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CONSIDERAÇÕES SOBRE O SISTEMA PAULISTA DE INOVAÇÃO A PARTIR DAS POLÍTICAS PARA DEMANDA

RETHINKING THE INNOVATION SYSTEM OF SÃO PAULO UNDER THE DEMAND-SIDE POLICIES APPROACH

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ABSTRACT

The Brazilian state of São Paulo has a remarkable capacity in science, technology and innovation (ST&I), holding important universities, research institutions, funding agencies and enterprises research and development centers. During the last fifteen years new public policies aiming to promote innovation were established in Brazil. Although the robustness of São Paulo innovation system and the innovation laws in force, there are still bottlenecks to overcome in the São Paulo innovation system. This study aims rethink the innovation system of São Paulo under the demand-side policies approach. Our method is based on a descriptive and documental analysis, from the data and information available by governmental agencies, ministries and institutes. Our results suggest that the review of public policies on ST&I shall emphasize the demand-side combined with the state capacities in turn.
Key words: innovation system, public policy, innovation law, science and technology.

1. INTRODUCTION

In the last two decades in Brazil were established several laws and public policies aiming at the promotion of innovation. The Brazilian Innovation Law, Law 10.973 of 2004, was a milestone in the building of a national system of innovation. In January 11th, 2016 was sanctioned in Brazil the Law 13.243, called Legal Code of Science and Technology, modifying and adding provisions to Law 10.973 of 2004. After more than one decade in force, the returns of these public policies shall be evaluated. However, this evaluation is not a simple task.

In this study we purpose a regional analysis of São Paulo, a Brazilian state of the southeast region. First of all, from the regional analysis we obtained more accurate information of the ST&I system. In second place, we understand that technological capabilities do not spread evenly across nations and their regions (STORPER, 1995, p. 896). In third place, we took São Paulo for our investigation bearing in mind that this state has a robust structure in ST&I with an expressive amount of expenditure in R&D, a significant graduated human resources and it holds a huge number of institutions and organizations directly or indirectly involved with ST&I.

The government of the state of São Paulo, by its Secretary of Science, Technology and Innovation (SDECTI), supports a study aiming the creation of a guideline of ST&I in São Paulo (SDECTI, 2014, p.7). This study is being coordinated by Research Foundation of São Paulo state (Fundação de Amparo à Pesquisa do Estado de São Paulo, FAPESP) through workgroups formed by researchers and professors from different research areas. These workgroups are dedicated to different activities, including the institutional diagnosis of the current situation of R&D in São Paulo and the investigation and diagnosis of the legal and regulatory framework in ST&I.

This study aims rethink the innovation system of São Paulo under the demand-side policies approach. Our theoretical approach in this study comprises bibliography references from the national systems of innovation (FREEMAN, 1988; NELSON, 1993; LUNDVALL, 1992, LUNDVALL, 2009) and demand-side policies (EDQUIST, HOMMEN, 1999, EDQUIST et. al., 2000, EDLER, GEORGHIOU, 2007, EDQUIST, 201, EDLER, 2009, EDQUIST,2014).

Accordingly, the diagnosis conducted by FAPESP is crucial to identify inconsistencies in the existing policies, conflicting rules and other deficiencies and to allow

the investigation of the public capacities of action in the elaboration of programs, projects and institutions for ST&I, as well in the attraction of ST&I's investments.

This study is segmented in four sections: the first comprises this introduction comprising justification and main objective of this study. The second part will address the theoretical approach and in the third section we will place the discussion of São Paulo innovation system and results of our investigation. Lastly, the fourth section comprises our conclusions.

2. THEORETICAL APPROACH

The National System of Innovation framework (NSI) is a theory approach, based on the evolutionary literature. The NSI is useful to "to describe, compare and try to understand the similarities and differences across countries in their innovation systems" (OECD, 2005. p. 46). The NSI theory approach, according to Nelson (1993, p. 505), was based on a comparative analysis among innovation systems from different countries. The first conclusions of the NSI comparative analysis was that "institutional structures supporting the technical innovation are complex and variegated" (NELSON, 1993, p. 521).

