

The innovative behaviour of agri-food industry`s firms in El Salvador

Elias Humberto PERAZA CASTANEDA

Alumno del Doctorado en Economía. Universidad de Valladolid
Avenida del Valle Esgueva, 6 – 47011, Valladolid. Tel: +34-983423898

eliashumberto.peraza@alumnos.uva.es

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ABSTRACT: The agri-food industry is of great importance for the Central American economies and the Salvadoran economy is not an exception. This paper seeks to determine which of internal and external factors known for the innovation economics literature are crucial to the innovative behaviour of agri-food companies in El Salvador. In this paper first, the concept of innovation in the agri-food industry companies` specific context for a less developed country is analysed. Then the results of a review of the literature on the factors affecting business innovation are presented. Next, the situation of innovation in Salvadoran agri-food companies is briefly characterized using the information of 155 observations which represent to the 378 firms that were included in the first National Survey of Innovation 2013. Finally, an empirical study of the innovative behaviour of companies is realized through a binary logistic regression analysis, where the dependent variable are the various forms of innovation and explanatory variables are the variables that characterize the economic and innovative activity of Salvadoran agri-food industry`s firms.

1. INTRODUCTION

The agri-food industry is linked both commercially and technologically with the agricultural sector and it is of great importance for the Central American economies, which have historically depended on this sector (Soluri, 2009). The Salvadoran economy is not an exception, with an industrial development marked by the influence of their agricultural export past, which provided reasonable profit to economic power during the early twentieth century, because of this economy has been inserted late in activities with higher added value (Acuña Ortega, 1994). In addition, this sector has been affected by cycles in public policy support and other solid weak support in recent decades.

Overall, the first National Innovation Survey 2013 about manufacturing companies reinforces the idea that innovation is present in the activity of the agri-food industry and it is considered within the formula of the sector's competitiveness and its strategy for revitalizing the productive resources of their companies. As for the characteristics of this sector in El Salvador, it has a clear territorial concentration in two departments: San Salvador and La Libertad. In addition, the industry appears with a specialization profile in these departments and others such as Sonsonate and Usulután.

The agri-food industry has an important role in terms of competitiveness in El Salvador as shown its productivity and its export capacity. For the first aspect, the food industry is the 9.4% of the Salvadoran economy in 2012. Besides, this sector shows a high productivity, especially for subsector about beverage. For the second aspect, the food industry has a dynamic export performance, its main commercial destination is Central America and its largest single client is United States.

2. THE PHENOMENON OF INNOVATION IN THE CONTEXT OF THE SALVADORAN AGRI-FOOD INDUSTRY

In a context where Salvadoran food industry's companies are aware of the need to innovate for keeping their competitiveness in both domestic and international markets, the present paper analyses the determinants that may influence such innovation. Innovation is understood in the terms established by the OECD (OCDE, 2005), which in the case of the agri-food industry would be reflected: in product innovations, such as functional foods (Annunziata y Vecchio, 2011; Jones y Jew, 2007; Sirò *et al.*, 2008); process innovations as those aimed at promoting the safety, traceability and quality of foods by developing technologies designed to monitor pathogens and other hazards from farm to fork (Aung y Chang, 2014; Caswell *et al.*, 2008; FAO, 2003; U.S. GAO, 2005). About organizational innovations, a lot of these have been derived from necessary adjustments to meet ISO quality standards (IOS, 2000; Rao *et al.*, 1997), showing that in this sector, the firm's organizational structure has followed to the strategic decisions (Chandler, 1962). As for marketing innovations, computer systems have facilitated the consumer brand management and relationships, so most studies agree that the development of new packaging and product

formulations in the face of changing preferences consumers in the food and beverage industry is a key element (Tollin, 2008).

3. DETERMINANTS OF INNOVATIVE ACTIVITY

The study of business innovation is an active area of research, because of it is associated with potential improvements in productivity (Salavou y Avlonitis, 2008). In addition, innovation enables companies to discover and exploit new business opportunities, by creating an added value that gives them a stronger competitive position (Fernández Moreno *et al.*, 2008; Hitt *et al.*, 1996). One of the most important lines of business innovation in research is focusing on the analysis of its determinants (Damanpour *et al.*, 2009) .

