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Determinants of innovation in small- and medium-sized enterprises in Senegal

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Abstract

For small and medium-sized enterprises (SMEs), innovation is an essential element of survival, particularly in the current context in which globalisation and the development of new technologies are increasing the competitive pressures on firms. For this reason, analyses of the factors that determine innovation are of paramount importance. However, research regarding this issue is crucially lacking, specifically in West Africa and Senegal. Nevertheless, SMEs are an essential component of production in these contexts and have a major role in economic growth. The purpose of this article is to investigate the factors that motivate innovation within SMEs in Senegal. From the OECD perspective, we examine four dimensions of innovation: product innovation, market innovation, process innovation and organisational innovation. Using a sample of 1107 Senegalese SMEs surveyed in 2007 and 2014, we estimate a logistic econometric model to explain innovation referencing certain firm and manager characteristics. To our knowledge, this study is one of the few empirical works regarding the determinants of innovation among SMEs in Senegal and West Africa. The results demonstrate that innovation among SMEs is influenced by several firm characteristics and that this influence varies according to the type of innovation. R&D, export sales, region of operation and competition are the most significant determinants of innovation for Senegalese SMEs.

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1. Introduction

For small and medium-sized enterprises (SMEs), innovation is an essential element of survival, particularly in the current context in which globalisation and the development of new technologies are increasing the competitive pressures on firms. For this reason, analyses of the factors that determine innovation are of paramount importance. Such information can furnish public authorities with empirical evidence regarding the essential factors for promoting SMEs. It can also provide SME managers with key information for strengthening firms, especially in an increasingly competitive environment characterised by a short product cycle and continuous rapid technological change (Laforet, 2011). However, research regarding this issue is crucially lacking, specifically in West Africa and Senegal. Nevertheless, SMEs are an essential component of production in these contexts and have a major role in economic growth (Quartey et al., 2017; Ussif and Salifu, 2020; Endris and Kassegn, 2022).

SMEs form the basis of the economic landscape in Senegal, given their economic proportions. According to the latest General Census of Enterprises, there are 407,882 enterprises in Senegal, 99.9% of which are SMEs (ANSD, 2017). Such enterprises are of different sizes, ranging from very SMEs to large enterprises. The Senegalese Small and Medium Enterprises Charter of December 2003 defines SMEs as any physical or legal person producing goods or market services. Within this group, there are small businesses (with 1–20 employees) and medium-sized businesses (with less than 250 employees), which are largely active in the informal sector and do not maintain or report formal accounts. SMEs operate in various areas of economic activity, including trade, services, industry, agriculture and other provisions. The vast majority of Senegalese SMEs have a majority of shareholders.

The purpose of this article is to investigate the factors that motivate innovation within SMEs in Senegal, which is defined referencing the Olso manual of the Organization for Economic Co-operation and Development (OECD) (2005). It is the implementation of a new product or the significant improvement of a product (good or service), a process, a new method of marketing or a new method of organisation in business practices, work organisation or relations with the outside world. From the OECD perspective, we examine four dimensions of innovation: product innovation, market innovation, process innovation and organisational innovation. Using a sample of 1107 Senegalese SMEs surveyed in 2007 and 2014, we estimate a logistic econometric model to explain innovation referencing certain firm and manager characteristics. The results demonstrate that innovation among SMEs is influenced by several firm characteristics and that this influence varies according to the type of innovation.

The remainder of this paper is organised as follows. In section 2, we briefly review the literature on the determinants of innovation. In section 3, we present the data and estimation methodology. In section 4, we present the results obtained. Finally, section 5 presents our conclusions.

2. Review of the literature

Research regarding the determinants of innovation has experienced a revival in recent years. This work has essentially sought to highlight the role of SMEs' internal and external characteristics in relation to the capacity for innovation. Research on the internal characteristics often has focused on the influence of size, age, form of ownership and managers' experience.

Studies investigating external characteristics have examined aspects such as location, the economic dynamics of the external environment (growth, level of competition, level of competitiveness and related factors), access to credit and openness to the outside world, among other concerns.

