaral and Quintin (2006) propose a model with managers that differ in their skill levels, thus generating a formal sector that is skill intensive.

The rest of the paper is organized as follows: Section 3 describes the data used in this paper; section 4 presents the econometric analysis of the data, and finally section 5 presents some concluding comments.

2   Hypotheses

We discussed in the introduction how the Management and Economics literatures view the interaction between the formal and informal sectors of the economy, in particular regarding formal firms' choice of innovation strategies. We now proceed to present the hypotheses that will be tested empirically using the Enterprise Survey data. As discussed in the introduction, Aghion et al. (2005) find empirical evidence consistent with the existence of an inverted-U relationship between competitive pressure and innovation activities. This implies that the marginal effect of competitive pressure on the probability of innovativeness is decreasing with competitive pressure, being positive for low values of this contextual variable, and eventually becoming negative. Mendi (2015) recently develops a theoretical model that is consis-

tent with this finding. We hypothesize that both competitive pressure from both formal and informal firms, and also from informal firms only, affects the introduction of new products and processes in a non-constant way. In particular, the sign and magnitude of the effect depends on the level of competitive pressure, controlling for other internal and external determinants of innovativeness. Therefore, we formulate two sets of hypotheses. On the one hand, we expect competitive pressure coming from both formal and informal firms to have a non-linear influence on innovativeness. On the other hand, we expect a more restrictive measure of competitive pressure, namely that coming from informal producers, to have a non-linear effect on innovativeness. We will make use of three measures of innovativeness: indicator variables of the firm having introduced a new product and a new process, respectively, as well as an indicator variable of the firm having introduced either a new product or a new process. The hypotheses are formulated as follows:

Hypothesis 1 *The effect of competitive pressure on the probability of a firm being innovative decreases with the level of competitive pressure.*

In our data, we will distinguish between product and process innovations. Additionally, we observe whether the firm licenses technology from other firms. We hypothesize that all these activities will be affected in the same way by the competitive pressure from rivals. Thus, we formulate the following sub-hypotheses:

Hypothesis 1a *The effect of competitive pressure on the probability of a firm introducing a new product decreases with the level of competitive pressure.*

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Hypothesis 1b *The effect of competitive pressure on the probability of a firm introducing a new process decreases with the level of competitive pressure.*

As pointed out in the introduction, this paper goes beyond establishing the existence of an inverted-U relationship between competitive pressure and innovation activities. In fact, we consider a particular source of competitive pressure, namely that from informal producers. According to Banerji and Jain (2007), informal firms typically produce lower-quality versions of the products produced by informal firms. Therefore, we may think of the competition between formal and informal firms as one in which there is vertical differentiation, with formal firms producing higher-quality goods. The theoretical model in Mendi (2015) precisely analyzes the implications of this degree of vertical differentiation on the formal firm's incentives to innovate. On the one hand, competitive pressure reduces the incentives to innovate, since it erodes post-innovation rents. However, at the same time, it provides the formal firm with an extra incentive to further differentiate from informal producers, thus escaping competition. Mendi (2015) finds that that there are parameter values that give rise to the inverted-U pattern. This is expressed in the following hypotheses, which are analogous to those previously formulated:

Hypothesis 2 *The effect of the relevance of informal firms as an obstacle to formal firms' operations on the probability of a firm being innovative is decreasing.*

Hypothesis 2a *The effect of the relevance of informal firms as an obstacle to formal firms' operations on the probability of a firm introducing a product*

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innovation is decreasing.

Hypothesis 2b *The effect of the relevance of informal firms as an obstacle to formal firms' operations on the probability of a firm introducing a process innovation is decreasing.*

All these hypotheses will be tested using the data from the World Bank's Enterprise Survey, described in the following section. In particular, we will study the intensity of the marginal effect of different measures of competitive pressure, and how this effect depends on the realization of this variable.

3   The data

This paper makes use of the World Bank's Enterprise Survey data, accessed in October 2015. The Enterprise Survey makes use of an extensive questionnaire that is administered in a number of different countries, mostly developing countries. While the core questionnaire does not include questions on innovation activities, for a number of African and Latin American countries, the manufacturing module of the Enterprise Survey included in 2006 two questions directly related with innovation outcomes, as well as questions providing information on up to what degree practices of firms in the informal sector represented an important obstacle to firm activities.

In particular, regarding innovation outcomes, the questionnaire includes a question on whether the firm introduced any new or significantly improved products or services within the three years prior to the survey. Similarly, there is a question on whether the firm introduced, within the three years

prior to the survey, any new or significantly improved production processes. The latter two are similar to those included in the Community Innovation Survey questionnaires. This way, in addition to observing whether firms introduced any product and/or process innovations, we can classify firms as innovative and non-innovative, with the former category being those firms that introduced either a new product and/or a new process in the three years prior to the implementation of the survey.