There is extensive literature on these determinants of the various innovation processes into the firms, distinguishing between internal and external factors (Águila Obra y Padilla Meléndez, 2010; Drucker, 1994; Rodríguez y Guzmán, 2013; Rogers, 1995). Internal factors are linked to the various features of the organizations (Galende y Fuente, 2003). These factors are, to a greater or lesser extent, under the control of the organization and therefore directly affected by business decisions (Hadjimanolis, 2000). External factors, however, are related to the business environment and affect all organizations. These exogenous factors are linked to socio-economic and administrative context in which the organization operates and can be taken to take advantage or alleviate disadvantage, whether they are opportunities or threats (Liñán, 2007).

For observing the possible relationship between the various factors and the innovative behaviour's firms is necessary to establish variables that quantifying it. This process may arise in some cases, several additional variables indicative alternatives for the same appearance or conditioning factor. The internal factors are: business size; the age of the company; planning activities and management capacity; export propensity; research capacity and human capital. The external factors are: the existence of public funding; the presence of agglomeration economies; and the overall level of economic dynamism of the business environment (Gómez García y Aleixandre Mendizábal, 2014).

The business dimension, in terms of number of employees or annual turnover, is a factor that is traditionally considered to favour innovative behaviour in firms, although researches into such cases have not always yielded few conclusive results. The age of the company, or

business age, is also one of the factors that usually have been considered as possible determinants of innovative behaviour in organizations. However, the results of research carried out on a potential impact positively on the innovation process can't be considered conclusive, nor for traditional firms (Do, 2014; Galende y Fuente, 2003; Hansen, 1992; Sorensen y Stuart, 2000).

The export propensity is other aspect that raise the existence of a possible link between innovation and the characteristics of the market in which the firm operates. A first indicator of the potential ratio is the proportion of sales in foreign markets on the total annual turnover of the company. In this regard, several studies (Buesa Blanco y Molero Zayas, 1998; Flor Peris *et al.*, 2004; Nassimbeni, 2001; Wakelin, 1998) indicate that the companies that innovate tend to have greater export share and, simultaneously, that exporting firms improve their ability to innovate to remain competitive.

Two particularly interesting internal factors are: first, research capacity which influence positively in generating innovation processes at firms. The R&D expenditure in firms is a relevant indicator (Águila Obra y Padilla Meléndez, 2010; Borra Marcos *et al.*, 2005; Galende y Fuente, 2003); and also and the degree of availability and use of ICT in business, confirming that the greater the use of ICT greater commitment exists in the company with innovative activity (Espasandín *et al.*, 2004). Second, the human capital of companies is another factor considered of particular relevance to the innovative behaviour of companies, being able to establish a direct and positive relationship between human capital formation, innovation and business competitiveness (Dakhli y Clerq, 2004; Galende y Fuente, 2003; Pizarro Moreno *et al.*, 2011). In addition, both internal factors may characterize whether the agri-food system innovation in El Salvador is more DUI type, based on synthetic knowledge or STI type, based on the analytical knowledge (Asheim, 2009; Berg Jensen *et al.*, 2007).

Among external factors, belonging to the business environment, which may condition their innovative activity, it highlights the influence of the actions of the government, primarily through policies to promote business innovation and technological improvement (Arthurs *et al.*, 2009; Herrera y Heijs, 2007; Rolfo y Calabrese, 2003; Veciana Vergés, 2007). Other contextual factors, that may be relevant for innovation in enterprises, are the level of

income per capita in the economic area where those are located. As for the impact of this factor, it is proposed that the highly developed areas have start-ups mature and innovative, internationalized and efficient (European Commission, 2010; Romero y Martínez-Román, 2012).

