SANTA CATARINA: an analysis of industrial concentration between 2002 and 2015

SANTA CATARINA: uma análise da concentração industrial entre 2002 e 2015

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ABSTRACT

The aim of this article is to perform a study of Santa Catarina industry, analyzing the concentration level of this sector and participation of each region on the industrial production. We compare performances among industrial regions of the state between 2002 and 2015, seeking to verify the existence of variance in participation in the industrial activity of one region in relation to another (intrastate). The econometric model called *differences in differences* is used, identifying conditions that may implicate in the future economic and sustainable development of the regions of Santa Catarina. The results reveal a reduction of participation in the industrial production of the microregions that represent the largest shares in the Santa Catarina Industrial GDP, Joinville and Blumenau. Besides, Florianópolis, Itajaí, Concórdia, Chapecó, Criciúma, Curitibanos increased their shares.

Keywords: Industrial Sector. Concentration analysis. Santa Catarina.

RESUMO

O objetivo principal deste artigo é fazer um estudo da indústria catarinense, analisando o nível de concentração do setor industrial através do índice de Gini Industrial, que mede o nível de concentração do setor. São Comparados os desempenhos entre as regiões do estado no período entre 2002 a 2015, buscando avaliar a existência de mudanças de participação na atividade industrial de uma região em relação à outra (intra-estadual). O modelo econométrico denominado diferenças em diferenças é utilizado, identificando condicionantes que possam comprometer no futuro o desenvolvimento econômico e sustentável das regiões do Estado de Santa Catarina. Os resultados revelam a queda da participação das regiões mais industrializadas e que apresentam a maior participação no PIB de Santa Catarina, Joinville e Blumenau. Adicionalmente, Florianópolis, Itajaí, Concórdia, Chapecó, Criciúma, Curitibanos elevaram suas participações.

Palavras-chave: Setor Industrial. Análise de Concentração. Santa Catarina.

JEL: L11, R15, R12

INTRODUCTION

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The process of decreasing of concentration in the Brazilian industrial sector has a wide bibliography. Historically we can say that the sector has been in a process of reduction of industrial concentration since the 1970s. Regarding this issue, Santa Catarina State is widely studied, due to its characteristics and the ability to attract industrial activities in Brazil.

Diniz (1993 and 1995) highlights the growth of the Southern region of Brazil from 1970 to 1989, specially verifying the growth of Santa Catarina industry in the western regions of the state, Florianópolis and Blumenau-Joinville. The author emphasizes the role of local entrepreneurs and national and regional industries focused on the national and international markets.

Analyzing the spatial associations in the Brazilian industrial sector between 1994 and 2004, Silva and Silveira Neto (2009) found an expansion in the participation in the industrial employment in Santa Catarina, with emphasis on the Itajaí microregion.

The importance of Vale do Itajaí and Norte Catarinense mesoregions are highlighted by Saboia (2010), which, together with the Northeast of Rio Grande do Sul mesoregion, accounted for 7% of Brazilian industrial employment in 2007. These three mesoregions showed a high growth in industrial employment, above the growth verified in other Brazilian states.

Otávio (2016) shows the importance of Northern of Santa Catarina and Itajaí Valley mesoregions for the industrial growth of the state, attempting with 36% and 29%, respectively, in industrial Gross Domestic Product (GDP) in 2010 compared to 1996. On the other hand, the author points to the West region area for presenting a growth reduction. Considered as one of the states that absorbed relevant part of the industrial activity in the country during the process of reducing industrial concentration, it is important to demonstrate the main characteristics of Santa Catarina industry and the industrial history of this state, as depicted in the following sections.

After the initial analysis of the development of the Santa Catarina state, this paper aimed to evaluate its industrial sector, verifying the pattern of concentration from 2002 to 2015, identifying if the industrial sector presented any increasing or reducing in its concentration.

INDUSTRIAL HISTORY OF SANTA CATARINA

Over the industrialization process of Santa Catarina state, it is important to verify the industrial knowledge brought by European immigrants, that resulted in a local entrepreneurial culture; the actions of the state government, developing plans that promoted the expansion and integration of Santa Catarina industrial sector, an industrial park based on non-Santa Catarina raw materials, with great export potential of industrialized products and the formation of regional poles and local concentrations of companies in the same sector due to the productive specialization.

The first point in this process is the resolution of infrastructure problems that limited the growth of the state's industry. Goularti Filho (2002a) highlights the importance of government plans initiated from 1956[3] to 1979. These plans were designed to operate in the following areas : finance, aimed to create capacity to finance

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[3] Filho (2002), calls the attentions to the importance of the following governmental economic plans: POE (Equipments and Constructions Plan - SC) in 1956, the PLAMEG (Governmental Goals Plan) from 1961 to 1965, the PLAMEG II between 1966 and 1970, the PCD (Santa Catarina's Plan of Development) between 1971 and 1974 and the PG (Government Plan - SC) between 1975 and 1979.

investments; transport, aiming to integrate regions and markets; energy, to distribute and generate more energy in the state; telecommunications, in order to increase supply of communication in the state.

Another point that deserves to be mentioned is the actions that improve the financial structure of Santa Catarina, was the creation of the BDE (State Development Bank) and the BRDE (Far South Regional Development Bank), in partnership with the states of Paraná and Rio Grande do Sul, both in 1962. Some projects were also developed to foment and motivate industry and agro-industry, specially with long-term credit investment. So it was created the FUNDESC (Santa Catarina State Development Fund) in 1970.

The results of these plans begin to present significant results, especially in the period from 1963 to 1980. Cunha (2002) mentions the increase of state participation in the value of Brazilian industrial transformation in this period; an increase in the number of small and medium-sized establishments, generating 157 thousand of new industrial jobs between 1970 and 1980, and Santa Catarina accounting for 5.43% of industrial workers in the country in 1980. Between 1949 and 1970, the growth of state's manufacturing industry was 8.7%, while in the country was 8.3% and 9.2% in São Paulo in the same period. The growth of the industry of durable consumption goods was 7.7% in Santa Catarina, with a growth rate higher than São Paulo (7.1%) and Brazil.