Therefore, the roles played by private and public institutions in the technology promotion are not obvious. The argument, part of the common sense, that the private enterprises do the industrial innovation and public institutions have poor role in this context is not accepted in the NSI approach (NELSON, 1993, p. 522). The NSI theoretical approach also rejects the viewpoint that there are clear lines separating basic from applied research, as established by the linear model (NELSON, 1993, p. 522).

The linear model concept was based on a reflection from the state's viewpoint about the role of S&T. The report written by Vannevar Bush and addressed to the President of United States after the Second World War was the milestone of the linear model. According to this model the innovation was understood as a sequential and hierarquical process, beginning with basic through applied research and then achieving the product development and further marketing and sale (GODIN, 2006, p. 639-640).

Additionally, the NSI theoretical approach assumed that knowledge was the most fundamental resource in the modern economy whereas the most important process is learning. In this way, learning is understood as a social embedded process which depends on institutional and cultural context (LUNDVALL, 1992, p. 1). Moreover, the countries differ on

their traditions and cultural aspects and this complexity was taken by the NSI studies. The NSI analysis also held in the understanding and explanation about why technology develops in certain direction and in a certain rate in different social and economic contexts (LUNDVALL, 1992, p. 12).

The innovation system approach brought a new point of view to the innovation promotion more focused on each country's economic, social and political features in opposition of the oversimplified assumption of a global technological development (CASSIOLATO, LASTRES, 2005, p 37). Under the NSI approach the ST&I development is a result of local and organizational environments aligned with strong institutions which promote the conditions to the interactive learning (FREEMAN, 1988, p. 339-340).

According to NSI approach, R&D expenditure can be understood as a kind of input to the process of innovation, but it not shall be taken as a sole indicator. R&D is just an input effort and does not say anything about what comes after the effort (LUNDVALL, 1992, p. 6). In this way, the NSI approach is based on learning in connection with routine activities. Lundvall (2009, p.3) discuss the innovation systems under two modes: the Science-Technology-Innovation (STI), based on R&D inputs and other "linear" indicators and the Doing, Using and Interacting (DUI).

> The STI mode constitutes only one of the pillars of the learning and innovation process. Much learning, especially of tacit and localized knowledge, is through the DUI mode, which refers to learning on the job as employees face ongoing changes that confront them with new problems, as well as learning taking place in an interaction with external customers. (LUNDVALL, 2009, p. 3)

The institutions play a key role in this process (NELSON 2008, p. 8). The legal and regulatory systems are relevant institutions for the ST&I system, which are intensively related to the local context (HODGSON, 2014, p. 51). According to the new institutional economic (NIE) approach, the institutions are understood as the rules of the game in society (NORTH, 1995, p.8). Beyond the NIE approach, the institutions may be defined in two biases: constraining and enabling (CHANG, EVANS, 2005, p.7). From this viewpoint, the role of law as institution cannot be limited to a private ordering claim, essential custom or just an emanating result from the will of legislators. Law shall be understood as an essential hybridity system, whose operation necessarily involves custom and state (HODGSON, 2014, p.68).

The Brazilian Federal Constitution grants to the states and federal district the competence to legislate on ST&I. However, the Constitution predicts also that the laws on

ST&I shall respect interpretation standards (hierarchical and epistemological approach) the federal law establishes the general guidelines whereas the states and federal district promote the complementary rules. Therefore, the interpretation of the innovation Brazilian state's law need to involve from the Constitution to any administrative rule related to ST&I promotion.

In the last decade seventeen Brazilian states enacted their innovation laws and related policies. In 2008, São Paulo state enacted laws aiming to foster the innovation in its regional boundaries. The São Paulo innovation law has similar structure with the Brazilian Innovation Law1 strengthening the rules of the arrangement of technological parks and productive local systems, as well as stimulating the interaction between public researcher and entrepreneur and innovative activities and also disseminating the options of financing and subsidies to innovate.