Finally, the last factor in the environment that can also reach conditioning business innovation within a territory is the population and demographic dynamics (Fagerberg *et al.*, 2009; Goto, 2000; Weil, 2013). Thus, in principle, the population has a particular region or geographic area, there will be greater potential in terms of human capital; i.e. people who, to receive appropriate training and qualifications, generate ideas that are not subject to diminishing returns (Weil, 2013). The same could also be said for potential consumers of goods and services and employees. As occurs in the previous case, also this factor the external environment of the company can be approximated both from a static perspective, using a reference value in terms of a certain number of people; as well as from other dynamics, through the evolution of the population and labour growth.

4. INNOVATIVE ACTIVITY IN AGRI-FOOD INDUSTRY AT EL SALVADOR

The analysis of the determinants of innovation in the agri-food industry of El Salvador needs to be framed in the context of innovative activity in this sector in Central American developing countries (Gu *et al.*, 2012; Padilla Pérez, 2013).

The results of the first survey on innovation for El Salvador (Ministry of Economy, 2013) shows that that at least 42,06% of surveyed firms in the agri-food sector have introduced some form of innovation over the past three years. Analysing the type of innovation carried out by the Salvadoran agri-food sector firms, the technological ones (products / process) more frequent than the organizational or marketing ones. Thus, 33,60% of the firms in this sector stated to have made some technological innovation compared to 24,87 % that reported having carried out any marketing or organizational ones.

Technological innovations in particular are supported in an intense way through research and development activities (R&D), although it is not the only way. In El Salvador, 24,34% of agri-food industry firms perform R&D activities and 11,11% have a specific R&D department. The main alternative way to carry out innovation activities is the acquisition of technologically advanced equipment for developing countries (Dutrénit y Sutz, 2014).

5. THE DETERMINING FACTORS IN INNOVATION OF AGRIFOOD INDUSTRY'S FIRMS IN EL SALVADOR

Starting from the information available to firms 378 agri-food Industry's firms in El Salvador, then the influence of various factors, according to previously exposed, can condition the innovative behaviour of these analyses. To this end, it carried out an econometric analysis using a binary logistic regression model to different types of innovation (product, process and organizational- marketing). It is consistent with the methodology used for the study of innovative behaviour by Berg Jensen *et al.* (2007) and specific to that sector by Acosta *et al.* (2015).

Before the econometric analysis, a bivariate analysis to identify relationships between the different determinants and the decision to innovate in the firm has been conducted, considering both the internal and the external factors previously described. The results are summarized in Table 1 and Table 2

. In both Tables, the columns show four different forms of innovation: (1) "any kind of innovation" (2) "product innovation" (3) "process innovation" and (4) "organizational or marketing innovation". Meanwhile, the corresponding rows show the indicative variables of the determinants of innovation. Besides, for each determinant, there is a business segmentation criterion and the number of firms that fulfil the criteria. The statistical test used to contrast in crosstabs was the chi-square Pearson, distinguishing between different levels of statistical significance (Carneiro *et al.*, 2011; Hicks *et al.*, 2009; Ruiz-Maya Pérez *et al.*, 1990).

In the case of internal factors and with reference to "any kind of innovation" (Table 1, column 1), five factors show statistical significance at 1%: size of firm, sales of firm, employment of firm, make R&D activities, use industrial property; and 2 factors can be added if the significance is 5%: Percentage of employees with university degree, percentage of export over sales. Hence, for these variables the hypothesis of no relationship between them and the innovative behaviour is rejected. That is not the case of three variables: age of the firm, location of headquarters in El Salvador and presence of foreign capital.

The significant factors in product innovation decision (column 2) are different to those of the previous analysis, although they share six determinants. Nine factors show statistical significance at 1%: Size of firm, sales of firm, employment of firm, age of firm, make R&D activities, use industrial property, localization in El Salvador and presence of foreign capital; and one factor can be added if the significance is 5%: percentage of export over sales. Only the relationship between product innovation and percentage of employees with university degree is rejected.