Analyzing the results of these actions in government plans and part of the results until 1980, Diniz (1993) indicates that some cities of Santa Catarina also absorbed part of the industrial activity that lost concentration in São Paulo state, mainly due to the structure that was being developed.

In the following years, the performance of Santa Catarina's industry was a little smaller, when compared to the rest of the country, due to the 1980s crises. Another problem would occur due to the economic opening in the mid-1990s. According to FIESC (Federation of the State of Santa Catarina), the export profile of the state was fundamental for that "lost decade" crisis didn't affect the Santa Catarina economy significantly. In 1970 the exports of the state represented 2% of the total exported in Brazil, and in the beginning of the 1990s this value was 6%, and 70% representing industrialized or semi-industrialized products.

Also in this period, according to Goularti Filho (2002b), in the 1990s years the industrial sector of Santa Catarina presented a restructuring of some sectors, such as the ceramic industry, the carboniferous complex, the electro-metal-mechanical sector and the textile-clothing segment. Part of this process occurs due to the new economic reality lived in the country, and in a positive way due to state incentives to the industrial sector.

It is important to verify an important fact that occurred in the Brazilian economic scenario in this years, directly impacting the national industrial sector and state development policies: the "fiscal war"[4]. According to Nascimento (2008), the "fiscal war" represents a dispute between Brazilian states and municipalities, aiming to attract investment and tax revenue. As a resource in this dispute, states and municipalities

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[4] The phenomenon of the "fiscal war" is in economic terms, representing the fiscal dispute in the federative context, that is, it refers to the intensification of extreme and uncooperative competitive practices among the Federation entities, regarding the management of their industrial policies. Thus manipulating the rates of a given tax becomes the fundamental element of policies related to business attraction (OTÁVIO; 2016, p. 38 Apud FERNANDES; WANDERLEI, 2000, p. 02).

ensure fiscal, financial and infrastructure benefits to attract companies interested in investing or reallocating their investments to this states or municipalities.

In this context, the beginning of the 2000s was not very favorable for the development of Santa Catarina's industry. It is important emphasize the government's efforts to improve its situation, especially granting fiscal incentives. According to datas from SEBRAE/SC, based on IBGE "Brazilian Municipal Traits - Public Management of 2006", the State was named top one on National fiscal dismissal. Back that time, 80% of the 293 cities of Santa Catarina state had fiscal incentive concerning industrial activities.

Incentives to industrial sector

It is important to verify the incentives focused on the industrial area, particularly the actions in strategic cities or regions aimed at this objective. As shown in table 1, we noted that the most offered benefits by the Santa Catarina cities involve the donation or assignment of land and fiscal exemption, more specifically the Urban Land and Building Tax (IPTU) and Tax on Services (ISS).

Table 1: Number of cities with incentives to attract economic activity

Year	Incentives	Exemption of IPTU	Exemption of ISS	Land donation	Land cession	Others	Industrial District
2001	246	134	142	181	-	96	118
2002	259	140	152	198	-	146	148
2006	235	138	74	82	127	159	139
2009	237	147	95	87	136	157	117

Source: Elaborated by the authors with data from IBGE.

Although the cities have their own policies for attracting economic activities, the Santa Catarina State Development Program (PRODEC), stands out strongly. Santa Catarina's main program[5] to foment the industrial sector, created in 1988, actually produced more significant results mainly since 1997. The program consists of a postponement equivalent to a predetermined percentage of the ICMS value to be generated by the venture, working as a kind of working capital for companies.

The maximum amount of incentives could reach 100% of the fixed investments, not including the acquisition costs of land. The company had a period from 120 to 300 months to use the benefit, with the chance of waiting from 48 to 120 months to start paying, and the percentage equivalent to financing could reach 90% of the ICMS increment generated by the new investment.

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[5] The state has other incentive programs, among then some were gathered into the PRODEC, such as Proind - Industrial Deployment and Expansion Incentive Program, Promic - Santa Catarina Industry Modernization Program, Prodap - Productive Activities Deconcentration Program and Prodec Agroindustrial

Other features of the program are the best financial conditions for projects that were installed in less developed cities, having as a reference the Human Development Index (HDI). The city HDI where the project will be carried out is equal or lower than 95% of the state's average HDI. In these way, depending on the industrial sector, since 2007, the interest rate could be zero.

It is important to note that the program also assists expansion projects, not only being restricted to implementation projects. PRODEC brings as one of the criteria for approval issues such as job and income generation, contribution to spatial and reduce the concentration of productive activities, improvement of industry competitiveness, contribution to the development of new technologies, production of new products related to the products manufactured in the state, among others.

A result from PRODEC, according to data from Santa Catarina Federation of Cities (FECAM), from 1998 to 2011, was the approval of 340 contracts, generating 53,671 jobs, as shown in table 2. According to Goularti (2014) the program also helped Santa Catarina companies to consolidate both regionally as in their respective markets. This is due to the characteristic of Prodec of allowing expansion projects.

According to Goularti (2014), since its creation in 1988 until 2010, Prodec has granted a total of R $ 12.19 billion in incentives, helping a total of 510 companies and it is estimated that has generated a total 68,063 employments. The "fiscal war" does not generate any attraction from industries from other states, and then not motivate[6] Santa Catarina to actively participate in this incentive.

Due to the characteristics of its composition, PRODEC was expected to be a way to encourage the localization of projects in less developed regions, contributing to the development of these regions, reducing regional inequalities and encouraging the reduction of concentration of the Santa Catarina industrial sector.

Table 2: Approved contracts by PRODEC from 1998 to 2011

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[6] The only exception is taken into account concerning the harbors, due to the significant raise in the number of import companies. However, through other incentive programs, the Pró Emprego, created in 2007, making the state take part of a dispute known as the "harbors war."

Year	Approved contracts	Jobs Generated	Year	Approved contracts	Jobs Generated
1998	94	17,887	2005	20	2,584
1999	5	435	2006	29	3.963
2000	4	184	2007*	8	991
2001	18	1.715	2008	46	6,581
2002	32	3.330	2009	31	8,146
2003	8	616	2010	25	4,757
2004	9	748	2011	11	1,734
	Total			340	53,671

Source: FECAM, adapted by the author.
* allows entry of Commerce in PRODEC.

