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Managing innovation under competitive pressure from informal producers ☆

Pedro Mendi[a,*], Rodrigo Costamagna[b]

[a] Department of Economics, Universidad de Navarra. Pamplona 31009, Spain
[b] INALDE Business School, Universidad de la Sabana. Autopista Norte, Km.7, Costado Occidental, Chía, Colombia

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ABSTRACT

The existence of a large informal sector may be a factor constraining formal firms' choices of innovation strategies in many developing countries. This paper addresses this issue and 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. This pattern arises even after controlling for the number of competitors, suggesting that the pressure that informal firms exert on formal firms go beyond a mere increase in the number of competitors.

1. Introduction

Developing countries are characterized by institutional, cultural and other contextual factors that impose an effective constraint on the activities of firms (Michalopoulos and Papaioannou, 2015; Zhou and Peng, 2012). In particular, the presence of a large informal sector (Lewis, 1954; Webb et al., 2009) which sometimes actually introduces a divide that gives rise to a dual economy (Huber, 1985), largely conditions formal firms' strategies. The International Labor Organization defines "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" (Williams and Lansky, 2013).

Although so far relatively unexplored, the study of the consequences of informal economic activity arises as a new frontier in the field of Management, see for instance McGahan (2012), Webb et al. (2013), Bruton et al. (2012), Birkinshaw et al. (2014), or Godfrey (2011) for recent contributions to the discussion of this topic. Specifically, McGahan (2012) argues that formal and informal firms should be studied together, since they compete for the same customer and resources. In fact, the OECD Global Forum on Competition (OECD, 2009) claims that informal firms, while being less efficient than formal firms, usually fail to comply with economic regulations and tax obligations, allowing them to steal market share from formal firms. Furthermore, the study of informal activity yields important insights in areas such as the boundaries of the firm, diversification, dynamic capabilities, absorptive capacity, the resource-based view, property rights, governance, stakeholder theory, organizational legitimacy, disruptive technology, and innovation (McGahan, 2012).

Thus, the inclusion of informality challenges established theoretical frameworks with empirical implications that are yet to be discussed. The presence of informal firms conditions the traditional view in business strategy regarding the building of barriers to competition, constraining the creation of sustained competitive advantages. This study precisely explores the impact of informality on formal firms' resource allocation in innovation activities, a factor that is largely recognized as a crucial component of a competitive advantage (Danneels, 2002; Porter, 1990). Using The World Bank's Enterprise Survey data, we test whether competitive pressure from informal producers indeed affects the likelihood of formal firms introducing new products and processes, and we discuss the potential implications of these results for the design of business strategy and public policy. We find evidence of a decreasing marginal

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* Corresponding author.
E-mail addresses: pmendi@unav.es (P. Mendi), rodrigo.costamagna@inalde.edu.co (R. Costamagna).

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effect on innovation of the intensity of competitive pressure from informal firms, consistent with the inverted-U relationship between competitive pressure and innovation in Aghion et al. (2005). We go beyond their analysis by showing that the effect of informality is present even after controlling by the overall degree of competition, as well as observable firm characteristics. Hence, 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.

The rest of the paper is organized as follows: Section 2 discusses previous contributions to the literature. Section 3 introduces the different hypotheses tested in the empirical section. Section 4 describes the data used in this paper. Section 5 presents the econometric analysis of the data. Section 6 discusses the implications of the findings for policy and strategy design. Finally, Section 7 presents some concluding comments.

2. Literature overview

The tradition in the research on determinants of innovation is founded on seminal contributions such as Schumpeter (1942) or Arrow (1962), relating innovation to firm size and market structure. Regarding the specific issue of competitive pressure and innovation, theoretical predictions are quite sensitive to modelling assumptions, see surveys in De Bondt and Vandekerckhove (2012), Gilbert (2006), or Vives (2008). In fact, early theoretical contributions predict a negative relationship between the intensity of competition and innovation (Schumpeter, 1942), while the empirical literature finds a positive relationship (Bloom et al., 2016; Nickell, 1996). Some other contributions find an inverted-U relationship between competition and innovation (Levin et al., 1985; Scott). An influential analysis is Aghion et al. (2005), who find an inverted-U relationship between competition and innovation: innovation is lowest among monopolistic firms and among those that face intense competition in the industry. However, despite the large number of theoretical and empirical studies on the effect of competition on innovation, no consensus has been reached.

While in developed countries, most competitors are other formal firms, in developing countries many formal firms compete directly against informal producers, which differ from formal firms. La Porta and Shleifer (2008) or La Porta and Shleifer (2011) find that informal firms are much less productive than small formal firms, in terms of sales per worker. 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 interaction between the formal and informal sectors also has effect on country-level productivity (Acemoglu et al., 2007) and whether resources are misallocated (Bartelsman et al., 2013; D'Erasmo et al., 2013; Hsieh and Klenow, 2009; Restuccia and Rogerson, 2013). All this points at the relevance of the study of informal firms and their interplay with formal firms.

