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Business Innovation in the Spanish Companies (2003-2016): The Human Factors Definitely Count

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BUSINESS INNOVATION IN THE SPANISH COMPANIES (2003-2016):

THE HUMAN FACTORS DEFINITELY COUNT

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Abstract

This research analyses determining factors of business innovation in Spain during a long period of study. A panel is carried out with data from 2003 to 2016 obtained from the Spanish Technological Innovation Panel (PITEC) survey to determine their influence, and in particular variables related to human factors are included to observe their impact on innovation. Along with other general factors such as firm size, ownership of the company, turnover and financing of the company, it is found that training in R & D & I has a relevant influence on business innovation. The article put special emphasis on human factors and is an invitation to continue their study.

Keywords: business innovation, panel data, RDI

1. Introduction

A multitude of economic studies have demonstrated the importance of academic research on innovation and economic growth (Griffith, 2000; Klette & Griliches, 2000; Tushman, 1977; Griliches, 1998; Tidd Bessant & Pavitt, 2005; Veugelers, 2014; among other relevant examples). Innovation is clearly considered one of the fundamental strategic elements for improving business competitiveness, including for small and medium-sized companies (Acs & Audretsch, 1990; Moya, Alemán, & de Lema, 2011).

The strategy used by the company to position itself in the market is a factor that plays a key role, not only in the performance of the company, but also in the innovative attitude it adopts (Moya, Alemán, & de Lema, 2011). For this reason, analysing the factors influencing the research strategy and innovative activity is a central issue in business management, being especially important in the case of SMEs, due to their weight in our economy and employment.

In the rest of the article, we will delve into the situation of Spanish companies when addressing the research and innovation processes, and after setting the scene on the subject of study, an analysis will be carried using data from the Spanish Technological Innovation Panel (PITEC), which is carried out yearly by the Spanish National Statistics Institute (INE), as a basis, to finally draw the conclusions that emerge from said analysis.

2. Theoretical Background

Several systematic reviews can be found addressing innovation management in all types of companies, including small and medium-sized companies (Pittaway et al, 2004; Thorpe, et al, 2005). There is consensus in affirming the superiority of large companies in the field of innovation (Acs & Audretsch, 1990; Nieto & Santamaría, 2010) given that they can rely on their formal processes, and internal capacities and abilities, to develop innovations; capabilities that have been considered strategic assets closely controlled by the company (Iturrioz, Aragón, & Narvaiza, 2015).

Business performance has been linked to innovation and innovative companies can achieve up to twice the profitability (Akgun, et al, 2007; Tidd, Bessant & Pavitt, 2005). In addition to drive performance and growth, the innovation improves a wide variety of

capabilities of the company that allow it to delve the ability to enter new markets and attract its customers, as Charan and Lafley (2008) point out.

Regarding how to obtain economic resources for research and innovation, there is a nascent, but fast-growing literature on the financing of innovation that made large advances in recent years (see Kerr & Nanda, 2015, for a comprehensive overview). Empirical studies often compare different levels of aid, the national and the regional, and also the European ones (Arranz et al., 2019; Blanes & Busom, 2004). Key factors identified that exert an influence on the innovation include, amongst others, size of the company, education of the employees, level of internationalisation, organisational environment, technological innovation and markets (Mol & Birkinshaw, 2009; Bujidos et al, 2019; Azar & Ciabuschi, 2017). There are also plenty of studies which examine the linkages between R&D and productivity, determinants of R&D or adoption of technology (Seenaiah, & Rath, 2018).

Other relevant factors observed in the literature as key determinants of innovative activity and economic success are the personnel: the qualified human resources and the knowledge base they represent (Hoffman et al., 1998). With the human resources, the companies can promote particular behaviours that can foster group innovation by influencing individual proactivity (Lee et al., 2019; Tajeddini, Martin, & Altinay, 2020). Recently, Hernandez et al. (2020) demonstrated that process innovation favours survival when companies have high level of employees' education (i.e doctorate degree employees), Employee innovativeness is argued to cover a broader range of behaviours than creativity (Rao, 2016), however, there is little systematic understanding of how employee engagement can drive innovation in organizations.

3. Empirical Analysis

3.1. Data

The data have been collected from a survey by the National Statistics Institute (INE). This survey is conducted annually and accumulated over 13 years, forming panel data. The data are structured to ensure that each individual's responses in the sample, the enterprises, can be compared to track their evolution. This is achieved by implementing an identity variable for one. According to INE (2016), the survey focuses on collecting

information on the resources invested in innovation and the general characteristics of firms operating in Spain.