Still referring to the capacity of the program to incentive the reduction of industrial concentration in the state, what can be seen is the consolidation of large companies, forming an industrial agglomeration and concentration around these companies, limiting the development to bordering areas. Part of this result is also due to the characteristic of Santa Catarina industry, throughout its industrial process that was distributed in the state territory in specialized regional poles, limiting the reduction of concentration capacity.

Political-administrative decentralization

Considering PRODEC as an important program for the economic development, the administrative reform sanctioned by Complementary Law no. 243, in January 2003, established a new administrative structure for the Executive. This had important role in the process of decentralization of government and regionalization of development, since aimed to provide the state government to be present in all regions in Santa Catarina, stimulating the development of the regions and reducing the discrepancies in the social, economic and cultural fields.

The program was presented by Luiz Henrique da Silveira, after the 2002 election for governor of the state. Based on the german regional governments model, the proposed political-administrative decentralization established the State Development Council (DESENVESC[7]), 29 Secretariats for Regional Development (SDR) and the respective Regional Development Councils (CDR).

The project was constituted regionally by establishing 29 SDRs formed by a set of cities in 2003. The number of SDRs increased to 30 in 2005 and then to 36 in 2007.

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[7] The State Development Council - DESENVESC. Reported directly to the Governor's office, which has been created to formulate state policies for economic development, employment and income and the search for a new development model for Santa Catarina state.

Each SDR is an executive government unit focused on serving a particular region of the state, aiming to facilitate the treatment demands of the cities and its regions, speeding up the project approval and defining priority areas for investments.

According to Mattedi and Rudnick (2013), the role of the SDR is to promote the sustainable development of the regions, promoting social welfare, encouraging economic development, generate employment and income, improving the participation of civil society in the above issues, contributing to the process of planning of the regions and other activities.

> It is in charge of the State Department of Regional Development, guide the institutions and cities, about the financial and fiscal benefits available in banks and official agencies, such as BRDE, BADESC, PRODEC and PRÓ-EMPREGO. (MATTEDI; RUDNICK, 2013; p.35)

Concerning the activities of the Regional Development Councils (CDR), present in each SDR, its action is deliberative. Mattedi and Rudnick (2013) indicate that the councils are collective for the purpose of advising, guiding and formulating guidelines for regional development programs. Abrucio and Filippim (2010) point out that the CDRs also relate regional needs by defining which priorities are, afterwards, these are forwarded to the state government that considers these needs in the budget or not.

Three main modifications occurred from Complementary Laws no. 284, 381 and 534 in the respective years 2005, 2007 and 2011. Table 3 summarizes the main changes implemented with these laws. As a result, over the years it has been verified that the reduction of concentration and development has indeed brought the government closer to the state's regions, improving dialogue, understanding regional needs, approving budgets and projects, mainly by speeding up procedures and reducing bureaucratic steps.

Table 3: Major program changes in administrative policy reform

Act	Main modifications	Details
Complementary Law 284 (2005)	The structure was divided in 2 levels: Sectoral and Regional.	Sectoral Level: Secretariats of State. It aims to formulate, regulate and control the public policies, according to the respective area of activity. Regional Level: the SDR. It aims to coordinate and execute the public policies defined for the State, according to the respective region.
	Increase the number of SDR and CDR	It creates the Dionísio Cerqueira's SDR and CDR, adding a total of 30 Regional Secretariats.
Complementary Law 381 (2007)	Defines the limits of operation and jurisdiction between the levels.	Sectoral Secretariats: are assigned to plan and regulate public olicies. SDR: limited to implementing the policies developed by the Sectoral Secretariats in its respective regions.
	Increase the number of SDR and CDR	It creates the Itapiranga, Quilombo, Seara, Taió, Timbó and Braço do Norte SDR and CDR, adding a total of 36 Regional Secretariats.
Complementary Law 534 (2011)	The responsibility of the PPA is transferred.	PPA: The State Secretariat of Finance is responsible for elaboration and management of the multiannual plan (PPA), instead of the State Secretariat of Planning

Source: elaborated by the author based on Dias (2014).

However, according to Oganauskas (2016), concerning the ability of new political-administrative structure to reduce regional differences and contribute with the development, the political character affected the functioning of the proposed new organization. This is partly due to the representativeness in terms of the importance of the positions that were created in the SDR, ranging from 9 to 20, according to the SDR classification, generating conflict between deputies, state secretaries and regional SDR secretaries.

Still referring to the behavior of the structure, Oganauskas (2016) also points to units created for important purposes only on paper, noting that the CDR were losing importance in the new structure. Issues such as these undermined the developmental of the program, considering that the objective was to approve projects that benefited a set of municipalities and not isolated municipalities.

In this way, the proposed purposes of the new political-administrative structure are extremely important to reduce regional inequalities. However, the operation of the structure, based on the findings presented, is unable to achieve such objectives. As points to be improved, Mattedi and Rudnick (2013) pointed to important issues such as the political factor, lack of articulation between cities, the capacity of organization and cooperation between cities of each SDR, since that one of the criteria for project approval is the number of cities benefited by the project, as well as the efficiency of each SDR.

METHODOLOGY

Based on the results on a spatial analysis, both by PRODEC and by the SDR political-administrative reform, results from 2002 to 2012 indicate that there was no improvement in the industrial productive distribution between the state regions. Otherwise, the result appears to be to strengthen concentration in the more structured regions.

To better exemplify this argument, Goularti (2014) made relevant findings regarding PRODEC. According to the author, in the period[8] from 1988 to 2012 the program granted a total of R $ 13.5 billion in incentives. Considering the distribution of these by regions of the state, for the period from 1988 to 2010 the Northeast region gained 39.3% of the total incentives, the Vale do Itajaí region accounted for 16.7% of the incentives, followed by the Planalto Norte, that reached 14% of the liberation, Then, the next region was Grande Oeste, that obtained 9.6% of the incentives in the period, the Serrana region reached 9.1% of the released incentives, following by the Southern Santa Catarina that accumulated 6.7% and the Grande Florianópolis region, 4.7% of the incentives released between 1988 and 2010.