The number of related factor is smaller if "innovation process" is analysed (column 3). Two factors are significant at 1%: Use industrial property and localization in El Salvador, and one determinant can be added if the significance is 5%: Sales of firms. Finally, the "organizational-marketing Sales" (column 4) has the same determinants of process innovation (column 3) but adding localization in El Salvador with a significance of 5%.

Table 1. Internal factors conditioning innovation in Salvadoran agri-food industry

		Any Innovation (1)		Product innovation (2)		Process innovation (3)		Org-Mark Innovation (4)	
		% Yes	Sig. χ^2 Pearson	% Yes	Sig. χ^2 Pearson	% Yes	Sig. χ^2 Pearson	% Yes	Sig. χ^2 Pearson
		Size of firm	Small [n ₀ = 267]	34.1%		15.0%		21.7%	
	Median [n ₁ = 43]	55.8%	0.000***	34.5%	0.000***	16.7%	0.118	31.0%	0.087*
	Big [n ₂ = 70]	64.3%		40.0%		31.8%		33.3%	
Sales of firm	<1 mill US\$ [n ₀ = 244]	32.4%		13.1%		23.8%		20.8%	
	1-7 mill US\$ [n ₁ = 76]	53.9%	0.000***	34.2%	0.000***	13.0%	0.020**	32.9%	0.046**
	≥7 mill. US\$ [n ₂ = 58]	66.7%		41.4%		33.3%		31.6%	
Employment of firm	≤ 50 per [n ₀ = 266]	34.6%		15.4%		21.4%		20.8%	
	51-100 per [n ₁ = 42]	48.8%	0.000***	31.0%	0.000***	16.7%	0.060*	34.1%	0.025**
	≥ 100 per [n ₂ = 72]	66.7%		40.3%		33.3%		33.8%	
% of employees with university degree	≤5% employ. [n ₀ = 152]	35.5%		17.8%		24.2%		21.1%	
	>5% employ. [n ₁ = 226]	46.5%	0.035**	24.3%	0.128	22.1%	0.640	27.4%	0.159
% export over sales	Nothing [n ₀ = 276]	37.8%		18.1%		21.0%		23.6%	
	≤40% Sales [n ₁ = 78]	53.8%	0.024**	32.1%	0.014**	28.2%	0.339	33.3%	0.066*

	>40% Sales [n ₂ = 25]	52.0%		30.0%		28.0%		12.0%	
Age of firm	<10 years [n ₀ = 66]	51.5%		37.9%		18.2%		28.4%	
	11-20 years [n ₁ = 142]	41.8%	0.195	18.3%	0.003***	29.1%	0.093*	19.1%	0.129
	≥20 years [n ₂ = 171]	38.6%		18.7%		19.9%		28.5%	
	Make R&D activities	No [n ₀ = 287]	32.8%		11.1%	0.000***	16.7%	0.000***	20.9%
	Yes[n ₁ = 92]	70.7%	0.000***	55.4%	0.000***	42.9%	0.000***	37.0%	0.002***
Use industrial property	No [n ₀ = 355]	38.3%		17.7%	0.000***	20.8%		23.1%	
	Yes[n ₁ = 24]	100.0%	0.000***	83.3%	0.000***	58.3%	0.000***	52.2%	0.002***
Localization in El Salvador	No [n ₀ = 194]	40.7%		27.5%	0.006***	22.7%		20.1%	
	Yes[n ₁ = 185]	43.5%	0.567	15.8%	0.006***	23.3%	0.874	29.7%	0.030**
Presence of foreign capital	No [n ₀ = 349]	41.7%		20.1%	0.003***	23.2%		25.2%	
	Yes[n ₁ = 30]	46.7%	0.595	43.3%	0.003***	20.7%	0.757	20.7%	0.588

Note: *** significant to 1%; ** significant to 5%; * significant to 10%.

