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The Brazilian Public Policy to Foster Innovation: relation with innovation in products and processes and with companies' cooperation

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1. Introduction

The innovation systems approach points out that the technological advance, especially important for the development of emerging countries, results from the interaction of a series of actors and institutions (Nelson, 1993). In this approach, public policy is placed in a prominent place, as it can strengthen the capacity of innovation and interaction between actors in the system, facilitate the flow of knowledge and technology, and stimulate companies to consider innovation as one of the key aspects of their business strategy.

According to OECD (2015, p. 2), "while not a goal in itself, innovation provides the foundation for new businesses, new jobs and productivity growth and is thus an important driver of economic growth and development".

In less than two decades, there have been advances in Brazilian public policy to foster innovation, although some researchers point out much is still to be implemented in terms of a systemic view (Szapiro et al, 2016; Plonski, 2005).

In order to have a deeper understanding of the impacts of some variables of the ongoing policy, this paper aims at exploring the relationship between the Brazilian public policy to foster innovation (i) with the implementation of innovation in products and processes by the companies, as well as (ii) with the companies' cooperation with external actors in innovation activities.

Therefore, this paper applies econometric methodologies to analyse data that covers the period from 2006 to 2014, from Brazilian Innovation Survey (PINTEC – Pesquisa de Inovacao)[i], elaborated by the Brazilian Institute of Geography and Statistics (IBGE), of the Ministry of Science, Technology, Innovation and Communications.

2. Public Policy to foster innovation and the Brazilian Innovation Survey

The importance of public policies in fostering innovation is that it affects other subsystems and has the capacity to transform the competitive environment, providing favourable conditions for companies' innovative strategies (Gadelha, 2001).

In times of fiscal constraints, it should be established priorities in order to tackle the main challenges in promoting innovation. According to OECD (2015, p. 2), the agenda priorities to "strengthen innovation performance and put it to use for stronger, greener and more inclusive growth" are presented below:

a) strengthen investment in innovation and foster business dynamism;
b) invest in and shape an efficient system of knowledge creation and diffusion;
c) seize the benefits of the digital economy;
d) foster talent and skills and optimise their use;
e) improve the governance and implementation of policies for innovation.

Most of these broad priorities appear to be included in Brazilian public policy to foster innovation, although the systemic view of the policy, the intensity and applicability of the tools that allow it to be effectively implemented seems still an issue to be solved. Szapiro et al (2016) point that although the growing focus on innovation in new industrial policies is perceptible, it concludes that the absence of a systemic view on the innovation process still compromises the effectiveness of S&T policies.

The resumption of industrial policy in Brazil in 2000 decade included innovation as a key variable for increasing the competitiveness of the productive base. The establishment of funds

to support scientific and technological development, known as Sectoral Funds, through Law 10.168/2000, made possible the expansion and the sustainability of resources destined to ST&I (Szapiro, 2016). This law created the Program to Encourage University-Company Interaction for Innovation Support, whose main objective is to stimulate Brazilian technological development through cooperative scientific and technological research programs among universities, research centres and the productive sector (BRAZIL, 2000).

At the end of 2004, the Innovation Law was created, Law nº 10.973 and its alteration, which deals with incentives for innovation and scientific and technological research in the productive environment (BRASIL, 2004), in order to strengthen university-company interaction and it also launched the legal basis for the establishment of public grants to companies to apply in innovation projects.

From on this legal basis, the Brazilian Innovation Agency (FINEP- Financiadora de Estudos e Projetos), a public company linked to the Ministry of Science, Technology, Innovation and Communications, started, in 2006, to offer grants (non-reimbursable financing) using resources from sectoral funds.

Another important milestone in stimulating innovation in companies was the publication in 2005 of Law nº 11,196, known as Law of Good, which provides tax incentives, and allows depreciation and accelerated amortisation to firms conducting R&D (Brazil, 2005).

Especially for companies that belong to technology sector (hardware and automation) to invest in R&D, another source of tax incentives is the Informatics Law, Law 8.241, established in 1991, and its further alterations (Brasil, 1991). Together, Law of Good and Informatics Law constitutes the main instruments of government support to innovation.

In order to monitor and monitor the results generated by the public policies of support to innovation, the Brazilian Innovation Survey (PINTEC – Pesquisa de Inovação) was established. It is carried out by the Brazilian Institute of Geography and Statistics (IBGE), with the support of the FINEP and the Ministry of Science, Technology, Innovations and Communications. Based on the Oslo Manual, in order to allow comparability of information with other countries, it has its first publication in 2012. Currently, the six available publications, 2000, 2003, 2005, 2008, 2011 and 2014, provide sectoral information on the innovation activities carried out by Brazilian companies (Pintec, 2017).