Regarding competitive pressure from other firms, formal or informal, the firm is asked to report how many competitors it faces in the market for its product or service. Measuring more specifically competitive pressure from informal producers, the firm is requested to rank in a 0 to 4 scale how much of an obstacle are the informal sector competitors to the firm's operations. Additionally, the questionnaire requests the firm to indicate what is the first, second, and third most important obstacles to firm operations, with one of the options being competition from informal producers.

The list of countries that include data on both innovation and informal sector practices are: Angola, Argentina, Bolivia, Botswana, Burundi, Chile, Colombia, Democratic Republic of Congo, Ecuador, El Salvador, Gambia, Guatemala, Guinea, Guinea Bissau, Honduras, Mauritania, Mexico, Namibia, Nicaragua, Panama, Paraguay, Peru, Rwanda, Swaziland, Tanzania, Uganda, and Uruguay. In all cases, the survey year was 2006, and the total number of firms surveyed is 8163. However, due to the existence of missing values in some of the variables, the final sample size is smaller in some of the specifications whose estimated coefficients are reported below.

Table 1 presents the definitions of the variables used in the empirical anal-

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Table 1: Variable definitions

Dependent variables	
innovative	Dummy that takes value 1 if the firm introduced either a new product or a new process, 0 otherwise
innprod	Dummy that takes value 1 if the firm introduced a new product, 0 otherwise
innproc	Dummy that takes value 1 if the firm introduced a new process, 0 otherwise
Independent variables	
competpres	Number of competitors that the firm faces
obstacle	Relevance of informal firms as obstacle to firm's operations
obst_region	Regional average of informal firms as obstacle to firm's operations
top3_region	Percentage of firms in the region that declare operations of informal firms to be among the top-3 obstacles to firm's operations
Controls	
group	Dummy that takes value 1 if the firm belongs to a group of firms, 0 otherwise
lnemp	Logarithm of the number of employees
age	Firm age, in years
exportint	Percentage of the firm's sales that are exported
manager_exp	Manager's experience, in years
mainbuyer	Dummy that takes value 1 if the main buyers for the firm's product are final consumers, 0 otherwise

ysis, distinguishing between dependent, independent, and control variables. As controls, we have made use of variables that account for observable firm characteristics, such as size, belonging to a group of firms, firm age, or the proportion of the firm's revenues coming from foreign markets. Additionally, in all specification we have included a full set of country dummies, as well as sector dummies. In fact, firms are classified into the following manufacturing sectors: Textiles, Garments, Food, Metals and Machinery, Electronics, Chemicals and Pharmaceuticals, Non-metallic and Plastic Materials, and Other Manufacturing. We introduce a dummy for each of these industries.

The dependent variables are in all cases binary variables, indicating the introduction of new products, and/or new processes. A firm is considered to be innovative if it introduces either a new product or a new process. Regarding the set of independent variables, *competpres* is based on the number of competitors that the firm faces in its market. In particular, firms are requested to indicate how many competitors did the establishment's main product line face. Rather than reporting the exact number of competitors, firms are to choose among none, one, 2 to 5, or more than 5. We normalize these categories to make them be between zero and one, with the measure being increasing in the number of competitors. The main feature of this variable is that it constitutes an objective measure of competitive pressure, not being based on subjective perceptions about the intensity of competition. Moreover, *competpres* includes competitive pressure from other formal and informal firms.

In contrast, the *obstacle* variable is a subjective measure of the importance of the presence of informal firms as an obstacle for the firm's normal activities,

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in a 4-point Likert scale. We have normalized *obstacle* to be between zero and one. This is intended to measure the proximity of the formal firm to informal firms in terms of physical location and product characteristics. For instance, in the theoretical framework developed in Mendi (2015), it would be correlated with the degree of vertical product differentiation between the products of formal and informal producers.

The main disadvantage of using this measure is its subjective nature. In particular, it may be endogenous if unobserved firm-specific characteristics are simultaneously determining the firm's perceptions of the intensity of competition and the innovation outcome. One of these is managerial ability. While we try to managerial ability by including a variable that measures the manager's years of experience, we acknowledge that other unobserved factors may be present that introduce correlation between the measure of competitive pressure and innovation.

For this reason, we will also make use of the regional average of this measure fo competitive pressure from informal firms. In this, we follow Arnold et al. (2008) that study the impact of services inputs on total factor productivity using a sample of Sub-Saharan countries in the Enterprise Survey. They mitigate the influence of individual subjective measures by considering regional averages of these subjective measures. We therefore assume that firms located in the same region within a country face similar intensity of competition from informal firms. In a similar way as in Arnold et al. (2008), the aggregation of *obstacle* across firms within the same region mitigates the influence of individual observations. Therefore, *obst_region* is defined as the regional average of the *obstacle* variable.

The *top3_region* variable is defined in an analogous way. Firms must determine what are the top three obstacles for their operations. *top3_region* is the proportion of firms within the region that declare that the presence of informal firms is among the top three obstacles to their normal operations. We believe that this measure is less subject to biases than *obstacle*, since it is based on a ranking of potential obstacles rather than on absolute scores.