In the case of external factors, there are few determinants that show statistically significant linkages to the different types of innovation (Table 2). All determinants refer to socio-economic variables of the department where the firms are located and the division in two groups use the national average for the considered variables, e.g., 76 agri-food firms are located in departments with less than 297 inhabitant/Km², which is the national average, and 319 firms are located in more populated departments.

With reference to "product innovation" (Table 2, column 2), one factor shows statistical significance at 5%: annual accumulative growth of employment in 2007-2012; and three factors can be added if the significance is 10%: Population density, annual accumulative growth of population in 2007-2012 and annual accumulative growth of industrial Employment in 2007-2012. Hence, for these variables the hypothesis of no relationship between them and the innovative behaviour is rejected.

For "organizational and marketing innovations" (column 4) one factor shows relation with the innovative behaviour of the company at 5% significance: Population density; and another can be considered if significance is 10%: annual accumulative growth of industrial Employment in 2007-2012.

Two type innovation, “any type of innovation” (Table 2, column 1) and “process innovation” (Table2, column 3) do not have significant link to any external factor. Hence, the Salvadoran agro-food firms are only influenced by the socio-economic environment in the case of product innovations and non-technological innovations.

Table 2. External factors conditioning innovation in Salvadoran agri-food industry

		Any Innovation (1)		Product innovation (2)		Process innovation (3)		Org-mark innovation (4)	
		% Yes	Sig. χ^2 Pearson	% Yes	Sig. χ^2 Pearson	% Yes	Sig. χ^2 Pearson	% Yes	Sig. χ^2 Pearson
Population Density 2012	≤ 297 inh/km ² [n ₀ = 76]	38.7%	0.506	28.9%	0.097*	21.3%	0.699	15.4%	0.042**
	> 297 inh/km ² [n ₁ = 303]	42.9%		20.1%		23.4%		27.1%	
Δ Annual Population 2007-2012	$\leq 1.7\%$ [n ₀ = 60]	36.7%	0.343	30.0%	0.098*	23.7%	0.887	18.6%	0.229
	$> 1.7\%$ [n ₁ = 319]	43.3%		20.4%		22.9%		26.0%	
Business Density	≤ 7.7 emp/km ² [n ₀ = 58]	39.7%	0.686	27.6%	0.237	24.1%	0.857	20.7%	0.424
	> 7.7 emp/km ² [n ₁ = 320]	42.5%		20.6%		23.1%		25.6%	
Δ Employment 2007-2012	$\leq 3.32\%$ [n ₀ = 248]	41.9%	0.879	18.5%	0.030**	21.9%	0.464	27.8%	0.610
	$> 3.32\%$ [n ₁ = 131]	42.7%		28.2%		25.2%		19.1%	
% Industrial Employment	$\leq 15.9\%$ total [n ₀ = 67]	40.3%	0.726	28.4%	0.159	23.9%	0.843	19.4%	0.259
	$> 15.9\%$ total [n ₁ = 312]	42.6%		20.5%		22.8%		26.0%	
Δ Annual industrial Emp. 2007-2012	$\leq 1.65\%$ [n ₀ = 160]	38.8%	0.264	26.9%	0.036*	21.3%	0.485	20.5%	0.095*
	$> 1.65\%$ [n ₁ = 218]	44.5%		17.9%		24.3%		28.0%	

Note: *** significant to 1%; ** significant to 5%; * significant to 10%.

In order to analyse the influence of previously identified external and internal determinants in an integrated way a multivariate binary logistic regression model is implemented. As different types of innovation can be considered ("any innovation", "product innovation", "innovation process" and "marketing or organizational innovation"), up to four models are formulated. In all these models, the dependent variable is 1 if the firm has innovated and 0 otherwise. All the independent variables included in the models, which are those that show a possible link in the previous bivariate analysis, are categorical (Table 3).