From the perspective of the resource-based view of the firm (Barney, 1991; Penrose, 1995; Wernerfelt, 1984), innovation is essential in the resource and capability-building process that creates a sustained competitive advantage. However, the development of these valuable, rare, hard to imitate and organizationally embedded resources and capabilities is very much context-specific. Indeed, many developing countries are characterized by material financial, and human resource scarcity, which effectively constraints firms' choices of strategies, and ultimately performance. For instance, Pansera and Owen (2015) study resource-constrained innovation in Bangladesh, see also Baker and Nelson (2005), Gibbert et al. (2007), or Keupp and Gassmann (2013). A key driver of contextual factors is the institutional setting. Institutional theories consider that the institutional environment effectively constraints firms' actions (Dunning and Lundan, 2008; Peng et al., 2009). In this line, (Meyer and Peng, 2005, 2016) argue that in developing economies institutional factors are more likely to change and thus, firms' decisions are more likely to be context-specific than in developed countries, which are characterized by more stable institutions. This is even more evident in the case of countries with lowest income levels, as those in Sub-Saharan Africa, and in this line Zoogah et al. (2015) argue that institutions and resources are relevant in studying Management in Africa. The presence of institutions may constrain formal firms' choices by means of the persistence of mandatory cultural practices, which could perpetuate phenomena such as clientelism or corruption. These contextual factors may affect firms' innovation decisions (Egbetokun, 2015; Tigabu et al., 2015), or even country-level innovation strategy (Amankwah-Amoah, 2016). There is a close interconnection between institutions and the informal sector, in the sense that the informal sector may be in part explained by the country's institutional setting, and, conversely, the presence of an informal sector may affect institutional efficiency.

3. Hypotheses

We now proceed to present the hypotheses that will be tested empirically using the Enterprise Survey data. We distinguish between the direct effect on innovation of the measures for competitive pressure from informal producers and the moderating role of other variables on this relationship.

3.1. Effect of informality on innovation

Formal firms operating in a context where informal firms are widespread are likely to be negatively affected by the operations of informal firms. While sometimes the informal sector itself has been a source of innovations (Bhattacharyya et al., 2010; Prahalad, 2005; Radjou et al., 2012), and some examples may be found where formal and informal firms collaborate for innovation (George et al., 2012; von Hippel, 2005), informal firms typically disrupt formal firms' innovation practices. This negative effect may have different channels. First, formal and informal firms compete for the same customers and resources (McGahan, 2012). Regarding access to inputs such as human capital, the presence of a large informal sector may also introduce a distortion in the process of skills accumulation, since the ready availability of jobs in the informal sector, which typically require low skills, may discourage the accumulation of human capital, thus making this factor more scarce.

The other channel by which informal producers may affect formal firms' innovation decisions is via competition in the product market. By their very nature, informal firms face lower entry costs than formal firms, since they are less affected by regulatory burdens imposed on formal firms (Djankov et al., 2002; McKenzie and Seynabou Sakho, 2010). Therefore, the presence of informality is likely to increase the number of competitors for a firm's product. Theoretical predictions and empirical evidence on the relationship between competitive pressure and innovation are mixed. While a number of studies suggest that competition among producers decreases incentives to innovate (Aghion and Howitt, 1992; Grossman and Helpman, 1993; Spulber, 2013), other contributions find a positive effect of competition on innovation and productivity (Blundell et al., 1999; Galdón-Sánchez and Schmitz, 2002; Symeonidis, 2002). This disparity of results is not surprising, since on the one hand, competitive pressure 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

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effect. Vives (2008) organizes the theoretical discussion by analyzing different behavioral assumptions and industry structures, and the results are very sensitive to the modeling assumptions. Aghion et al. (2005) find empirical evidence consistent with the existence of an inverted-U relationship between competitive pressure and innovation activities. Therefore, for low levels of competitive pressure, increases in competitive pressure cause an increase in innovation activity. This is the escape competition effect. In contrast, when competition is too intense, incentives to innovate are dampened, or rent-dissipation effect.

In addition to increasing the number of competitors in the industry, informal firms create competitive pressure via quality, since they typically produce lower-quality versions of the products produced by formal firms (Banerji and Jain, 2007). In developing countries, where the income of consumers are typically very low, this is clearly a factor undermining firms' profits, since consumers will be typically unable to afford the higher-quality product and thus choose the low-quality, affordable product. Mendi (2015) introduces the quality dimension in a model of vertical differentiation, as in Shaked and Sutton (1982). The model features a competitive fringe that can be interpreted as the informal sector, and the model predicts the existence of an inverse-U shaped relationship between competitive pressure and innovation, where the relationship is not driven by the number of competitors, but by the degree of vertical differentiation between the products of formal and informal firms.