Another important point noted by Goularti (2014) refers to concentration of resources released to large companies. According to the author, between 1988 and 2012 fifteen companies accumulated a total of R $ 6.75 billion in incentives, which is equivalent to 50.4% of the total incentives released in the period.

With regard to reduction of concentration and regionalized development, by SDR project, there is an unequal distribution of approved projects, where regions with structural resources and a capital base received most of the investments. This fact is noted by Mattedi and Rudnick (2013) when pointing out that between 2003 and 2009 the SDRs that received the largest investments were more economically and socially structured, and not the secretaries located in the poorest regions of the state.

Based on these datas, this study has as a goal to verify the changes in the concentration's pattern of Santa Catarina's industrial activity from the perspective of its microregions, from 2002 to 2015, in order to analyze the changes that has occurred in the distribution of industrial activity in this period.

Methodological Analysis

For this analysis we used data of gross value added of the industry at current prices, Industrial GPI, by city, for period from 2002 to 2015. The data were collected from Brazilian Institute of Geography and Statistics (IBGE), considering the base year 2010.

Dealing with the geographical division of the state in the microregion and municipality units, the data were transformed into the participation of these regions in the state industrial GDP for each year, evolution of the participation of these regions in the state industrial GDP based on 2002 and growth industrial GDP of each microregion.

Initially this study presents the analysis of the dynamics of the changes verified in the industrial concentration pattern, identifying the performance of the microregions with the largest participation in the Santa Catarina industrial GDP, also aiming to verify

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[8] In his work, Goularti (2014) ranges his time for analyses, between 1988 and 2012. It has been done in three different times, from 1988 to 1997, 1998 to 2005 and 2006 to 2012. The reason for this division is based on the changes that happened with Prodec characteristics.

if they increase their participation or reduce their participation in the analyzed period. In contrast, the study applies the same method for regions with lower participation in the industrial GDP of the state.

The second part of the analysis is the application of the econometric model called *differences in differences*. The model allows to capture behavioral changes by comparing the performance of two regions over two different time periods. In this case, applying the model, it will be observed the variation in the share of Industrial GDP for the microregions in two periods defined before and after a specific year, specifying the structural change.

In this way, it is expected, according to the predicted results - specially the decrease of industrial GDP, when the permanence of the most participative states are compared to the less ones - to notice the changes in the permanence of one region compared to the others states. As a result, allowing the analyzes of its industrial sector's pattern after the structural change.

The model is composed of a binary variable named *Mi*, that assumes value 0 or 1, assuming value one if representing the control group, and zero for another microregion, thus determining the treatment group compared to the microregion control group.

The second variable, also binary, is represented by *Ti*, that assumes value 0 for the period before to the structural change and value 1 for the later period, allowing to capture the effects of the behavioral change in relation to the previous period, from the analysis of industrial performance of microregions in different periods.

The third variable is composed by the interaction of the variables *Mi* and *Ti*, represented by its product, assuming values 0 or 1.

Then, the estimates will be expressed by equation 1:

$$Y_i = \alpha + \beta_1 M_i + \beta_2 T_i + \beta_3 M_i T_i + \vartheta_i \tag{1}$$

Yi represents the share of each microregion in the state's industrial GDP;

Mi represents the binary variable defined as 0 for the treatment group and 1 for control group for microregions;

Ti represents the binary variable, with a value of 0 for the first period, after the structural change, and 1 for the second period;

α, β_1, β_2 and β_3 are parameters;

ϑ_i represents the error term;

i indicates the year.

The binary variable *Ti* indicates the period and captures aggregated factors that affect *Yi* at each moment, but with the same effect in both treatment and control groups. The binary variable *Mi* indicates the microregion to capture possible differences between the groups. Thus, the most important coefficient for analysis is the *MiTi* and interaction, which shows the change, from the first to the second period, in the *Yi* level difference between the two groups.

The expected value of *Yi* in the four distinct situations will be represented by Y*kh, with h indicating the beginning (h=0) or ending (h=1) and k indicating the control group (k=1) or the treatment group (k=0). Then we have:

Expected value *Yi* before structural change in treatment group:
$$Y_{10}^* = E(Y_i|M_i = 1, T_i = 0) = \alpha + \beta_1;$$

Expected value *Yi* after structural change in treatment group:
$$Y_{11}^* = E(Y_i | M_i = 1, T_i = 1) = \alpha + \beta_1 + \beta_2 + \beta_3;$$
Expected value *Yi* before structural change in control group:
$$Y_{00}^* = E(Y_i | M_i = 0, T_i = 0) = \alpha;$$
Expected value *Yi* after structural change in control group:
$$Y_{01}^* = E(Y_i | M_i = 0, T_i = 1) = \alpha + \beta_2; \; Y_{01}^*$$
$$= E(Y_i | M_i = 0, T_i = 1) = \alpha + \beta_2;$$

The value of β_3 shows how much growth between the two periods in the treatment group differs from growth in the control group. Alternatively, we demonstrate how much the difference between groups is different from first to second period.

DATA ANALYSIS

The industrial sector of the Santa Catarina state was characterized along its industrialization process by presenting a certain concentration in several poles, conferring a certain balanced development in the regions. The state has six microregions: Southern Santa Catarina, Vale do Itajaí, Serrana, Northern Santa Catarina, Western Santa Catarina and Greater Florianopolis. These six regions have twenty microregions, presented in table 4.

This characteristic of poles is noted verifying the distribution of industrial activities in the regions of the state. In Southern Santa Catarina there is a presence of industries related to the ceramic and disposable plastics sector. In the western region the industries are mostly related to the food and furniture sector. Industrial activities in the textile and clothing sector are more intense in the Vale do Itajaí microregion, while in the Serrana microregion are industrial activities related to the wood, paper and pulp sector.