Firm age is among the factors that have been the most analysed regarding the determinants of innovation; however, the relationship between this variable and innovation is not clearly defined. Intuitively, we expect a positive relationship between firm age and its capacity for innovation. Indeed, older firms are expected to have more experience in improving efficiency and thus in innovating. However, a negative relationship may well be observed between the two variables, as in some cases, change may be more difficult for well-established firms than for new firms. This was demonstrated by Shefer and Frenkel (2005), who examined industrial firms in the northern part of Israel and found that younger firms were more likely to invest in research and development compared with older, more established firms. Montalvan-Burbano et al. (2019) sought to identify the factors that influence activities associated with organisational innovation of SMEs in the hospitality sector in the province of Santa Elena, Ecuador, determining that age had a highly significant negative impact on organisational innovation.

The relationship between firm size and innovation has been the subject of several studies (Damanpour, 2010; Laforet, 2008; Bertschek and Entorf, 1996), but the results remain mixed, as argued by several meta-analyses on the topic (Baumane-Vītoliņa et al., 2022; Khosravi, Newton, and Rezvani, 2019; Camisón-Zornoza et al., 2004; Lee and Xia, 2006). For example, Bertschek and Entorf (1996) found the relationship between innovation and firm size to be nonlinear, indicating that small and large firms are more innovative than medium-sized firms. Damanpour (2010) reviewed the results of empirical studies on the relationship between size and innovation and his findings reveal that the quantitative analysis of research results did not produce evidence regarding the effect of size on product and process innovation. Saunila and Ukko (2014) analysed the intangible aspects of innovation focusing on the influence of size and industry on innovation in Finnish SMEs. The authors found firm size to have no significant effect on innovation capabilities. Montalvan-Burbano et al. (2019) also found that size has no influence on organisational innovation.

Foreign ownership is generally expected to have a positive influence on innovation because firms with foreign ownership can leverage the assets held by foreign partners to strengthen innovation capabilities; however, this link is not entirely linear. For example, parent companies may limit the transfer of specific assets to firms operating in other countries when they do not hold a significant majority stake. Guadalupe et al. (2012) found that parent companies of multinational firms acquire firms in foreign countries that are considered more conducive to product and process innovation and adoption of new technologies.

The relationship between innovation and exporting has been extensively analysed (D'Angelo et al., 2020; Love and Roper, 2015; Golovko and Valentini, 2014; García et al., 2012; etc.). García et al. (2012) examined the influence of learning via export on the efficiency of 1534 Spanish manufacturing firms from 1990 to 2002, determining that Spanish manufacturing firms that export are more productive than those that do not[1]. The authors' main hypothesis was that through interaction with foreign agents in the process of exporting, firms acquire new knowledge (advanced technologies or advanced knowledge). Alvarez and Robertson (2004), Criscuolo, Haskel and Slaughter (2010) and Salomon and Shaver (2005) demonstrated that

[1] Nevertheless, they find that the influence of knowledge acquired through exporting depends on the technological capabilities of firms.

export sales have a positive effect on firms' innovation through a process called 'learning-by-exporting'. Shu and Steinwender (2019) reviewed the research on the impact of trade liberalisation on firms' innovation performance, finding that trade liberalisation boosts productivity and innovation in emerging countries. In developed countries, export opportunities and access to imported intermediate products tend to encourage innovation. The positive effects of trade on innovation are more pronounced in firms that are initially more productive, while the negative effects are more pronounced in those identified as initially less productive. Golovko and Valentini (2014) found that large firms engage more in process innovation after entering export markets. The authors analysed the learning-by-exporting phenomenon using a panel of Spanish firms from 1990 to 2002, determining that export markets allow firms to be in contact with a portfolio of knowledge that is not available in the local market and is likely to boost innovation capabilities.

Access to credit is an essential element of firms' innovative capacity (Bayarçelik, Taşel, and Apak, 2014; Lecerf, 2012; Laforet, 2011). It contributes to SMEs' financial strength, which Lecerf (2012) identified as an important lever of innovation. This idea was also supported by Laforet (2011), who argued that the resources available for innovation are more related to financial factors and employee skills in the context of SMEs. Xie et al. (2013) also asserted that financial capital is one of the resources needed for a firm to start up and develop.

