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Impact Evaluation of a Cluster Program

An Application of Synthetic Control Methods

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Abstract[*]

This paper analyzes the impact of a cluster tourism policy in the region of Colonia, Uruguay. The policy was implemented as part of an IDB-supported program. The study conducted a comparative analysis of Colonia vs. other tourism regions of the country applying a synthetic control method. This method of identifying the counterfactual is especially useful in comparative case studies where there are a limited number of control units. This is the first time that the synthetic control method has been applied to a cluster policy. The estimations show a positive impact of the cluster program on the inflow of international tourists to Colonia of 30 percent in the period 2008–2015; however, no significant impact on total expenditure was found.

JEL Codes: H43, O25, O54, R10
Keywords: cluster policy, impact evaluation, synthetic control methods

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1. Introduction

Since the publication of the seminal work by Porter (1990), cluster development policies (CDPs) have become increasingly popular as a tool for promoting productive development in developed and developing economies alike.[1] Although the scope and size of CPD interventions vary across countries, they frequently operate at the subnational level, where firms tend to agglomerate around specialized productive activities. The aim of these policies is to eliminate, or at least compensate for, coordination failures among firms and between firms and governments to guarantee the provision of the public goods needed to ensure the competitiveness of the agglomeration.

Despite their pervasiveness, CDPs are among the least evaluated productive development policies. Evaluating the impact of CDP interventions is far more complex than evaluating a typical productive development policy. Most of the literature on impact evaluation of productive development policies draws on the social policy approach, where the focus of intervention is on lifting individual beneficiaries out of poverty. However, evaluating the impact of a CDP on individual firms does not provide useful information. Since the aim of CDP programs is coordination between private and public actors to provide public goods—which by definition affect all stakeholders of clusters—all of the firms in the agglomeration are to some extent treated firms. Some are treated directly because they actively engage in cluster activities, while others are treated indirectly as the result of the provision of public goods or spillovers. Thus, these policies should be analyzed at a higher level of aggregation, comparing treated agglomerations with untreated ones. This paper takes a step forward in this direction by assessing the impact of a CDP program in a particular region of Uruguay and using the synthetic control method to build a control group comprising other untreated regions in the same country.

The paper is structured as follows. Section 2 presents a brief review of the literature on CDP programs and evaluations. Section 3 describes the Program for the Competitiveness of Clusters and Production Chains (Programa de Apoyo a la Competitividad de Conglomerados, or PACC) and outlines its impact channels. Section 4 describes the data. Section 5 presents the empirical strategy. Section 6 summarizes the results, and Section 7 concludes.

[1] A survey carried out by the European Cluster Observatory in 2012 identified about 570 “cluster initiatives” across the European Union. In 2010, the U. S. Small Business Administration launched some 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 to Marshall (1920). It was later expanded in Arrow (1962) and Romer (1986), and formalized by Glaeser et al. (1992) as the Marshall-Arrow-Romer (MAR) model. Agglomeration economies are usually defined as the formation of clusters of firms that belong to a specific industry and are located in a particular geographic area. The tendency of firms in the same industry to concentrate geographically has been extensively studied in the literature (Delgado, Porter, and Stern, 2014; Ellison and Glaeser, 1997; Jaffe, Trajtenberg, and Henderson, 1993; Kerr and Kominers, 2015). Agglomeration helps firms establish links with other firms within the cluster, which leads to gains from coordination and the internalization of externalities at the cluster level. However, coordination failures are a common problem, leading to sub-optimal allocation of resources. As Rosenstein-Rodan (1943) points out, coordination failures frequently emerge when the investment decision of one agent is interrelated to those of others and externalities emerge due to this interrelationship. These coordination failures have particularly adverse consequences for the provision of cluster-specific public goods.[2]

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

The benefits of industry clusters have gained attention in the public policy arena thanks to the works of Porter (1990, 1998, 2000). Governments throughout the world increasingly support CDPs to take advantage of agglomeration economies in their countries to increase productivity (Crespi, Fernández-Arias and Stein, 2014). The justification for government intervention, and therefore the existence of CDPs, lies in the presence of coordination failures and the provision of public goods (Maffioli, Petrobelli, and Stucchi, 2016). Although the objective of CDPs is to strengthen linkages

[2] Public goods have two properties that make them unsuitable for market provision. Nonrivalry, meaning that, once produced, public goods could be used without limit by all actors in the agglomeration. The second property is limited appropriability, meaning that control mechanisms are highly ineffective in excluding free riders. Typical public goods are primarily information, such as new legislation, sectoral regulations, generic technological knowledge applicable to the sector, branding, and others. Misalignment of incentives will make Coasian self-regulating solutions out of reach. Thus, coordination of collective action through public policy is the only way to deliver these goods.

and relationships between firms within a cluster, they are only a tool to reach the final goal: stimulating productivity as a way to increase competitiveness.

The presence of spillovers is a well-studied phenomenon in the economics of agglomeration literature. Because of their intrinsic characteristics, however, how to measure spillovers and the general equilibrium effects of cluster policies remains an open question in the literature. Researchers do not usually have sufficiently rich firm-level data to correctly estimate them. Huber (2012) finds very little empirical evidence of the mechanisms of local knowledge spillovers and cautions academics and policymakers against making assumptions about the existence of spillovers in clusters.