For this research it is important to highlight that in Pintec, the sources of funds for innovation activities are classified as: (a) from the company itself), and (b) from third parties (liabilities). In the case of third party financing, it is divided into three categories: (a) public (b) from other Brazilian companies (including private banks, suppliers, other private research institutes, technology centres and universities); and (c) from abroad. We consider in this research as private financing (liabilities) the funds originated from other Brazilian companies.

3. Research design

3.1 Data collection

The data collected are related to aggregated information from PINTEC, by economic sector of companies in the Brazilian scope, according to the National Classification of Economic Activities (CNAE 2.0 - Classificacao Nacional de Atividades Economicas[ii]) and refer to: i) products and processes classified as innovative for the Brazilian market; ii) levels of public and private funding (liabilities) directed towards innovation activities; iii) tax incentives and government subsidies driven to innovation activities; iv) levels of cooperation related to innovation activities among the sectors analysed and external actors.

The period of analysis covers the years 2006 to 2014, based on three PINTEC publications: 2008, 2011 and 2014 (latest one). The publications refer to a period of three consecutive years

in the case of qualitative variables, such as innovations in products and processes implemented, and the last year of the research reference, in the case of qualitative variables. Thus, for PINTEC 2008, qualitative data refers to a 2006-2008 period, and quantitative data refers to 2008. The same applies to the other two publications (IBGE; 2010, 2013, 2016). The publications were selected in order to keep the same pattern of sectors classification, as from PINTEC 2008 the research adopts CNAE 2.0 version. Therefore, PINTEC 2008 is the first publication that possible absorbed the impacts of Law of Good in innovations activities.
For the composition of the sample, the information of the sectors that did not contain all the data for the conduction of the statistical and econometric tests was disregarded. The outliers were expurgated by means of the statistical influence of the observations, as proposed by Cameron and Trivedi (2010). After applying such procedures to exclude the data, the final sample consisted of 165 observations, as shown in Figure 1.

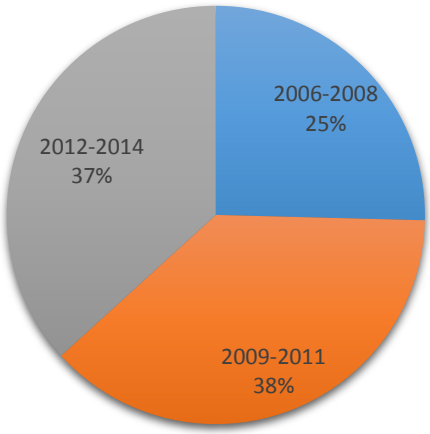

Figure 1: Frequency of data collected in relation to PINTEC publications

As shown in Figure 1, the data frequencies in the sample are relatively balanced in relation to the three PINTEC publications. A characteristic of the sample is that it is composed of only 165 observations. These observations are related to the aggregated information by sector of economic activities (CNAE) of the companies, which may avoid spurious inferences in the data analysis. It is expected, therefore, that this aggregate information in the sample captures an average behaviour within each sector in relation to the innovative efforts undertaken by companies.
Another aspect of the sample is that only the Brazilian scenario is included in the present study. Although this research design reduces the generalisation of results, it can provide more robust results by controlling factors that may be associated with innovative processes in a given country, such as: i) macro and microeconomic conditions; ii): legal enforcement and property rights; iii) political environment, among others.

3.2 Econometric models

The econometric models were developed using the Structural Equation (SE) technique. This econometric technique allows the decomposition of variances and correlations in a given conceptual model. In addition, it is useful in the development and validation of constructs (Acock, 2013). A construct can be defined as an abstract-level concept that can only be operated indirectly through observable proxies (Schumacker & Lomax, 2010).

Still on the SE, it allows to evaluate the degree of model adjustment by a series of statistical measures, according to Acock (2013):
a) Chi-Square Statistics (χ^2): this statistic indicates the adjustment of the covariance matrix for the variables used in the construct development. For this measure, it is expected not statistically significant values;
b) Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Squared Residual (SRMR): they represent the magnitude of the error term of the model. It is expected values under 0,08 to RMSEA and values under 0,05 to SRMR; and
c) Comparative Fit Index (CFI): adjustment measure between the developed model and a saturated model (without degrees of freedom).
Thus, the conceptual models developed in the present study were evaluated using the SE considering the variables presented in Table 1.