The data used covers 2003 to 2016, having a sample consisting of more than 6000 companies and more than 40,000 observations. This annual survey collects information from companies of any size and economic sector operating anywhere in Spain. It is assumed that the sample has comparative value and allows assessment and compare the evolution of innovation in Spanish companies at an international level (INE, 2016). The main statistics of the variables used to do this study will be included in table 1, these will help to understand the future model, the size of the variables and the observations included.

[Table 1 goes around here]

The dependent variable is quantitative, as it expresses innovation in numerical and continuous terms. The explanatory variables used are those that explain the general functioning of the firm (sector of activity, ownership of the firm, percentage of women in the firm, income and size of the firm) and others that focus on the characteristics of innovation. Within the variables that study business innovation, they are divided between:

The funds used for R&D&I investment by the companies, depending on their origin. This investment can be public or private. Within public funding, it is divided between that from the different regions of Spain, that from the State and obtained from European funds. Private investment can be internal, with the company's funds, or external, with funds from other companies or individuals. Variables are also used to analyse the importance of the proportion of the workforce dedicated to innovation, distinguishing between researchers and PhDs. The study also considers whether researchers are paid, whether the company has patents and whether it is located in a Technology Park.

The variables and their abbreviations will be compiled in table 2. These abbreviations will be used in the Correlation Matrix (see table 3).

[Table 2 goes around here]

Once the variables have been defined, the correlation matrix will analyse whether the explanatory variables used are related to the independent variable and whether this relationship is appropriate for a study. The correlation matrix is shown in the table 3.

[Table 3 goes around here]

The correlation matrix of this study shows an adequate correlation between the variables in the model. The results note a relation without multicollinearity, which prevents the correct estimation of the model. At first glance, it is possible to know which variables will best estimate the dependent variable and what relationship they will have with it. These relationships will be studied in the results section of this paper.

3.2 Methodology

To start with the study of the data and the creation of the model, the methodology, in this case it is necessary to start with the way in which we obtain the data. Given the way the data are arranged, Panel Data, it should be ensuring the proper use of the data to obtain correct estimation of the models. Panel Data models have two dimensions (Stock & Watson, 2011). In this case, the first is firms, and the second is time. Individuals must be maintained over time, as a panel data study must be able to analyse their evolution over time. If data are not available for all individuals over time, they are considered missing data.

Therefore, it can be deduced that in a Panel Data Model, individuals are followed over time, seeing how their main variables change. The Panel Data on Innovation in Spanish firms would be a short panel model, with many individuals in a short time, also this panel is unbalanced as it is impossible to follow the study in many firms, having a lot of missing values. Unbalanced models are not appropriate for various estimations, so first, proceed to find a balanced panel of data for estimations (Torrecillas & Labra, 2014).

Before balancing the panel, we will create the variables we want to use to estimate the dependent variable. The dependent variable reflects the investment in R&D&I during the years 2003 to 2007. The variable is expressed as a logarithm due to the high numbers present in the responses. As mentioned in section 3, the investment will be estimated with variables such as market sector, type of financing of the investment, income, weight of researchers in the firms' workforce and ownership of the firms. Once created, all missing values are removed, and the panel is balanced in STATA (Torrecillas & Labra, 2014).

This process is sometimes unnecessary, but given many missing values in the panel, it seems advisable to do so. After this, four years are removed from the panel, having from 2007 to 2016, and a large number of observations, resulting in 1309 individuals and 13090 observations.

The dependent variable used is quantitative and continuous and yields results as a function of the amount of money spent on R&D&I innovation. For this dependent variable and panel data, a standard regression model considering a time factor could be estimated. The models that could be used are the Aggregate Model, the fixed-effect model, and the random-effects model. The most apparent problem with the Aggregate Model is that it does not consider the time factor in the estimation, losing all the interest that panel data provides (Wooldridge, 2010).

The estimation considers several types of factors that should correctly explain a firm's decision-making. First, aspects related to the firm itself, the sector of work, firm size, ownership, and sector of work that should impact the firm's strategic decisions are assessed. After that, an analysis of variables related to the source of investment funding and expenditure on research professionals within the company will be performed.

The following subsections explain the estimation models used.