Completing this analysis, in the Northern Santa Catarina region there is a diverse number of industrial activities, as metallurgy, machinery and equipment, electrical materials, auto parts and furniture. In the Grande Florianópolis region there are activities related to computer science, information technology and software development.

We can verify that the participation in the Industrial GDP for the micro regions with the largest participation, Joinville and Blumenau accounted for 44.76% of the state's industrial GDP in 2002. At the end of the period analyzed these regions now account for 39.55%, with Joinville responsible for most of this reduction of participation.

Table 4: Participation of the microregions in the Industrial GDP between 2002 and 2015

Micro region	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Joinville	27.23	28.27	28.47	28.03	27.98	27.64	28.37	27.77	27.44	25.88	25.26	24.98	21.16	23.46
Blumenau	17.53	17.58	17.48	18.17	18.49	17.57	17.64	17.21	17.12	16.66	16.48	15.89	18.31	16.09
Florianópolis	6.62	6.18	6.08	6.12	6.16	7.03	6.44	7.33	7.55	8.08	8.39	8.21	7.62	7.47
Criciúma	6.11	5.91	6.06	6.27	6.03	5.71	5.77	5.65	5.73	6.40	6.14	6.42	6.87	6.86
Joaçaba	5.65	5.73	5.47	5.57	5.28	5.04	4.81	4.65	4.55	4.75	4.79	5.11	5.87	5.63
Chapecó	5.43	5.59	5.83	5.69	5.65	6.10	6.23	5.98	5.68	6.21	6.20	6.34	6.33	5.94
Itajaí	4.78	4.56	4.75	5.03	4.96	5.37	5.301	6.06	6.18	6.17	6.64	6.56	7.28	7.61
Tubarão	4.14	3.80	3.58	3.54	4.35	4.22	4.51	4.33	4.40	4.11	4.54	4.67	4.26	3.90
São Bento do Sul	3.61	3.77	3.80	3.67	3.52	2.97	2.77	2.56	2.36	2.65	2.78	2.85	2.93	2.53
Campos de Lages	3.23	3.19	3.18	3.15	3.01	2.84	2.66	2.61	2.88	2.57	2.65	2.86	3.03	3.21
Canoinhas	3.14	3.01	3.00	2.98	2.71	2.49	2.45	2.38	2.26	2.33	2.51	2.39	2.51	2.46
Rio do Sul	2.49	2.63	2.58	2.61	2.64	2.51	2.53	2.50	2.40	2.55	2.48	2.42	2.87	2.49
Xanxerê	2.28	2.04	1.88	1.87	1.75	2.06	2.03	2.12	2.09	2.30	2.27	2.25	1.57	1.64
Concórdia	1.66	1.68	1.95	1.63	1.84	1.74	1.67	2.27	2.51	2.43	1.85	2.20	2.19	3.22
São Miguel do Oeste	1.55	1.51	1.49	1.50	1.50	1.61	1.55	1.58	1.54	1.75	1.69	1.75	1.79	1.83
Araranguá	1.48	1.54	1.41	1.28	1.16	1.30	1.18	1.28	1.25	1.34	1.34	1.23	1.36	1.38
Curitibanos	1.47	1.38	1.30	1.16	1.19	1.97	2.29	1.80	2.01	1.85	1.95	1.78	1.71	2.05
Tijucas	1.03	1.10	1.16	1.18	1.22	1.23	1.22	1.32	1.44	1.35	1.28	1.40	1.54	1.54
Ituporanga	0.37	0.35	0.35	0.37	0.37	0.41	0.41	0.40	0.41	0.43	0.59	0.53	0.60	0.53
Tabuleiro	0.10	0.09	0.09	0.08	0.10	0.09	0.08	0.09	0.10	0.11	0.12	0.11	0.10	0.09
Total	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00

Source: Elaborated by the authors with data from IBGE.

Although the regions show a growth in the period, it was under the average, so reduce its participation. Graph 1 illustrates the evolution of industrial participation of these microregions. We have also to note that the analysis refers to the Rio do Sul microregion. This region shows little oscillation regarding the variation of participation in the state's industrial GDP, as shown in graph 2.

The Araranguá, Canoinhas and São Bento microregions also reduced their participation in Industrial GDP, as shown in Graph 3. These regions represented 8.24% of Industrial GDP in 2002, a percentage that reduces to 6.37% in 2015. It is noteworthy that Araranguá, in relation to the other two regions, is responsible for a smaller percentage of industrial production in the state.

Graph 1: Joinville and Blumenau, 1999=100
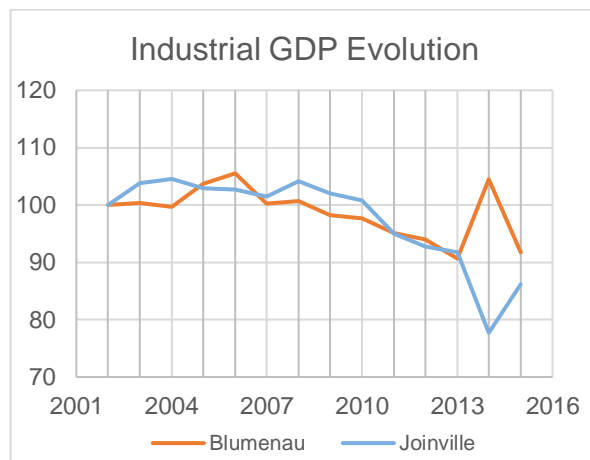
Source: Elaborated by the authors

**Graph 2: Rio do Sul, 1999=100**

Source: Elaborated by the authors

Other regions also had a reduction in participation in the period when comparing the year 2002 to 2015, but between the years of the series the participation of these regions in Industrial GDP presents variation, as show graph 4.

This is the case of Tubarão and Xanxerê microregions, accounting for 6.53% of Industrial GDP in 2002, and reducing this participation to 5.64% in 2015. It is important to highlight the less industrial activity of the Tubarão microregion, accounting for less than 1% of the state's industrial production in the period.