Table 1: Variables

Variables	Description	Formulas
Part_Finanpub	Average participation of public funds driven to innovation activities. These data refer to information aggregated by economic sector	$Ln\left(1+\left(\frac{FPubl_{it}}{FT_{it}}\right)\right)$
Part_Finanpriv	Average participation of private funds driven to innovation activities. These data refer to information aggregated by economic sector	$Ln\left(1+\left(\frac{FPriv_{it}}{FT_{it}}\right)\right)$
IncentF_P&D	Tax incentives drive to R&D activities -Law of Good	$Ln\left(1+\left(\frac{EA\_IncP\&D_{it}}{TE_{it}}\right)\right)$
IncentF_LeiInf	Tax incentives related to Informatics Law	$Ln\left(1+\left(\frac{EA\_LeiInf_{it}}{TE_{it}}\right)\right)$
Grants	Government grants	$Ln\left(1+\left(\frac{EA\_Sub_{it}}{TE_{it}}\right)\right)$
Product Innovation	Product innovation to Brazilian market	$Ln\left(1+\left(\frac{In\_Prod_{it}}{TE_{it}}\right)\right)$
Process Innovation	Process innovation to Brazilian market	$Ln\left(1+\left(\frac{In\_Process_{it}}{TE_{it}}\right)\right)$
Clients_Coop	Cooperation between companies (sector level) and clients in innovation activities	$Ln\left(1+\left(\frac{Coop\_Cli_{it}}{TE_{it}}\right)\right)$
Suppliers_Coop	Cooperation between companies (sector level) and suppliers in innovation activities	$Ln\left(1+\left(\frac{Coop\_Fornc_{it}}{TE_{it}}\right)\right)$
Comp_Coop	Cooperation between companies (sector level) and competitors in innovation activities	$Ln\left(1+\left(\frac{Coop\_Conc_{it}}{TE_{it}}\right)\right)$
UnvInst_Coop	Cooperation between companies (sector level) and Universities/ Research Institutes in innovation activities	$Ln\left(1+\left(\frac{Coop\_UnvInst_{it}}{TE_{it}}\right)\right)$

Source: Elaborated by the authors
ln: Logarithm neperian; $FPubl_{it}$: public funding for innovation activities for sector i and period t; $FPriv_{it}$: private funding for innovation activities for sector i and period t; FT_{it}: average total financing (own capital and third parties) for sector i and for period t; $EA\_IncP\&D_{it}$: number of companies adopting tax incentives for R&D activities (Law of Good) for sector i and period t; EA_LeiInf_{it}: number of companies adopting tax incentives related to Informatics Law for sector i and period t; EA_Sub_{it}: number of companies that makes use of government grants for sector i and period t; IN_Prod_{it}: number of products classified as innovative for the Brazilian market for sector i and period t; $Ind\_Process_{it}$: number of processes classified as innovative for the Brazilian market for sector i and period t; $Coop\_Cli_{it}$: number of companies that cooperates with clients in innovation activities in relation to sector i and period t;

Coop_Fornc_{it}: number of companies that cooperates with suppliers in innovation activities in relation to sector i and period t; Coop_Conc$_{it}$: number of companies that cooperates with competitors in innovation activities in relation to sector i and period t; Coop_UnivInst: number of companies that cooperates with universities/research institutes in innovation activities in relation to sector i and period t; e TE$_{it}$: total of companies that comprises sector i in period t.

The variables described in Table 1 were employed in three conceptual models which establish relations between the public policy to foster innovation, private funding (liabilities), cooperation processes with external actors, and innovation in products and processes for the Brazilian market.

Preliminary, but not tabulated, results obtained using the econometric technique of Structural Equations did not indicate statistically significant relationships for: (a) innovation in products and processes for the company itself; and (b) innovation in products and processes for the world market. Thus, they were not considered for the model's design.

The conceptual models 1 and 2 are presented in Figure 2. The difference between them is that the variable that represents private funding to innovation activities (Part_Finanpriv), was employed only in model 2. The letters indicated in models 1 and 2 (A to I) refers to the relationships established among the variables, and the signs in parentheses (positive or negative) indicate the expected signals for the coefficients.

The construct Public Policies to foster Innovation (Pub Pol Innovation) is formed by the variables Part_Finanpub, IncentF_P&D, IncentF_LeiInf and Grants (paths A, B, C and D). Positive signs and statistical significance were expected for these variables. It means that it was expected these variables captured the public initiatives in encouraging the innovation activities of the companies.

For Model 1, it was expected that the construct Pub Pol Innovation presented a positive and statistically significant relationship with the Product Innovation and Process Innovation (E and F path) variables. This could suggest that public policies to foster innovation have an impact on the development of new products or processes.