Although the regulation of ST&I policies in Brazil is recent, we highlight in Table 3 below the main information about the São Paulo state laws regarding on ST&I. Our analysis is that, besides the complexity of organizations (universities, research institutions, R&D centers etc.) established in São Paulo, partly refereed in the previous section, the legal framework in ST&I is very tricky. Moreover, the state laws shall complement the federal laws on ST&I and this systemic analysis demands legal knowledge of all the Brazilian legal framework. We understand that this legal framework standardization shall contribute for the reformulation of public policies in ST&I.

Table 3 – São Paulo: Legal Framework in ST&I of São Paulo state

Main Topic	Law	Purpose
Support of S&T Research (FAPESP)	Organic Law 5.918 of October 18, 1960	Creation of FAPESP
S&T State Funding (FUNCET)	Law 93 of 1972	Creation of FUNCET
	Law 13.784 of 2009	Amendment of FUNCET's Law
	Decree 50.930 of 2006	Regulation of FUNCET
Technology Parks System (SPTec)	Decree 50.504 of February 6, 2006	Creation of SPTec
	Decree 53.826 of December 16, 2008	Benefits for private enterprises to enter in SPTec
	Decree 54.196 of April 2, 2009	Regulation of SPTec and defines the support organizations and private enterprises
	Decree 54.906 of October 13, 2009	Amendment of Decree 54.826/2008

[1] Law 10.973 of 2004. We did not analyze deeply the Law 13.243 of 2016 in this study.

	Decree 54.690 of August 16, 2009	Amendment to SP Innovation Law
	Secretaries Resolution 3 of January 16, 2009	
	Decree 57.241 of August 17, 2011	Amendment to Decree 53.826/2008 Fiscal incentives
Innovation environment system (SPAI)	Decree 60.286 of March 25, 2014	Creation of SPAI
Incubator Network (RPITec)	Decree 56.424 of November 23, 2010	Promotion of Incubators in Brazil

Source: SDECTI, 2014; FAPESP, 2014.

In this way, we understand that the state shall be on charge to drive this difficult task of public policy review. However, the state probably does not have all capacities, primarily meaning human resources, to conduct this challenge. Therefore, the advisor support is crucial to overcome the state limitations and the workgroups coordinated by FAPESP are a proper example of this interaction. In August 2015 the government of state of São Paulo accepted the suggestion of FAPESP to have a scientist member in each government secretary. This is an example of a favorable interaction of the scientific environment with one arm of the policy making. We are arguing about the contribution of the public capacities, defined as set of tools and institutions available to governments to establish goals, arrange these goals into policies and then implement the policies (CASTRO, 2014, p.2)

Another theoretical approach relevant to this study is the demand-side policies. This approach is based on the evidence that innovation policy initiatives mostly come from supply side. The supply side polices include “fiscal measures, support for training and mobility, public financing of R&D, information and brokerage support and networking measures (EDQUIST, 2014, p.1).

In the other hand the “demand-side intervention is intended to increase the demand for innovations, to improve the conditions for the uptake of innovation and to improve the articulation of demand (EDQUIST, 2014, p. 2, EDLER, 2007, p. 952-3), Demand-side policies can be presented in four main groups systemic policies, regulation, public procurement and stimulation of private demand (EDLER, GEORGHIOU, 2007, p: 953).

3. METHODS

Our investigation about São Paulo innovation system was motivated by the study in progress within FAPESP workgroups. The data and information about São Paulo innovation system were obtained from FAPESP Indicators, Innovation Research (PINTEC, 2011) and Population Census (Census 2010) published by the Brazilian Institute of Statistics and Geography (IBGE) and ST&I indicators from Science, Technology and Innovation Ministry (MCTI). Our methods are based on documental investigation, regarding the FAPESP study referred above, laws and rules of ST&I in force and we developed a descriptive analysis. Our data were updated until 2015 and we are not committed with new available information.