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 way that depends on the level of competitive pressure, controlling for other internal and external determinants of innovativeness. Therefore, we expect competitive pressure from informal producers, to have a non-linear effect on innovativeness. The hypothesis is formulated as follows:

Hypothesis 1. *The effects of informal firms as obstacles to formal firms' product and process innovations are positive for low levels of competitive pressure and decrease with these variables.*

The existence of these effects will be tested by the inclusion of the measure of competitive pressure from informal producers in an econometric specification where the dependent variables are indicators of product and process innovations. However, the coefficient on the measure of competitive pressure from informal producers is simultaneously capturing both an increase in the level of competition and the effect of informality via other channels, such as more difficult access to inputs. For this reason, we will try to disentangle the two channels, increased competition and other channels by including in the econometric specification both measures as independent variables, namely number of competitors and informal firms as obstacle to formal firms' operations. We hypothesize that the other channels pointed out in McGahan (2012) will also be relevant and will add to the increased competition effect of informality. This is formulated in Hypothesis 2 as follows:

Hypothesis 2. *The effects of informal firms as obstacles to formal firms' product and process innovations are present controlling for the intensity of competition.*

3.2. Moderating factors

We expect some variables to play a moderating role on the relationship between competitive pressure from informal activities and product and process innovation. In particular, we focus on the role of firm age, exporting status, and belonging to a group of firms.

3.2.1. Firm age

First, regarding firm age, there are reasons to believe that the effect on innovation of the presence of informal producers will be stronger or weaker among younger firms (Audretsch et al., 2014; Balasubramanian and Lee, 2008; Cincera and Veugelers, 2014; Coad et al., 2016; Czarnitzki and Delanote, 2013; Garcia-Quevedo et al., 2014; Huergo and Jaumandreu, 2004). On the one hand, these are typically more dynamic than older firms, and probably less prone to organizational inefficiencies associated with excessive bureaucratization that their older counterparts. This makes them more flexible in dealing with an external threat as informal producers. On the other, firms that have been longer in the industry have longer credit histories, which makes them enjoy easier access to credit, which is often cited as a relevant obstacle to innovation. Furthermore, older firms have accumulated a greater experience and are more likely to have a better knowledge on consumer preferences, as well as on other market and institutional factors that may potentially constitute a barrier to innovation. While the two effects work in opposite directions, we expect the latter to be stronger than the former, and thus the negative effect of competitive pressure on innovation to be stronger among younger firms. This is reflected in the following hypothesis:

Hypothesis 3. *The innovation activities of younger firms are more intensely affected by the presence of informal firms than those of older firms.*

3.2.2. Belonging to a group of firms

Firms that belong to a group of firms have access to a broader pool of resources developed within the group, which may make their innovation performance be different than that of stand-alone firms (Un and Cuervo-Cazurra, 2008). In the context of developing countries, this may translate into an easier access to technology, market information, funds and qualified personnel, which could flow across different units within the same group. Given that lack of access to these resources often constitute relevant obstacles to innovation, and that informal firms hamper access to these resources (McGahan, 2012), we expect firms that belong to a group of firms to be less affected by the presence of informal firms. This is reflected in the following hypothesis:

Hypothesis 4. *The innovation activities of firms that belong to a group of firms are less intensely affected by the presence of informal firms than those of older firms.*

3.2.3. Exporting status

The previous literature has identified a close relationship between exporting and innovative behavior (Roper and Love, 2002; Wakelin, 1998). Exporting implies that firms are present in a number of different markets, thus making the firm less reliant on the idiosyncrasies of a particular market, effectively hedging firms' revenues from market-specific shocks. Thus, exporting firms apply the results of their innovation efforts on a wider, more stable market base. Furthermore, a firm's presence in foreign markets implies a greater exposure to tougher competition, making it more resilient to increased domestic competition. Therefore, it is reasonable to expect that the effect on innovation of informal presence among exporting firms will be weaker than in the case of non-exporting firms. We thus formulate the following hypothesis concerning the moderating role of a firm's exporting status:

Hypothesis 5. *The innovation activities of exporting firms are less intensely affected by the presence of informal firms than those of older firms.*

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4. The data

This paper makes use of the World Bank's Enterprise Survey data. 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 typically 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 some questions directly related with innovation outcomes (see Krammer (2016) for a recent contribution that uses the same data, focusing on the Sub-Saharan African subsample). The questionnaire also included questions providing information on up to what degree practices of firms in the informal sector represented an important obstacle to firm activities. 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 number of observations may vary in some of the specifications whose estimated coefficients are reported below.

Regarding innovation outcomes, the questionnaire includes questions on whether the firm introduced any new or significantly improved products or services, and any new or significantly improved production processes within the three years prior to the survey. These questions are similar to those included in the Community Innovation Survey questionnaires. Concerning 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, and the options are none, one, two to five, and more than five. 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.