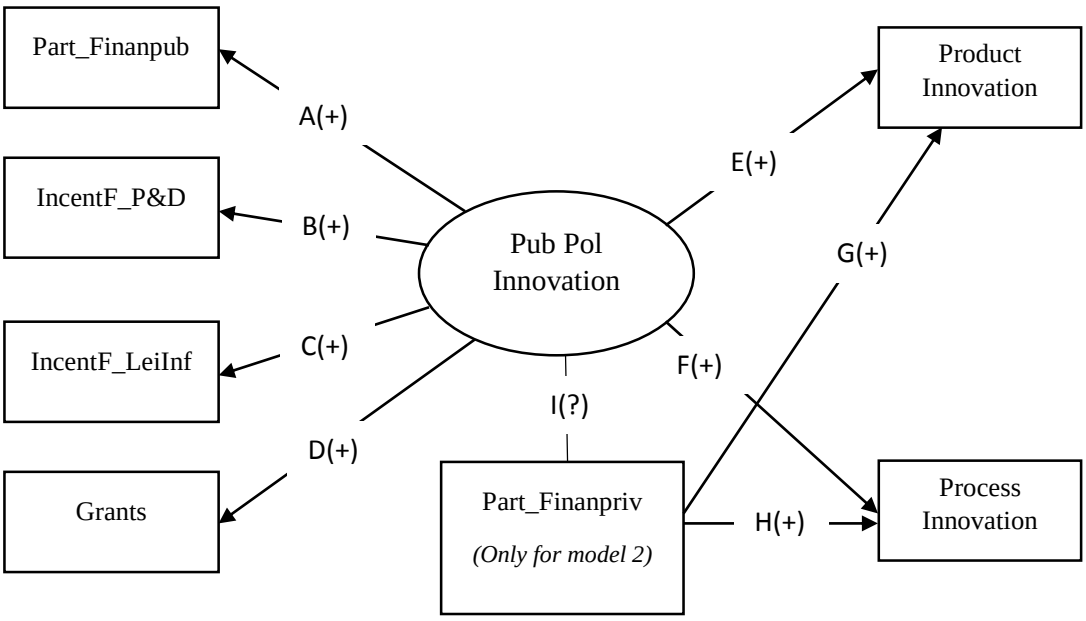

Figure 2: Models 1 and 2
Source: Elaborated by the authors

For model 2, it was expected that the relation among the variable Part_Finanpriv and the variables Product Innovation and Process Innovation (paths G and H) presented a positive sign and statistical significance, indicating, therefore, that private financing in relation to innovation activities is associated with the development of new products or processes. In model 2, it was not expected a priori a particular result between Pub Pol Innovation (construct) and the variable Part_Finanpriv (path I).

It should be emphasised that models 1 and 2 considered possible relationships among the variables that constitute the Pub Pol Innovation construct (Part_Finanpub, IncentF_P&D, IncentF_LeiInf and Grants) and Product and Innovation Process variables, by means of the specific error term of each variable.

Model 3 (Figure 3) shows the relation between the Pub Pol Innovation (construct) and (i) private funding to innovation activities and also with (ii) cooperative processes between companies and the following external actors: clients, suppliers, competitors, universities and research institutes. This model presents the relationships established (paths from A to M) as well as the expected signals for the coefficients by means of the signal, positive or negative, within parentheses.

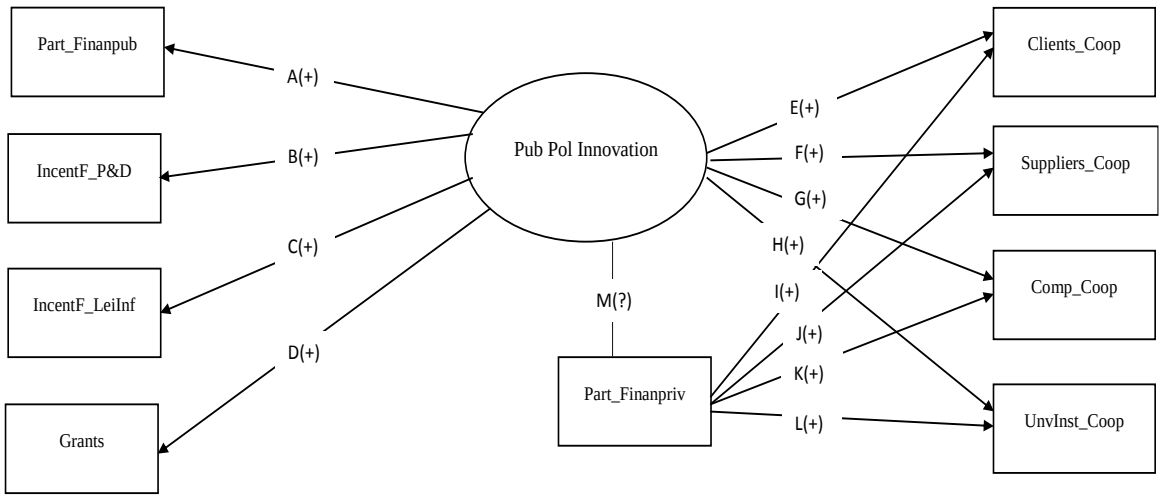

Figure 3: Model 3
Source: Elaborated by the authors

For model 3 it was expected that the variables that compose the Pub Pol Innovation construct (paths A, B, C and D) presented positive sign and statistical significance. That is, the construct was developed under the same set of variables in relation to models 1, 2 and 3.