4. RESULTS AND DISCUSSION

The state of São Paulo stands out in the national context of ST&I. Such state holds notorious installed capacity in the area of ST&I covering public and private universities, state and federal, public institutes and private research centers, funding agency and foundation to support scientific and technological research, incubators networks, technology parks and innovation centers, as well as companies that perform R&D.

The Table 1 below highlights the difference between the gross expenditure on R&D (GERD) by São Paulo state in comparison with national GERD. São Paulo's GERD reached in 2011 an amount around R$22 billion equivalent (approximately US$5 billion) of 1.61% of the state's GDP. On the other hand, the entire Brazilian GERD reached in the same year 1.20% of the Brazilian GDP, which was approximately R$47 billion (approximately US$12 billion)2. Additionally, the share of the R&D expenditure from São Paulo related to GDP is similar as the percent of other countries, members of Organization of Economic Cooperation Development (OECD), as Italy, Spain and Portugal which GERD was 1.25%, 1.33% and 1.49% of GDP respectively (FAPESP, 2014).

Table 1 – São Paulo and Brazil: GERD in relation with GDP (2012)

São Paulo	Brazil
% GDP's state 1,61	% GDP 1,15
R$22 billion	R$47 billion

Source: FAPESP, 2014; MCTI, Indicators 2000 to 2012.

[2] We are considering approximately the exchange rate of February 3, 2016 of US$1 = R$3,96. Source: http://www4.bcb.gov.br/pec/taxas/batch/taxas.asp?id=txdolar

The R&D expenditure includes the sum of the expenditures in graduate programs in Brazil and the budget spent in R&D by other public institutions (MCTI, 2015). Therefore, the position of São Paulo on R&D expenditure is closely related with the expenditure in graduate programs at the higher education institutions located in São Paulo, notably in University of São Paulo (USP), University of Campinas (UNICAMP) and Julio de Mesquita University (UNESP).

The Table 2 below shows the R&D expenditures by institutions in São Paulo ST&I system. The higher education institutions in São Paulo hold 22% of the state's GERD, while the state higher education institutions take in 2013 17% of this share. In the other side, the private enterprises support 59% of the total amount. The huge and intense share supported by private enterprises is a feature of São Paulo state. We emphasize that this data shall be carefully analyzed since that during the last decade several private enterprises obtained with the federal or state governments funding for performing R&D.

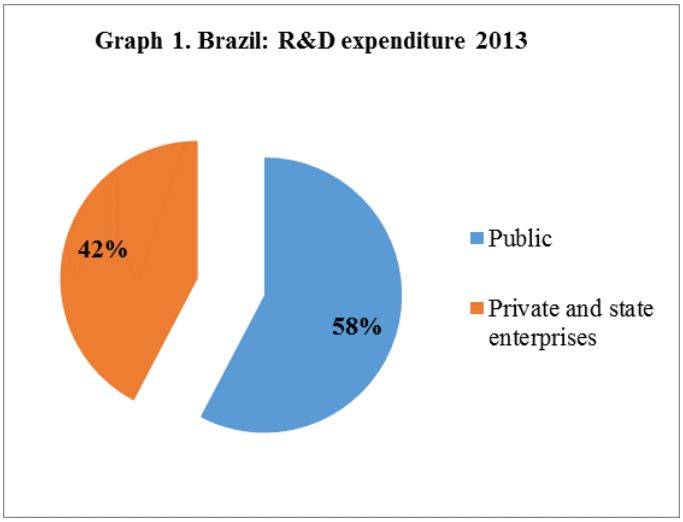
Table 2 – São Paulo: R&D expenditures by institution in São Paulo, 2013