Table 1 presents the definitions of the variables used in the empirical analysis, distinguishing between dependent, independent, and control variables. As controls, we use 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, following the classification of firms into the following manufacturing sectors: Textiles, Garments, Food, Metals and Machinery, Electronics, Chemicals and Pharmaceuticals, Non-metallic and Plastic Materials, and Other Manufacturing.

The dependent variables are in all cases binary, and *innprod* and *innproc* indicate the introduction of new products and new processes, respectively. Regarding the independent variables, *competpres* measures the number of competitors that the firm faces in its market, as explained above. We normalize these categories to make them be between zero and one, with the measure being increasing in the number of competitors. The main features of this variable are that it constitutes an objective measure of competitive pressure, not being based on subjective perceptions about the intensity of competition, and that it includes competitive pressure from other formal and informal firms. In contrast, the measure of the importance of the presence of informal firms as an obstacle for the firm's normal activities is subjective, and is reported in a 4-point Likert scale. We have normalized this variable to be between zero and one. 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.

In order to further mitigate endogeneity concerns, we will make use of the regional average of this measure for competitive pressure from informal firms. In this, we follow Arnold et al. (2008), who 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 across firms within the same region of firms' perceptions attenuates the influence of individual observations. Therefore, *obst_region* is defined as the regional average of the individual perceptions of the importance of informal firms as an obstacle to formal firms' operations. We define the *top3_region* variable in an analogous way. Firms must specify 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 the raw 4-point Likert measure, 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 industry-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 variable *age* is the logarithm of 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, *downstream* 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 *obst_region* and *obst_top3*. 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

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Table 1
Variable definitions.

Dependent variables	
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
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
Moderators	
young5	Dummy that takes value 1 if the firm is at most 5 years old, 0 otherwise
young10	Dummy that takes value 1 if the firm is at most 10 years old, 0 otherwise
group	Dummy that takes value 1 if the firm belongs to a group of firms, 0 otherwise
export	Dummy that takes value 1 if the firm exports, 0 otherwise
Controls	
lnemp	Logarithm of the number of employees
age	Logarithm of firm age, in years
exportint	Percentage of the firm's sales that are exported
manager_exp	Manager's experience, in years
downstream	Dummy that takes value 1 if the main buyers for the firm's product are final consumers, 0 otherwise

African counterparts, and African firms are more likely to sell directly to final consumers than Latin American firms in the sample.

5. Empirical analysis

5.1. Main effects

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. Furthermore, it is very likely that the same unobserved factors that may determine the introduction of new product technologies are also influencing the introduction of process technologies. For this reason, we will estimate bivariate probit models, 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 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.

Table 2
Summary Statistics.

	LatAm	Africa	Total
innprod	0.626	0.566	0.613
	(0.484)	(0.496)	(0.487)
innproc	0.600	0.458	0.567
	(0.490)	(0.498)	(0.496)
competpres	0.809	0.768	0.799
	(0.264)	(0.314)	(0.277)
obst_region	0.526	0.399	0.497
	(0.099)	(0.114)	(0.116)
top3_region	0.402	0.214	0.358
	(0.110)	(0.090)	(0.132)
group	0.103	0.155	0.115
	(0.304)	(0.362)	(0.319)
lnemp	3.228	2.970	3.168
	(1.231)	(1.129)	(1.213)
age	2.848	2.141	2.685
	(0.844)	(0.860)	(0.899)
exportint	4.978	6.156	5.250
	(13.126)	(19.861)	(14.957)
manager_exp	2.875	2.126	2.703
	(0.705)	(0.823)	(0.799)
downstream	0.224	0.554	0.300
	(0.417)	(0.497)	(0.458)

The hypotheses set forth in Section 3 deal with an inverted-U relationship between the probabilities of introducing new products and new processes, on the one hand, and the different measures of competitive pressure, on the other. This translates into a decreasing marginal effect of the different measures of competitive pressure on innovation. For this reason, we include in the specifications these measures of competition intensity as well as these variables squared. 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 *innprod* and *innproc*, using a bivariate probit model. In all cases, the following controls are included: *group*, *lnemp*, *age*, *expinten*, *manexper*, and *downstream*, 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 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.

The first two columns of Table 3 report estimated coefficients of a bivariate probit model where the independent variable of interest is *competpres*. Recall that an inverted-U relationship arises if the coefficient on the independent variable is positive, and that on the independent variable squared is negative. In our case, we find that this is so both for product and process innovations. However, while in the case of product innovations the statistical significance is high, in the case of process innovations, the coefficients are not statistically significant even at the 90% level. We thus find that the findings in Aghion et al. (2005) hold for product innovations, but the evidence for process innovations is weaker. Now, regarding the specific effect of competitive pressure from informal producers, models (2) and (3) report estimated coefficients from bivariate probit models where the measures for competitive pressure from informal firms are *obst_region* and *top3_region*. As it may be seen from the reported coefficients, these have the signs consistent with the existence of an inverted-U relationship between the dependent and the independent variables, and are statistically significant.