3. Methodology and data

In this study, we estimate a logit model to explain the characteristics of SMEs that influence innovation. A binary dependent variable is used in this, which is defined as follows:

$$Y_t = \begin{cases} 1, & \text{if SME t innovates} \\ O, & \text{otherwise} \end{cases} \quad (1)$$

Our model describes the probability that Y_t = 1, considering a class of binary response models of the following form:

$$P(Y_t = 1|X_t) = F(X_t'\beta) = F(Zt) \quad (2)$$

Here, F is a strictly increasing function taking values between zero and one, X_t is the column vector of the full set of explanatory variables associated with firm *t*, one of which takes the value 1 and β is the vector of explanatory variables, representing SME characteristics. We use the logistic distribution function as a function of F.[2] The characteristics considered in the model are the internal characteristics of the firm and its manager that were previously presented in the literature review, including firm size and age, managers' gender, level of education and professional experience and firms' region of operation.

We use World Bank data on the SMEs in Senegal in 2007 and in 2014. The sample includes 1107 SMEs (506 in 2007 and 601 in 2014) from various sectors of activity. These data provide information on the SMEs' and managers' characteristics as well as innovation behaviour. In the sample, SME market innovation is more significant (67%) in comparison with organisational innovation (35%).

[2] The models were estimated using Stata 17 software.

Table 1: Proportion of firms using the different types of innovation

Variable	Percentage	Standard deviation	Number of observations
New or improved product introduced in the last three years	47.57%	0.50	597
New or improved product for the market	67.02%	0.47	282
New production methods introduced in the last three years	39.67%	0.49	600
Innovation in organisational management	35.12%	0.48	598

Source: Authors based on World Bank data for Senegal in 2007 and 2014.

Table 2 shows that a significant number of SMEs in the sample conducted no innovation at all (over 39%). More than 20% introduced more than four innovation techniques, almost 11% introduced two innovation techniques and 18% introduced one innovation technique.

Table 2: Distribution of enterprises based on the number of innovations

Number of innovation techniques	Number	Percentage
0	236	39.33%
1	110	18.33%
2	70	11.67%
3	65	10.83%
4	119	19.83%
All	**600**	**100.00%**

Source: Authors based on World Bank data for Senegal in 2007 and 2014.

Table 3 shows that the proportion of SMEs competing with others is quite high (83%). In contrast, research and development (R&D) is quite low (4%), as are SMEs with foreign ownership (9%). Furthermore, 29% of SMEs reported having access to credit and 10% exported abroad.

Table 3: Characteristics of firms according to the determinants of innovation

Variable	Mean	Min	Max	Standard deviation	Number of observations
Competing with others	0.83	0	1	0.37	1,107
Research and development	0.04	0	1	0.19	1,107
The manager is a woman	0.11	0	1	0.32	600
Export sales	0.10	0	1	0.30	1,107

Access to credit	0.29	0	1	0.45	1,107
Foreign ownership	0.09	0	1	0.29	1,107
Manager's experience	17.00	0	60	10.58	1,106
Region of operation	1.76	1	4	1.12	1,107
Size of firm	1.66	1	4	1.00	1,107
Age of firm in 2014	17.56	1	84	11.29	1,107

Source: Authors based on World Bank data for Senegal in 2007 and 2014.

4. Results and discussion

The results of the estimation of the explanatory factors for SME innovation are presented in Table 4, detailing the results of the robust version of our binomial logit model that considers the problems related to autocorrelation and error heteroscedasticity. The convergence of the two models highlights the robustness of the results obtained.

The results demonstrate that innovation in SMEs is influenced by several firm characteristics, and this influence varies according to the type of innovation. For example, firm size significantly influences market and organisational innovation but has no influence on product and process innovation. Firm age significantly influences product innovation but has no influence on other forms of innovation. Foreign ownership only influences organisational innovation, whereas export sales influence both organisational and process innovation. The region of operation significantly influences organisational and market innovation but has no influence on product and process innovation. Manager's experience and access to credit do not influence any of the four forms of innovation.