	Value (R$ million)	**% of the GERD**	**% GDP**
Total	24,895.8	100%	1.63%
Higher Education	5,514.2	22%	0.36%
Federal Higher Education	917.3	4%	0.06%
State Higher Education	4,125.4	17%	0.27%
Private Higher Education	417.6	2%	0.03%
Funding Agencies	2,753.1	11%	0.18%
CNPq	545.6	2%	0.04%
CAPES	675.1	3%	0,04%
FINEP	429.3	2%	0.03%
FAPESP	1,103.2	4%	0.07%
Research Institutes	1,853.5	7%	0.12%
Federal Public Research Institutes	1,229.1	5%	0.08%
State Public Research Institutes	624.4	3%	0.04%
Private enterprises	14,775	59%	0.96%

Source: BRITO, 2015.

Notwithstanding the explanatory note about the source of the private enterprises expenditure on R&D in São Paulo, the Graph 1 below shows that the public sector in Brazil supported in 2013 the majority of the expenditures in R&D, whereas the business sector

(comprising private and state enterprises) took together 42% of the expenditures. Therefore, the role of the private enterprises in the São Paulo innovation system shall be deeply investigated.



Source: MCTI Table 2.1.3. 2000-2013.

The São Paulo innovation system comprises relevant organizations and institutions often engaged in an arrangement to promote innovation, including:

i. the innovation environment system (*Sistema Paulista de Ambientes de Inovação*, SPAI) comprising the system of technology parks (*Sistema Paulista de Parques Tecnológicos*, SPTec) and the incubator network (*Rede Paulista de Incubadoras de Empresas de Base Tecnológica*, RPITec) and the innovation agencies network (*Rede Paulista de Núcleos de Inovação Tecnológica*, RPNIT),

ii. Three São Paulo state's universities (USP, UNICAMP and UNESP), two public medical's schools (Faculdade de Medicina de Marília, FAMEMA and Faculdade de Medicina de São José do Rio Preto, FAMERP),

iii. four public federal universities (Unifesp, UFScar, UFABC and ITA) and other public city universities, philanthropic and private universities,

iv. 56 Technology higher education institutions (FATEC) and 211 other technical schools,

v. "S" system including Senai, Sesi, Senac, Sebrae e Sesc,

vi. Funding agencies (*Agência de Desenvolvimento Paulista*, *Desenvolve SP* and *Agência Paulista de Promoção de Investimentos e Competitividade, INVESTE São Paulo)*,

vii. Funds and Foundations, for instance FAPESP (*Fundação de Amparo à Pesquisa do Estado de São Paulo*),

viii. Public and Private ST&I Institutes, for example Institute for Technological Research (IPT) and Nuclear and Energy Research Institute (IPEN),

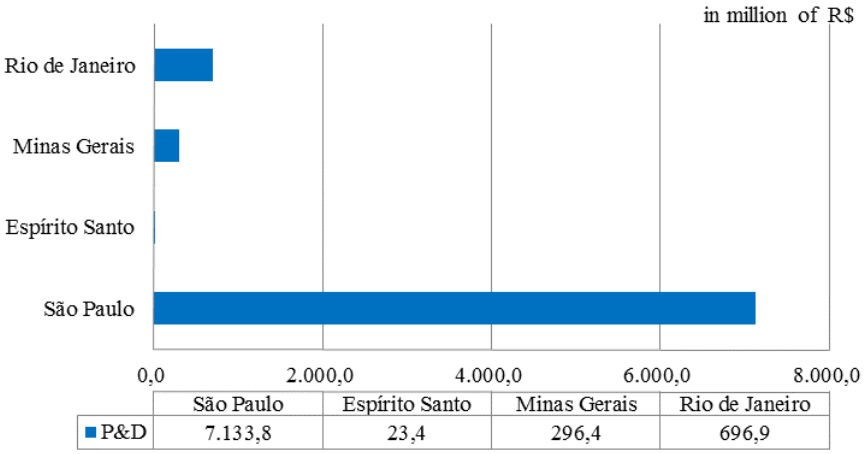
ix. Advisor Boards on ST&I of São Paulo state (*Conselho Estadual de Ciência e Tecnologia, CONCITE* and *Conselho das Instituições de Pesquisa do Estado de São Paulo, CONSIP),*

x. Legal system, comprising law and regulations, and

xi. Private enterprises which develops R&D and innovation activities in São Paulo.