The next step in the analysis is to include both effects, that given by the number of competitors, and that coming from the existence of informal producers, in the same econometric specification. This

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Table 3
Effect of competitive pressure, overall and from informal firms.

	(1)		(2)		(3)		(4)		(5)	
	Product	Process	Product	Process	Product	Process	Product	Process	Product	Process
competpres	0.732***	0.325					0.726***	0.324	0.707***	0.299
	(0.243)	(0.212)					(0.246)	(0.215)	(0.247)	(0.214)
competpres^2	−0.456**	−0.181					−0.461**	−0.192	−0.442**	−0.167
	(0.194)	(0.165)					(0.196)	(0.166)	(0.197)	(0.166)
obst_region			2.684**	4.980***			2.260*	3.919**		
			(1.244)	(1.754)			(1.326)	(1.798)		
obst_region^2			−2.286*	−4.590**			−1.921	−3.744**		
			(1.233)	(1.802)			(1.329)	(1.886)		
top3_region					4.118**	5.219***			3.905**	4.714***
					(1.666)	(1.374)			(1.710)	(1.308)
top3_region^2					−4.886**	−5.829***			−4.933**	−5.579***
					(2.184)	(1.942)			(2.249)	(1.880)
group	0.146**	0.092	0.127**	0.081	0.121*	0.072	0.126*	0.080	0.119*	0.072
	(0.069)	(0.066)	(0.064)	(0.068)	(0.064)	(0.068)	(0.068)	(0.066)	(0.068)	(0.066)
lnemp	0.223***	0.250***	0.193***	0.224***	0.193***	0.223***	0.224***	0.250***	0.223***	0.249***
	(0.022)	(0.025)	(0.020)	(0.021)	(0.020)	(0.021)	(0.022)	(0.025)	(0.022)	(0.025)
age	−0.015	−0.051**	−0.003	−0.036	−0.002	−0.037	−0.012	−0.047*	−0.011	−0.047*
	(0.022)	(0.025)	(0.021)	(0.024)	(0.021)	(0.024)	(0.022)	(0.025)	(0.022)	(0.025)
exportint	0.001	0.002	−0.001	0.001	−0.001	0.001	0.001	0.002	0.002	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
manager_exp	0.007	0.035	0.019	0.046*	0.022	0.049*	0.007	0.040	0.010	0.043
	(0.033)	(0.030)	(0.030)	(0.028)	(0.029)	(0.028)	(0.033)	(0.031)	(0.033)	(0.030)
downstream	−0.092**	−0.109***	−0.107***	−0.125***	−0.103***	−0.121***	−0.094**	−0.112***	−0.091**	−0.109***
	(0.039)	(0.038)	(0.040)	(0.038)	(0.039)	(0.038)	(0.040)	(0.039)	(0.040)	(0.039)
Constant	−0.742***	−0.792***	−1.065***	−1.766***	−1.046***	−1.422***	−1.273***	−1.679***	−1.306***	−1.507***
	(0.158)	(0.206)	(0.324)	(0.428)	(0.275)	(0.270)	(0.364)	(0.461)	(0.296)	(0.280)
Number of obs.	7252000		7865000		7865000		7192000		7192000	
Log likel.	−7837.319		−8504.108		−8497.036		−7763.625		−7757.102	
χ^2 *test of* $\rho = 0$	407.731		430.059		431.124		401.860		401.865	

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

is done in models (4) and (5). Specifically, in (4) we jointly include *competpres* and its square, as well as *obst_region* and its square. In the case of *competpres*, the sign, absolute value, and statistical significance of the coefficients is not affected relative to model (1). However, in the case of *obst_region* the statistical significance of both the level and the square of the variable are reduced, and the coefficient on the square of the variable loses its significance in the equation that determines the introduction of new products. Regarding the equation that determines the introduction of new processes, the size of the coefficients is somewhat reduced relative to model (2), although the statistical significance of both coefficients remains above the 95% level. When we make use of *top3_region*, the coefficients on the level and the square of the variable are significant at the 95% level. Finally, it is worth indicating that in all cases the test of the existence of a positive correlation between the error terms in the different bivariate probit models is highly significant (the test statistic follows a χ^2 distribution with one degree of freedom), thus confirming our choice of bivariate probit as the preferred estimation method.

The results reported in Table 3 suggest that the introduction of new products is affected by competitive pressure from other firms, but not the introduction of new processes. When we include the effect of competitive pressure from informal firms, we find the effect to be stronger on new processes. This suggests that the number of competitors is not the only relevant factor constraining formal firms' innovation strategies, but also the type of competitor is important. This is consistent with the quality dualism argument in Amaral and Quintin (2006) and the theoretical model in Mendi (2015). It also suggests that, in addition to increasing the number of competitors and thus reducing the incentives to innovate, the presence of informal firms affects formal firms' innovation decisions through other mechanisms, with access to inputs or finance being some likely channels.