Graph 3: Araranguá, Canoinhas and São Bento do Sul, 1999=100
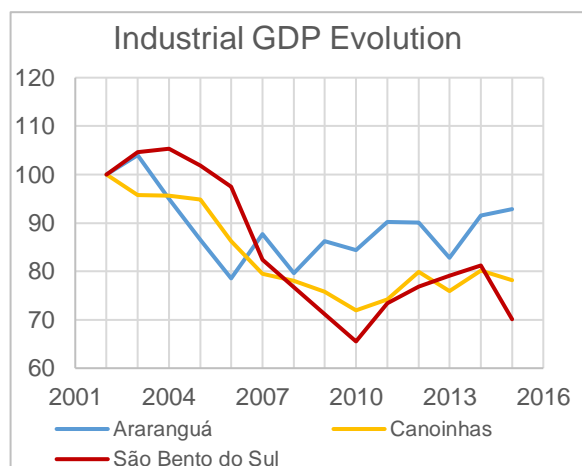
Source: Elaborated by the authors

**Graph 4: Tabuleiro, Tubarão and Xanxerê, 1999=100**
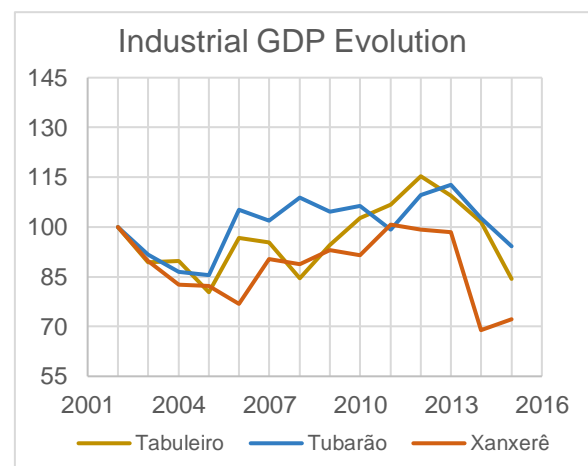
Source: Elaborated by the authors

The study also identified microregions with significant rates related to the increase of participation in the state's Industrial GDP. Among these regions, the Itajaí microregion has an increasing share in Industrial GDP by 60% over the period, as shown in graph 5.

Among the regions with the highest participation, we have Ituporanga, Tijucas and São Miguel do Oeste, as well as Itajaí. Together these four microregions accounted for 7.75% of Santa Catarina's Industrial GDP in 2002, to a total of 11.53% in 2015, and Itajaí with 4.7% in 2002 to 7.6% in industrial production in 2015.

Gráfico 5: Itajaí, Ituporanga, Tijucas and São Miguel do Oeste, 1999=100
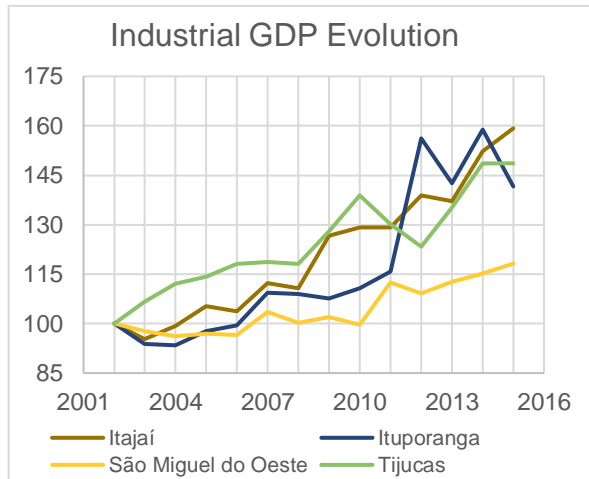
Source: Elaborated by the authors

**Gráfico 6: Concórdia and Curitibanos, 1999=100**
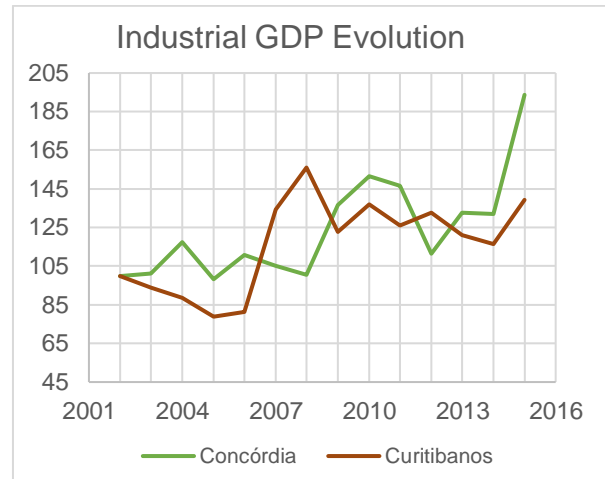
Source: Elaborated by the authors

We can also verify an increased participation for the Concordia and Curitibanos microregions, but the performance of these regions differs from the behavior of the regions presented in graph 5. As can be seen in graph 6, these two microregions presented oscillation in the period. The participation in Industrial GDP for Concórdia and Curitibanos accounted for 3.13% in 2002, rising to 5.27% in 2015.

The microregions that increase participation in the industrial GDP, such as Chapecó and Florianópolis, represented 12.06% in 2002 and 13.41% in 2015. Graph 7 demonstrates the impact of the reduction in the participle of Florianópolis region in the last years.