The Graph 2 below shows the supremacy of São Paulo on R&D expenditure in 2012 of more than R$7 billion, in comparison with other states from the southeast region. This difference remains expressive when compared with other states from different regions in Brazil. For instance, the share of São Paulo state's R&D expenditures in relation with the referred state Gross Domestic Product (GDP) was of 4.11%in 2013, whereas the same indicator from Minas Gerais was 0.41%, Rio Grande do Sul was 0.22%, Rio de Janeiro was 1,02%, Mato Grosso do Sul was of 0.57%, Bahia was 0.62% and Ceará was 0.40% (MCTI, 2015, p:7).

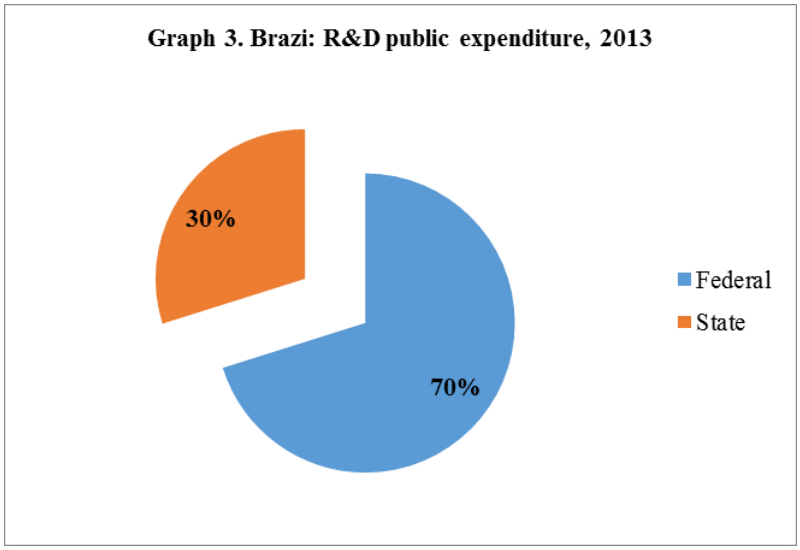
Graph 2. Southeast region: State's R&D expenditures, 2012



	São Paulo	Espírito Santo	Minas Gerais	Rio de Janeiro
P&D	7.133,8	23,4	296,4	696,9

Source: MCTI, 2013.

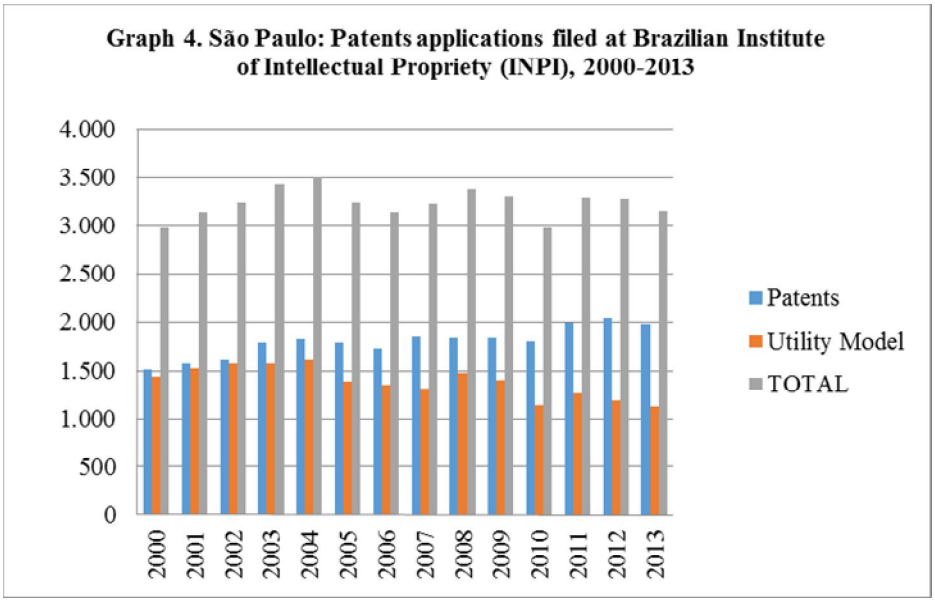
In São Paulo the largest share of the public expenditure in R&D is under the control of the state government, as opposed to what occurs in other Brazilian states whose R&D expenditures are on charge of the Brazilian federal government. The Graph 3 below shows the participations of federal and state governments in R&D expenditures, which is quite different of São Paulo numbers presented in Table 2 above.