3.2.1. Aggregated Model

Equation 1 shows the model, where X_{ji} are the independent variables used, v_i is the error term, β_0 is the constant term, and β_j are the regression coefficients. The pooled model estimates that individuals are heterogeneous but that all individuals are equal to each other. This model does not take panel data into account.

$$TEI_i = \beta_0 + \beta_j X_{ji} + v_i \quad (1)$$

3.2.2. Fixed-Effects Model

Fixed effects assume that the covariance between the individual and the explanatory variables is different from 0. Fixed-effects models can be performed using dichotomous

variables, the between estimators and the within-groups fixed-effect estimator itself. The between estimators use the mean of a variable over time but generates unbiased but inefficient estimators. While within-groups fixed-effect estimator gives efficient estimations, it transforms the model in the following way:

$$(y_{it} - \bar{y}_i) = (x_{it} - \bar{x}_i)\beta + e_{it} - \bar{e}_i \quad (2)$$

This model eliminates unobserved heterogeneity. Its main problem is that it eliminates values that are constant over time. In addition, the model proposes a test to compare it with an Aggregated model, using as H_0 that individuals are homogeneous. Thanks to this test, it will be possible to choose between one or the other (Wooldridge, 2010).

3.2.3. Random-Effects Model

The model assumes that there is no relationship between unobserved heterogeneity of the sample and the explanatory variables. The random-effects model ensures an efficient estimator considering the time effect (Wooldridge, 2010).

$$(y_{it} - \theta \bar{y}_i) = \mu(1 - \theta) + (x_{it} - \theta \bar{x}_i)\beta + v_{it}(1 - \theta) \quad (3)$$

After the estimation using random effects, the Breusch and Pagan statistical test should be effectuated (Breusch & Pagan, 1980). This test distinguishes between the Aggregate and Random models, with the same null hypothesis, the homogeneity of individuals.

Between fixed-effect and random-effects models, the decision is more complex. The fixed-effect model studies well the stable variables at t, so if there are many of these variables in the model, random effects should be used. However, suppose unobserved heterogeneity is correlated with controls. In that case, random-effects will not be considered, and fixed-effects will be the appropriate model. For this analysis, the Hausman test is going to be used (Hausman, 1978). This test examines whether unobserved heterogeneity is correlated with the explanatory variables by comparing both estimators. Two hypotheses are put forward. H_0 if the estimators are equal, the random-effects are more efficient, and H_1 , if the estimators are different, the fixed-effects are consistent with the random-effects.

In the results section, this whole process will be developed to find the best model that reflects the above, commenting only on the model that best fits.

4. Results and discussion

After applying the procedures set out in the methodology to the Technological Innovation Data Panel. A model capable of adequately estimating the evolution of investment in Research, Development, and Innovation (R&D&I) in Spain has been developed. During the process, successive ways of calculating the regression model on innovation were discarded, distinguishing between the fixed-effects model, the random-effects model and the aggregate model of the regression.

To distinguish between the fixed-effect model and the aggregate model, the test offered by the fixed-effect model is used to analyse whether there is heterogeneity between individuals. The test result, which has a p-value equal to 0, indicates that in this case, they are heterogeneous among themselves and, therefore, they must be analysed over time, discarding the Aggregate Model. The Breusch and Pagan (1980) test is used to select between the random-effects model and the aggregate model, which also yields a p-value of 0, indicating that the population is not homogeneous and, therefore, the random effects estimator is used.

The last distinction between the fixed-effect models and the random-effects model will be analysed using the Hausman test (Hausman, 1978). In this case, the Hausman test, with a p-value equal to 0, estimates that it is preferable to use the fixed-effect model because it is consistent instead of the random-effects model, which will not be efficient in estimation. The fixed-effects model is represented in the table 4.

[Table 4 goes around here]

This model is chosen to estimate business investment in R&D&I in Spain from 2007 to 2016. The starting year is 2007 because, after panel balancing, the omission of all missing values for the analysis, the first four years of the study were lost. Still, the analysis is rich as it covers the 2008 economic crisis and will serve to see the factors that influence the evolution of investment during an economic depression and its subsequent recovery,

which is similar to the current situation, where after the current Covid-19 depression, a situation of economic stimulus will be reached.

That said, the model ends up with 13090 observations from 1309 firms and shows a correlation between the individual variance and the explanatory variables of 0.38, which explains the choice of the fixed-effect model. The R^2 are those corresponding to the internal estimator of 0.12, the intermediate estimator of 0.47 and the overall estimator of 0.41, with average values, indicating that the model partly explains the variance of firms' propensity to invest.