Table 3. Explicative variables of innovation in Salvadoran agri-food industry

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
tamano	Size of firm	149	0.8658	0.8903	0	2
ven_12_cat	Sales of firm	149	0.8389	0.8388	0	2
emp_12_cat	Employment of firm	149	0.8456	0.9059	0	2
por_emp_for_univ_cat	% of employees with univ. degree	149	0.6309	0.4842	0	1
exp_ven_12_cat	% export over sales	149	0.4899	0.684	0	2
edad_cat	Age of firm	149	1.3423	0.7331	0	2
act_I_D	Make R&D activities	149	0.3154	0.4663	0	1
inv_prop	Use industrial property	149	0.0738	0.2624	0	1
capital	Localization in El Salvador	149	0.4899	0.5016	0	1
cap_ext_cat	Presence of foreign capital	149	0.1208	0.327	0	1
den_pob_12_cat	Population density	149	0.8188	0.3865	0	1
inc_pob_5a_cat	Δ Annual population 2007-2012	149	0.8456	0.3625	0	1
inc_ocu_ind_cat	Δ Annual industrial emp. 2007-2012	149	0.5705	0.4967	0	1
inc_ocu_5a_cat	Δ Employment 2007-2012	149	0.3423	0.4761	0	1

All models used a total of 149 observations representing a total of 378 agri-food Salvadoran firms; therefore, the weight method was implemented. For all the models different estimations were run in order to improve the resultant models in the different types of innovation. These estimations took into consideration the relationship among independent variables and the values of the estimators Pseudo-R² Nagelkerke, the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), which show acceptable values that they allow admitting the four models of this research as valid.

Table 4 shows the results of the model estimates binary multivariate logistic regression corresponding to four models considered in the innovative behaviour of firms: Any innovation (1), product innovation (2); process innovation (3) and organisational or marketing innovation (4). In these models the relationship between independent variables was evaluated and none of them shows problems of multicollinearity.

Table 4. Results of the econometric analysis of innovation in Salvadoran agri-food industry

Factor	Any innovation (1)		Product innovation (2)		Process innovation (3)		Org-Mark innovation (4)	
	Value	Sig.	Value	Sig.	Value	Sig.	Value	Sig.
act_I_D	1,597 (6,10)	***	2,051 (5,92)	***	1,518 (4,67)	***	0,666 (2,40)	**
0.sales_12_cat			0 (.)		0 (.)			
1.sales_12_cat			1,318 (3,54)	***	-1,170 (-2,81)	***		
2.sales_12_cat			0,831 (1,87)	*	-0,233 (-0,60)			
0.age_cat			0 (.)		0 (.)			
1.age_cat			-1,087 (-2,62)	***	0,770 (1,89)	*		
2.age_cat			-1,298 (-3,10)	***	-0,0401 (-0,10)	**		
ind_prop			3,281 (4,62)	***	1,028 (2,18)	**	0,942 (2,06)	**
capital			-1,082 (-3,11)	***			0,506 (2,06)	**
constant	-0,712 (-5,67)	***	-1,369 (-3,99)	***	-1,828 (-4,88)	***	-1,626 (-8,06)	***
Pseudo R2	0,080		0,332		0,118		0,043	
AIC	478,4		281,4		374,6		414,2	
BIC	484,5		305,4		395,6		426,2	
N	149		149		149		149	

t statistics in parentheses. * p<0.10, ** p<0.05, *** p<0.01

The model that estimates the relation between the presence of any innovation and the internal and external determinants (Table 4, column 1) identifies only the execution of R&D activities (*act_I_D*) as explanatory variable, with a significance of 1% and positive sign. Therefore, this presence of R&D activities as an explanatory factor is in line with the science push model of innovation, where R&D activities are an important source of knowledge generation, subsequently, in the process of innovation generation (Di Stefano *et al.*, 2012).

For product innovation model (Table 4, column 2), five determinants are related to an innovative behaviour at a significance of 1%: the R&D activities (*act_I_D*), sales of the firm (*sales_12*); age of the firm (*age_cat*), use industrial property (*ind_prop*) and location in San Salvador (*capital*). R&D activities (*act_I_D*) maintain the positive sign, the same as

sales (*sales_12*) and use of industrial property rights (*ind_prop*). These results show the importance for the generation of product innovation in the Salvadoran agri-food ecosystem of three elements: firstly, the economies of scales; secondly, the push of science; and, thirdly, the use by firms of the industrial property protection system.

