

IDB Paper

**Impact Evaluation of a Cluster Program: An Application of Synthetic Control
Methods¹**

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Abstract

In this paper we investigate the impact of a cluster tourism policy in the region of Colonia, Uruguay. This policy was implemented within the framework of an IDB supported program. A comparative analysis between Colonia and other touristic regions of the country was performed applying a synthetic control method. This identification method of the counterfactual is especially useful in comparative case studies where there are a limited number of control units. As far as we know it is the first time that is applied to a cluster policy. The estimations show a positive impact of the cluster program on the inflow of international tourists to Colonia of 24% in the period 2008-2015 and a not significant impact on their total expenditure.

Keywords: cluster policy, impact evaluation, synthetic control methods.

JEL Codes: H43, O25, O54, R10.

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1. Introduction

Since the seminal work by Porter (1990) cluster development policies (CDP) have become increasingly popular as a tool for productive development not only in developed countries² but also in developing economies. Although the scope and size of CDP interventions vary across countries, in a strict sense they tend to operate at sub-national level where firms tend to agglomerate around specialized productive activities. The aim of these policies is to eliminate or at least compensate the coordination failures among firms and between firms and governments in order to guarantee the provision of public goods needed for the competitiveness of the agglomeration.

Despite their pervasiveness, CDP are among the least evaluated productive development policies. Indeed, impact evaluation of CDP interventions are far more complex than in the case of typical productive development policy. Most of the literature of impact evaluation of these policies is inherited from the social policy approach where the focus of the intervention is on lifting an individual beneficiary out of poverty. However, focusing the impact evaluation of a CDP at individual firm level is completely uninformative. In the extent that the focus of CDP programs is the coordination for private and public actors for the provision of public goods – that by definition affect all the stakeholders of clusters – all the firms in the agglomeration are in some extent treated firms – some of them directly in the extent that actively engage in cluster activities, other indirectly as the result of the provision of public goods or spillovers. As such a proper assessment of these policies should be done at a higher level of aggregation, comparing treated “agglomerations” with untreated ones. This paper is a step forward in this direction by assessing the impact of a CDP program in particular regions of Uruguay and using synthetic control method to build a control group from among other un-treated regions from the same country.

The paper is structured as follows. Section 2 presents a brief literature review of CDP programs and evaluations. Section 3 describes the PACC program and outlines its impact channels. Section 4 describes the data. Section 5 presents the empirical strategy. Section 6 summarizes the results, while section 7 concludes.

² A survey carried out by the European Observatory of Clusters in 2012 identified about 570 “cluster initiatives” across the European Union. In 2010 the Small Business Administration of the US launched about 40 cluster programs across the country. Similar large scale initiatives are found in India and China (IDB, 2014)

2. Literature Review

The study of agglomeration economies can be traced back at least to Marshall (1920). Then expanded in Arrow (1962), Romer (1986) and later formalized by Glaeser et al. (1992) as the Marshall-Arrow-Romer (MAR) model. Agglomeration economies usually explain the formation of clusters of firms that belong to a specific industry and are located in a particular geographical area. The fact that firms from the same industry tend to geographically concentrate has been extensively studied in the literature (Delgado, Porter, and Stern, 2014; Ellison and Glaeser, 1997; Jaffe et al, 1993; Kerr and Kominers, 2015; Krugman, 1991). The agglomeration helps the establishment of links between firms within the cluster, which leads to gains from coordination and the internalization of externalities at the cluster level. However, coordination failures is a common problem that lead to sub-optimal allocation of resources. As Rosenstein-Rodan (1943) points out, coordination failures typically emerge when the investment decision of one agent is interrelated to those of others and externalities emerge due to this interrelation. These coordination failures are particularly severe at the moment of guaranteeing the provision of cluster specific public goods³.

Once these failures have been lifted, the theory says, the linkages between the firms will be stronger. These stronger linkages will build trust, and therefore, foster knowledge spillovers that tend to arise in every market transaction. Furthermore, as noted by Maffioli, Petrobelli and Stucchi (2016), firms with strong linkages may participate in networks leading to different positive outcomes: reduced transaction costs, increased efficiency, stronger originating and sharing of tacit knowledge, and stronger and more effective cooperative action (e.g. asset and input-sharing). All these will induce more innovation and gains in efficiency at cluster level.

The benefits of industry-clusters have gained attention in the public-policy sphere due to the works of Porter (1990, 1998, 2000). Governments all across the world are increasingly supporting cluster development programs (CDPs) to take advantage of several agglomeration economies that their countries have in order to increase

³ Public goods show two properties that make market provision unsuitable. Non-rivalry, which means that one produced the public good, could be used without any limit by all the actors in the agglomeration. The second property is limited appropriability that means that control mechanisms are greatly ineffective to exclude free riding users. Typical public goods refer mostly to information such as a new piece of legislation, sector regulations, generic technological knowledge applicable to the sector, branding, etc. Misalignment of incentives will make that a Coasian self-regulating solution will be out of reach, making the coordination of the collective action through public policy the only way to deliver these goods.

productivity (Crespi, Fernández-Arias and Stein, 2014). The justification for government intervention, and, therefore, the existence of CDPs, as mentioned previously, lies on the presence of coordination failures and the provision of public goods (Maffioli, Petrobelli and Stucchi, 2016). Although the objective of CDPs is to strengthen the linkages and relationships between the firms within a cluster, this is just a tool to reach its final goal: to stimulate productivity and, therefore, increase competitiveness.

Even though the presence of spillovers is a well-studied phenomenon in the economics of agglomeration literature, due to its intrinsic characteristics, how to measure spillovers and general equilibrium effects of cluster policies remain an open question in the literature. Researchers do not usually have sufficiently rich firm-level data in order to correctly estimate them. Huber (2012) suggests that there is yet very little empirical evidence on the mechanisms of local knowledge spillovers and suggests academics and policy makers to be more careful with the assumption of the existence of these spillovers in clusters.

To the best of our knowledge, relatively few studies have successfully studied indirect and/or total effects of cluster development programs. One of the few exceptions is Figal Garone et al (2015). Using firm-level data on Brazilian SMEs for the period 2002–09 and combining fixed effects with reweighting methods they estimate both the direct and indirect effects of a cluster development program in Brazil in three variables: level of employment, value of exports and the probability of exporting. To estimate the indirect effects the authors classify as indirect beneficiaries those firms that did not participate in the program and that were located in a municipality where there were direct beneficiaries in the same industry. The authors found positive spillovers in both export outcomes and a negative effect on employment in the first year after the program. This last effect is probably coming from labor mobility from indirect beneficiaries to direct ones.

While in Figal Garone et al. (2015) indirect beneficiaries are defined through geographical proximity criterion, in Castillo et al. (2015) indirect beneficiaries are identified through labor mobility. The indirect beneficiaries are the firms that hired workers that were working in a direct beneficiary firm. This source is an innovation program called FONTAR that was carried out in Argentina between 1998 and 2013. The paper measures spillovers as the improvement in performance of firms that hired

skilled workers from the treated firms. To estimate this effect a lagged dependent variable model is used to compare these indirectly affected firms with a group of firms that have a similar evolution on key variables before they hired skilled workers from the participant firms. The authors find that indirectly affected firms increased employment, wages, the exporting probability, and value of exports. In addition, the authors conclude that these effects are driven by improved productivity.

In Boneu et al. (2014) the authors estimate the spillover effects associated with a technological cluster located in the city of Córdoba, Argentina. While the direct beneficiaries are the small and medium size firms located in the city of Córdoba that integrate the technological cluster, the indirect beneficiaries are the same type of firms that are located in the outskirts of the city. The authors use a panel of firms in the ICT sector for the period 2003-2011 that allowed them to control for the dynamics of firms' sales and fixed-effect applying a system GMM estimator. The paper found that for every new participant into the program the sales of non-participant increase by approximately 0.7%.

Closely related to this paper, Castillo et.al. (2014) investigate the impact of a tourism policy on employment in the province of Salta, Argentina. Following the synthetic control method they use a combination of non-treated Argentinean provinces to construct a synthetic control province which resembles relevant characteristics of Salta before policy implementation. They find that the CDP policy increased tourism employment in Salta by an average of 11 percent per year, for an overall impact of around 110 percent between 2003 and 2013. In this paper we will follow a similar approach to estimate the aggregate effect of a cluster policy in Uruguay, adding to the very scarce literature rigorously quantitatively measuring the impact of cluster policies and in particular to the one that seeks to measure total (direct and indirect) effects.

The cluster policy that we focus on is a cluster policy aimed to increase the competitiveness of the tourism sector of a region in Uruguay (Colonia). The total investment in this policy in the period 2008-2014 was close to the 900 thousands US dollars and implied actions aimed at the development of business' linkages, soft touristic infrastructure improvement and a better promotion and commercialization strategy of Colonia as a touristic destination.

The city of Colonia has some particular characteristics that make it a very popular destination for tourists that visit Uruguay. First of all, it was declared a World Heritage

Site by UNESCO in 1995. Moreover, about a quarter of the tourists that visit Uruguay enter the country through Colonia's port. Furthermore, the city is only 50 km away from Buenos Aires, Argentina's capital. All these elements make the city the fourth most popular touristic destination in Uruguay. In the next section we describe the program and the theory of change behind it.

3. The PACC program

3.1. Description of the program

The Program for the Competitiveness of Clusters and Production Chains (PACC for its acronym in Spanish)⁴ was created in 2005, with the support of the Inter-American Development Bank. It had the aim to contribute to the development and competitiveness of clusters and supply chains. Since its inception the PACC has worked with 21 clusters. Each cluster intervention is divided into three components: a strategic plan, matching grants for different projects and strengthening of the supporting institutions of the cluster.

The PACC program had two main stages (see Diagram 1): 1) cluster selection and preparation of competitiveness strengthening plans and, 2) execution of projects and actions to strengthen public and private supporting institutions. The process starts with a call for clusters, spread among interested agents through public agencies. Firms gather around a sectorial chamber or association and together with a government agency (ministry or local government) submit applications. After a cluster is selected, its members should develop a strategic plan.

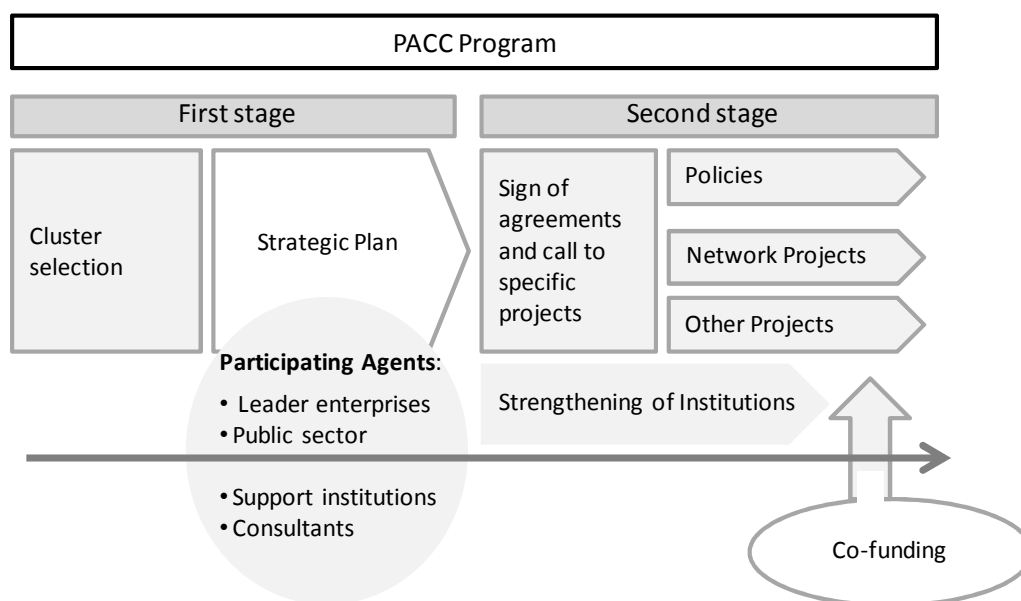
The strategic plan contains the proposal of specific projects that are co-funded by the public sector according to the level of appropriability of the outcomes by individual firms vis a vis the cluster. Those projects with high appropriability for only a limited number of firms in the cluster receive a lower percentage of subsidies in comparison with those that have an impact on the entire cluster (also known as structural projects). Simultaneously, there are initiatives directed to strengthening public and private supporting institutions.