Table 4: Robust standard error binomial logistic regression results

Variables	**(1) Model 1: Product innovation**	**(2) Model 2: Market innovation**	**(3) Model 3: Process innovation**	**(4) Model 4: Organisational innovation**
Export sales	0.441	0.552	0.781**	1.046***
	(0.331)	(0.451)	(0.324)	(0.344)
Access to credit	0.271	0.091	0.300	0.289
	(0.181)	(0.286)	(0.184)	(0.191)
Foreign ownership	0.359	-0.388	0.203	0.632**
	(0.282)	(0.385)	(0.281)	(0.275)
Manager's experience	0.005	0.009	-0.011	0.004
	(0.008)	(0.012)	(0.008)	(0.008)
Region of operation	0.254	-0.655**	0.182	0.618***
	(0.196)	(0.312)	(0.200)	(0.214)
Size of firm	-0.008	0.288**	-0.026	-0.172*
	(0.090)	(0.140)	(0.090)	(0.092)
Age of firm in 2014	-0.001***	-0.001	-0.000	-0.000
	(0.000)	(0.001)	(0.000)	(0.000)
Competing with	0.374*	-0.141	-0.324	0.403*

others				
	(0.199)	(0.308)	(0.205)	(0.224)
Research & development	0.612*	1.008*	1.408***	1.132***
	(0.364)	(0.549)	(0.380)	(0.348)
The manager is a woman	0.070	0.084	-0.051	-0.065
	(0.271)	(0.414)	(0.269)	(0.281)
Constant	-0.770***	0.381	-0.348	-1.358***
	(0.247)	(0.397)	(0.249)	(0.278)
Observations	596	282	599	597
Pseudo R-squared	0.0413			

Notes: Robust standard errors are in parentheses; *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

Export sales have a notably significant impact on organisational and process innovation. This result aligns with García et al. (2012), D'Angelo et al. (2020) and Golovko and Valentini (2014). The European Commission (European Commission, 2010) estimates that European SMEs that export (products or services) grow twice as fast as those that do not and that internationally active SMEs are three times more innovative with the products and services in their sector than those with a domestic focus. Generally, there is ample evidence that exporting SMEs have access to knowledge externalities in foreign markets, which they are likely to use to advance efficiency (García et al., 2012). Analysing 1534 Spanish manufacturing firms (from 1990 to 2002), García et al. (2012) found that firms' productivity increased after deciding to export, which is equated with the acquisition of new knowledge.

Access to credit is positively correlated with all forms of innovation but its influence is weak. This result contradicts Aidoo (2019) and Wellalage and Locke (2020). Aidoo (2019) analysed the impact of credit access on process innovation in manufacturing and service SMEs in African and Middle Eastern economies, finding access to credit to have a significant impact on process innovation. Wellalage and Locke (2020) analysed the effect of formal credit on SME innovation in developing countries, determining that the availability of formal credit stimulated all four types of innovation. The authors also found informal credit to be crucial for firms in imperfect capital markets.

Foreign ownership has a positive and highly significant influence on management innovation but has no effect on product, market and process innovation. The positive influence of foreign ownership on SME innovation is widely accepted in the literature (Udimal et al., 2019). In contrast, these results contradict those of Díaz-Díaz et al. (2008), who found that foreign ownership had no impact on innovation based on a sample of 1267 Spanish industrial firms. However, the authors note that the link between foreign ownership and innovation is nonlinear, in which a negative effect was observed below a certain level of foreign ownership concentration.

SME managers' experience has no influence on the four forms of innovation; rather, it is positively correlated with innovation, as in most studies (see Byukusenge and Munene, 2017), except for process innovation. The region of operation has a significant negative effect on market innovation. In contrast, its influence is significantly positive on organisational innovation. The region taken as a reference is Dakar. SMEs located in the Dakar region have a

higher probability of organisational innovation than those located in the other three regions. On the other hand, they have a lower probability of innovating on the market level than those located in the other regions.