Almost every explanatory variable is significant when related to the dependent variable, and, according to the F estimator, overall significance exists. The variables chosen were those that were significant in most of the previous estimations. However, whether the firm is privately owned or located in a technology park is not significant in the fixed-effect model. This difference could be explained by the fact that the fixed-effect model does not correctly analyse constant variables over time, and these are usually permanent conditions. However, it is worth noting that being a public company is significant and negatively related to business investment in innovation. This variable may be highly significant or, due to some privatisations that have taken place during this decade, it has been spared this problem.

As for the individual significance of the variables (see table 1), the total revenues obtained by the company throughout its financial year are significant in estimating how much it will invest. It is observed that during the decade studied, the company's revenues were directly related to the amount that the company invested in the future. Total revenues are also related to variables that refer to the size of the company. Thus, large firms, which tend to have higher profits, tend to invest more, as this is significantly and positively related to total investment, whereas micro-SMEs, tend to invest less, which may be since a smaller number of workers find it more challenging to adapt to new developments.

Other variables study the origin of the capital used by the company for the investment in innovation; these variables yield exciting results. Internal financing, coming from the funds obtained by the company from its operations, external financing, coming from other companies, and public financing, whether from the regions, the State, or the European

Union, are significant and positively related to investment. In contrast, investment from universities is not significant in the estimation.

The explanatory variables in the model related to the research within firms, such as full-time researchers and PhDs in the workforce, are directly related to final investment in R&D and innovation. It can also be related to the firm's patent development, which is also significant in this estimation, if a firm's researchers and their patents ultimately imply higher capital expenditure in innovation. Furthermore, the retribution to these researchers is registered as a variable. The variable is significant and inversely related to the final investment, which is expected, as it implies costs increases.

Another perspective would be to mention that variables related to the firm's sector of activity, innovation expenditure, the number of women in firms, and female researchers' proportion in firms are not significantly related to this research. Therefore, it could be said that the firms' sector, their expenditure, and the number of women in the workforce do not imply substantial changes in the final investment of the firms.

5. Conclusions

This article shows a comprehensive vision of the evolution of business innovation in Spain over more than ten years, which allows a robust overview of the factors that encourage and discourage it. Some of these factors have already been dealt with in the literature, but some others have been less studied and deserve to be analysed, particularly those related to human resources and company employees. Thus, it is observed that the training of employees exerts a greater influence on the external resources of personnel in R&D. They also exert influence, as has been observed, although practically not relevant are those related to ownership, firm size and location. These are relevant in the final financing, along with training and entrepreneurial research, of these companies. This is to be expected, as the organisation and business plan of the company is a sign of a strong enterprise capable of research and innovation.

The findings of this research support prior studies suggesting innovation requires coordinated management and leadership. The human resources within an organization are the single most important ingredient in the innovation success formula (Rao, 2016). The

innovative potential of an organisation resides in the knowledge, skills and abilities of its employees. (Patterson, Kerrin & Gatto, 2009), employee commitment and trust are key for the innovation. In this line, the salary result that coincides with the extant literature indicating proactive behaviour of employees at work is affected by contextual variables is not surprising (e.g., Belschak & Den Hartog, 2010).

Other relevant result is the observed differences between the origin of the funds (state, regional or European) that cannot simply by typical cost-based financial approaches. We agree with Sierra (2019) considering that alternative views are needed where innovation funding decisions are strategic and concern interactions between actors, each with their own characteristics and strategic intentions.

The present investigation shows some limitations, the most relevant being the difficulty of obtaining results beyond the factors already included in the survey, which constrains the analysis and does not allow the introduction of new variables that could be useful. Likewise, by including a long period of time to make the analysis more solid and robust and to have a long-term vision of the innovation phenomenon, it is difficult to process the data, homogenize it and establish a solid and robust sample, prepared for so many years.

In any case, we consider that the findings raised here, in particular and especially those related to the company's employees (their training, their qualifications, salary, etc.) represent a noteworthy contribution and, at the same time, an invitation to continue delving into topics that relate human resources and innovation, which is an exciting challenge for any researcher on these topics

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Table 1. Main Statistics.