As control variables, we include in all our specifications a full set of country and industry dummies, to account for unobserved country- or firm-specific factors. Additionally, we include *group*, a binary variable that takes value one if the firm belongs to a group of firms, zero otherwise. Firm size is controlled for by the inclusion of *lnemp*, the logarithm of the number of employees of the firm. The varaible *age* is firm age, in years. Export intensity is measured by *exportint*, which is the firm's exports as a percentage of its revenues. Manager's ability is measured by *manager_exp*, which is the manager's experience, in years. Finally, *mainbuyer* is a binary variable that takes value one if final consumers constitute the main buyer group for the firm's products, as opposed of other firms. It indicates whether the firm is located upstream or downstream in the value chain.

Table 2 presents summary statistics of the variables used in the analysis below, distinguishing between firms in Africa and in Latin America. Out of the 8163 observations, 6472 correspond to Latin American countries, whereas 1691 to Africa. For each variable, its average is reported, and standard deviations are also reported, in brackets, below the value of the average. On average, firms in Africa have fewer employees, are younger and less likely to be innovative and purchase licenses from other foreign firms. Most firms in

both subsamples are innovative, with a slightly higher proportion of product innovators than process innovators. Firms in both subsamples report a fairly intense competitive pressure, with an average value of *competpres* of 0.801, and fairly similar average values for both subsamples. Specifically focusing on competitive pressure from firms in the informal sector, Latin American firms seem to perceive competition with informal firms to be a more important obstacle, both according to *obstacle* and *obst_top*3. Apparently, African firms are affected by even more basic factors, such as access to electricity. For instance, the most frequently cited top 1 obstacle to business operations among African firms is access to electricity.

Regarding control variables, 11% of the firms in the sample are a part of a group of firms. Latin American firms and African firms are relatively similar in terms of size, with the average of *lnemp* being 3.17, and slightly higher average for the Latin American subsample. Latin American firms are considerable older than their African counterparts, and African firms are more likely to sell directly to final consumers than Latin American firms in the sample.

4   Empirical analysis

The empirical analysis whose results we now report make use of the variables that we described in the previous section. In all cases, the dependent variables are binary, which calls for the use of econometric methods suited to this feature. In particular, we will estimate separate probit models. Additionally, it is very likely that the same unobserved factors that may determine the

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Table 2: Summary Statistics

	LatAm	Africa	Total
Innovative	0.711	0.619	0.690
	(0.453)	(0.486)	(0.463)
Product	0.621	0.566	0.608
	(0.485)	(0.496)	(0.488)
Process	0.594	0.458	0.563
	(0.491)	(0.498)	(0.496)
Competpres	0.811	0.767	0.801
	(0.262)	(0.314)	(0.276)
Obstacle	0.542	0.401	0.509
	(0.356)	(0.371)	(0.364)
Obst_top3	0.430	0.215	0.380
	(0.495)	(0.411)	(0.485)
Group	0.103	0.155	0.115
	(0.304)	(0.362)	(0.319)
Ln(Emp)	3.230	2.971	3.171
	(1.231)	(1.130)	(1.214)
Ln(Age)	2.904	2.149	2.730
	(0.988)	(0.880)	(1.015)
Expinten	4.958	6.199	5.244
	(13.111)	(19.940)	(14.971)
Manexper	2.873	2.127	2.701
	(0.703)	(0.823)	(0.797)
Mainbuyer	0.225	0.554	0.301
	(0.418)	(0.497)	(0.459)

introduction of new product technologies are also influencing the introduction of process technologies. For this reason, we will also estimate a bivariate probit model, where the dependent variables are *innprod* and *innproc*, and the error term in these two equations is allowed to be correlated. Also, as pointed out in the previous section, in all the specifications we will include a full set of country and industry fixed effects. Furthermore, as in, for instance Arnold et al. (2008), errors will be clustered at the regional level, to take into account possible correlation of the error term within regions, due to unobserved region-specific factors.

The hypotheses set forth in Section 2 deal with an inverted-U relationship between the variables of interest. This translates into a decreasing marginal effect of competitive pressure on innovation. For this reason, we include in the specifications the measure of competition intensity as well as its square. In the econometric analysis, we will verify whether the signs and statistical significance of the coefficients are as predicted.

The following tables report estimated coefficients of different specifications where the dependent variables are *innovative*, *innprod*, and *innproc*. In all tables, the first three columns report estimated coefficients of probit models where the dependent variables are *innovative*, *innprod*, and *innproc*, respectively. Columns (4) and (5) report estimated coefficients of a bivariate probit model where the dependent variables are *innprod* and *innproc*. In all cases, the following controls are included: *group*, *lnemp*, *age*, *expinten*, *manexper*, and *mainbuyer*, in addition to country and industry dummies. There is considerable empirical evidence that points at the relevance of these control variables as determinants of innovativeness. This makes it necessary

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for use to control for these factors. Finally, both the independent variable of interest and its square will be included in the specification, to account for the possibility of the effect being non-linear in the variable of interest.