The PACC program started in 2005, but the first disbursement for projects was made in the year 2007. Even though the program ended in the year 2014, most of the

⁴Programa de Apoyo a la Competitividad de Conglomerados.

disbursement was made in the period 2008-2010. The projects supported in each cluster had a wide scope: technical assistance, training, procurement of machinery and equipment for collective use, promotion of best managerial practices, environmental management, clean production, waste management, occupational health, actions directed to attraction of direct investment identified as critical in the strategic plan, development of collective trademarks, reorientation of training supply, facilitation of certification processes, market intelligence and access, development of distribution channels, technical assistance on quality-related topics, etc.

Diagram 1. PACC's support model



Source: PACC (2009).

International commercialization actions were predominant, with almost 60 projects implemented. Capacity building initiatives were second in terms of frequency, with nearly 40 initiatives up to June 2013. Other projects included missions abroad, research and development, and quality enhancement actions. The program also invested resources on strengthening the execution capabilities of business support institutions, including supervisory and monitoring actions and coordination of workshops where officials, consultants and businessmen discussed relevant topics related to the program's impacts. Also the program provided funding for training activities, consulting services, and technical assistance for ministries and organizations aiming to improve their capacities to implement support policies.

In the case of the cluster Tourism Colonia, the objective was to promote tourism in the Department of Colonia and in particular in the UNESCO World Heritage capital of the Department: Colonia del Sacramento. Therefore, the implicit objective was to increase the level of activity of the tourism sector in Colonia. The cluster participated to the second call for proposals open by the PACC program.

The Department of Tourism of Colonia led the proposal. The director of the Department was a technocrat with deep knowledge of the field that got her position in a public competition. The local lodging association, that also joined the proposal, had been promoted inter-sectorial collaboration during the previous years and had formulated a basic strategic plan. Public-Private interactions at the moment of starting the CDP program were intense, complex and not absent of conflict. Among other things, the arrival of new international hotel operators was perceived as threatening the traditional family owned domestic establishments. The ferry company that managed the route between Colonia and Buenos Aires, the largest market, refused joining the program. And it took a while until the restaurants association decided to enter to the program. Another challenge was that the sector was experiencing a surge in demand, so businessmen were more interested in capturing short term profits than in projects with medium and longer term maturity. The Department of Tourism can be credited with solving these initial challenges and then mobilizing all the actors behind the initiative.

In order to overcome the problems of fragmented representation by the private sector and to improve the cooperation among public agencies, the CDP first established the cluster association: The Colonia Tourism Association (ATC). This association gathered together public and private actors and provided institutional support to the interventions. The Department of Tourism was also another key actor as not only facilitated interaction with other local actors, but also with other actors at the national level such as the Ministry of Tourism, that later on also joined the cluster (Rius, 2013). The intervention strategy proposed several lines of action all aimed at improving the city as tourism destination. To do this, the ATC reached a consensus on 19 initiatives that required about US\$ 900.000 of investment. On average the program financed up to 70% of each one of them. These projects covered a wide range of interventions from very basic ones (such as the design of the web site for city) to very demanding ones in terms

inducing collective action (such as the development of common trademark, benchmarking exercises with other similar regions around the world, the incorporation of new marketing technologies such as QR codes, English training for employees or strengthening the ATC).

Nowadays, the cluster Tourism Colonia is integrated by multiple sectors, such as the hospitality, gastronomic, commercial and transport sectors, to name only the most important ones. The cluster brings together business unions, the Ministry of Tourism (MINTUR), the Municipal Government of Colonia (IMC) and, up to 2014, the Office of Budget and Planning (OPP), which was the office in charge of implementing the PACC.

Given the scope of most of the projects of the program, i.e. the production of club goods, it makes more sense to look for effects at the level of macro variables related to tourism in Colonia than trying to identify effects at firm-level. All the firms in Colonia, directly or indirectly, have been affected by the program, making difficult if not impossible an identification strategy at the firm level. Moreover, by focusing the analysis at the level of macro local variables we will be able to capture the direct and indirect effects of the program. In the next section we explain in detail our empirical strategy to identify some of the macro effects of the program.

In the next section we will discuss in detail how we expect the cluster policy to affect different outcomes.

3.2. Impact channels

As discussed previously, the rationale behind CDP interventions is that firms' competitiveness depends not only on individual actions, but also on the actions of other agents, and coordination failures among these in a geographical agglomeration are limiting factors to achieve competitive states.

The causal mechanisms through which the PACC –thought of as a particular cluster development program, differing from other CDPs applied in different contexts or countries– would generate an increase in competitiveness, are explained in Diagram 2. Given the complexity of the program, in the diagram we discriminate the causal effects into four separate mechanisms, although it should be kept in mind that there are feedbacks from one to another.

Before presenting the main mechanism expected to be working in the case of PACC some other issues about the theory of change presented in the diagram need to be briefly discussed. First, we need to explicitly account for contextual events which may affect the observed outcome. For instance, a change in macro or meso-level factors -i.e. those that affect all firms or group of firms as changes in norms or international markets- can act as a limiting condition for the achievement of some outcomes, even when the intervention and all mechanisms are working properly. In addition, other micro aspects linked to firms' characteristics are also relevant for the success of the program (e.g. firms' capabilities, resources, technology and integration to international markets).

According to the type of interventions that the PACC generated, we can distinguish four potential mechanisms through which the interventions affected the ultimate goal of increasing competitiveness.

A first type of intervention of the PACC was directed to increasing coordination among private agents, generating cluster specific institutions. The underlying assumption was the existence of coordination failures along some value chains and in some regional clusters. This is the typical justification for cluster policies. In the presence of agglomeration economies (in regions or value chains) the facilitation of coordination and the spread of information among firms in the cluster should help to internalize the external economies related to knowledge spillovers, labor pooling and other input/output externalities; this in turn should have an impact on the average productivity of firms affected by the intervention and therefore on their "competitiveness" (Marshall, 1920)⁵. This is the first mechanism depicted in Diagram 2.

A second type of initiative was directed to coordinate investment in club goods. The second theoretical mechanism in Diagram 2, states that the coordination among all relevant actors in a cluster with specific purposes can lead to investment in strategic assets for the sector. For this causality to have a positive effect in the upcoming stages of this mechanism, the persistent participation of a critical mass of interested agents (enterprises, public institutions, etc.) is needed.

PACC supported the actions needed to generate a cluster strategic plan, following an inclusive perspective. The result of this process was a sector validated document

⁵ As spillovers are hardly measurable, agglomeration economies are difficult to observe empirically (Hanson, 2001). It is noticeable in our case that the program forced the networking by formal instances of collaboration as a prerequisite for financial support; but spillovers cannot be observed as an independent outcome.

containing the strategic lines of actions for the cluster. The consensual definition of strategic lines for the cluster, at least at a theoretic level should help to build consciousness on the benefits of cluster-level investments, even in those cases where the appropriability of the action is very low at the individual level, i.e. it should ease the creation of club goods. Given that the most common club goods generated were directed to the objective of facilitating the access to external markets (e.g. participation in fair trips), we expect this channel to have worked mostly through the impact on easing the access to external markets, and therefore increasing exporting opportunities.

One of PACC objectives was to coordinate the actions of public agencies. If coordination of public institutions is achieved, and this is conducive to better public policies, we expect this to have a positive effect on a cluster's competitiveness. This is the third mechanism in Diagram 2.

Co-financing is the final theoretical mechanism identified in Diagram 2. These funds could be used for capacity building, traveling, or any other type of investment identified as a priority for the cluster. This funding is directed not only to generate club goods but also in some cases private goods. In theory, given that this funding was subsidized by the public sector it should increase the private investment's returns on both private and club goods and also lift some financial restrictions, where both channels lead to increased total investment. This in turn should lead to an increase in productivity and "competitiveness". Given that some of these investments were on club goods it also served as a way of strengthening and increase network links, and this could have an additional impact on the competitiveness of the cluster through the first theoretical mechanism.