A positive and statistically significant relationship was expected between the Pub Pol Innovation (construct) variable and the Part_Finanpriv variable with the representative variables of the cooperative processes between the companies and external actors (Clients_ Coop, Suppliers_ Coop, Comp_Coop and UnvInst_Coop). These results may indicate that certain incentives for innovation, such as public policies, may create conditions for a greater level of cooperation among different external actors in innovation activities. Still in relation to model 3, there was no expected association, a priori, between the variable Public Policies (construct) and the variable (Part_Finanpriv).

4. Results and Discussion

The initial analyses were based on descriptive statistics of the variables used in the study (Table 2).

Table 2: Descriptive statistics

Variables	Mean	Median	Standard Deviation	Coefficient of Variation
Part_Finanpriv	0,0198	0,0040	0,0447	2,2576
Part_Finanpub	0,1457	0,1000	0,1448	0,9938
IncentF_P&D	0,0696	0,0391	0,0875	1,2572
IncentF_LeiInf	0,0349	0,0068	0,0684	1,9599
Grants	0,0312	0,0106	0,0514	1,6469
Product Innovation	0,0896	0,0654	0,0888	0,9911
Process Innovation	0,0524	0,0350	0,0603	1,1508
Clients_Coop	0,0382	0,0218	0,0528	1,3822
Suppliers_Coop	0,0458	0,0296	0,0580	1,2664
Comp__Coop	0,0308	0,0144	0,0497	1,6136
UnvInst_Coop	0,0349	0,0168	0,0456	1,3066

Source: Elaborated by the authors

The descriptive statistics indicated that the variable Part_Finanpriv presented the highest Coefficient of Variation (CV), of 2.2576. This suggests a high variability of private (liabilities) funding in entrepreneurial activities related to innovation issues. The variable IncentF_LeiInf presented a relatively high CV, of 1.9599. In turn, the variables Part_Finanpub and Product_Innovation presented the lowest CV, of 0.9938 and 0.9911, respectively. In general, the descriptive statistics indicated a high dispersion of the variables, where additional tests (Swilk and Sfrancia) rejected the null hypothesis that the variables assume a normal distribution In order to obtain more information about the characteristics of the sample, a Spearman correlation test (Table 3) was performed. This test does not assume that the variables come from a normal distribution (Cameron & Trivedi, 2010). The correlation coefficients are presented in Table 3.

The variable Part_Finanpriv presented a marginally significant correlation, at the 10% level, only with the variable IcentF_P & D. The variable PartFinanpub presented positive sign and statistical significance with the other variables of the study. This result points out that public funding can be an important factor in stimulating the innovation activities in companies.

Table 3: Spearman's Correlation coefficients

Variables	1	2	3	4	5	6	7	8
1	1							
2	0,031	1						
3	-0,172*	0,157**	1					
4	0,002	0,211***	0,204***	1				
5	-0,044	0,194***	0,476***	0,426***	1			
6	-0,117	0,1419*	0,506***	0,373***	0,537***	1		
7	-0,026	0,155**	0,432***	0,271***	0,589***	0,707***	1	
8	-0,135	0,365***	0,365***	0,164**	0,279***	0,261***	0,310***	1
9	-0,095	0,571***	0,571***	0,143*	0,507***	0,323***	0,412***	0,662***
10	-0,068	0,163***	0,287***	0,163**	0,439***	0,220***	0,299***	0,478***
11	-0,045	0,236***	0,614***	0,203***	0,635***	0,522***	0,565***	0,279***

Source: Elaborated by the authors

***1% level of significance; **5% level of significance; *10% level of significance

1-Part_Finanpriv; 2-Part_Finanpub; 3-IncentF_P&D; 4-IncentF_LeiInf ; 5-Grants; 6-Product Innovation; 7-Proces
Suppliers_Coop; 10-Comp_Coop; 11-UnvIns_Coop.

The variables that measure the Pub Pol Innovation construct - PartFinanpub, IncentF_P & D, IncentF_LeiInf and Grants, presented statistically significant correlations (1% and 5% of significance), which corroborates with the idea of association among these variables. The variables Product_Innovation and Process_Innovation presented a relatively high, of 0.707, and statistically significant correlation. This may suggest a dependency between product development and innovation in processes. The variables that measure the levels of cooperation among several external actors (Clients_Coop, Suppliers_Coop, Comp_Coop and UnvInst_Coop) had positive and statistically significant correlations among themselves at 1% level.

The next step in the analysis of results is related to Models 1, 2 and 3. The results for Model 1 are presented in Figure 4.