Table 3 reports estimated coefficients of different probit and bivariate probit specifications where the independent variable of interest is *competpres*, which measures the number of competitors, formal and informal, that the firm faces. In all cases, the coefficient on *competpres* is positive, whereas that on its square is negative. This suggests the existence of an inverted-U-shaped relationship between the number of competitors in the industry and the firms' innovative activities. In the first column, where the dependent variable is *innovative*, both coefficients are statistically significant, and so they are in column (2), where the dependent variable is *innprod*. In column (3), where the dependent variable is *innproc*, only the coefficient on *competpres* is statistically significant. When estimating a bivariate probit model, which allow the error terms of both equations to be correlated, the results are similar in terms of signs, sizes, and statistical significance of the coefficients of interest. Finally, the coefficient on *competpres* and its square are found to be statistically insignificant, although they have the expected sign. Regarding the control variables, in all cases, larger firms are found to be more innovative, whereas the likelihood of introducing product and process innovations decreases with firm age. Firms that sell directly to consumers are found to be less likely to innovate than firms that sell to other firms.

The results reported in Table 3 are consistent with the findings in Aghion et al. (2005), which motivate the theoretical analysis in Mendi (2015). Our contribution from this point on is to verify whether there is empirical evidence

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Table 3: Effect of competitive pressure, full sample

	Probit	Probit	Probit	Bivariate Probit	
	(1)	(2)	(3)	(4)	
	Innovative	Product	Process	Product	Process
Competpres	0.694***	0.730***	0.377*	0.768***	0.359*
	(0.246)	(0.234)	(0.208)	(0.244)	(0.212)
Competpres2	-0.480**	-0.473**	-0.242	-0.500**	-0.227
	(0.191)	(0.188)	(0.163)	(0.195)	(0.166)
Group	0.127*	0.146**	0.090	0.138**	0.086
	(0.075)	(0.069)	(0.066)	(0.067)	(0.064)
Ln(Emp)	0.264***	0.233***	0.254***	0.229***	0.255***
	(0.027)	(0.022)	(0.025)	(0.022)	(0.024)
Ln(Age)	-0.075***	-0.054**	-0.087***	-0.052**	-0.087***
	(0.028)	(0.025)	(0.027)	(0.025)	(0.028)
Expinten	0.004*	0.001	0.002	0.001	0.002
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Manexper	0.023	0.022	0.048	0.021	0.049
	(0.039)	(0.034)	(0.032)	(0.033)	(0.032)
Mainbuyer	-0.087**	-0.077*	-0.106***	-0.087**	-0.104***
	(0.044)	(0.039)	(0.039)	(0.039)	(0.038)
Constant	-0.574***	-0.715***	-0.752***	-0.710***	-0.763***
	(0.181)	(0.149)	(0.193)	(0.153)	(0.200)
Observations	7334	7330	7335	7323	

All specification include country and industry fixed effects.
Standard errors in parenthesis are clustered at the regional level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4: Effect of informal firms as obstacles to innovation, full sample

	Probit	Probit	Probit	Bivariate Probit	
	(1)	(2)	(3)	(4)	
	Innovative	Product	Process	Product	Process
Obstacle	0.599***	0.607***	0.309	0.591***	0.317*
	(0.192)	(0.176)	(0.191)	(0.175)	(0.189)
Obstacle2	-0.360*	-0.346*	-0.093	-0.332*	-0.098
	(0.193)	(0.178)	(0.196)	(0.178)	(0.194)
Group	0.129*	0.148**	0.096	0.143**	0.093
	(0.074)	(0.066)	(0.071)	(0.064)	(0.069)
Ln(Emp)	0.235***	0.204***	0.226***	0.201***	0.226***
	(0.026)	(0.021)	(0.022)	(0.021)	(0.021)
Ln(Age)	-0.063**	-0.043*	-0.076***	-0.041*	-0.076***
	(0.028)	(0.025)	(0.027)	(0.025)	(0.027)
Expinten	0.001	-0.001	0.001	-0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Manexper	0.028	0.029	0.046	0.028	0.047
	(0.035)	(0.031)	(0.030)	(0.030)	(0.030)
Mainbuyer	-0.110**	-0.092**	-0.121***	-0.101**	-0.118***
	(0.043)	(0.041)	(0.038)	(0.041)	(0.037)
Constant	-0.442***	-0.564***	-0.657***	-0.546***	-0.668***
	(0.139)	(0.117)	(0.169)	(0.118)	(0.176)
Observations	7924	7918	7924	7910	

All specification include country and industry dummies.
Standard errors in parenthesis are clustered at the regional level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

consistent with competitive pressure from informal producers influencing innovation activities, and whether the relationship also exhibits an inverted-U shape. For this reason, Table 4 reports estimated coefficients as those on Table 3, but using *obstacle* and its square as independent variables, replacing *competpres* and its square. The variable *obstacle* is expected to give a more precise measure of the intensity of competition coming specifically from informal producers. However, its main drawback is the fact that it is a subjective measure, which could be a source of biases. We will try to mitigate this potential bias by using regional averages of these measures, following Arnold et al. (2008).