To the best of our knowledge, relatively few studies have successfully analyzed indirect and/or total effects of cluster development programs. One such study is FigalGarone et al. (2015). Using firm-level data on Brazilian SMEs for the period 2002–09 and combining fixed effects with re-weighting methods, they estimate both the direct and the indirect effects of a cluster development program in Brazil on three variables: level of employment, value of exports, and 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 export outcomes and a negative effect on employment in the first year after the program. The latter effect may be coming from labor mobility from indirect beneficiaries to direct ones.

While FigalGarone et al. (2015) define indirect beneficiaries using geographic proximity criteria, Castillo et al. (2015) identify them by labor mobility. Indirect beneficiaries are firms that hired workers that were working in a direct beneficiary firm. The program evaluated is an innovation program called FONTAR, which was carried out in Argentina between 1998 and 2013. The paper measures spillovers by the degree of performance improvement of firms that hired skilled workers from the treated firms. To estimate this effect, the study uses a lagged dependent variable model to compare these indirectly affected firms with a group of firms that had a similar evolution on key variables before they hired skilled workers from the participant firms. The authors find that the indirectly affected firms experienced increases in employment, wages, the probability of exporting, and the value of exports. The authors conclude that increased productivity drives these effects.

In Boneu et al. (2014), the authors estimate the spillover effects associated with a technological cluster located in the city of Cordoba, Argentina. While the direct beneficiaries are the small and medium-sized firms in the city of Cordoba that make up the technological cluster, the indirect beneficiaries are the same types of firms located

on the outskirts of the city. The authors used a panel of firms in the information and communications technology (ICT) sector for the period 2003–11, which allowed them to control for the dynamics of firm sales and fixed effects, applying a generalized method of moments estimator. The paper finds that for every new participant in the program, sales of nonparticipant firms increase by approximately 0.7 percent.

Closely related to the last paper, Castillo et al. (2015) 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 untreated Argentinean provinces to construct a synthetic control province that shares relevant characteristics with Salta before policy implementation. They find that the CDP 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 follow a similar approach to estimate the aggregate effect of a cluster policy in Uruguay. The paper adds to the scant literature on this subject by rigorously and quantitatively measuring the total (direct and indirect) effects of cluster policies. The purpose of the cluster policy that we focus on here was to increase the competitiveness of the tourism sector of a region in Uruguay (Colonia). The total investment in this policy between 2008 and 2014 was approximately $900,000. It attempted to develop business linkages, improve soft tourist infrastructure, and improve Colonia's strategy to promote and market Colonia as a tourist destination.

The city of Colonia has some particular characteristics that make it one of the most popular destinations for tourists visiting Uruguay. First, UNESCO declared it a World Heritage Site in 1995. Moreover, one-quarter of all tourists visiting Uruguay enter the country through Colonia's port. The city is only 50 km away from Buenos Aires, Argentina's capital.

3. The PACC Program

3.1. Program Description

The PACC was created in 2005 with the support of the Inter-American Development Bank. Its aim was 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 has three components: a strategic plan, matching grants, and strengthening of the supporting institutions of the cluster.

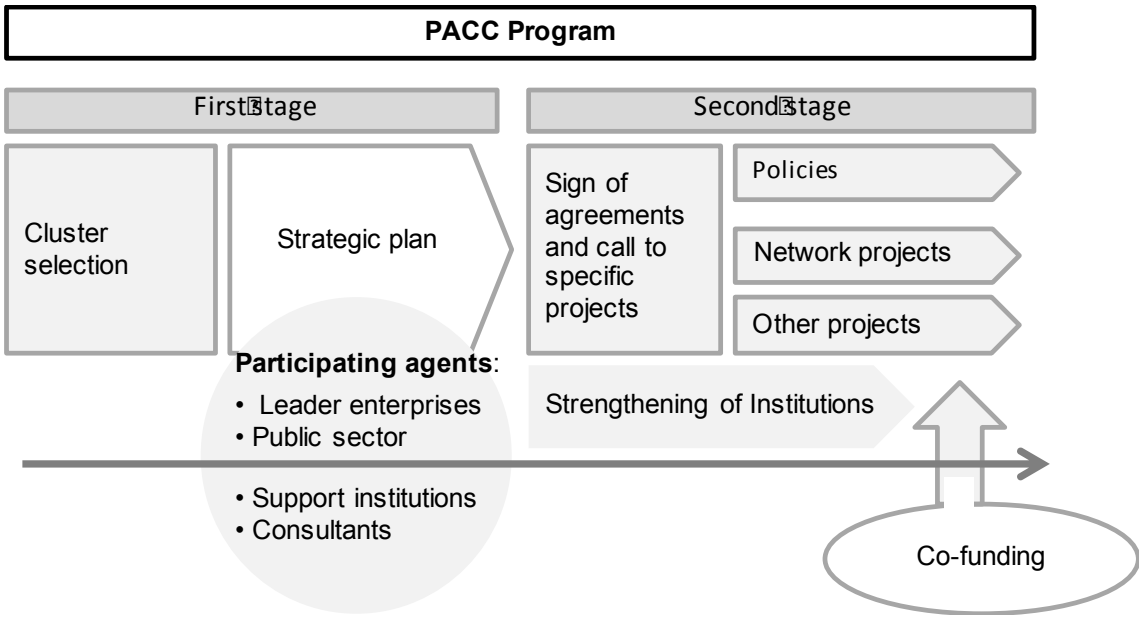
The PACC had two main stages: (i) cluster selection and preparation of competitiveness strengthening plans, and (ii) execution of projects and actions to strengthen public and private supporting institutions (Figure 1). The process starts with

a call for clusters, which is disseminated among interested agents through public agencies. Firms coalesce around a sectoral chamber or association and, together with a government agency (ministry or local government), submit an application.