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 in a linear probability model. On the other hand, we have introduced in the specification the different measures of competitive pressure squared, 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.

Figs. 1, 2, 3, and 4 plot the estimated marginal effects of *obst_region* and *top3_region* on the probability of the firm introducing a new products and processes. We have plotted these effects against the range of observed 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 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 some cases the 95% confidence interval contains the zero value. Therefore, the effect on formal firms' innovation decisions of informal firms' operations induces firms to be more innovative when these have an initially low pressure, but eventually stifles innovation efforts when pressure from informal producers is too high. This is controlling for the number of competitors that the formal firm faces. Notice that the pattern

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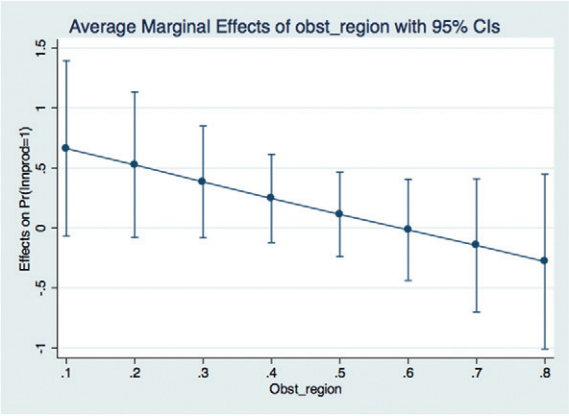

Fig. 1. Marginal effects of *obst_region* on product innovation.

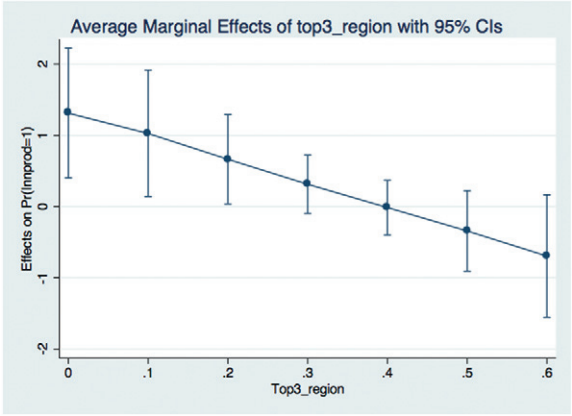

Fig. 3. Marginal effects of *top3_region* on product innovation.

is more clear if the *top3_region* is used as the measure of competitive pressure from informal producers.

5.2. Moderating factors

Tables 4 and 5 present the results from bivariate probit specifications where the independent variable of interest is interacted with other variables that are assumed to act as moderators of the effect of informality on formal firms' innovation strategies, as enunciated in Hypotheses 3, 4, and 5.

First, regarding firm age, we create two dummies, *young5* and *young10*, that take value one if the firm is less than 5 and 10 years old, respectively, and zero otherwise. We interact these variables with *obst_region* and *obst_region* squared, and results are shown on Table 4, where model (1) uses *young5* and model (2) uses *young10*. Recall that we hypothesized that younger firms would be more affected by the competitive pressure exerted by informal firms. We find some partial support for this hypothesis, since the sign of the coefficients reinforce the estimated effect of *obst_region*, although the coefficients on the interaction terms fail to be statistically significant even at the 90% level, except for the interaction between *young5* and *obst_region* in the product equation, with is statistically significant at the 10% level. In any case, the coefficients of the interaction terms are larger in absolute value in the case of *young5* than in the case of *young10*, suggesting that the incremental effect of age fades as the firm accumulates more experience.

Regarding Hypotheses 4 and 5, which predicted a weaker effect of informality for firms that belong to a group and for firms that export, respectively, Table 5 presents estimated coefficients of bivariate probit specifications where *obst_region* has been interacted with *group* (model 1) and with *export* (model 2). Regarding the moderating effect of group, the signs of the estimated coefficients are the opposite to what we predicted in Hypothesis 4, although the coefficients on the interaction terms are not statistically significant. On the other hand, and also contrary to our prediction, exporting seems to be reinforcing the effect of *obst_region* in the product equation, although coefficients are not statistically significant.