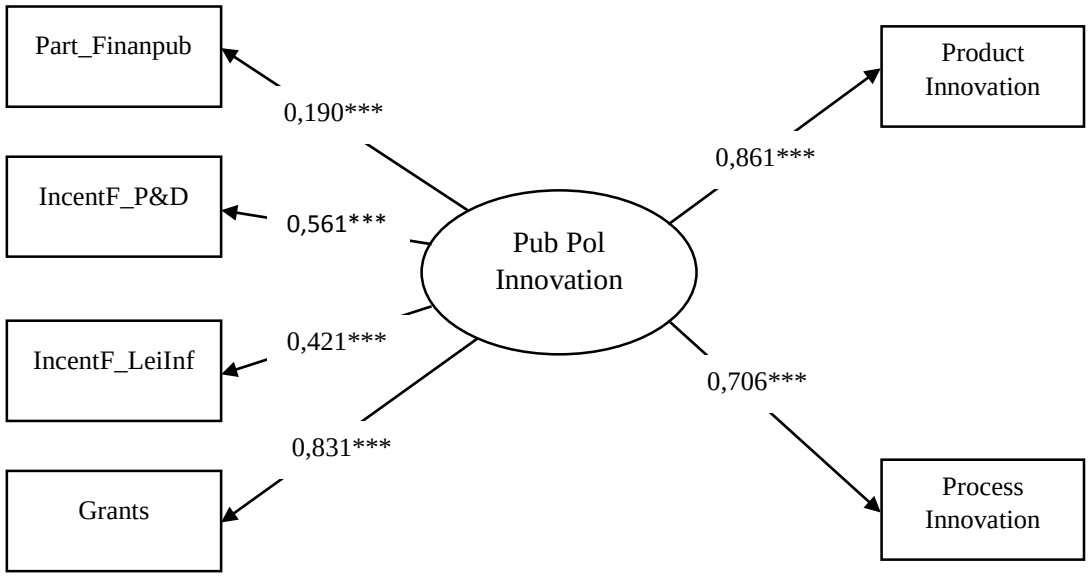

Figure 4: Model 1 – Adjust measurements

Source: Elaborated by the authors

Observations: 165; χ^2 statistics: 4,667; Probability of χ^2 statistics: 0,458; RMSEA: 0,000; CFI: 1,000; SRMSR: 0,020; Coefficient of determination: 0,940

***1% level of significance; **5% level of significance; *10% level of significance

Model 1 presented satisfactory adjustment measures. χ^2 statistics were not statistically significant and the error measures were relatively low. The variables that form the construct Publ Pol Innovation – PartFinanpub, IncentF_P&D, IncentF_LeiInf and Grants – presented coefficients with a positive sign and statistical significance.

Positive and statistically significant coefficients were identified between the Pub Pol Innovation construct and the variables Product_Innovation and Process_Innovation. The Wald test, however, pointed out that these relationships are not statistically different at the level of 5% (χ^2 = 3.41, prob> χ^2 = 0.0648). The results suggest an association between the adoption of public policies to foster innovation in the Brazilian scenario and the implementations of products and processes classified as innovative.

In Model 2, the variable Part_Finanpriv is added. The results for this model are shown in Figure 5.

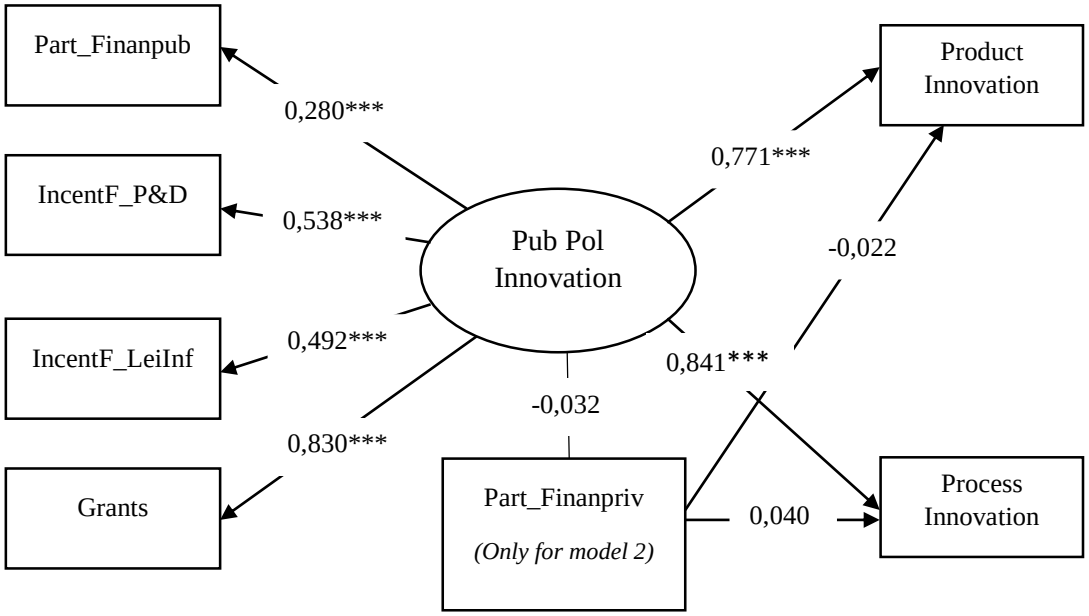

Figure 5: Model 2 – Adjust measurements

Source: Elaborated by the authors

Observations: 165; χ^2 statistics: 11,243; Probability of χ^2 statistics: 0,188; RMSEA: 0,050; CFI: 0,989; SRMSR:0,034; Coefficient of determination:0,851.