Once a cluster is selected, its members develop a strategic plan. The strategic plan contains a proposal of specific projects to be co-funded by the public sector according to the level of appropriability of the outcomes by individual firms vis-à-vis the cluster. Those projects with high appropriability for only a limited number of firms in the cluster receive a lower percentage of subsidies compared to 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 started in 2005, and the first projects were funded in 2007. Although the program ended in 2014, most disbursements were made between 2008 and 2010. Projects supported in each cluster were broad in scope. They included 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 aimed at attracting direct investment identified as critical in the strategic plan, development of collective trademarks, reorientation of training, facilitation of certification processes, market intelligence and access, development of distribution channels, and technical assistance on quality-related issues, among others**.**

Figure 1. PACC's Support Model



Source: Authors' elaboration based on information from the program.

International marketing actions predominated, with almost 60 projects implemented. Capacity-building initiatives were second in terms of frequency, with nearly 40 initiatives funded as of June 2013. Other projects included missions abroad, research and development, and quality enhancement actions. The program invested in strengthening the implementation capacity of business support institutions, including supervisory and monitoring actions and coordination of workshops where officials, consultants, and entrepreneurs discussed topics related to the program's impacts. It also provided funding for training and consulting services, and technical assistance for ministries and organizations aiming to improve their capacity to implement support policies.

The objective of the Tourism Colonia cluster was to promote tourism in the Department of Colonia, specifically to Colonia del Sacramento, the departmental capital inscribed on the UNESCO World Heritage list. Thus, the implicit objective was to bolster the tourism sector in Colonia. The cluster participated in the PACC's second call for proposals.

The Colonia Department of Tourism led the proposal. The director of the department was a technocrat with deep knowledge of the field, who obtained her position through a public competition. The local lodging association, a party to the proposal, had been promoting inter-sectoral collaboration prior to the competition and had formulated a basic strategic plan. Public–private interactions were intense, complex, and adversarial when the CDP began. Among other things, the arrival of international hotel operators threatened traditional family-owned domestic establishments. The ferry company that managed the route between Colonia and Buenos Aires, the largest market, refused to join the program. It took the restaurant association a while to decide whether to join. Another challenge was that the sector was experiencing a surge in demand, and entrepreneurs were more interested in capturing short-term profits than engaging in projects with medium- to longer-term maturity. The Department of Tourism can be credited with solving these initial challenges and mobilizing all the actors behind the initiative.

To overcome the problem of fragmented representation by the private sector and improve cooperation among public agencies, the CDP first established a cluster association: The Colonia Tourism Association (Asociación de Turismo de Colonia, or ATC). It convened public and private actors and provided institutional support to the interventions. The Department of Tourism was a key actor that facilitated interaction with other local actors and with national actors, such as the Ministry of Tourism (Ministerio de Turismo, or MINTUR), which subsequently joined the cluster (Rius, 2016).

The intervention strategy included several actions aimed at improving the city's attractiveness as a tourism destination. To do this, the ATC reached consensus on 19 initiatives that required about US$900,000 of investment. On average the program financed up to 70 percent of each one of them. These projects covered a wide range of interventions, from basic ones (such as the design of the website for city) to very demanding ones aimed at inducing collective action (e.g., developing a common trademark and exercises to benchmark Colonia with other similar regions around the world, incorporating new marketing technologies such as QR codes, teaching English to employees, and strengthening the ATC).

Today, the ACT encompasses multiple sectors, including the hospitality, gastronomic, commercial, and transport sectors, to name only the most important ones. The cluster brings together business unions, MINTUR, the municipal government of Colonia and, until 2014, the Office of Budget and Planning, which was in charge of implementing the PACC.

Given the scope of most of the projects (e.g., the production of club goods), it makes more sense to look for effects using macro variables related to tourism in Colonia than trying to identify effects at the firm level. The PACC has impacted all firms in Colonia directly or indirectly, making it nearly impossible to identify effects at the firm level. Moreover, by focusing the analysis at the level of macro local variables, we will be able to capture both the direct and the 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 and how we expect the cluster policy to affect various outcomes.

3.2. Impact Channels

The rationale behind CDP interventions is that firms competitiveness depends not only on individual actions but also on the actions of other agents. Coordination failures within a geographical agglomeration are limiting factors to achieve competitive states.