Source: MCTI Table 2.1.3. 2000-2013.

Taking into account the outputs of São Paulo state, regarding the publications indicators São Paulo shows also relevant indicators when compared with other Brazilian states or Latin America countries. The publications with researchers from São Paulo were 50% of the Brazilian knowledge measured in paper published in well known scientific journals (FAPESP, 2014, p.7).

Regarding on intellectual propriety rights we highlight the number of patent filed in the Brazilian Institute of Intellectual Propriety Rights (Instituto Nacional de Propriedade Industrial, INPI) between 2000 and 2013. The Graph 4 below indicates that the numbers of patent's files in São Paulo were remained flat during the last decade, although the several public policies established through this period to promote innovation. We highlight that intellectual property rights are not the most accurate indicator for innovation, once not all the economic sectors are sensible of this protection (for example, software sector as part of the information technology sector, which is worldwide recognized as less dependent of intellectual propriety rights) (LEVIN, 1987, HOVENKAMP, 2008, p: 106).



Source: MCTI. State Indicators S&T, 2015.

However, the number of filed patents in São Paulo in comparison with other countries is narrow. For example, according to World Intellectual Propriety Organization (WIPO) in 2014 only the company Huawei Technologies had 3.442 patent applications published under the Patent Cooperation Treaty (PCT), which is higher than the total of patent application filed in 2013 by applicants based in São Paulo state.

São Paulo is a state with 645 municipalities located at southeast region in Brazil. According to IBGE, the São Paulo population in 2010 was of 41.262.199. The per capita GDP in 2012 was R$30,8 thousand, whereas the nominal monthly from household income of the resident population in 2014 was R$1,432 (IBGE, 2014 and SEADE, 2014). The SP GDP is currently the highest among the Brazilian states and in 2012 the São Paulo's GDP amounted R$1,408,904 trillion which represents 32,1% of the national GDP.

São Paulo state is supplier of goods and services to other Brazilian states and to export. According to IBGE and São Paulo Foundation of Data Analysis (SEADE), São Paulo GDP was in 2012 around of R$1.2 trillion. The services, agribusiness and industries support 69%, 29% and 2%, respectively, of São Paulo's GDP. Also the state holds the majority of the financing institutions currently in operation in Brazil (SEADE, 2014).