***1% level of significance; **5% level of significance; *10% level of significance

Model 2 presented adequate adjustment measures for both χ^2 statistics and error measures. The variables that comprise Pub Pol Innovation construct had a positive coefficient and statistical significance at 1% level.

The variable Part_Finanpriv did not present statistical significance with the variables Product_Innovation and Process Innovation. In addition, it was not identified a significant relationship between the Part_Finanpriv variable and the Pub Pol Innovation construct.

The construct Pub Pol Innovation presented a positive coefficient and statistical significance at 1% level with the variables Product_Innovation and Process_Innovation. Model 2 pointed out that the coefficients for this relationship were not statistically different (χ^2= 2.06, prob> χ^2 = 0.1507). As model 1, model 2 also provides evidence that public policies that encourage innovative practices by companies are linked to the in the Brazilian context.

The results for Model 3 are presented in Figure 6, and seems to be suitable to produce inferences.

The variables Part_Finanpub, IncentF_P&D, IncentF_LeiInf and Grants were statistically significant at 1% level. For Pub Innovation Pol (construct) and Part_Finanpriv variables were found compelling results. The Pub Pol Innovation variable was positively associated with the variables that measure the levels of cooperation between the companies and external actors - Clients_Coop, Suppliers_Coop, Comp_Coop and UnvInst_Coop. In addition, the coefficients of the relationship between Pub Pol Innovation (construct) and the variables Suppliers_Coop and UnvInst_Coop presented relatively high values, respectively of 0.895 and 0.820. The results for the variable Part_Finanpriv point out that private financing directed to innovation activities is not a factor associated with how companies and external actors cooperate to develop innovative products or services.

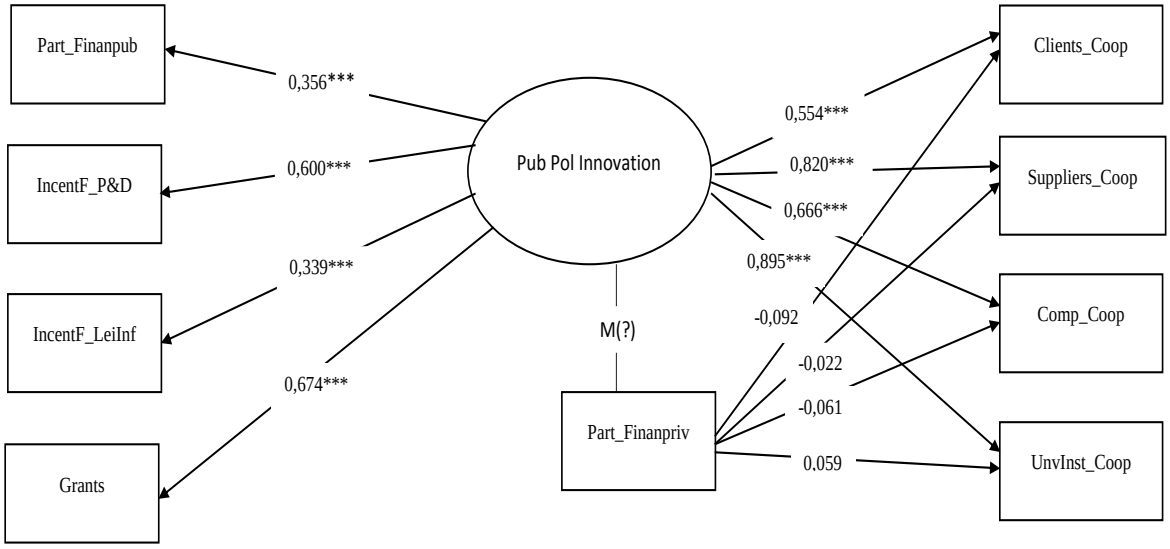

Figure 6: Model 3 – Adjust measurements

Source: Elaborated by the authors

Observations: 165; χ^2 statistics: 19,322; Probability of χ^2 statistics: 0,188; RMSEA: 0,079; CFI: 0,980; SRMSR:0,039; Coefficient of determination:0,985.