Figure 2 explains the causal mechanisms through which the PACC—considered a particular type of cluster development program distinct from other CDPs applied in different contexts or countries—would generate an increase in competitiveness. Given the complexity of the program, the causal effects are divided into four separate mechanisms (see Figure 2), with feedback loops between them.

Before presenting the main mechanism expected to be at work in the case of the 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. A change in macro or meso-level factors (e.g.,

those affecting all firms or groups of firms such as changes in norms or international markets) can hamper the achievement of some outcomes, even when the intervention and all of its mechanisms are working properly. Other micro aspects linked to firm characteristics are also important for the success of the program (e.g., firms' capabilities, resources, technology, and integration into international markets). According to the types of interventions generated by the PACC, we can distinguish four potential mechanisms through which the interventions affected the ultimate goal of increasing competitiveness.

The first type of PACC intervention aimed to increase coordination among private agents, generating cluster-specific institutions. The underlying assumption was the existence of coordination failures along some value chains and in certain regional clusters. This is the typical justification for cluster policies. In the presence of agglomeration economies (in regions or value chains), facilitating coordination and disseminating information among firms in the cluster should help 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). This is the first mechanism depicted in Figure 2.

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

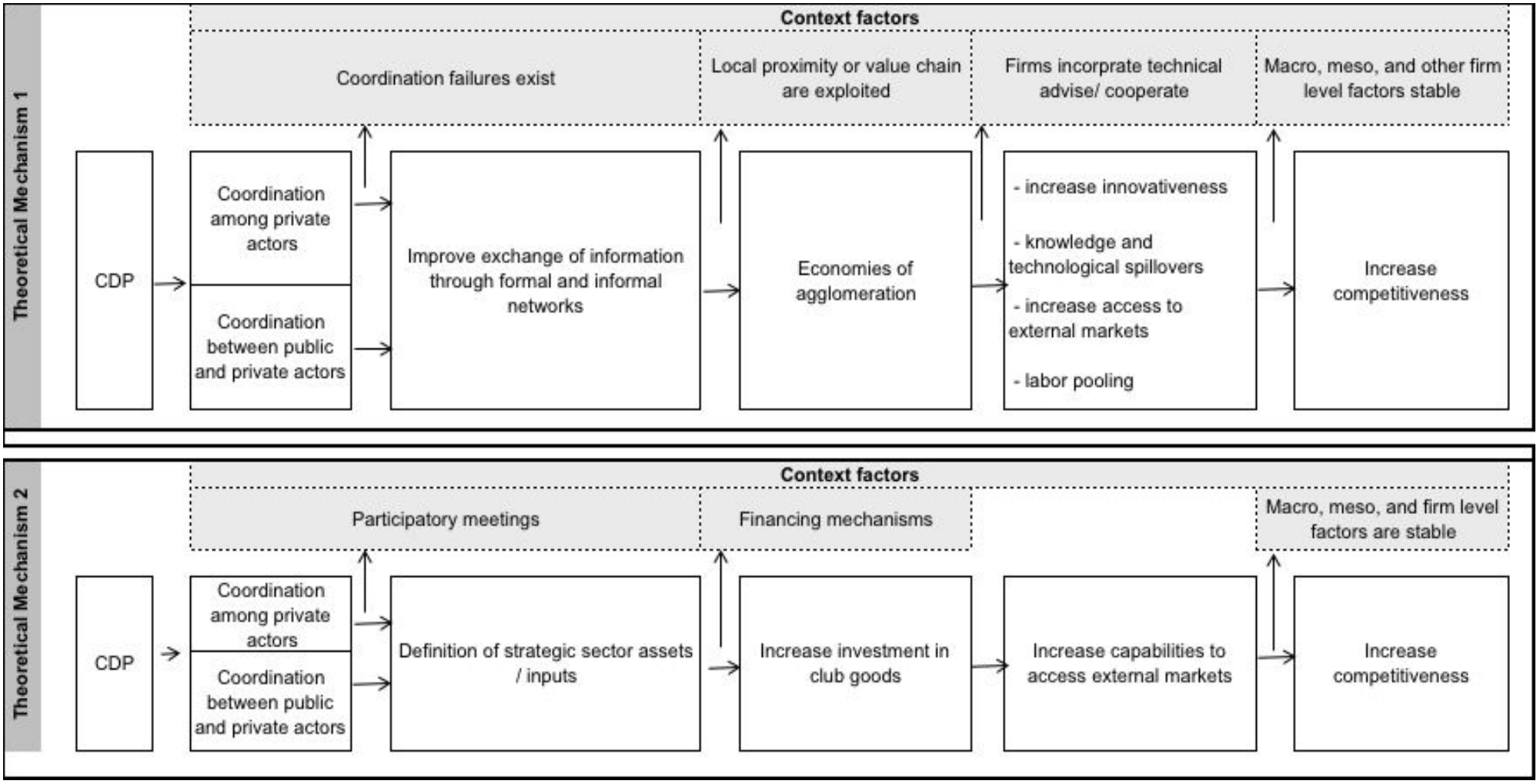
The PACC supported the actions needed to generate a cluster strategic plan, following an inclusive approach. The result of this process was a sector-validated document containing the strategic action plans for the cluster. The agreed definition of strategic action plans for the cluster, at least on a theoretic level, should help to build awareness of the benefits of cluster-level investments, even in cases where the appropriability of the action is very low at the individual level, that is, it should facilitate the creation of club goods. Given that the most common club goods generated were aimed at facilitating access to external markets, we expect this channel to have worked mostly through its impact on facilitating access to external markets and, in so doing, increasing export opportunities (exporting tourism services, in this case).