6. Discussion

Our results suggest that the environment in which the firm operates greatly conditions the strategies chosen by firms regarding 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 and for the number of innovators that the firm faces, we have found that the presence of informal firms 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. In our sample, informal firms activities are a strong obstacle to formal firms innovations and current innovations fail to shield formal firms' competitive. 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

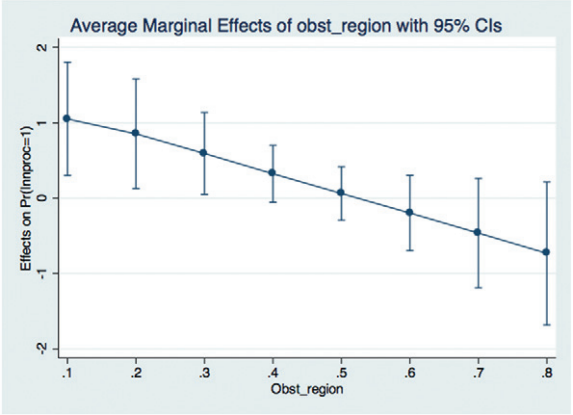

Fig. 2. Marginal effects of *obst_region* on process innovation.

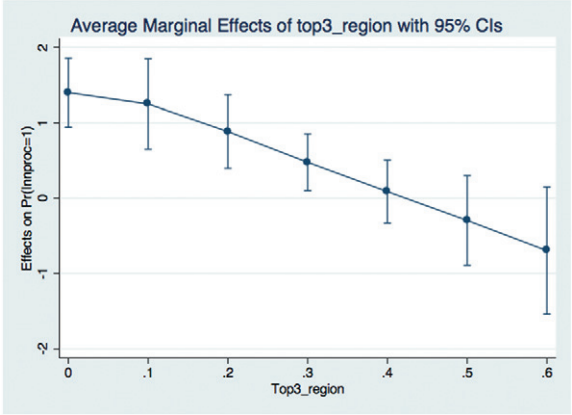

Fig. 4. Marginal effects of *top3_region* on process innovation.

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Table 4
Moderating effect of firm age.

	(1)		(2)	
	Product	Process	Product	Process
competpres	0.725***	0.325	0.727***	0.322
	(0.243)	(0.213)	(0.246)	(0.214)
competpres²	−0.460**	−0.193	−0.462**	−0.191
	(0.194)	(0.165)	(0.196)	(0.165)
obst_region	1.905	3.478**	2.114	4.061**
	(1.388)	(1.765)	(1.549)	(1.752)
young5	−0.924*	−0.780		
	(0.548)	(0.782)		
young10			−0.070	−0.002
			(0.480)	(0.492)
Age 5 years or less = 1 × Obst_region	4.001*	3.718		
	(2.424)	(3.360)		
Age 10 years or less = 1 × Obst_region			0.544	−0.304
			(2.051)	(2.069)
obst_region²	−1.518	−3.214*	−1.798	−3.923**
	(1.398)	(1.840)	(1.586)	(1.804)
Age 5 years or less = 1 × Obst_region × Obst_region	−4.087	−4.154		
	(2.557)	(3.507)		
Age 10 years or less = 1 × Obst_region × Obst_region			−0.472	0.406
			(2.113)	(2.106)
group	0.124*	0.079	0.124*	0.080
	(0.068)	(0.066)	(0.068)	(0.066)
lnemp	0.224***	0.251***	0.224***	0.250***
	(0.022)	(0.025)	(0.022)	(0.025)
age	−0.014	−0.053**	0.020	−0.066**
	(0.030)	(0.027)	(0.034)	(0.030)
exportint	0.001	0.002	0.001	0.002
	(0.001)	(0.001)	(0.001)	(0.001)
manager_exp	0.007	0.040	0.009	0.038
	(0.033)	(0.031)	(0.033)	(0.031)
downstream	−0.095**	−0.114***	−0.093**	−0.112***
	(0.040)	(0.039)	(0.040)	(0.039)
Constant	−1.215***	−1.612***	−1.351***	−1.626***
	(0.372)	(0.459)	(0.406)	(0.456)
Number of obs.	7192000		7192000	
Log likel.	−7761.748		−7760.823	
χ^2 *test of* $\rho = 0$	402.157		397.228	

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

choose differentiation strategies to escape competition from informal firms, thus ending up in a low-differentiation equilibrium. Under these circumstances, existing formal firms innovations do not seem to be a viable source of competitive advantage.

The fact that 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, the 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.

The empirical analysis also highlights that there is a different impact of the informal competition depending on whether we consider process or product innovations. In particular, we find that process innovations are more intensely affected by informality than product innovations. This is consistent with an environment in which most innovations are product innovations that are mostly imitative, low-return innovations. This scenario makes the returns from process innovations low: while processes are difficult to imitate, formal firms expect low return on these investments, due to squeezed margins. In developing countries, it is typically easier to introduce a new variety of product than to engage in a redesign of production processes, especially if the firm lacks the necessary skills to either produce new technology ex-novo or to adapt frontier knowledge. Hence, industries facing high competitive pressure from informal firms are discouraged to develop innovations, especially new processes. Then, informal firms find strategic advantages in the informality, while formal firms face unfair competition that cannot be balanced with higher levels of innovation. Accordingly, policy makers should consider the provision of incentives to enhance formal technological development and, ultimately, the quality of goods consumed.