***1% level of significance; **5% level of significance; *10% level of significance.

The results found for Model 3 corroborates with the idea that public policies can strengthen mechanisms of cooperation among different actors. Networks associated with innovation activities may require investments in which the expected return usually occurs in the long run. The characteristic of these types of investments may be a factor that does not attract, at least in undeveloped markets, the attention of investors. Nevertheless, less developed markets, such as Brazil, are characterised by low legal enforcement, including property rights.

4.1 Additional tests

A concern about the results obtained in Models 1, 2 and 3 is whether the variables used in statistical and econometric tests, from the three publications of the PINTEC survey (2008, 2011 and 2014), were comparable. In order to investigate this question, a multivariate analysis of variance (MANOVA) was employed. This test aimed to identify if the means of the variables present statistically significant differences among the publications of PINTEC Survey. For this test, the coefficients obtained refer to marginal differences in relation to 2008 publication (considered as the base publication for comparison of results). The results are shown in Table 4.

Table 4: Análise Multivariada de Variância

Variables	Coefficients	Standard Error
Part_Finanpriv		
Publication 2011	-0,0273***	0,0104
Publication 2014	-0,0361***	0,0095
Constant	0,0433***	0,0085
Part_Finanpub		
Publication 2011	-0,0711	0,0595
Publication 2014	-0,0386	0,0361

Variables	Coefficients	Standard Error
Constant	0,1911***	0,0321
IncentF_P&D		
Publication 2011	0,0243	0,0224
Publication 2014	0,0590***	0,0205
Constant	0,0292	0,0182
IncentF_LeiInf		
Publication 2011	-0,0131	0,0159
Publication 2014	-0,0088	0,0145
Constante	0,0394***	0,0129
Grants		
Publication 2011	0,0051	0,0153
Publication 2014	-0,0047	0,0140
Constante	0,0320**	0,0125
Product Innovation		
Publication 2011	-0,0010	0,0277
Publication 2014	-0,0096	0,0253
Constante	0,1052	0,0225
Process Innovation		
Publication 2011	0,0019	0,0192
Publication 2014	0,0007	0,0176
Constante	0,0551	0,0156
Clients_Coop		
Publication 2011	0,0113	0,0160
Publication 2014	0,0298	0,0245
Constante	0,0216*	0,0130
Suppliers_Coop		
Publication 2011	0,0201	0,0158
Publication 2014	0,0316	0,0295
Constante	0,0226	0,0129
Comp_Coop		
Publication 2011	0,0108	0,0155
Publication 2014	0,0294	0,0241
Constante	0,0136	0,0126
UnvInst_Coop		
Publication 2011	0,0021	0,0127
Publication 2014	0,0050	0,0116
Constante	0,0317	0,0103

Source: Elaborated by the authors

***1% level of significance; **5% level of significance; *10% level of significance

The results presented in Table 4 show statistically significant differences for the average of the Part_Finanpriv variable in relation to the 2008 publication (base year) of PINTEC survey. This suggests a decline in the average use of private funds by firms in innovative activities. This result corroborates with the results obtained by models 2 and 3, in which the variable Part_Finanpriv was not associated with the other variables.

Except for the variable IncentF_P&D, for the publication of 2014, the other variables did not present statistically different averages. This result corroborates that the results of Models 1, 2 and 3 are not biased by significant changes in variables across the three publications of PINTEC survey.

5. Conclusions and constraints

According to the tests employed, public funding can be an important factor in stimulating the innovation activities in companies. The results showed that the Brazilian public policy to foster innovation has a consistent association with innovation in products and processes for the Brazilian market for the period from 2006 to 2014. The results also point out a dependency between product development and innovation in processes for the Brazilian market, what can suggest that companies are not implementing innovation just in order to reduce production and commercialization costs, but to support the development of new products.

The variables that measure the levels of cooperation among companies and external actors, especially suppliers and universities and research institutes, is associated with public efforts to innovate. Both results are consistent with the three tested models.

When the participation of private funds, as liabilities, is analysed, the results go in a different direction. It suggests that the innovation public policy is not encouraging the increase in ST&I from private sources. It also points out that private financing directed to innovation activities is not a factor associated with how companies and external actors cooperate to develop innovative products or services.

More than that, the additional tests employed suggests a decline in the average use of private sources by firms in innovative activities. This result corroborates with those obtained by models 2 and 3, in which the variable Part_Finanpriv was not associated with the other variables.

As pointed by OECD (2015), "establishing a national strategy for innovation is one thing; its implementation is often another matter". Thus, the results obtained through this research have to be observed through the lenses of a still not consolidated innovation system.

As this paper considered as private funds just the liabilities from a private source, we suggest that future research includes the analysis the investment in innovation activities using equity, which can demonstrate if companies are really including innovation as one of the key aspects, or it is just dependent on public support.

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