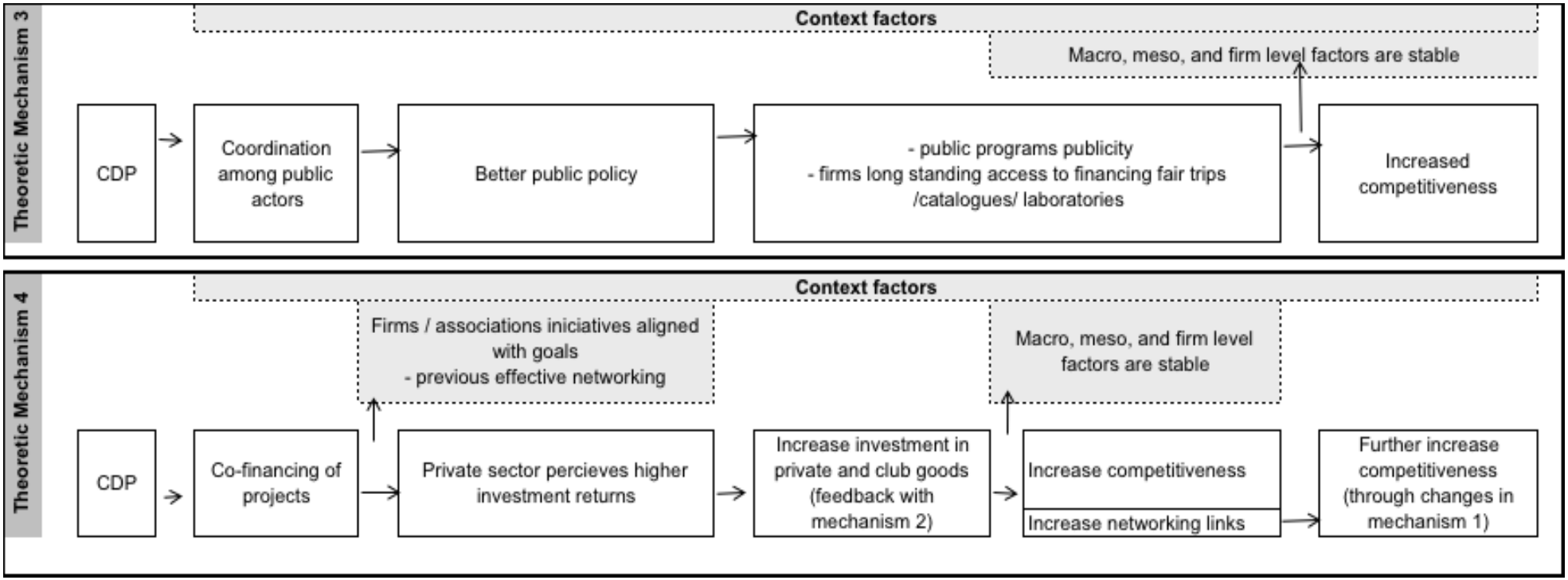
One of the PACC's objectives was to coordinate the actions of public agencies. If coordination of public institutions is achieved, and this is conducive to better public

policies, we expect this coordination to have a positive effect on a cluster's competitiveness. This is the third mechanism in Figure 2.

Co-financing is the final theoretical mechanism identified in Figure 2. These funds could be used for capacity building, travel, or any other type of investment identified as a priority for the cluster. This funding is aimed at generating both club goods and, in some cases, private goods. In theory, since the public sector subsidized this funding, the return on private investment in both private and club goods should increase, and some financial restrictions should be lifted, so that 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 in club goods, the funding was also a way to strengthen and increase network linkages, which could have an additional impact on the cluster's competitiveness through the first theoretical mechanism.

Figure 2. Causal Mechanisms of the CDP as Applied in Uruguay





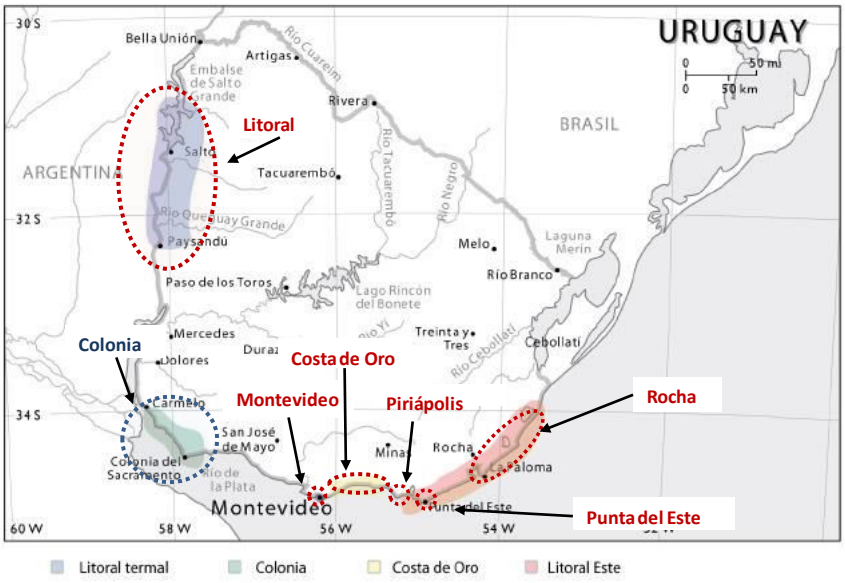
Source: Authors' elaboration.