An implication of our analysis for the design of business strategies is that firms affected by informal firms should explore differentiation strategies that add value and make sure this value added is perceived as such by consumers. The challenge is to do it in an environment in which consumers' incomes are low, making the products produced by informal producers an attractive alternative (Prahalad, 2005). A feasible strategy could be to cooperate with other formal producers to enhance demand for formal firms' products by

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Table 5
Moderating effect of exporting status and belonging to a group of firms.

	(1)		(2)	
	Product	Process	Product	Process
competpres	0.725***	0.333	0.642***	0.261
	(0.245)	(0.216)	(0.247)	(0.213)
competpres²	−0.459**	−0.196	−0.385*	−0.134
	(0.195)	(0.166)	(0.198)	(0.166)
obst_region	2.113	3.996**	2.012	3.912**
	(1.358)	(1.696)	(1.346)	(1.805)
export			−0.231	0.435
			(0.564)	(0.745)
group	−0.181	0.336	0.127*	0.076
	(0.550)	(0.529)	(0.069)	(0.067)
Group = 1 × Obst_region	2.037	0.070		
	(2.594)	(2.294)		
Exporting = 1 × Obst_region			2.354	−0.626
			(2.440)	(3.034)
obst_region²	−1.711	−3.704**	−1.662	−3.744**
	(1.343)	(1.782)	(1.331)	(1.889)
Group = 1 × Obst_region × Obst_region	−2.742	−1.189		
	(2.825)	(2.414)		
Exporting = 1 × Obst_region × Obst_region			−2.340	0.627
			(2.488)	(2.994)
lnemp	0.225***	0.251***	0.203***	0.232***
	(0.022)	(0.024)	(0.023)	(0.025)
age	−0.012	−0.047*	−0.020	−0.053**
	(0.022)	(0.025)	(0.022)	(0.025)
exportint	0.001	0.002	−0.004***	−0.003*
	(0.001)	(0.001)	(0.001)	(0.001)
manager_exp	0.007	0.039	0.007	0.039
	(0.034)	(0.031)	(0.033)	(0.030)
downstream	−0.091**	−0.108***	−0.081**	−0.102***
	(0.040)	(0.039)	(0.039)	(0.039)
Constant	−1.257***	−1.732***	−1.156***	−1.624***
	(0.371)	(0.436)	(0.367)	(0.465)
Number of obs.	7192000		7192000	
Log likel.	−7760.027		−7741.966	
χ^2 test of $\rho = 0$	402.170		404.012	

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

means of advertising or consumer education. For instance, formal firms have a common interest to differentiate their products from those by informal producers by stressing features such as higher reliability and durability or even less health hazards. Another way is by increasing consumers' switching costs, for instance by exploiting network externalities. Orchestrating may also be a viable alternative (Sull and Ruelas-Gossi, 2010): to coordinate products and services from different producers in such a way that the final product is both simple to the consumer and difficult to imitate by informal firms, see an example in Ruelas-Gossi (2009).

7. 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. 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.

In light of the empirical results, a crucial question must be asked: How to deal with informality? Certainly, it is a fact that informality may not be easily avoided in the sampled regions, namely, Africa and Latin America. Indeed, informality can eventually force formal organizations to develop non conventional capabilities to reach and sustain a competitive advantage. Actually, our results show that existing intra organizational resources and capabilities may not protect formal firms innovation-based advantages. 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 or patents is a mechanism to shield formal firms' innovations from informal competition, but little is

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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 an obstacle to formal firms' innovation reflect that informality also creates a competitive advantage. 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.

The introduction of informality into the strategy and management field challenges scholars and practitioners for empirical discussions for future research. Informality is a structural problem suggesting that there is a shared responsibility that must be addressed by both, policy makers and businessmen. Therefore, policy makers and businessmen must orchestrate innovation policies and strategies so as to boost the levels of innovation activities. Otherwise, formal firms innovations will be deteriorated and the potential spillover effects of innovations will be absent. All these considerations call for a study the relationship between policies such as tax levels to the formal sector and labor costs of formal activity as a determinant of innovation activities. Accordingly, the fact that younger firms are the must affected by informal competitive pressure reveal that policy makers have to be engaged with this specific unfair type of competition.

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Pedro Mendi holds a PhD in Economics from Northwestern University. He is currently an Associate Professor of Economics at Universidad de Navarra in Pamplona, Spain. His research interests are economics of in- novation and new technology, and vertical relations. His research has been published in journals such as Research Policy or Journal of Economics and Management Strategy.

Rodrigo Costamagna obtained his PhD from Universidad de Navarra. In addition to running a successful family business, he is an Assistant Profes- sor of Management at INALDE Business School, Universidad de La Sabana in Bogotá, Colombia. His research interests include the determinants of competitiveness and innovation. His research has been published in journals such as Journal of Business Research.

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