Size is significantly and positively correlated with market innovation and negatively correlated with organisational innovation. This ambiguous relationship aligns with the literature that highlights an ambiguous relationship between size and innovation (Baumane-Vītoliņa et al., 2022; Khosravi, Newton, & Rezvani, 2019; Camisón-Zornoza et al., 2004; Lee & Xia, 2006). The positive influence of firm size on market innovation seems to validate the perspective that large SMEs have advantages in exploring new markets (Azar & Ciabuschi, 2017; Hansen, 2010; Nieves, 2016). The negative influence of firm size on organisational innovation corroborates arguments contending that organisational change is more difficult in larger organisations due to the associated costs (Pawar & Eastman, 1997; Vaccaro et al., 2012). However, the lack of a significant effect of size on product and process innovation corroborates the work of Damanpour (2010) and Saunila and Ukko (2014). In contrast, while De Mel et al. (2009) found that size influences organisational and process innovation, our results demonstrate that the influence of size on innovation is more significant for market innovation.[3]

Firm age is negatively correlated with all four forms of innovation and its influence is highly significant on product innovation. This result is consistent with Lee (2004), who found that younger firms are more innovative than older ones. Our results concerning managers' age and experience are consistent with Harel, Schwartz and Kaufmann (2021), who determined that the dominance of managers in the innovation process is particularly high.

Competition acts positively and significantly on product and organisational innovation, which aligns with research arguing the importance of competition in for motivating firm competitiveness (see Hlioui, Gabsi, and Omri, 2022; Ganter and Hecker, 2013; Hecker and Ganter, 2013; Moen, Tvedten, and Wold, 2018; Salayou, Baltas, and Lioukas, 2004). Moen, Tvedten and Wold (2018) determined that competition influenced most innovation indicators very strongly in the context of Norwegian SMEs. Hlioui et al. (2022) also found that the direct effect of competition improved innovation.

R&D positively and significantly influences each of the four forms of innovation and is more significant for process and organisational innovation. This result is consistent with the majority of research regarding the determinants of innovation (Balsmeier and Czarnitzk, 2014; Wellalage and Locke, 2020; Udimal et al., 2019). In contrast, managers' gender has no influence on innovation regardless of the type of innovation considered. This result contradicts those of Ruiz-Jiménez and Fuentes-Fuentes (2016), who determined that gender had a highly significant impact on innovation and a positive moderating influence on the relationship between managerial capabilities and innovation.

5. Conclusion

This study sought to analyse the factors that determine innovation among SMEs in Senegal. Using data from a World Bank survey of SMEs, we analysed the relationship between firm characteristics and innovation using an ordinary least squares estimator. To our knowledge, this study is one of the few empirical works regarding the determinants of innovation among SMEs in Senegal and West Africa. The results show that R&D, export sales, region of operation and

[3] There is a positive correlation between firm size and product and market innovation, and a negative correlation is observed between process and organisational innovation.

competition are the most significant determinants of innovation for Senegalese SMEs. R&D is the firm characteristic that most affects innovation, regardless of the type of innovation. Opening up to foreign markets through exports has a significant impact on organisational and process innovation. Opening up to foreign countries via the opening of capital to foreign shareholders has a positive influence on organisational innovation. Competition also has positive effects on organisational and product innovation. Firm size acts differently according to the type of innovation, with a positive effect on market innovation but a negative effect on organisational innovation. The manager's gender has no effect on innovation. Organisational innovation appears to be most affected by firm characteristics of the, whereas process innovation is the least affected by the same characteristics. Manager's characteristics in terms of experience and gender do not seem to be a determining factor for the different types of innovation analysed. Knowledge externalities linked to openness to foreign countries (via exports and foreign ownership) seem to benefit SMEs more, primarily at the organisational level.

In light of these results, we recommend a greater opening of Senegalese SMEs to the international market to benefit from the knowledge externalities of partner firms. This opening can be accomplished by competing in foreign markets as well as opening capital to foreign shareholders. We also advocate more significant development of R&D at the SME level, as it is proven to be very decisive for all types of innovation.

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