Graph 7: Chapecó and Florianópolis, 1999=100

Graph 8: Campos de Lages, Criciúma and Joaçaba, 1999=100
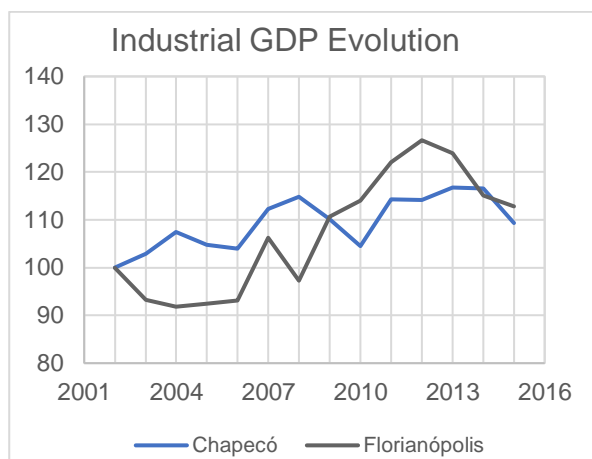
Source: Elaborated by the authors
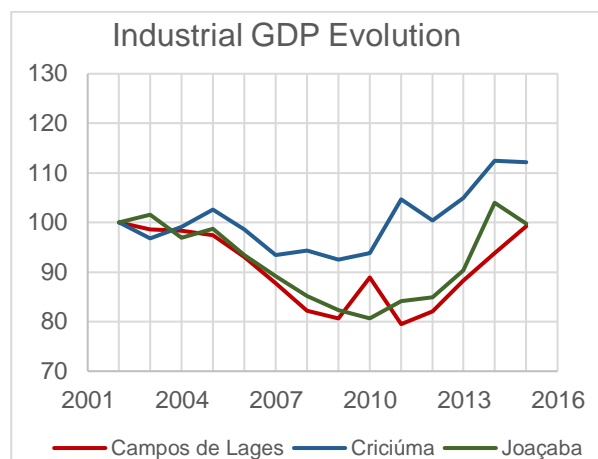
Source: Elaborated by the authors

The analysis for Campos de Lages, Criciúma and Joaçaba microregions shows that these regions together represented 15% of the state's industrial production in 2002, reduced to 12.9% in 2009 and in the end of the period by 15.7%. Graph 8 shows this reduction behavior followed by the recovery of participation in the industrial GDP of these regions. It is also emphasized that the Criciúma microregion showed a slight increase participation, from 6.1% in 2002 to 6.8% in 2015.

Results of differences in differences model

As presented in the methodology, to use this model we need to define the period before and after the structural change, and also the structural change. Thus, based on the recent findings regarding the Santa Catarina industrial sector presented in the previous chapters, the period before the structural change was defined as the period from 2002 to 2006, and the period after the structural change being from 2007 to 2015.

Justifying the selection of periods, Goularti (2014), noted that in the period between 2006 and 2012 PRODEC granted a total of R$ 8.6 billion, accounting for 64.3% of the total incentives. In the period from 1988 to 2012, in total the program granted R$ 13.5 billion in incentives. In the previous interval, 1998 to 2005, accounted for R $ 4.4 billion, equivalent to 32.6% of releases made over the entire period. Assuming there was a period between releases of the program and beginning of results, the analysis chose 2007 as the structural change year.

This is also corroborated by Complementary Law No. 381 of 2007, representing the last change in the total number of SDRs to 36 secretaries, in addition to better defining the form and limits of performances of the Sectoral Secretariats and the Regional Development Secretariats. Therefore, the model put emphases on the conclusions of industrial concentration and make sure if the direction of the results, indicates the reduction of concentration in industrial sector.

The results were estimated using *Stata* statistical package. To correct the heteroskedasticity, we used the robust model. In the methodology applied in this analysis, the econometric model of polygonal adjustments for binary variables is considered as an alternative model to the *differences in differences*, but it is only used when a clear break in the trend is identified, which did not occur when we observed graph 1 to graph 8.

The analysis of the variable related to the years of the study, , that receives a zero value between 2002 and 2006, and one after 2006, indicates that captures the difference in the increase in industrial GDP participation of the treatment and control groups in the period after the structural change, in relation to the previous one.

Table 5 presents the estimated β_2 coefficients. For the positive and significant cases, such as Chapecó, Concórdia, Curitibanos, Florianópolis, Itajaí, Ituporanga, São Miguel do Oeste, Tijucas and Tubarão microregions, the results indicate an increased participation in the state's Industrial GDP in the period 2007-2015 compared to the period 2002-2006. The magnitude of this increase is interpreted, using the Chapecó result as an example, as follows: this region increased its share by an average 0.47 percent in the period 2007-2015, compared to 2002-2006. For the Araranguá, Criciúma, Tabuleiro, Rio do Sul and Xanxerê microregions, the individual significance test of this variables shows that there are no systematic differences between the means of these regions over the years.

Table 5: estimated β_2 coefficients

Microregions	Araranguá	Blumenau	Campos de Lages	Canoinhas	Chapecó
β_2	-0,0008	- 0,0085**	- 0,0034***	-0,0055***	0,0047***
Microregions	Concórdia	Criciúma	Curitibanos	Florianópolis	Itajaí
β_2	0,0048***	0,0009	0,0064***	0,0134***	0,0154***
Microregions	Ituporanga	Joaçaba	Joinville	Rio do Sul	São Bento do Sul
β_2	0,0012***	-0,0052***	-0,0222***	-0,0006	-0,0096***
Microregions	São Miguel do Oeste	Tabuleiro	Tijucas	Tubarão	Xanxerê
β_2	0,0017***	0,0001*	0,0023***	0,0044**	0,0007***

Source: Elaborated by the authors.
Note: significance level * p<010; ** p<0.05; *** p<0.01

Concerning the regions of Blumenau, Campos de Lages, Canoinhas, Joaçaba, Joinville and São Bento do Sul, the negative rates of β_2 reveal that their average participation in state industrial GDP has decreased from 2007 to 2015, whether it is compared to their averages from 2002 to 2006.

Following the analysis, considering β_3 as the most important coefficient, due to demonstrate the variation in the industrial GDP participation of each microregion (control group) in the period after structural change (2007-2015) compared with the previous one, 2002 to 2006 (treatment group). Thus, the parameter is estimated to compare one microregion individually with another microregion. The results of parameter are presented in Table 6.

Due to the number of estimates, we discuss the results of the microregions with the largest participation in the industrial production of the state, Joinville and Blumenau. We also present the results for the Itajaí and Ituporanga microregions, with the largest increases in the Industrial GDP participation, and then the results of β_3 are presented for Canoinhas and São Bento do Sul, regions with reduction of Industrial GDP participation over the period.