4. Data and Descriptive Statistics

4.1. Data

The main data source used in this paper is the Survey on Receptive Tourism (Encuesta de Turismo Receptivo), which provides disaggregated information on Uruguay's main seven tourist destinations: Colonia, Costa de Oro, Montevideo, Pirápolis, Punta del Este, Rocha, and the thermal littoral.[3] For each of these regions, there is quarterly information on the number of visitors, tourists' expenditures, and visitors' average length of stay between 2000 and 2015.

Map 1. Tourism Regions in Uruguay



Source: Uruguay XXI Institute, Tourism and Real Estate Report (2011).

We are also using information from the Continuous Household Survey (Encuesta Continua de Hogares, or ECH) conducted in Uruguay. Specifically, residents' average household income was used as a proxy for the level of development of each region.[4]

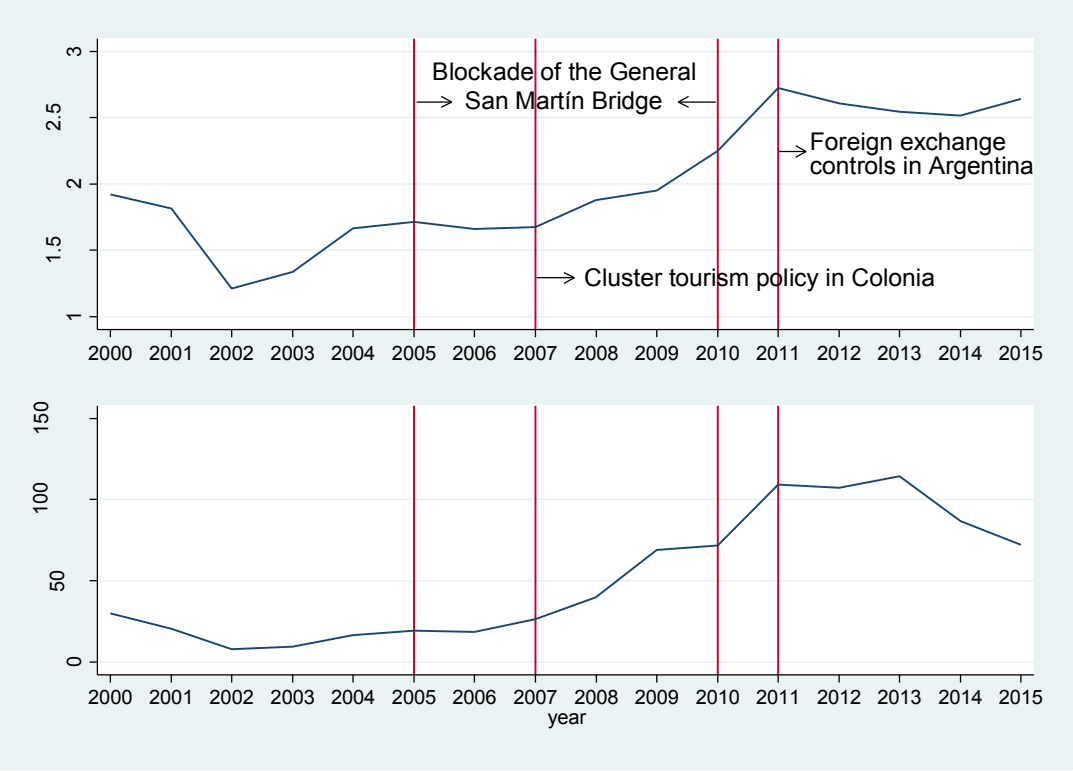
[3] The remaining destinations are grouped in a residual category.

[4] Although a priori the ECH provides several variables that describe the residents and the labor market of each region, the nature of the sample makes it difficult to obtain precise medians at the region level. This problem gets worse when attempting to construct sector-level variables in each region, such as the number of people employed in the hotel and restaurant sector. In fact, there was no gain in the mean prediction error when synthetic controls are constructed, including predictors using information from the ECH.

4.2. Descriptive Statistics

Between 2000 and 2002, the economic crisis that plagued the region, particularly the Argentinean crisis (see Figure 3), did not spare the tourism sector. The number of visitors recovered slightly between 2003 and 2004, remaining stagnant until 2007. Between 2007 and 2011, there was significant growth. Between 2011 and 2015, the number of tourists again remained flat, while their average spending fell starting in 2013.

Figure 3. Number of Tourists and Annual Expenditure



Source: Authors' elaboration based on information from the Ministry of Tourism.
Note: For the seven tourism regions in Uruguay.