Diagram 2. Causal mechanisms of the CDP as applied in Uruguay

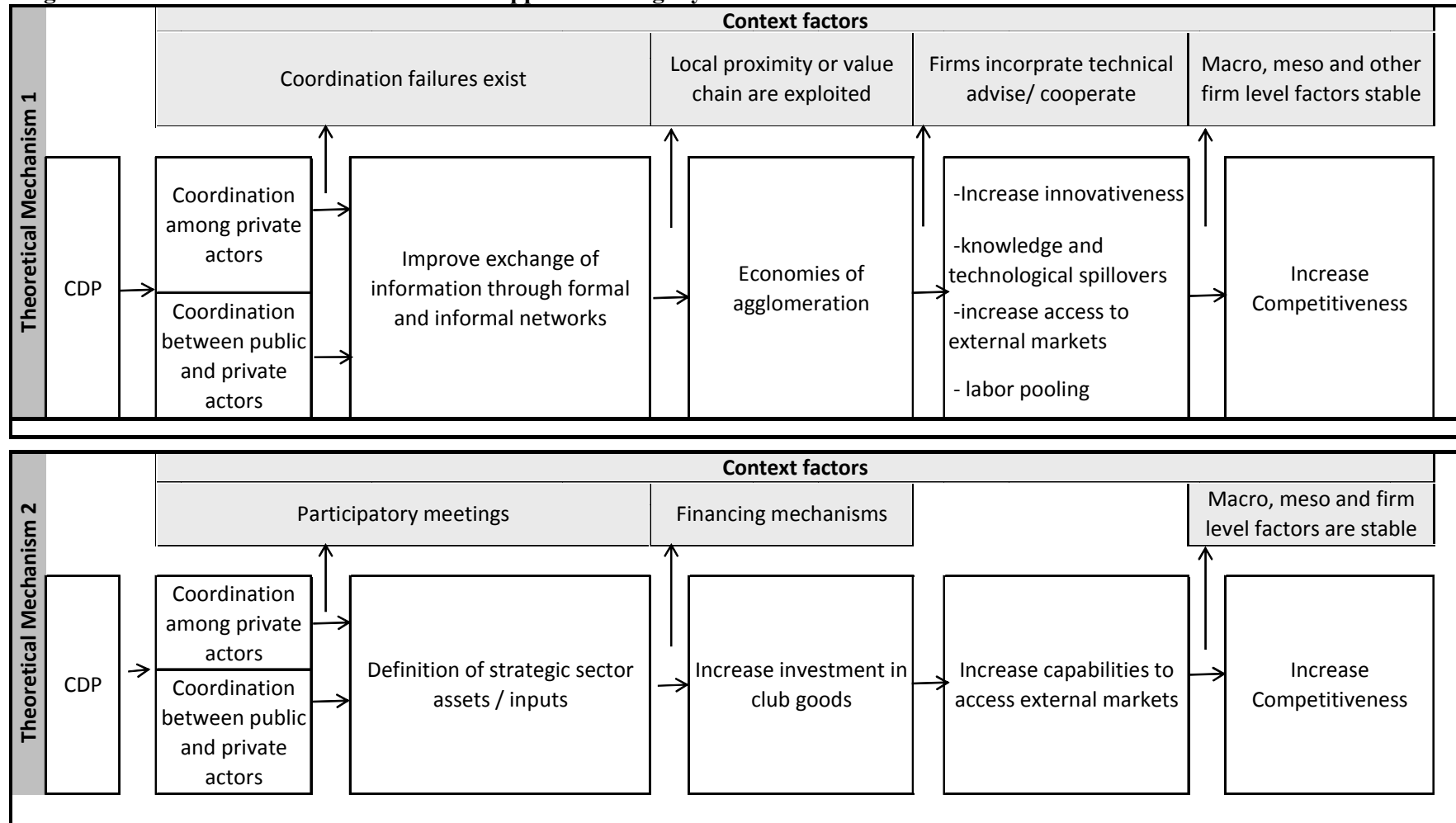
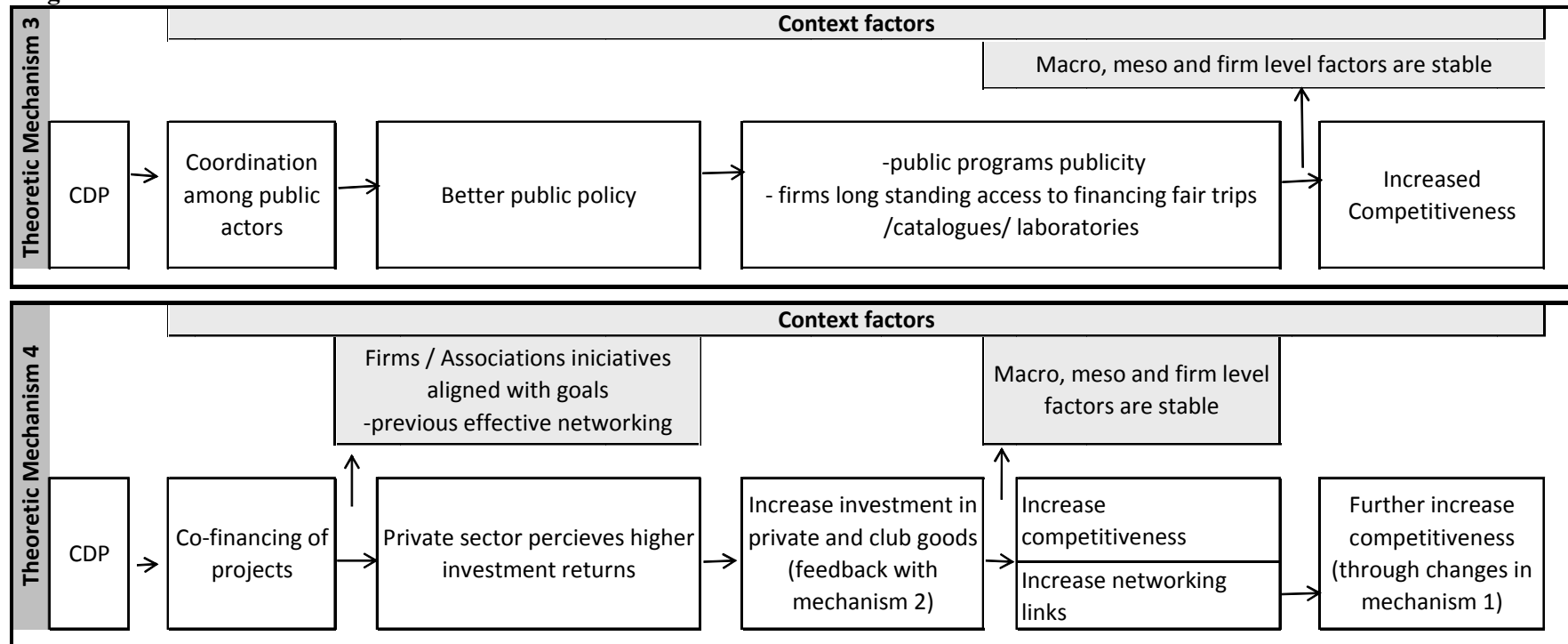


Diagram 2.Cont.



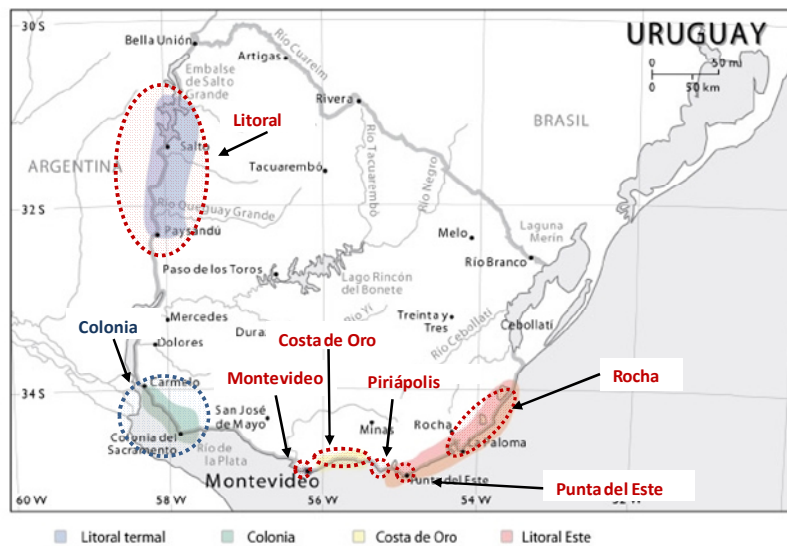
Source: Own elaboration.

4. Data and descriptives

4.1. Data

The main data source used in this paper is the “Encuesta de Turismo Receptivo” which provides disaggregated information for Uruguay’s main seven touristic destinations, namely: Colonia, Punta del Este, Montevideo, Costa de Oro, Pirápolis, Rocha and the thermal littoral⁶. For each of the aforementioned regions, there is quarterly information about number of visitants, tourists’ expenditures and average stay of visitants between the years 2000 and 2015.

Figure 1. Touristic Regions in Uruguay



In addition we are using information from “Encuesta Continua de Hogares” the Uruguayan household surveys. More specifically, the information about average residents’ household income was used as a proxy of the level of development of each region.⁷

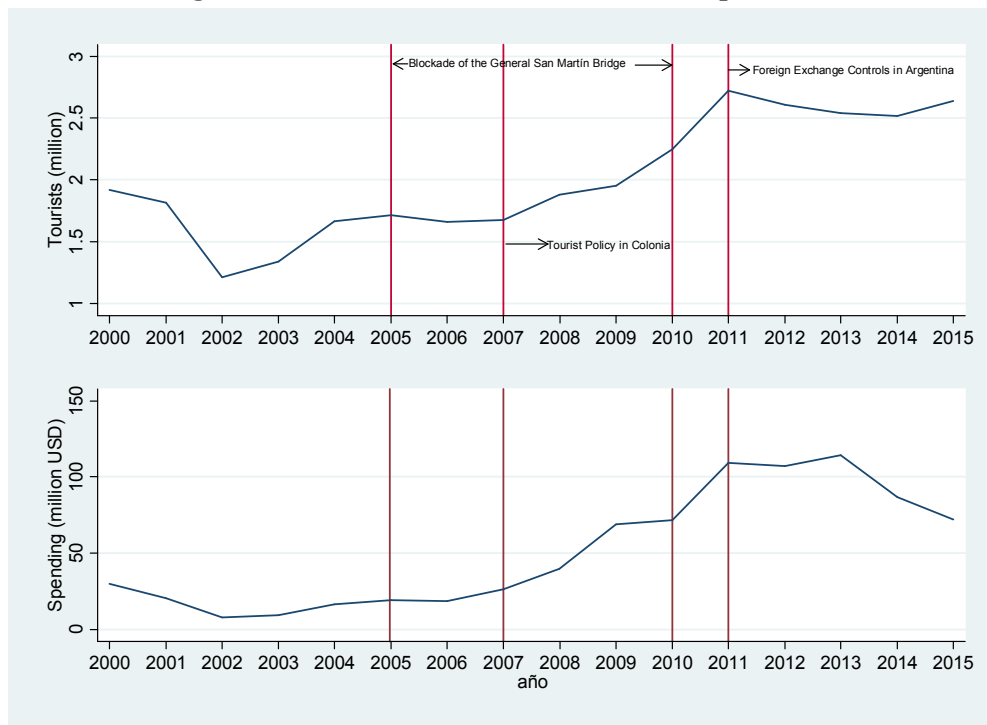
⁶ The remaining destinations are grouped in a residual category.

⁷ Even though a priori the ECH, provides several variables which enable to characterize the residents and the labor market, the nature of the sample makes it difficult to obtain precise medians at small region level. This problem gets worse if inside these regions we need to construct variables at a sector level, for instance, the number of people employed in the sector restaurants and hotels. In fact, there was not a gain in the mean error of prediction when constructed the synthetic control including predictors with information from ECH beyond average household incomes.

4.2. Descriptive Statistics

Since the beginning of 2000 and until 2002, tourist activity has not gone unscathed by the country's and region economic crisis, especially the Argentinean crisis (see Figure 2). The number of visitants had a slightly recover between 2003 and 2004 and then stayed at a standstill until year 2007. Between 2007 and 2011, there was an important growth. Since 2011 and until 2015, the number of tourists once more remained standstill while the expenditure showed a decrease from 2013.

Figure 2. Number of tourists and annual expenditure



Note: For the 7 touristic regions in Uruguay.

The international tourism in Uruguay is highly concentrated in the region, especially Argentines (57% of the total) and Brazilians (15% of the total). Hence, tourism performance is highly affected by the evolution of Argentina's demand determinants. This is especially true for Colonia, given its proximity to Buenos Aires. The determinants include macroeconomic variables, especially the evolution of the level of activity and the bilateral exchange rate but also economic policy measures taken in Argentina which affect Uruguay's tourism demand.

Regarding the level of activity, Argentina's GDP growth was favorable to the touristic demand between the years 2003 and 2011. Between the years 2003 and 2008, Argentinean GDP grew at high rates (9% average). In 2009, there was a contraction due to the international crises but it recovered and reported high growth rates again between 2010 and 2011 (8% average). Since 2012 until 2015, the Argentinean economy entered a period of stagnation.

The trend of the bilateral real exchange rate with respect to Argentina was one of appreciation or the Uruguayan currency; except for the years 2002 and 2003 when there was an important devaluation of Uruguayan peso (see Figure A.1 in the Appendix). On the other hand, respect to Brazil, it is observed a competitiveness gain until 2007 and a loss since then, which results in a bilateral exchange rate in 2015 near to the one observed in 2000.