On the contrary, the age of firms (*age_cat*) is a significant variable but with negative sign. So, younger companies are more likely to generate product innovations, perhaps because they are more aware of the importance of innovation in the performance of firms. In addition, the fact of being located in the country's capital (*capital*) is negatively related to the realisation of product innovation. Hence, the presence of urbanization economies is not detected, at least in the product innovation generation of the agro-food sector.

With regard to process innovation model (Table 4, column 3), two determinants are significant at 1%: the execution of R&D activities (*act_I_D*) and the firm's sales (*sales_12*). The first determinant keeps the positive sign as in previous models, but sales changes its sign to negative. Therefore, economies of scale play a different role in the innovation generation of the agri-food Salvadoran industry and an increase of sales is only linked to product innovations. With a significance of 5%, appears the use of industrial property rights (*ind_prop*), which keeps the positive sign of other types of innovations.

Finally, the organizational and marketing innovation model (Table 4, column 4), do not have any significant relationship between the innovative performance and the internal and external determinant at a 1% level of significance. At a 5% level of significance, three variables can be considered: the execution of R&D activities (*act_I_D*), use of industrial property rights (*ind_prop*) and the fact of being located in the country's capital (*capital*). The first two variable keep the positive sign as in the other kind of innovations, and, therefore, they can be interpreted in a similar way. For the third variable, the capital location, the positive sign can be interpreted as the importance of urbanisation economics for the realisation of these types of innovation, just the contrary that happened for the product innovations.

6. MAIN RESULTS OF THE EMPIRICAL STUDY AND CONCLUSIONS

In a globalized and knowledge-based economy, agri-food companies have to innovate to maintain and improve their competitive options on the market. This behaviour has taken

place both in developed and developing countries. For the latter countries, as is the case of El Salvador, that is special relevant as agri-food industry account for important share of the national employment, production and exports (Domínguez, 2014).

When delving into the analysis of innovative behaviour of these Salvadoran firms, it is possible to identify various internal conditioning factors to the organization that can foster innovation while the results don't allow noting a clear influence of external to innovate.

The results of the empirical study show that determinants of innovation vary depending on the types of innovation consider, although some of them are present in all of cases, i.e. R&D activities and the use of industry property right are positively related with all kind of innovations in the Salvadoran agri-food industry. Hence, the support of these activities and the reinforcement of intellectual property protection system can be an action line for public policies.

Within the group of factors that are linked in a special way a certain type of innovation are: the sales of firms, the age of firms and location of the firm in the country's capital.

The sales of firms is positively related with product innovations while is negatively related with process innovation. This factor is linked to the relevance of economies of scale in the innovation process. Hence, the size of the Salvadoran agri-food firms can play a role in the way that they decides to innovate, being more frequent the product innovator among the big companies and more frequent the process innovator among the small companies.

The age is negatively related with product innovation. An explanation to this result is that younger firms are more likely to generate product innovations to enter in the market while more mature companies are more liked to improve their processes, as a way implement a cost leadership strategy.

Finally, the urbanisation economies, included by the variable of being located in El Salvador shows the rise of urban diseconomies in some types of technology innovations, while in the non-technological the proximity to a big cosmopolitan area influence positively.

The results of the analysis provide new empirical evidence for a developing country on the determinants of the innovative behaviour of the agri-food industry firms. Although the

study is quite temporal and spatial limited, the results can serve as guidance for Salvadoran agri-food business when making innovation related decisions about their expenditure on R&D activities, their use of industrial property or their location. Besides, it makes them aware of the importance of economies of scale in product innovation process or the need to keep their innovation efforts whatever their age. Besides, these results can be useful for Salvadoran Public Administration in the design of policies to promote business innovation in the agri-food industry, as some internal determinants are identified as related to different forms of innovation.

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