VARIABLE		MEAN	STD. DEV.	MIN	MAX	OBS
TEI	OVERALL	13.5648	1.697661	6.206576	20.03076	N=13090
	BETWEEN		1.571337	9.410526	19.30159	n=1309
	WITHIN		0.6439347	7.499607	17.71544	T=10
PUC	OVERALL	0.0318564	0.1756243	0	1	N=13090
	BETWEEN		0.1687823	0	1	n=1309
	WITHIN		0.0487447	-0.8681436	0.9318564	T=10
PRC	OVERALL	0.6983193	0.4590049	0	1	N=13090
	BETWEEN		0.4218029	0	1	n=1309
	WITHIN		0.1813566	-0.2016807	1.598319	T=10
IPRC	OVERALL	0.2278839	0.4194833	0	1	N=13090
	BETWEEN		0.3841192	0	1	n=1309
	WITHIN		0.168879	-0.6721161	1.127884	T=10
TU	OVERALL	16.97486	1.933518	10.30136	23.64707	N=13090
	BETWEEN		1.903078	11.90632	23.19562	n=1309
	WITHIN		0.3453658	10.56701	22.10024	T=10
IN	OVERALL	13.25835	2.353523	4.204693	22.5471	N=13090
	BETWEEN		2.065728	7.763509	20.97803	n=1309
	WITHIN		1.129058	4.72512	19.11273	T=10
LE	OVERALL	0.370741	0.4830217	0	1	N=13090
	BETWEEN		0.462814	0	1	n=1309
	WITHIN		0.138782	-0.529259	1.270741	T=10
MSME	OVERALL	0.0266616	0.1610985	0	1	N=13090
	BETWEEN		0.1395699	0	1	n=1309
	WITHIN		0.080538	-0.8733384	0.9266616	T=10
ORRDI	OVERALL	0.9446142	0.2287405	0	1	N=13090
	BETWEEN		0.1853473	0	1	n=1309
	WITHIN		0.134135	0.0446142	1.844614	T=10
ERRDI	OVERALL	44.17248	31.35278	0	100	N=13090
	BETWEEN		26.01461	0	100	n=1309
	WITHIN		17.51292	-45.82752	134.1725	T=10
TRDI	OVERALL	5.281199	12.12594	0	100	N=13090
	BETWEEN		9.807983	0	86.11	n=1309
	WITHIN		7.134993	-69.7288	95.2812	T=10
REW	OVERALL	36.32391	25.37232	0	99.7	N=13090
	BETWEEN		20.27868	0	98.9	n=1309
	WITHIN		15.2582	-49.11609	117.3539	T=10
PHDW	OVERALL	0.3624905	0.4807377	0	1	N=13090
	BETWEEN		0.359821	0	1	n=1309

	WITHIN		0.3189461	-0.5375095	1.26249 T=10
RTR	OVERALL	0.4713522	0.4991977	0	1 N=13090
	BETWEEN		0.3689556	0	1 n=1309
	WITHIN		0.3363982	-0.4286478	1.371352 T=10
PT	OVERALL	0.1719633	0.377363	0	1 N=13090
	BETWEEN		0.2996954	0	1 n=1309
	WITHIN		0.2294499	-0.7280367	1.071963 T=10
TP	OVERALL	0.0946524	0.2927454	0	1 N=13090
	BETWEEN		0.274534	0	1 n=1309
	WITHIN		0.1018958	-0.8053476	0.9946524 T=10
REGF	OVERALL	0.2578304	0.4374569	0	1 N=13090
	BETWEEN		0.3439875	0	1 n=1309
	WITHIN		0.2704117	-0.6421696	1.15783 T=10
STF	OVERALL	2.191719	11.04602	0	100 N=13090
	BETWEEN		8.362471	0	79.12 n=1309
	WITHIN		7.220228	-57.80828	92.19172 T=10
EUF	OVERALL	0.2628724	0.4402105	0	1 N=13090
	BETWEEN		0.3057747	0	1 n=1309
	WITHIN		0.316783	-0.6371276	1.162872 T=10

Table 2. List of variables used in the analysis.

Dependent Variable		Values
TEI	Total Expenditure on Innovation	Logarithmic value of R&D&I investment
Explanatory Variables		Values
PUC	Public Company	Public Company = 1, otherwise = 0
PRC	Private Company	Private Company = 1, otherwise = 0
IPRC	International Private Company	International Private Company = 1, otherwise = 0
TU	Turnover	Logarithmic value of turnover
IN	Investment	Logarithmic value of investment
LE	Large Enterprise	Large Enterprise = 1, otherwise = 0
MSME	Micro SME	Micro SME = 1, otherwise = 0
ORRDI	Own Resources in R&D&I	Percentage of Own Resources in R&D&I investment
ERRDI	External Resources in R&D&I	Percentage of External Resources in R&D&I investment
TRDI	Training in R&D&I	Training Investment in R&D&I = 1, otherwise = 0
REW	Researchers Workforce	Percentage of Researchers in enterprise's workforce
PHDW	PhD Workforce	Percentage of PhD's in enterprise's workforce
RTR	Retribution to Researchers	Percentage of paid researchers in the company
PT	Patents	Patents = 1, otherwise = 0
TP	Technological Park	Technological Park location = 1, otherwise = 0
REGF	Regional Funding	Regional Funding in R&D&I = 1, otherwise = 0
STF	State Funding	Statal Funding in R&D&I = 1, otherwise = 0
EUF	European Union Funding	EU Funding in R&D&I = 1, otherwise = 0