Due to close proximity between the cities of Colonia and Buenos Aires, it is important to consider some events in the analyzed period which may have affected the evolution of the inflow of Argentinean tourists and the level of their expenditures. First of all, it is important to mention the conflict between the Uruguayan and Argentinean government which aroused as a consequence of the settlement of a Pulp Plant at the margins of "Rio Uruguay" in the city of Fray Bentos. Between 2005 and 2010, Argentinean residents of Gualeguaychú and green organizations mobilized against the plant's settlement. Among the actions taken, one of the most relevant was the crossing blockade made to the international bridge "Libertador General San Martín", a border crossing point between both countries.

Although it is clear the negative effect the aforementioned closure had in the influx of Argentinean tourists to Uruguay, it is not clear that the effect it may had in Colonia was equally negative. The reason is that basically, for the population of Buenos Aires, Colonia turned into an alternative entry/exit point to Uruguay. In Figure A.3 in the Appendix, it can be seen the significant decrease in the influx of tourists through Fray Bentos and simultaneously, and increase in the entries through Colonia.

However, the bigger importance of Colonia as an entry/exit point does not either imply an increased importance as a touristic destination, albeit it is not possible to discard a

positive externality of San Martin bridge block over the influx of Argentinean visitors.⁸ This fact represents a constraint to identify the impact of the cluster policy as the bridge block went further from 2007, the same year in which the touristic cluster in Colonia started developing.

Nonetheless, Colonia's biggest income growth took place in 2006 and 2007, previous to the program. In Figure A.5 in the appendix, it can be seen the number of tourists as a proportion of the number of people who entered through the Port of Colonia. Such proportion, until 2004 was approximately 0.4, and decreased significantly between 2006 and 2007 until it reached a ground of 0.26. This result is according with the fact that Colonia increased its importance for Argentineans as an entry point to the country. However, the number of tourists in Colonia increased rapidly since 2008, despite that the blockade of the bridge General San Martin continued until year 2010.

Another important factor to highlight is related to the Argentinean foreign exchange policy. In November 2011, the Argentinean government imposed an exchange rate control in order to tackle outflows of capital. This implied restrictions to the purchase of foreign currency with purpose of foreign travel (this policy was known as "cepo cambiario"). From then on, there was a widespread of other measures aimed to stop different ways to elude exchange rate controls. A very popular practice amongst Argentineans consisted of travelling to Uruguay (mainly to Colonia) in order to withdraw cash in dollars at the official exchange rate (cheaper than the parallel market one in Argentina) from the cash dispensers. Argentinean authorities imposed different measures such as surcharge (up to a 35%) to the purchases made with international credit or debit cards and maximum limits of extraction of money abroad with the objective of counterbalance these practices.⁹

The exchange rate control (which extended until the end of 2015), as also the measures which sought to limit Argentineans spend in foreign countries, had an impact in Uruguay's touristic demand. In Figure 2 can be seen that year 2011 is the beginning of a

⁸ A similar effect may be expected in the thermal littoral (which includes zones in the departments of Paysandu and Salto), regarding the other two land crossing points with Argentina are in this region. It should be pointed the latter was an entry/exit point alternative from residents of other provinces and not the ones in Gran Buenos Aires.

⁹ A similar practice happened with the Uruguayan casinos which work with USD. Argentinians went to casinos, bought certain amount of money in chips and afterwards changed those chips for USD at the official exchange rate.

standstill in the entering of tourists and in their expenditure (it is also important to highlight that in this period the Argentinean economy begins a stagnation phase).

However, the effect of these episodes over the demand of international tourism in Colonia is *a priori*, ambiguous. On the one hand, the policy meant an important constraint to the Argentinean demand, which could have affected tourism in Colonia. On the other hand, given that the city of Colonia turned into an attractive place for Argentines to use credit cards in order to avoid the foreign exchange restrictions, a positive externality over the tourist demand in Colonia cannot be discarded.

If we observe the evolution of the number of tourists and expenditures in tourism in the seven regions of the country from 2011 (see Figures in the Appendix), both Colonia and the Litoral (the two touristic regions bordering Argentina) present a slowing down of growth while the remaining regions present a fall.

Considering that our main objective is to identify the effects of a cluster tourism policy which starts in 2007, we can be relatively confident that between 2008 and 2010 this impact was not distorted by the previous commented episodes. Since 2011, the difference between what happened in Colonia and the control group may be distorted by these events. However it is not clear the direction of this bias, since likely the Litoral region that is in the control group was probably affected in similar way than Colonia.

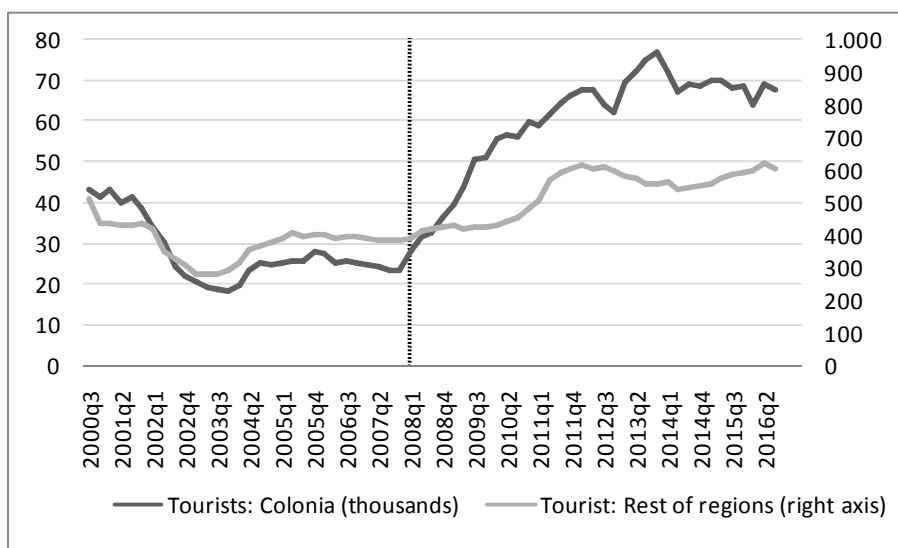
Figure 3 shows the number of international tourists visiting Colonia and all the remaining touristic regions. The year 2008 is a turning point and it coincides with the start of the program. If we observe each of the other regions individually (see Figure A.2 in the Appendix), it is also possible to appreciate a change in trend the same year in the Litoral region and also in the coast of Rocha.

If we compare the year 2009 with 2006, Colonia increased its participation in the total number of international tourists by 5.4 percentage points (see Figure 3).¹⁰ If we look at the total expenditure (Figure 5), the differences in trend between Colonia and the rest of the regions since the beginning of the cluster program are not clear. Albeit between 2009 and 2010 the tourism expenditure increases at a higher rate in Colonia, the contraction suffered since 2014 is also more accelerated. Colonia's participation in total

¹⁰ We consider the year 2006 as the last pre-program year since the plan for the cluster Tourism Colonia was approved in 2007 and the first structural project was approved in 2008.

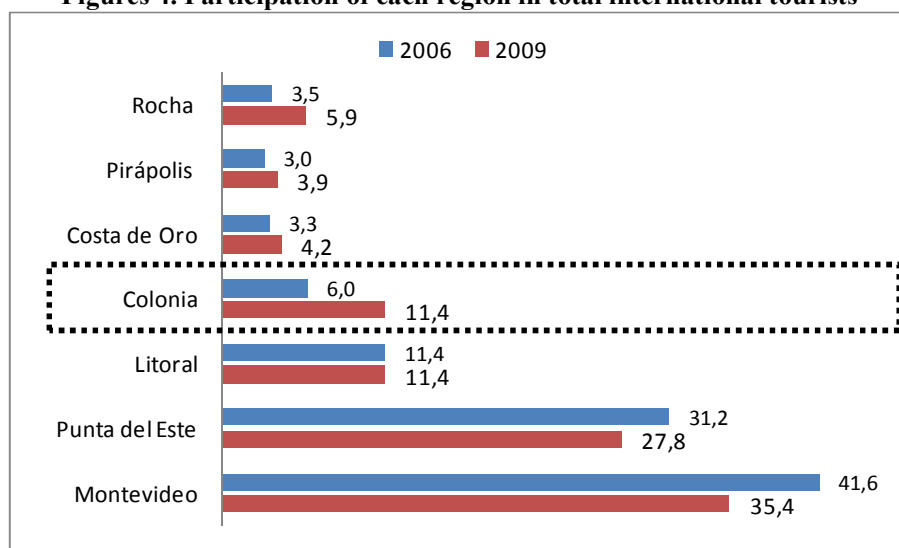
expenditure between 2006 and 2009 increases 2.2 percentage points (from 3.2% to 5.4%).

Figure 3. Number of international tourists by touristic regions of Uruguay (seasonally adjusted)



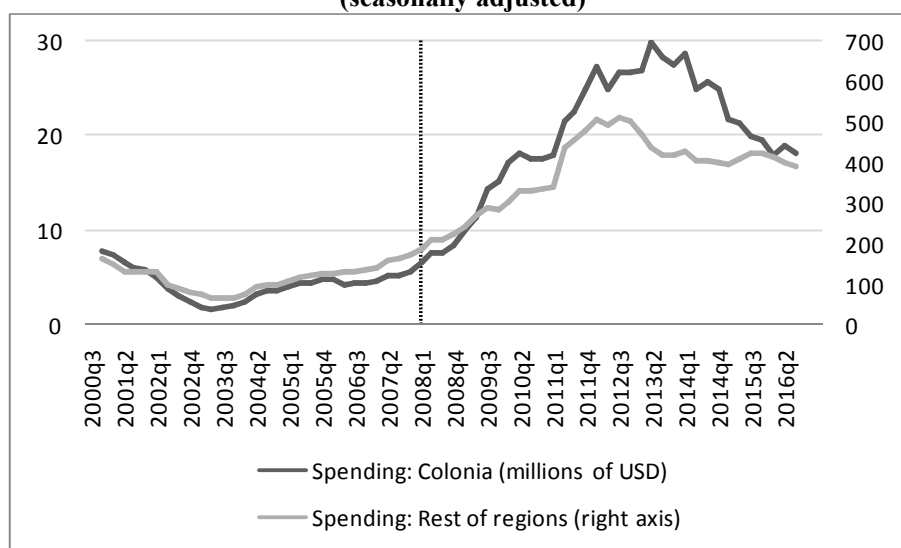
Source: own elaboration based on information from the Ministry of Tourism

Figures 4. Participation of each region in total international tourists



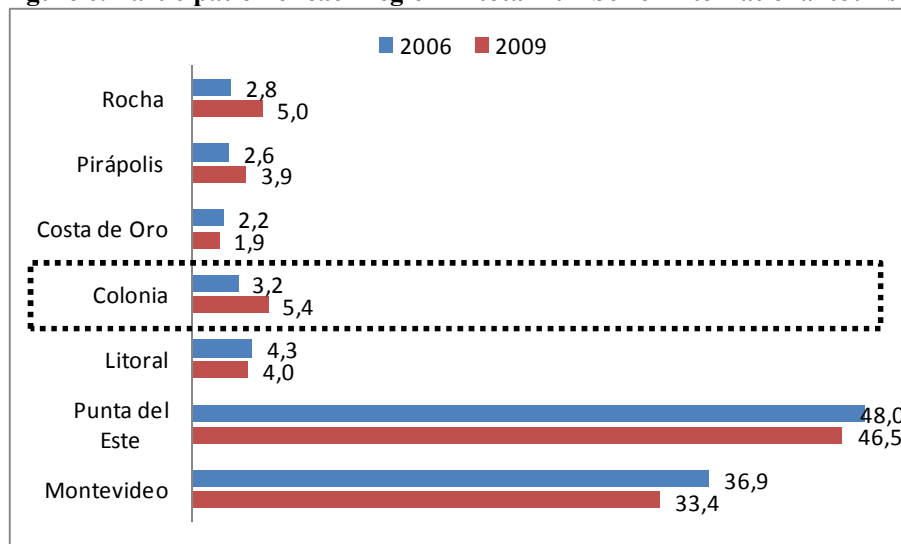
Source: own elaboration based on information from the Ministry of Tourism

**Figure 5. Total expenditure of international tourists by region
(seasonally adjusted)**



Source: own elaboration based on information from the Ministry of Tourism.