Comparing the estimates coefficients on Tables 3 and 4, the results are qualitatively very similar. In fact, the statistical significance is virtually identical, with an inverse-U pattern in the case of product innovation, but not in the case of process innovation, where only the coefficient on *obstacle* is statistically significant, but not that on this same variable squared. The magnitude, sign, and statistical significance of the coefficients on the control variables used is also similar to those in the previous table.

Tables 5 and 6 report estimated coefficients of specifications where the main independent variables are *obst_region* and *top3_region*, also including the squares of these variables. Recall that *obst_region* is the regional average of *obstacle*, whereas *top3_region* is the proportion of firms in the region that declare that the presence of informal firms is among the top three obstacles for their operations. The fact that these variables are regional averages somewhat, albeit not perfectly, mitigates the potential endogeneity problem of the *obstacle* variable. The estimated coefficients on these variables and

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Table 5: Effect of regional averages of informality as obstacle, full sample

	Probit	Probit	Probit	Bivariate Probit	
	(1)	(2)	(3)	(4)	
	Innovative	Product	Process	Product	Process
Obst_region	3.330***	2.380**	4.427***	2.435**	4.762***
	(1.217)	(1.170)	(1.655)	(1.221)	(1.725)
Obst_region2	-2.971***	-1.951*	-4.022**	-2.023*	-4.358**
	(1.085)	(1.102)	(1.684)	(1.185)	(1.758)
Group	0.099	0.125*	0.079	0.122*	0.077
	(0.072)	(0.064)	(0.068)	(0.062)	(0.066)
Ln(Emp)	0.239***	0.203***	0.229***	0.200***	0.229***
	(0.025)	(0.020)	(0.021)	(0.020)	(0.021)
Ln(Age)	-0.062**	-0.042*	-0.073***	-0.041*	-0.072***
	(0.027)	(0.024)	(0.026)	(0.024)	(0.027)
Expinten	0.000	-0.001	0.001	-0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Manexper	0.035	0.034	0.060**	0.033	0.060**
	(0.036)	(0.031)	(0.030)	(0.030)	(0.029)
Mainbuyer	-0.109**	-0.093**	-0.122***	-0.101**	-0.119***
	(0.044)	(0.040)	(0.039)	(0.040)	(0.038)
Constant	-1.085***	-0.989***	-1.610***	-0.983***	-1.695***
	(0.335)	(0.315)	(0.407)	(0.323)	(0.423)
Observations	7955	7949	7956	7941	

All specification include country and industry dummies.
Standard errors in parenthesis are clustered at the regional level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6: Effect of informality as top3 obstacle, regional average, full sample

	Probit	Probit	Probit	Bivariate Probit	
	(1)	(2)	(3)	(4)	
	Innovative	Product	Process	Product	Process
Top3_region	4.794***	4.036**	5.062***	4.015**	5.116***
	(1.843)	(1.655)	(1.350)	(1.657)	(1.360)
Top3_region2	-5.589**	-4.811**	-5.677***	-4.784**	-5.720***
	(2.611)	(2.154)	(1.862)	(2.148)	(1.892)
Group	0.092	0.119*	0.072	0.115*	0.069
	(0.072)	(0.064)	(0.068)	(0.062)	(0.066)
Ln(Emp)	0.238***	0.202***	0.228***	0.199***	0.228***
	(0.025)	(0.020)	(0.021)	(0.020)	(0.021)
Ln(Age)	-0.062**	-0.041*	-0.073***	-0.040*	-0.073***
	(0.028)	(0.024)	(0.027)	(0.024)	(0.027)
Expinten	0.001	-0.001	0.001	-0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Manexper	0.038	0.037	0.063**	0.036	0.063**
	(0.035)	(0.030)	(0.029)	(0.030)	(0.029)
Mainbuyer	-0.105**	-0.090**	-0.117***	-0.098**	-0.115***
	(0.044)	(0.040)	(0.038)	(0.040)	(0.038)
Constant	-1.039***	-1.017***	-1.362***	-1.000***	-1.380***
	(0.306)	(0.274)	(0.260)	(0.275)	(0.265)
Observations	7955	7949	7956	7941	

All specification include country and industry dummies.
Standard errors in parenthesis are clustered at the regional level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

their squares are consistent with the existence of an inverted-U-shaped relationship with innovation activities, and the statistical significance is also high in most cases. For instance, the coefficient on *obst_region* is positive and highly significant in all columns of Table 5, except in column (6), whereas the coefficient on *obst_region* squared is negative and statistically significant. Similar results are reported on Table 6, where *top3_region* and its square is used instead.