International tourism demand to visit Uruguay is highly concentrated in the Colonia region, especially from Argentina (57 percent of the total) and Brazil (15 percent of the total). Hence, Argentina's demand determinants significantly affect Uruguay's tourism performance. This is especially true for Colonia, given its proximity to Buenos Aires. These determinants include macroeconomic variables, especially the evolution of the level of activity and the bilateral exchange rate, but also economic policy measures taken by Argentina that affect Uruguay' s tourism sector.

With respect to level of activity, Argentina's GDP growth between 2003 and 2011 positively affected tourism demand. Between 2003 and 2008, average annual GDP growth in Argentina was 9 percent. 2009 saw a contraction in the level of activity

due to the international crisis, but it recovered quickly and the economy again reported high growth rates (8 percent on average) between 2010 and 2011. Between 2012 and 2015, the Argentinean economy was stagnant.

The Uruguayan currency tended to appreciate with respect to the Argentinean peso in this period, with the exception of 2002 and 2003, when there was a sharp devaluation of Uruguayan peso (see Figure A.1 in the Appendix). With respect to Brazil, however, Uruguay gained in competitiveness until 2007, after which it fell behind, resulting in a bilateral exchange rate in 2015 near the one observed in 2000.

Because of the close proximity of Colonia to Buenos Aires, it is important to consider some events in the period of analysis that may have affected the evolution of the inflow of Argentinean tourists and the level of their expenditures. The first was the dispute between the Uruguayan and Argentinean governments over the location of a pulp mill on the banks of the Uruguay River in the city of Fray Bentos. Between 2005 and 2010, Argentinean residents of Gualeguychú and green organizations mobilized against the mill's construction. One of the most important actions taken was the blockading of the Libertador General San Martín Bridge, a border-crossing point between the two countries.

Although the effect of the bridge closure on the influx of Argentinean tourists to Uruguay was clearly negative, it is less clear that it negatively affected tourism to Colonia. This is because, for the people of Buenos Aires, Colonia became an alternative entry/exit point to and from Uruguay. Figure A.3 in the Appendix shows the significant decrease in the influx of tourists through Fray Bentos and a simultaneous increase in entries through Colonia.

However, the greater importance of Colonia as an entry/exit point does not imply that it became more important as a tourist destination—although it is not possible to discount the bridge blockade as a positive externality with respect to the influx of Argentinean visitors.[5] This represents a constraint on identifying the impact of the cluster policy, since the bridge blockade went beyond 2007, the same year that the tourism cluster in Colonia began to develop.

Nonetheless, Colonia's largest revenue growth occurred in 2006 and 2007, prior to the start of the program. Figure A.5 in the Appendix shows the number of tourists as a proportion of the number of people who entered through the Port of Colonia. Until 2004, this proportion was approximately 0.4. It decreased significantly between 2006 and 2007 until it reached a floor of 0.26. This result is consistent with the fact that

[5] A similar effect may be expected in the thermal littoral (which includes areas in the departments of Paysandu and Salto), as the other two land crossing points with Argentina are in this region. The latter was an alternative entry/exit point for residents of other provinces but not those in Buenos Aires.

Colonia became more important for Argentineans as an entry point to the country. However, the number of tourists in Colonia increased rapidly starting in 2008 despite the fact that the blockade of the Libertador General San Martín Bridge continued until 2010.

Another important factor is Argentina's foreign exchange policy. In November 2011, the Argentinean government imposed an exchange rate control to curb capital outflows. It imposed restrictions on the purchase of foreign currency for the purpose of foreign travel (known as the exchange-rate trap, or "cepo cambiario"). From then on, a plethora of other measures to prevent people from eluding exchange-rate controls were put in place. A popular practice among Argentineans consisted of traveling to Uruguay (mainly to Colonia) to withdraw cash in dollars from automatic teller machines at the official exchange rate (cheaper than the parallel market rate in Argentina). The Argentinean authorities imposed measures, such as a surcharge of up to 35 percent on purchases made using international credit or debit cards and maximum limits on money withdrawn abroad, to counterbalance these practices.[6]

The exchange rate restrictions (which lasted until the end of 2015), as well as the measures that sought to limit Argentineans' spending in foreign countries, had an impact on tourism demand in Uruguay. As Figure 2 shows, 2011 marked the beginning of a standstill in tourist arrivals and expenditures. It is also important to highlight that the Argentinean economy entered a phase of stagnation at the same time.

However, the effect of these episodes on international tourism demand in Colonia is, a priori, ambiguous. First, the policy represented an important constraint on Argentinean demand, which may have affected tourism in Colonia. Second, because Colonia became an attractive place for Argentineans to use credit cards to avoid the foreign exchange restrictions, a positive externality on tourism demand in Colonia cannot be discounted. The evolution of the number of tourists and their expenditures in the seven regions of the country starting in 2011 (see Figures A.2 and A.3 in the Appendix) shows that growth slowed in both Colonia and the Litoral (the two tourism regions bordering Argentina), but tourism and expenditures declined in the remaining regions.