Figure 6. Participation of each region in total number of international tourists



Source: own elaboration based on information from the Ministry of Tourism.

5. Empirical strategy

In order to analyze the impact of PACC in the tourism sector in Colonia, the present work will focus on demand indicators. To do this, we will work with information provided by the “Encuesta de Turismo Receptivo” and more precisely with information about the number of international tourists and their expenses.

Given that the treatment unit is a region and at the same time there is a group of aggregated units (or regions) which could stand as a potential control group, the synthetic control method appears as an appropriate technique. Moreover, given the difficulty of applying traditional impact evaluation methods in this case, this seems one of the only ways of producing a quantitative impact evaluation.

The synthetic control method has been used to study economic impacts caused by several different events. For instance, synthetic control methods were previously used to measure the effects of terrorists attacks (Abadie & Gardeazabal, 2003), of natural disasters (Cavallo et al., 2013), of particular economic regimes (García Ribeiro et al., 2013), of tobacco control policies (Abadie et al., 2010), of major sports events (García et al., 2015) and tourism development policies (Castillo et al., 2015).

Basically, the synthetic control method assigns a weight to every unit of the control group according to an optimization process which minimizes the distance between vectors which contain information related to the variables of interest for the period before the intervention, for the treated and control units.

Following Abadie et al. (2010) we define D_{jt} as the indicator of treatment for region j at moment t . The observed outcome variable Y_{jt} equals the sum of the effect of the treatment ($\alpha_{jt}D_{jt}$) and the counterfactual Y_{jt}^N which is specified as a factor model:

$$\begin{aligned} Y_{jt} &= \alpha_{jt}D_{jt} + Y_{jt}^N \\ &= \alpha_{jt}D_{jt} + (\delta_t + \theta_t \mathbf{Z}_j + \lambda_t \mu_j + \varepsilon_{jt}) \end{aligned} \quad (1)$$

where δ_t is a unknown common time effect, \mathbf{Z}_j is a vector ($r \times 1$) of observed covariates not affected by the treatment, θ_t is a vector ($1 \times r$) of unknown parameters, λ_t is a vector ($1 \times F$) of observed common factors, μ_j is a vector ($F \times 1$) of unknown factorial loads and ε_{jt} is a zero mean independent error. If $j=1$ is the region affected by the policy, the treatment effect is estimated by approximating the unknown Y_{jt}^N with a weighted average of untreated regions.

$$\hat{\alpha}_{1t} = Y_{1t} - \sum_{j \geq 2} \omega_j Y_{jt}$$

We call T_0 the number of periods before the treatment, T the total periods and j the observed regions $\{1, \dots, J + 1\}$ where the first is the unit which receives treatment and the rest are “donors”. Y_j is the results vector ($T \times 1$) for unit j and Y_0 is the results matrix ($T \times J$) of all donors. \mathbf{W} is a weights vector ($J \times 1$) of all donors observations, $(\omega_2, \dots, \omega_{J+1})$, so $\sum_{j=2}^{J+1} \omega_j = 1$ and $\omega_j \geq 0$. The weighted mean of donors is constructed as $Y_0 \mathbf{W}$. $Y_j = (\bar{Y}_j \setminus \bar{Y}_j)$ is the partition between pretreatment and post treatment results vectors. X represents the combination of k predictors, which include the r covariates Z y M linear combinations of \bar{Y}_j ($k=r+M$). Analogous, X_0 is the matrix ($k \times J$) of predictors for donors. Finally, \mathbf{V} is a matrix ($k \times k$) of predictors’ weights.

The synthetic control method consists in finding the optimal weighting matrices W and V . The inference process is valid for any V but Abadie et al. (2010) suggests choosing the matrix in an appropriate way to minimize the outcome variable prediction error between the treated unit and the synthetic control in the pre-treatment period. Afterwards, W is chosen in such a manner that it minimizes the square root of the prediction mean error of predictor variables, $\|X_1 - X_0 W\|_V$. In this way, the treated region and its synthetic control result similar along the dimensions which matter to predict the outcome variable previous to the treatment.

Under specific conditions, Abadie et al. (2010) show that the bias of \hat{a}_1 tends to zero when the number of periods before the treatment (T_0) increases in relation to the scale of ε_{jt} . The synthetic control obtained is a good approach to the counterfactual, and thus, its path post treatment reflects what would have happened with the treated region in the absence of intervention.

In order to determine the statistical significance, placebo tests are performed. This consists in taking each region from the control group and apply the same method as it were a treated unit (excluding the treated region from the respective synthetic control), in order to obtain a distribution of the placebo effects. If the distribution contains effects as large as the effect of a truly treated unit, then we should assign a high probability that the effect has happened by chance. This non-parametric test has the advantage that it does not impose any error distribution.

Formally, if $\hat{\alpha}_{jt}^{PL} = \{\hat{\alpha}_{jt} : j \neq 1\}$ is the distribution of the placebo effects, then the p-value of the estimated effect $\hat{\alpha}_{1t}$ is the following:

$$\begin{aligned} \text{p-value} &= \Pr(|\hat{\alpha}_{jt}^{PL}| \geq |\hat{\alpha}_{1t}|) \\ &= \frac{\sum_{j \neq 1} 1(|\hat{\alpha}_{jt}^{PL}| \geq |\hat{\alpha}_{1t}|)}{J - 1} \end{aligned}$$

The p-value is interpreted as the proportion of the control group units which have an estimated effect at least as large (in absolute value) as the treated unit.

It is important to note that inference using these p-values can be overly conservative given that placebo effects may be large in cases where a good adjustment in the pre-treatment period is not achieved for the placebo regions (i.e. a good synthetic control is not achieved). An alternative is to divide the effects $\hat{\alpha}_{jt}$ by the square root of the mean squared error of prediction in the pre-treatment period (\tilde{s}_j), and obtain a pseudo t-statistic, $\hat{\alpha}_{jt}/\tilde{s}_j$.

Both p-values are defined for each of the post treatment periods. Analogues for both statistics for the entire post treatment interval can also be defined using as the average effect the root of the mean squared error of prediction (\tilde{s}_j). Therefore, the p-value for the joint significance of the effects for all the post treatment periods is defined as the proportion of placebos which have \tilde{s}_j/\tilde{s}_1 at least as large as the treated unit.

$$\text{p-value} = \frac{\sum_{j \neq 1} 1(\tilde{s}_j/\tilde{s}_j \geq \tilde{s}_1/\tilde{s}_1)}{J - 1}$$

6. Results

The post treatment period is defined as the period starting in the year 2008. We will be working with quarterly data. Given the important seasonal variability of variables we have decided to work with seasonal adjusted series.¹¹ The pre intervention period is the interval of time that goes from the third quarter of 2000 to the fourth quarter of 2007.

The set of predictor variables for the results shown below includes the outcome variables for each one of the years previous to the intervention, the expenditures per

¹¹The analysis with annual data is also available upon request. The results are very similar.

tourist (for the last year, i.e. 2007) and the average household income (average 2005-2007). We have also performed estimations for different sets of predictor variables: expenditure per tourist and average household income per year (instead of the average pre-intervention) and also including other information obtained from the household surveys (people employed, rates of informality). The inclusion of these variables does not improve the synthetic control adjustment (judging by the root mean squared error of prediction) and does not change the main conclusions (results are available upon request).¹²

6.1. Number of tourists

The synthetic control for the number of tourists is an average which includes the region Costa de Oro (0.56), Rocha (0.20), Litoral (0.22), Montevideo (0.02) and excludes Punta Del Este and Piriápolis.

Table 1.Regions Weights in Synthetic Colonia

Tourist Region	Weights
Punta del Este	0.00
Montevideo	0.02
Costa de Oro	0.56
Piriápolis	0.00
Rocha	0.20
Litoral	0.22

It is important to notice the weight of two regions which experience an increase in the number of tourists and expenditure after 2007, Litoral and Rocha. Litoral is a bordering region with Argentina that probably has been affected by the events described in the previous section (bridge blockage, exchange rate controls, and spending restrictions imposed on Argentinean tourists) in a similar way as Colonia. On the other hand, Rocha is one of the “sun and beach” travel destinations which has experienced one of the biggest growths in the past years.¹³

¹² It was also analyzed the possibility of working with series in natural logarithm, however, a better adjustment of the synthetic control was obtained without the logarithmic transformation.

¹³ Rocha’s coastline is a “wilder” destination than its competitors which are the coastline of Maldonado (Piriápolis and Punta del Este) and Costa de Oro. In the past years, both national and international tourists have shown an increasing preference for this coastal region.

Table 2 presents the average values for the different variables for Colonia, the average of the other regions and the synthetic control. Notice that the synthetic control is much closer to Colonia than the simple average of other regions.

Table 2. Predictor means before treatment

	Colonia	Other Tourist Regions (avg)	Synthetic Colonia
Tourists (thousands)			
2000q3-2000q4	42.3	78.8	44.3
2001q1-2001q4	40.7	72.3	38.2
2002q1-2002q4	27.6	58.7	28.8
2003q1-2003q4	19.1	47.2	21.9
2004q1-2004q4	23.2	58.8	26.9
2005q1-2005q4	26.1	66.4	27.2
2006q1-2006q4	25.8	66.0	26.3
2007q1-2007q4	24.1	64.3	23.2
Spending (millions of USD)			
2000q3-2000q4	8.6	31.3	10.2
2001q1-2001q4	6.5	22.7	7.8
2002q1-2002q4	3.6	16.8	5.2
2003q1-2003q4	1.9	11.4	2.8
2004q1-2004q4	3.3	15.4	3.8
2005q1-2005q4	4.5	19.7	4.3
2006q1-2006q4	4.5	21.9	5.0
2007q1-2007q4	5.2	26.6	5.4
Spending per tourist (thousands of USD)			
2007q1-2007q4	193.1	344.9	217.7
Per capita household income (USD)			
2005q1-2007q4	725.6	825.8	751.2

Figure 7 shows the evolution of the number of tourists in Colonia and the synthetic control. It can be appreciated a positive and persistent effect since the beginning of the cluster program. The point estimate of the impact between 2008 and 2015 implies an increase of 14 thousand tourists per quarter which is equivalent to a 24% increase in the number of tourists during the period.