In our econometric analysis, we have introduced two elements that imply that the effect of the independent variables of interest will be non-linear, and hence, will depend on the realization of the independent variable. On the one hand, we have made use of a probit specification, which is a non-linear function of the regressors. Therefore, coefficients can not be interpreted as marginal effects, as would be in a linear probability model. On the other hand, we have introduced in the specification the square of the measure of competitive pressure, which implies a non-constant marginal effect of this independent variable, even in a linear probability model. For these reasons, we still have to estimate the marginal effects of the independent variables of interest on the different innovation outcomes.

The following six figures plot the estimated marginal effects of different measures of competitive pressure from informal producers, specifically *obst_region* and *top3_region* on the probability of the firm being innovative, as well as on the probabilities of introducing a new product and a new process. We have plotted these effects against the range of values of the independent variables of interest, namely *obst_region* and *top3_region*. As it may be observed from the different figures, the pattern that emerges is that the

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marginal effect of the independent variables of interest is positive for low values of the measures of competitive pressure and decreases as *obst_region* and *top3_region* grow. For high enough values of these variables, the marginal effect is negative, although in all cases the 95% confidence interval contains the zero value. Therefore, when competitive pressure from informal producers is low, increasing competitive pressure actually increases the likelihood of innovating. That is, when the formal firm's products are sufficiently differentiated, further differentiation is profitable. However, as the pressure from informal producers intensifies, a differentiation strategy is a less viable option, thus making it less likely that firms in the formal sector sustain their competitive advantage.

These results suggest that the environment in which the firm operates greatly conditions the strategies chosen by firms in what regards the generation and perpetuation of a competitive advantage. Controlling for other firms characteristics that may be responsible for a firm's choice of innovation as a competitive strategy, we have found that the competitive pressure that informal firms exert is in fact conditioning formal firms' decisions to innovate. Therefore, managers must take into account the fact that the set of strategies that are available to them in order to create or sustain a competitive advantage is context-specific. This may actually induce firms to choose other non-differentiation strategies to erect barriers that keep competitors at bay.

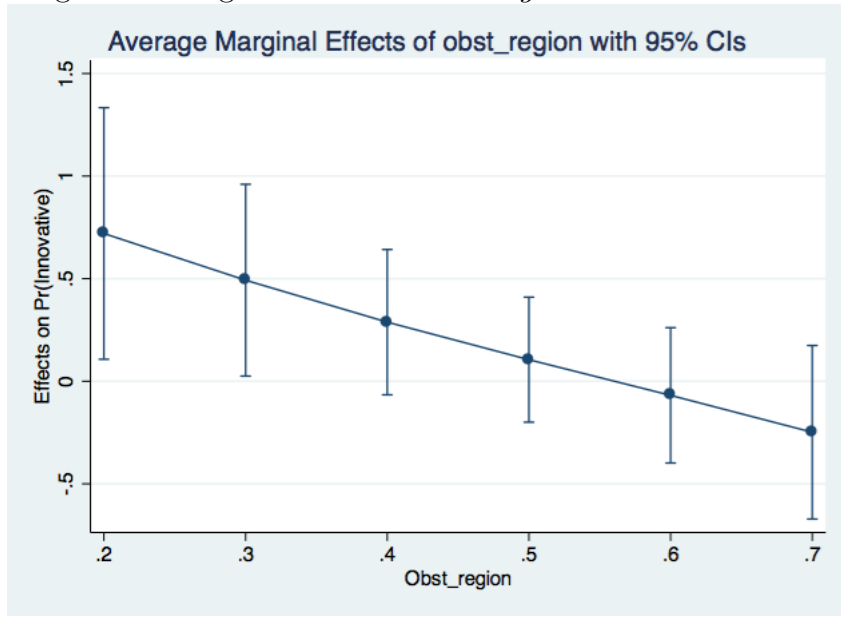Figure 1: Marginal effects of *obst_region* on innovativeness

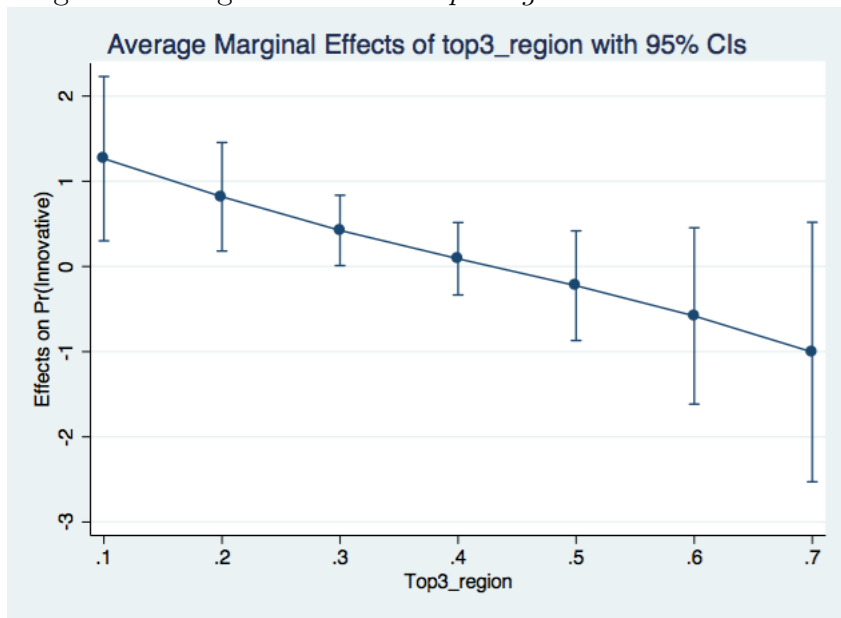Figure 2: Marginal effects of *top3_region* on innovativeness