Table 3. Correlation Matrix

	TEI	PUC	PRC	IPRC	TU	IN	LE	MSME	ORRDI	ERRDI	TRDI	REW	PHDW	RTR	PT	TP	REGF	STF
PUC	0.0546																	
PRC	-0.2979	-0.2760																
IPRC	0.2170	-0.0985	-0.8265															
TU	0.4942	0.0542	-0.2310	0.3319														
IN	0.5084	0.1191	-0.2471	0.2414	0.7355													
LE	0.4501	0.1310	-0.2515	0.2587	0.7062	0.5841												
MSME	-0.1650	-0.0057	0.0840	-0.0831	-0.3047	-0.2078	-0.1270											
ORRDI	0.0961	-0.0398	0.0344	-0.0444	-0.1017	-0.0827	-0.0873	0.0256										
ERRDI	-0.0275	-0.0109	-0.0347	-0.0271	-0.1705	-0.1222	-0.1227	0.0686	0.3412									
TRDI	0.0756	-0.0146	-0.0907	0.0288	-0.1311	-0.0502	-0.0764	0.0477	0.1055	0.2838								
REW	-0.1746	-0.0381	0.0576	-0.0686	-0.1917	-0.2207	-0.1651	0.0576	0.3467	0.7952	0.1986							
PHDW	0.1898	0.0134	-0.0050	-0.1107	-0.1337	-0.0148	-0.0543	-0.0074	0.1187	0.0782	0.0541	0.0076						
RTR	0.3391	0.0196	-0.0129	-0.0854	-0.0051	0.0669	0.0448	-0.0233	0.1497	0.0734	0.1223	0.0045	0.3124					
PT	0.3122	0.1675	-0.1420	-0.0830	-0.0195	0.0744	0.0622	-0.0415	0.0696	0.1451	0.1334	0.0515	0.2910	0.3342				
TP	0.1475	0.0513	-0.0593	-0.0848	-0.1797	-0.0532	-0.0553	0.0485	0.0475	0.1149	0.1264	0.0301	0.2062	0.1720	0.2503			
REGF	0.2959	-0.0065	-0.0802	0.0058	0.0932	0.1330	0.1203	-0.0379	0.0969	0.0826	0.1184	0.0161	0.1568	0.2187	0.1988	0.1071		
STF	0.1733	0.0019	-0.0984	-0.0478	-0.0600	-0.0062	-0.0065	-0.0205	0.0480	0.0793	0.0749	0.0004	0.1409	0.1252	0.2021	0.1532	0.1021	
EUF	0.1521	0.0083	-0.0279	-0.0030	0.0332	0.0603	0.0375	-0.0148	-0.0109	-0.0016	-0.0055	0.0024	0.0797	0.0824	0.0673	0.0612	0.0686	0.0205

Table 4. Estimation results Data Panel in Innovation from 2007 to 2016.

Data Panel on Innovation from 2007 to 2016	
	Coefficient
PUC	-0.247* (0.142)
PRC	0.020 (0.092)
IPRC	-0.025 (0.096)
TU	0.167*** (0.166)
IN	0.073*** (0.005)
LE	0.114*** (0.040)
MSME	-0.221*** (0.069)
ORRDI	1.05*** (0.044)
ERRDI	0.001** (0.000)
TRDI	0.153*** (0.017)
REW	0.002*** (0.000)
PHDW	0.001* (0.000)
RTR	-0.009*** (0.000)
PT	0.057*** (0.020)
TP	0.001 (0.000)
REGF	0.105*** (0.017)
STF	0.197*** (0.016)
EUf	0.064*** (0.024)
Constant	8.747*** (0.293)
n	13090
Groups	1309
R²-Within	0.127
R²-Between	0.495
R²-Within	0.429
Prob > F	0.000
F test al error=0	0.000

Hausman

0.000

Notes: Standard deviation in parenthesis. * Significant at 10%, ** significant at 5% and *** significant at 1%