Figure 8 shows the difference between the number of tourists in Colonia and its synthetic control during the period before the policy, where fluctuates around zero, and after the policy, where it shows a positive impact. The biggest impact is observed between 2009 and 2010 and between 2013 and 2014. In the years 2011 and 2012 the estimated impact decreases, coinciding with the period of exchange rate controls and strong restrictions to use foreign currency in Argentina. This suggests that the *a priori* ambiguous effect of the restrictive policy in Argentina on the tourism in Colonia, was in fact a negative effect.

Figure7. Number of tourists: Colonia vs Synthetic Control, 2000:01-2016:03

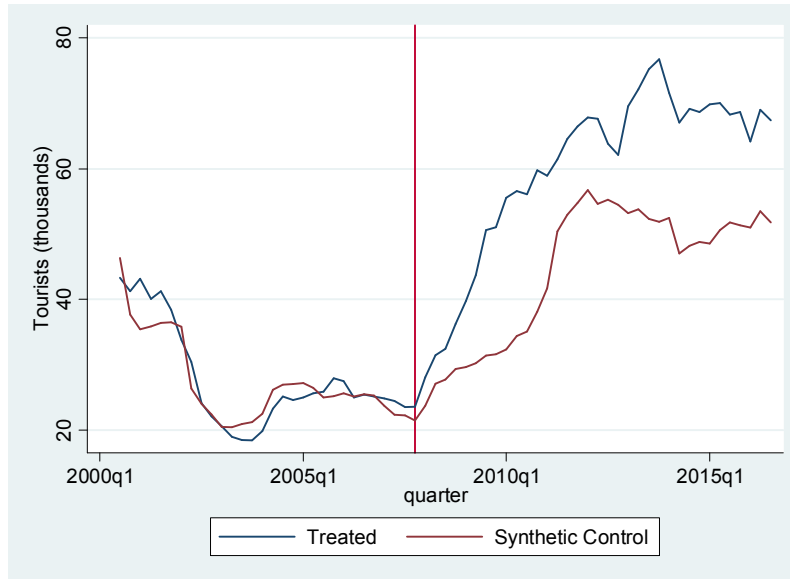
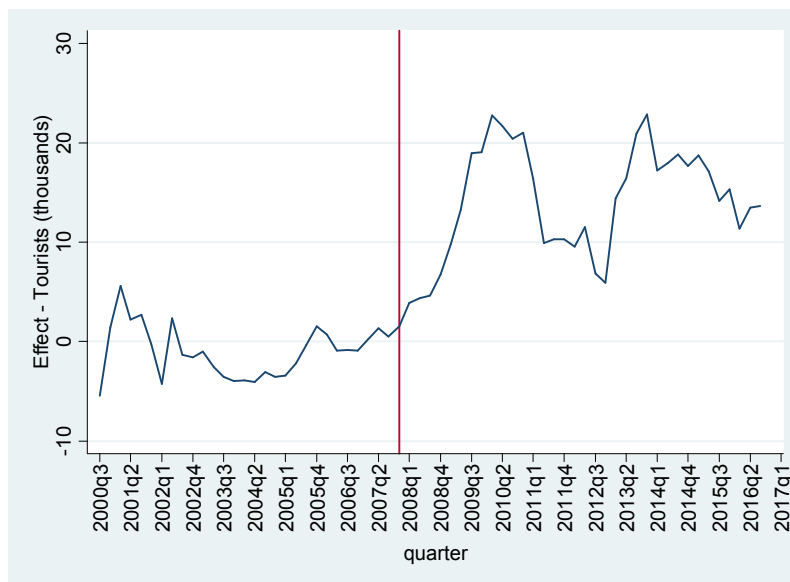


Figure 8. Number of tourists: Estimated impact



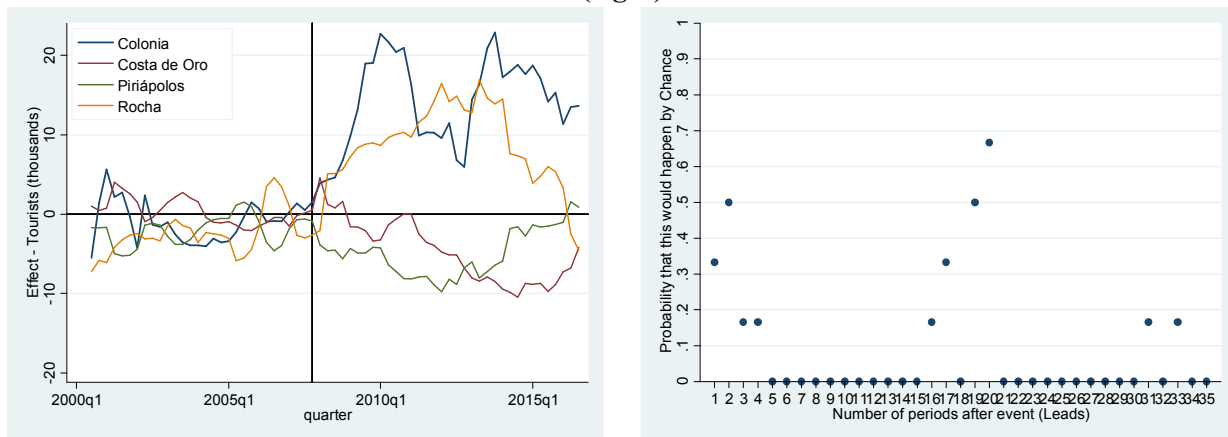
Next we will analyze, in first place, the significance of the estimated effect and, second, the robustness of the effect to the temporal interval used for the synthetic control identification.

Although the small number of donor regions does not necessarily imply a constraint to identify a good synthetic control, it does represent a constraint to make inference due to the reduced number of placebo effects which can be estimated. Such weakness is

increased if, as we will see in this case, we cannot find a good synthetic control for several placebos (regions), i.e. if the adjustment for the pre-intervention period is not good. This could render the post treatment period estimated effects for the placebos rather uninformative.

Taking in consideration unadjusted p-value which considers only the number of placebo effects of absolute magnitude at least as larger as the one for Colonia, the estimated impact is not significant. However, if the placebo effects are adjusted by the prediction error previous to the treatment, in most of the quarters the estimated impact is statistically significant (right panel, Figure 9). In the left panel of Figure 9, the estimated effect for Colonia and the placebo effects, excluding from graph three regions with bad pre-intervention adjustment (Litoral, Montevideo and Punta del Este), are presented.

Figure 9. Estimated Impacts Colonia vs Placebos (left) and significance contrasts (right)



The following table presents the RMSE pre-intervention (first column) and post-intervention (second column) and the ratio between the latter and the first one (third column). These two last measures can be used to analyze the significance of the estimated impact in the number of tourists in Colonia in the post-treatment period (i.e. between 2008 and 2015). The last two rows of Table 3 show the two alternative p-values. The first (second column) is the unadjusted one and it shows a p-value of 0.5. The second one that is adjusted by the prediction error previous to the treatment has a p-value equal to 0. In other words, in this last case, after correcting the estimating impact of each region (Colonia and placebos) by how good was the adjustment of the synthetic control for each of them in the period pre-treatment, we find that none of the

placebos show a higher impact after 2008 than the one identified in Colonia (vis a vis their respective synthetic control).

**Table 3. Root Mean Square Error of Prediction of Number of Tourists:
Colonia vs Placebos**

Región	\tilde{s}_j	\tilde{s}_j	\tilde{s}_j/\tilde{s}_1
Colonia	2.7	16.6	6.1
Punta del Este	14.0	17.2	1.2
Montevideo	28.9	48.7	1.7
Costa de Oro	1.6	9.1	5.5
Piriápolis	2.1	8.3	3.9
Rocha	2.9	11.5	3.9
Litoral	15.1	30.4	2.0
p-values:			
$\sum_{j \neq 1} 1(\tilde{s}_j \geq \tilde{s}_1)/J - 1$		0.5	
$\sum_{j \neq 1} 1(\tilde{s}_j/\tilde{s}_j \geq \tilde{s}_1/\tilde{s}_1)/J - 1$			0

Robustness Checks

Given the available information, it is possible to make some robustness analysis of the impact we have found. First, we will see the sensibility of the results to the exclusion of regions from the set of donors used for the construction of the synthetic control. Given that the Litoral and Rocha are two regions which showed a highly relative increase in the number of tourists since 2008, while Costa de Oro had a much moderated growth, we can reasonably expect the magnitude of the impact to grow when excluding the first two regions, and decrease when Costa de Oro is excluded, and this will have consequences in terms of the significance of the effect. This is precisely what happens. The next table shows the impact significance contrast when some regions are excluded from the synthetic control.¹⁴ The impact is not significant if the region Costa de Oro or the regions Costa de Oro and Litoral are excluded from the group of donors. However, continues to be positive (and significant) in the remaining cases.

¹⁴The sign of the impact is always positive.

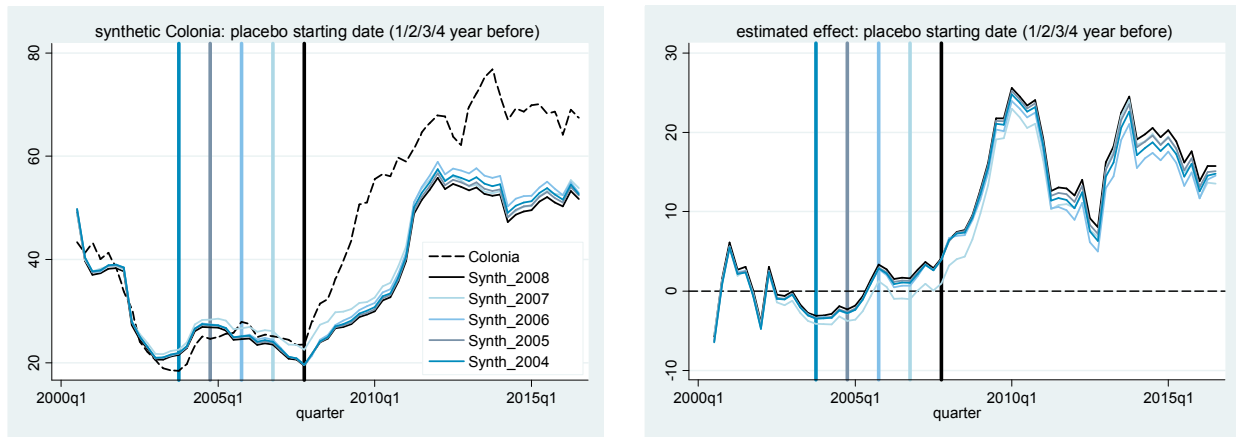
Table 4. Robustness of the impact to the exclusion of regions from donors group

Excluding from donors	\bar{s}_j/\bar{s}_j
Costa de Oro	0.2
Rocha	0.0
Litoral	0.0
Costa de Oro, Rocha	0.0
Costa de Oro, Litoral	0.3
Rocha, Litoral	0.0
Costa de Oro, Rocha, Litoral	0.0

A second robustness analysis is related with the date established to determine the pre and post-program period for the empirical exercises. Until this point, this year was the year 2008. We will change this now.

The exercise consists in replicating the same analysis but assuming alternative starting dates: 2007, 2006, 2005 and 2004. This exercise is interesting in order to analyze whether events which happened in those years may be the real cause of the estimated effect after 2008. Particularly, to discuss if the blockade of the bridge with Argentina, which starts in 2005 and gets worse in 2006, could be the real event behind the positive effect that we are finding after 2008 or, at least, one of its causes.