Figure 3: Marginal effects of *obst_region* on product innovation
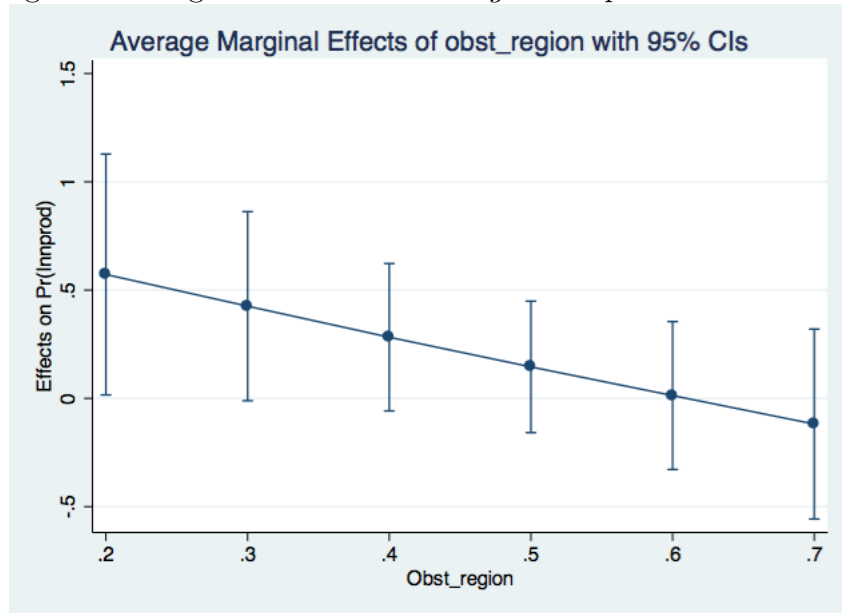

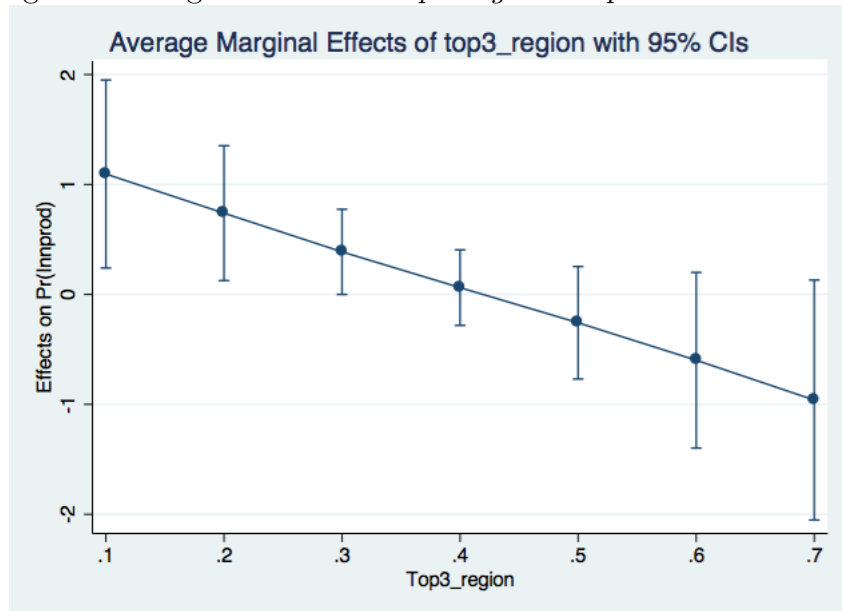Figure 4: Marginal effects of *top3_region* on product innovation