Interpreting the Joinville microregion results, the β_3 estimator shows a negative sign, indicating that, comparing to the other microregion, except for Blumenau and São Bento do Sul, its industrial GDP share was relatively reduced, in individual analysis for the period from 2007-2015, compared to 2002-2006. Comparing Joinville's β_3 estimator with Itajaí microregion, the parameter indicates that Joinville showed an average reduction of 3.76 percent in its participation in industrial production from 2007 to 2015, compared to 2002 to 2006.

The Itajaí microregion presented an increase participation in the period, except comparing with Florianópolis microregion. The positive sign of the parameter indicates that the region increases its share of industrial GDP in relation to these regions from 2007 to 2015 compared to 2002 to 2006.

The non-significant results presented for the parameter β_3 indicates that there was no different behavior between these microregions in the analyzed period, that is, both regions showed a similar behavior of variations in industrial GDP in the analyzed period, due to occur in both regions an increase or decrease participation, as well as an oscillating behavior that does not allow to verify a specific relation between the microregions.

Table 6: estimated β_3 coefficients

Microrregião	Araranguá	Blumenau	Campos de Lages	Canoinhas	Chapecó
Joinville	-0,0214**	-0,0137	-0,0188**	-0,0167*	-0,0270***
Blumenau	-0,0077**	-	-0,0051	-0,0031	-0,0133***
Microrregião	**Concórdia**	**Criciúma**	**Curitibanos**	**Florianópolis**	**Itajaí**
Joinville	-0,0271***	-0,0232**	-0,0286***	-0,0356***	-0,0376***
Blumenau	-0,0134***	-0,0095**	-0,0149***	-0,0219***	-0,0239***
Microrregião	**Ituporanga**	**Joaçaba**	**Joinville**	**Rio do Sul**	**São Bento do Sul**
Joinville	-0.0234***	-0.0170*	-	-0.0216**	-0.0126
Blumenau	-0,0097***	-0,0034	0,0137	-0,0079**	0,0011
Microrregião	**São Miguel do**	**Tabuleiro**	**Tijucas**	**Tubarão**	**Xanxerê**
Joinville	-0,0239***	-0,0223**	-0,0245***	-0,0267***	-0,0229**
Blumenau	-0,0102***	-0,0086**	-0,0108***	-0,0130***	-0,0092**
Microrregião	**Araranguá**	**Blumenau**	**Campos de Lages**	**Canoinhas**	**Chapecó**
Itajaí	0,0162***	0,0239***	0,0188***	0,0209***	0,0106***
Ituporanga	0,0020**	0,0097***	0,0046***	0,0067***	-0,0036***

Cotinues

Continuation

Microrregião	Concórdia	Criciúma	Curitibanos	Florianópolis	Itajaí
Itajaí	0,0105***	0,0144***	0,0090***	0,0020	-

Ituporanga	-0,0037**	0,0002	-0,0052***	-0,0122***	-0,0142***
Microrregião	**Ituporanga**	**Joaçaba**	**Joinville**	**Rio do Sul**	**São Bento do Sul**
Itajaí	0,0142***	0,0206***	0,0376***	0,0160***	0,0250***
Ituporanga	-	0,0064****	0,0234***	0,0018***	0,0108***
Microrregião	**São Miguel do**	**Tabuleiro**	**Tijucas**	**Tubarão**	**Xanxerê**
Itajaí	0,0137***	0,0153***	0,0131***	0,0109***	0,0147***
Ituporanga	-0,0005	0,0011***	-0,0011*	-0,0033*	0,0005
Microrregião	**Araranguá**	**Blumenau**	**Campos de Lages**	**Canoinhas**	**Chapecó**
Canoinhas	-0,0047***	0,0031	-0,0021*	-	-0,0102***
São Bento do Sul	-0,0088***	-0,0011	-0,0062***	-0,0042***	-0,0144***
Microrregião	**Concórdia**	**Criciúma**	**Curitibanos**	**Florianópolis**	**Itajaí**
Canoinhas	-0,0103***	-0,0064***	-0,0188***	-0,0188***	-0,0209***
São Bento do Sul	-0,0145***	-0,0106***	-0,0160***	-0,0230***	-0,0250***
Microrregião	**Ituporanga**	**Joaçaba**	**Joinville**	**Rio do Sul**	**São Bento do Sul**
Canoinhas	-0,0067***	-0,0003	0,0167*	-0,0048***	0,0042***
São Bento do Sul	-0,0108***	-0,0045**	0,0126	-0,0090***	-
Microrregião	**São Miguel do Oeste**	**Tabuleiro**	**Tijucas**	**Tubarão**	**Xanxerê**
Canoinhas	-0,0071***	-0,0056***	-0,0078***	-0,0099***	-0,0062***
São Bento do Sul	-0,0113***	-0,0097***	-0,0119***	-0,0141***	-0,0103***

Source: Elaborated by the authors.
Note: significance level * p<010; ** p<0.05; *** p<0.01

CONCLUSION

The results indicate a reduction of participation in the industrial production of the microregions that represent the largest shares in the Santa Catarina Industrial GDP, Joinville and Blumenau. Also, there is a reduction of participation of these two microregions when compared to the other microregions of the state, especially analyzing the differences between the years 2007 to 2015 and 2002 to 2006.

In an opposite way, an increasing participation in industrial production is noted in Itajaí, Concórdia, Florianópolis, Chapecó, Criciúma, Curitibanos and other microregions. These findings indicate a decrease of concentration in the Santa Catarina industrial GDP between 2002 and 2015.

The loss of participation in the industrial production of traditionally industrial regions of the state does not represent reduction of industrial importance of these regions. Similarly, the increased participation of other regions must also be observed with some caution, because in regions with low industrial participation, a small growth may result in enlarged variation.

As a result, the outcomes show that, contrary to the previous studies of industrial concentration, in this analysis level, the microregions with higher participation in the

state's industrial GDP has a reduction of participation. On the other hand, we see regions of small and medium size presenting an increase in participation in the industrial GDP. Then, we have a decrease of concentration in the industrial sector over the period. Further studies can expand the analysis to verify if this reduction of concentration in industrial sector is related to regional development.

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