The results (see Figure 10) show that even when a different starting date is used, it is not until 2008 when a positive gap for Colonia began to be observed. In other words, largely, the previous estimated effect does not changed significantly if we estimate and “release” the synthetic control well before 2008.

Figure 10. Impact on the Number of Tourists assuming different starting dates for the intervention

6.2. Total expenditure

The same exercise of the previous section was performed with the variable total expenditure made by tourists in Uruguay. In this case we do not find a significant difference between Colonia and the Synthetic Control (Figure 11). The gap between them oscillates around 0 (Figure 12). The differences in every particular year, sometimes positive and sometimes negative, never results significant considering the placebo tests (right panel Figure 13). As a result, the impact in the entire post-treatment period is not significant (Table 5).

Therefore, although it was identified a positive impact in the inflow of tourists to Colonia, there is no evidence of increase in the total expenditure. This conclusion remains unchanged if the period of time used for the identification of the synthetic control is modified (see Figure 14).

The positive impact previously estimated over the number of tourists, and the no impact on the total expenditure, implies that the average expenditure per tourist decreased in the post-treatment period. In the Appendix, the results obtained repeating the same exercises as above for the variables average expenditure per tourist and average number of days of stay and average expenditure per tourist per day are presented (Figures A.6-A.8). A negative gap is observed for the three variables, even though in none of the cases the results were statistically significant.

A possible hypothesis to explain the decrease in the average expenditure per tourist is that the demand induced by the program may have captured a different tourist with a lower level of expenditure (i.e. with different socioeconomic level, habits, etc).

Figure 11. Expenditure: Colonia vs Synthetic Control, 2000:01-2016:03

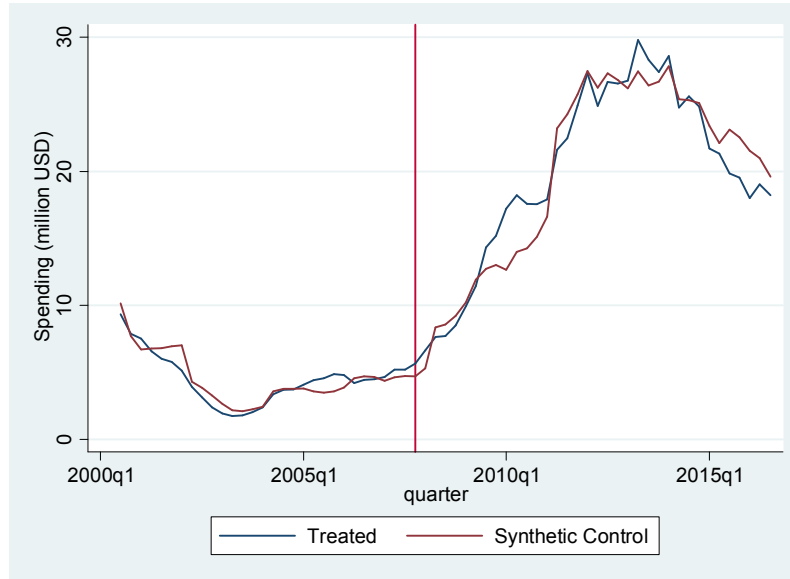


Figure 12. Expenditure: Estimated Impact

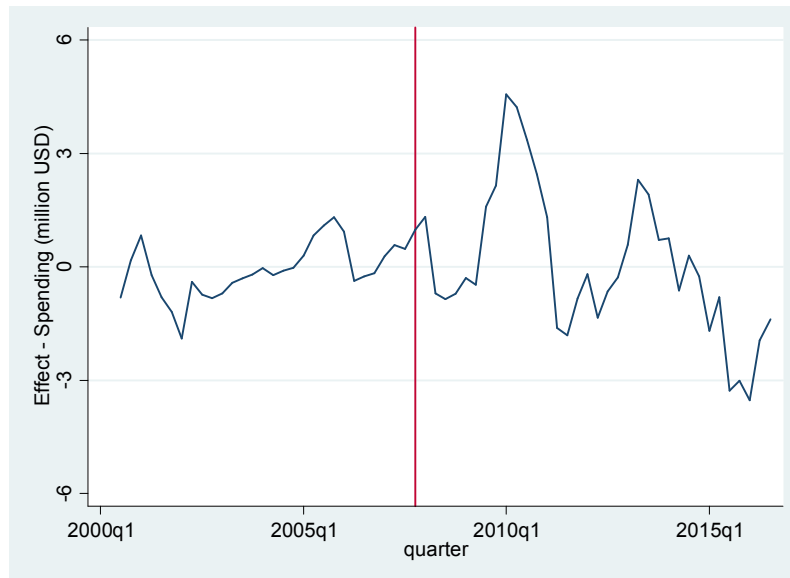


Figure 13. Estimated impact on expenditure: Colonia vs Placebos (left) and significance tests (right)



Figure 10. Impact on expenditure assuming different starting dates for the intervention

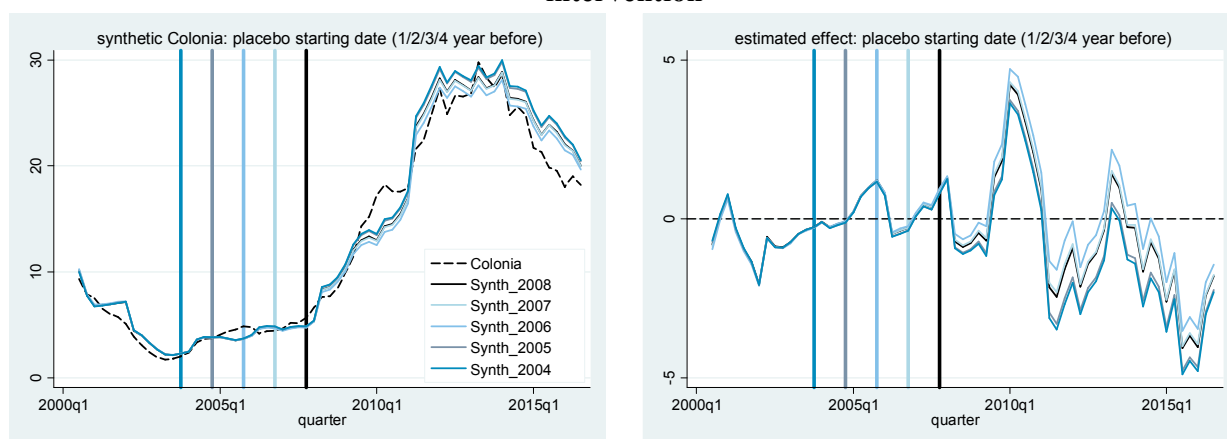


Table 5. Root mean square error, Expenditure Predictions: Colonia vs Placebos

Region	\hat{s}_j	\tilde{s}_j	\tilde{s}_j/\hat{s}_j
Colonia	0.7	1.9	2.7
Punta del Este	24.4	67.6	2.8
Montevideo	8.8	15.6	1.8
Costa de Oro	0.7	10.4	15.0
Piriápolis	0.8	2.7	3.5
Rocha	1.0	9.0	8.8
Litoral	3.3	7.0	2.1
p-values:			
$\sum_{j \neq 1} 1(\hat{s}_j \geq \hat{s}_1)/J - 1$		1	
$\sum_{j \neq 1} 1(\tilde{s}_j/\hat{s}_j \geq \hat{s}_1/\hat{s}_1)/J - 1$			0.66

7. Conclusions

In this paper we investigated the impact of a clustertourism policy in the region of Colonia, Uruguay. A comparative analysis between Colonia and other touristic regions of the country was performed applying a synthetic control method. This identification method of the counterfactual is especially useful in comparative case studies where there are a limited number of control units. The synthetic control method attributes a weight to every unit of the donor group according to an optimization process which minimizes the distance between vectors which have information related to the interest variables for the period before the intervention, for the treated unit and the controls.

The estimations show a positive impact of the cluster program on the inflow of international tourists to Colonia. The estimated impact was of 14 thousands tourists per quarter between 2008 and 2015, which represent a 24% increase in the number of tourists in the period.

Regarding the significance of impact in the different years after the beginning of the program, the evidence shows that the impact was always significant with the exception of the years 2011 and 2012, when the difference between Colonia and its counterfactual is not significant. Probably, this fact may be explained by the capital controls imposed by the Argentinean government on Argentinean tourists.

In addition, we did not find a significant impact on the total expenditure. This could be explained by a composition effect in the total number of tourists arriving to Colonia. Probably the incremental number of tourists was concentrated in segments of lower relative income. Or alternatively, that due to the border mobility and foreign exchange constraints in Argentina, there was a negative effect on the quality of tourism that arrived to Colonia (a tourism that remained less days in the Colonia and/or spent fewer resources).

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Appendix

Figure A.1. Bilateral Real Exchange Rate (2007=100)