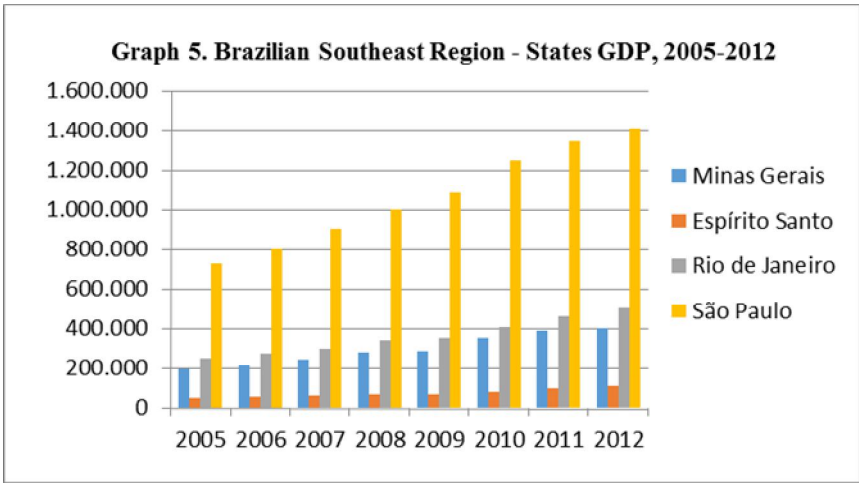
The São Paulo economy was historically based on the agriculture, notably the coffee plantation since the nineteenth century. From this historical point of view, the favorable climate, soil and geographical conditions were crucial elements for the agriculture development of the state. Between 1876 and 1883 the production of this fruit doubled,

jumping from 16% of the national production to 25% in the same period (CANO, 2002, p. 64).

Another interesting feature of the coffee production in São Paulo was the role of the European migration as labor force of this state. These foreign workers, most of them from Italy replaced the slave labor in the coffee plantation and have contributed to end of slavery and transition to the wage labor in Brazil (FURTADO, 2005, p. 128).

Although the relevance of the coffee production, other agriculture crops using different techniques have relevant production in the state of São Paulo since the beginning of the twenty century. According to CANO (2002, p. 68) the agriculture production of São Paulo in the first decades of the nineteenth century was more than the sum of the agriculture production in the same period of Minas Gerais, Rio de Janeiro and Espírito Santo, other states from the southeast region in Brazil. The industry in São Paulo has also considerably grown in the first decades of the 1900 strengthening the outstanding position of São Paulo.

Consider the historical development of São Paulo economy is useful to understand the actual position of this state on the national context. The Graph 5 below highlights the disparity of São Paulo's GDP in comparison with the other Brazilian southeast states from 2005 to 2012.



Source: Fundação João Pinheiro, http://www.fjp.mg.gov.br/index.php/produtos-e-servicos1/2745-produto-interno-bruto-de-minas-gerais-pib-2. Access August 14th, 2015

However, our purpose with all this overview of São Paulo innovation system is to highlight that despite the positive indicators and relevant numbers, the performance of this ST&I system is narrow and the results are below the expectations. Therefore, the SDECTI,

FAPESP and other public and private organizations of the state are mobilized in workgroups to purpose a new guideline to ST&I in São Paulo.

5. CONCLUSIONS

The supremacy of São Paulo ST&I system on regard of its R&D expenditure, the capacity of its universities and the private enterprises established at this state is under no doubt. However, the outputs of São Paulo ST&I system are still narrow and the limitations of this system motivated the study in progress under FAPESP coordination and government support. Our analysis came in this way aiming to contribute in the investigation of possible ways to overcome the bottlenecks and deficiencies found and to be find in São Paulo SI&I system.

From the information about the São Paulo ST&I system and the theoretical approaches referred in previous section, we understand that more or less the linear model remains in force in the São Paulo innovation system. One reason for this conclusion comes from the weak interaction of the organizations placed in the São Paulo innovation system. But, this is not the unique problem. To overcome this and other bottlenecks in the structure and articulation of innovation systems is needed a review and reformulation of public policies. However, this reformulation shall be preceded by a deep and extended diagnosis of the innovation environments of a country or region (EDQUIST, 2011, p.2).

In addition, the policy-makers shall bear in mind that the current public policies in Brazil, as São Paulo for instance, are limited to the supply side and this should be changed whether the promotion of innovation in a systemic way is the goal.

In São Paulo, a significant mobilization is in progress within the workgroups coordinated by FAPESP which are on charge to suggest new ST&I guidelines for São Paulo. However, the investigation of these workgroups are not finished and the ST&I guideline is not already known. Our expectation with this study is contribute with this mobilization adding theoretical approaches and information as to provoke the debate.

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