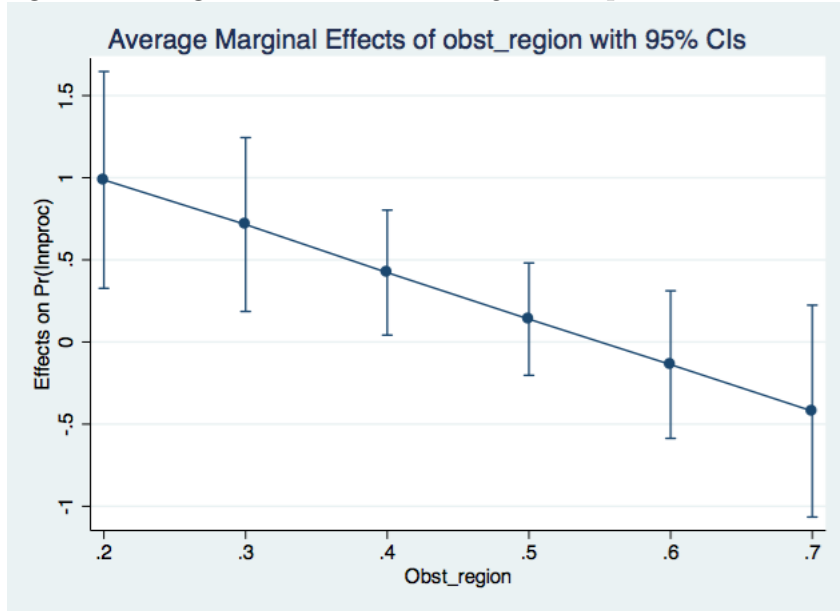Figure 5: Marginal effects of *obst_region* on process innovation

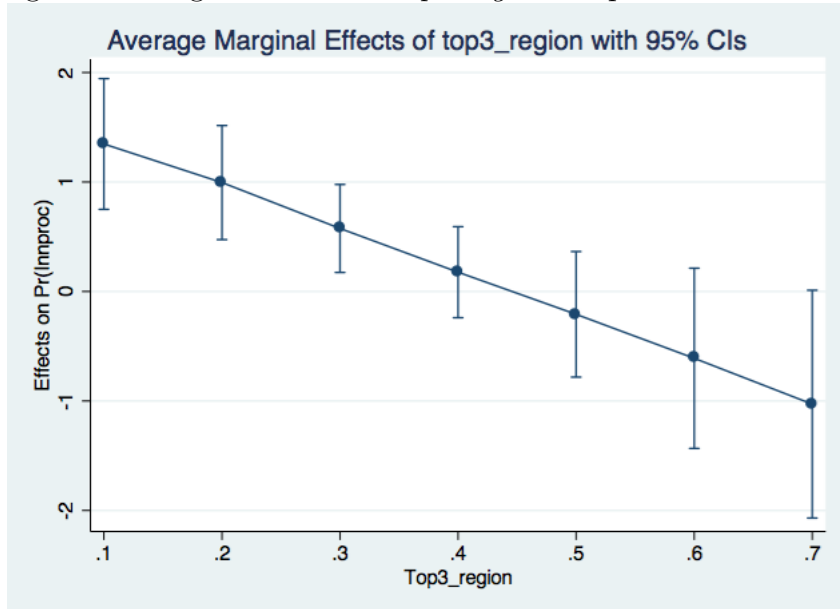Average Marginal Effects of obst_region with 95% CIs

Figure 6: Marginal effects of *top3_region* on process innovation

Average Marginal Effects of top3_region with 95% CIs

5 Conclusions

The activities of informal firms certainly affect and constrain the operations of firms in the formal sector. In this paper, we focus on an activity that is particularly important, taking into account its relevance in the generation and sustainability of competitive advantage, namely innovation. For this reason, we analyze data from the World Bank's Enterprise Surveys conducted in a number of Latin American and African countries in 2006. All these surveys include questions on the introduction of product and process innovations and technology licensing, as well as on the importance of competition against informal firms as an obstacle to the operations of formal firms. Using different measures of competitive pressure from informal producers, which try to ameliorate the subjective nature of this particular variable, we find that the marginal effect of competitive pressure on innovation is not constant. In particular, we find it to be positive for low levels of competitive pressure. As competitive pressure increases, its marginal effect decreases. The results from this study highlight the importance of external factors, in this case the operations of informal firms, as effectively constraining the set of available strategies that firms have to create and sustain a competitive advantage.

Indeed, informality can eventually force formal organizations to develop non conventional capabilities to reach and sustain a competitive advantage. Thus, the management of innovation might not only be based on the firm's ability to enhance internal resources and capabilities as in the resource-based view, but also with the organizational ability to fit with the features of this context. On the one hand, legal protection such as property rights, patents,

and so forth, are a mechanism to shield formal firms' innovations from informal competition, but little is known regarding the effectiveness of legal issues within developing economies like Latin American and African countries. On the other hand, formal firms facing informal competition may choose to allocate resources in innovations to reduce costs (process) or new products development in order to impose barriers to imitation. However, informality is a structural condition that pushes formal firms to deal with the rules of informality. For instance, the fact that informal firms are obstacle for formal firms to innovate reflect that informality also poses advantages. Therefore, the management of innovation should not be analyzed in isolation and, hence future research agenda on the creation of competitive advantages through innovation must consider informal competition factor.

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