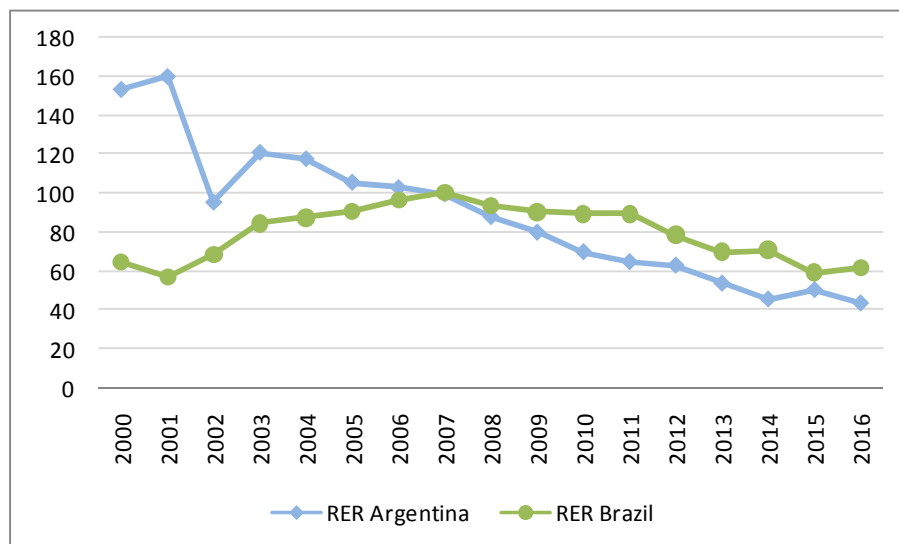
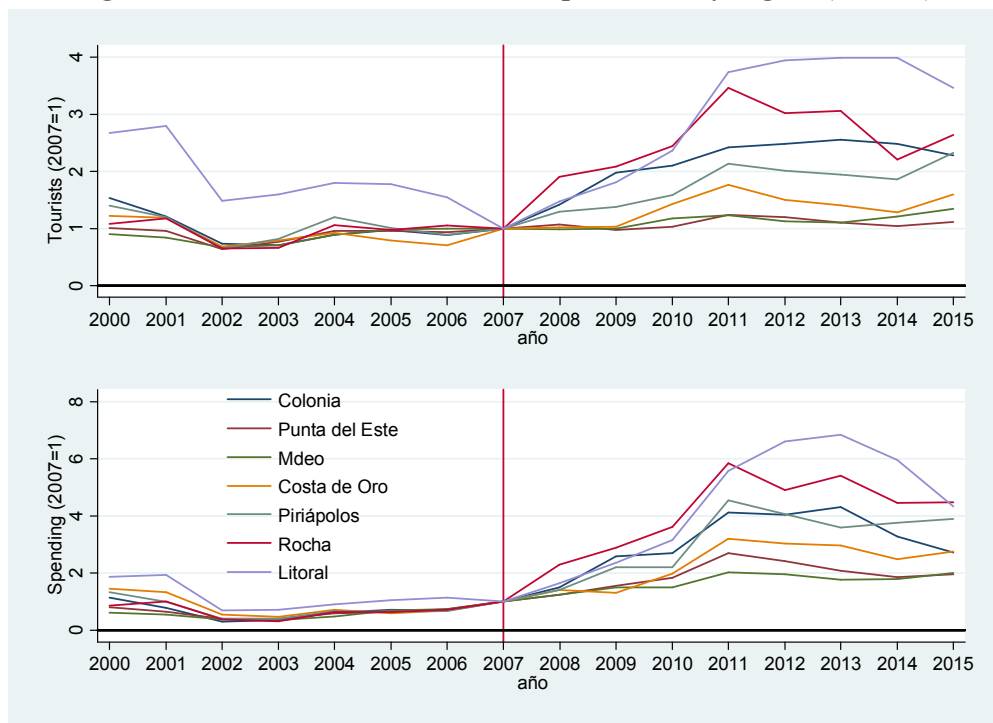
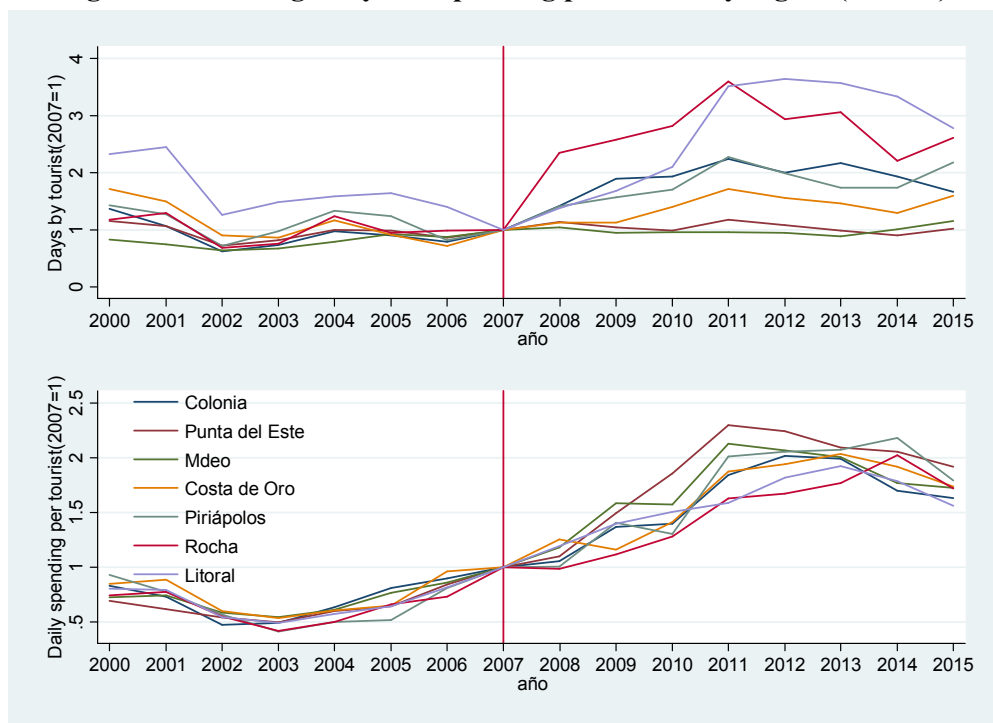


Figure A.2. Number of tourists and expenditure by region (2007=1)



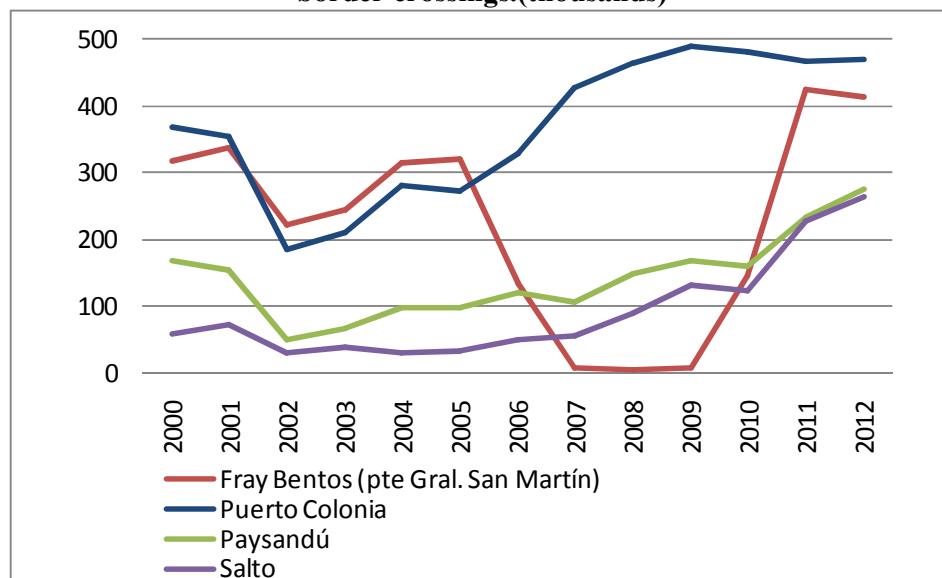
Source: own elaboration based on information from the Ministry of Tourism.

Figure A.3. Average stay and spending per tourist by region (2007=1)



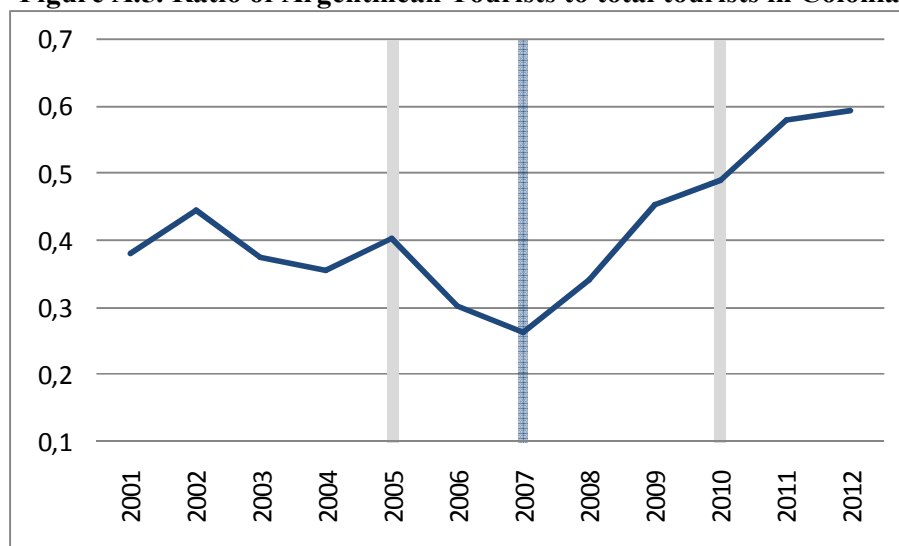
Source: own elaboration based on information from the Ministry of Tourism.

Figure A.4. Inflow of Argentinean tourists by the port of Colonia and three other border crossings.(thousands)



Source: own elaboration based on information from the Ministry of Tourism.

Figure A.5. Ratio of Argentinean Tourists to total tourists in Colonia



Note: Gray lines indicate the period when the blocking of the Gral. San Martín bridge took place.

Figure A.6. Impact on Spending per tourist in Colonia vs. Synthetic Control

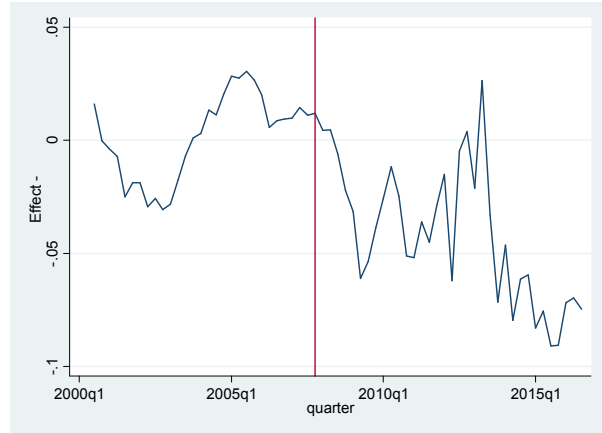
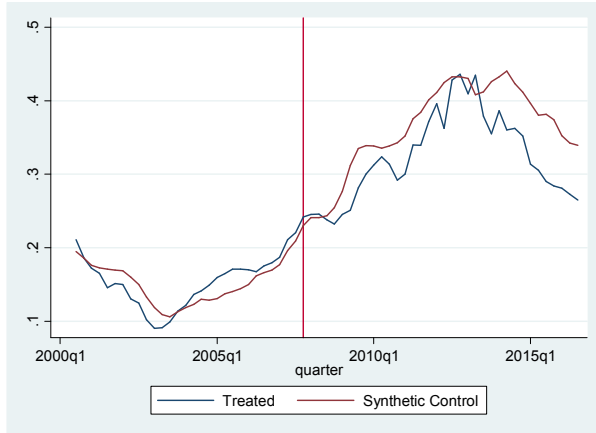


Figure A.7. Impact on the average number of days of stay in Colonia vs. Synthetic Control

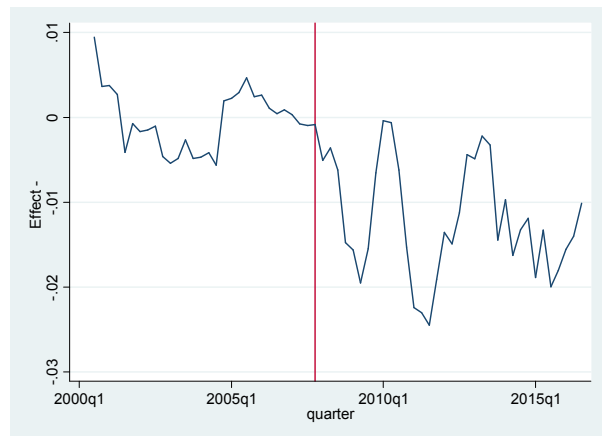
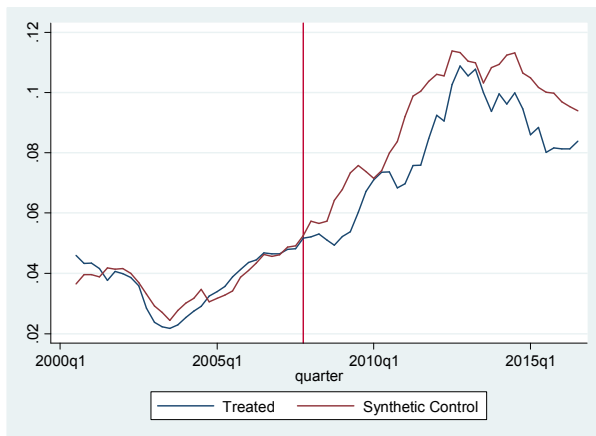


Figure A.8. Average expenditure per tourist per day in Colonia vs. Synthetic Control