Since our main objective is to identify the effects of a cluster tourism policy that began in 2007, we can be relatively confident that between 2008 and 2010 this impact was not distorted by the episodes described above. Starting in 2011, the difference between what happened in Colonia and the control group may be distorted by these

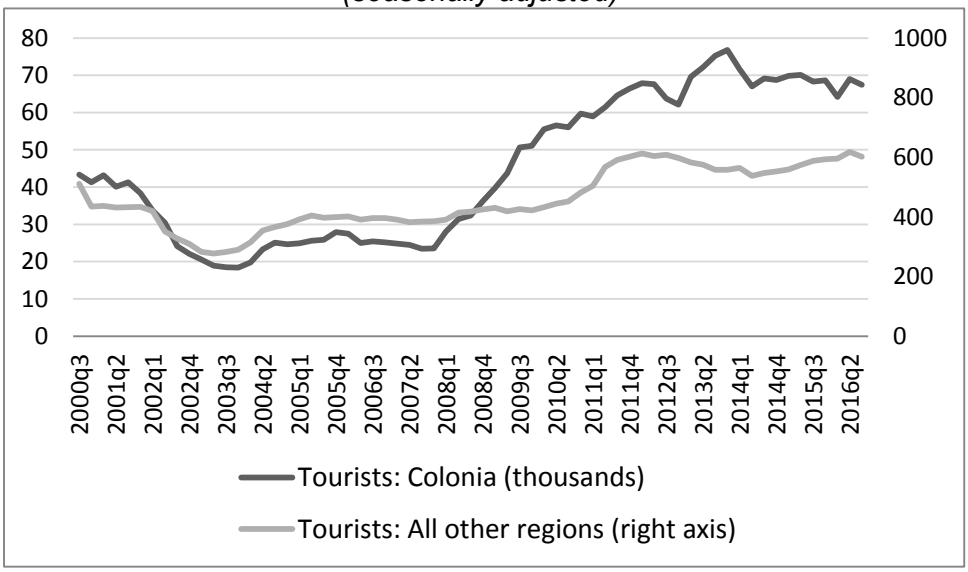
[6] A similar practice occurred with the Uruguayan casinos that used US dollars. Argentinians went to the casinos, spent a certain amount of money on chips, and then exchanged those chips for U.S. dollars at the official exchange rate.

events. However, the direction of the bias is not clear, given the likelihood that the Litoral region, which is in the control group, was affected in similar way as Colonia.

Figure 4 shows the number of international tourists visiting Colonia and all of the remaining tourism regions between 2000 and 2016. 2008 was a turning point, and it is also the year that the cluster program started. If we observe each of the other regions individually (see Figure A.2 in the Appendix), it is also possible to observe a shift in the trend that year in the Litoral region and on the coast of Rocha.

If we compare 2009 to 2006, the total number of international tourists visiting Colonia increased by 5.4 percentage points (see Figure 3).[7] In terms of total expenditure (Figure 5), the differences in trends between Colonia and the other tourism regions since the start of the cluster program are not clear. Although tourism expenditure increased at a higher rate in Colonia between 2009 and 2010, it also contracted more steeply starting in 2014. Colonia's participation in total expenditure between 2006 and 2009 increased by 2.2 percentage points (from 3.2 percent to 5.4 percent) (Figure 6).

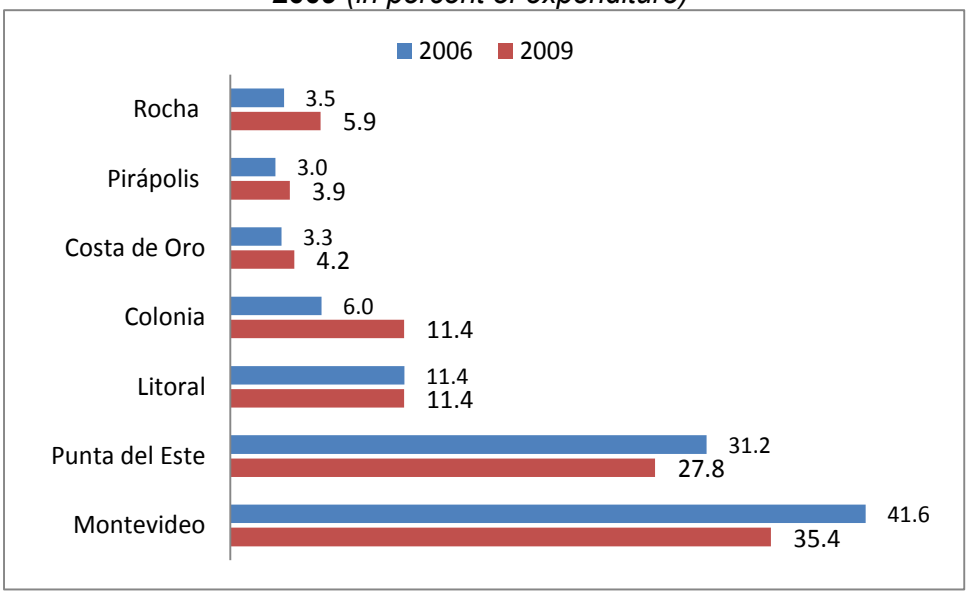
Figure 4. Number of International Tourists by Tourism Regions of Uruguay
(seasonally adjusted)



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

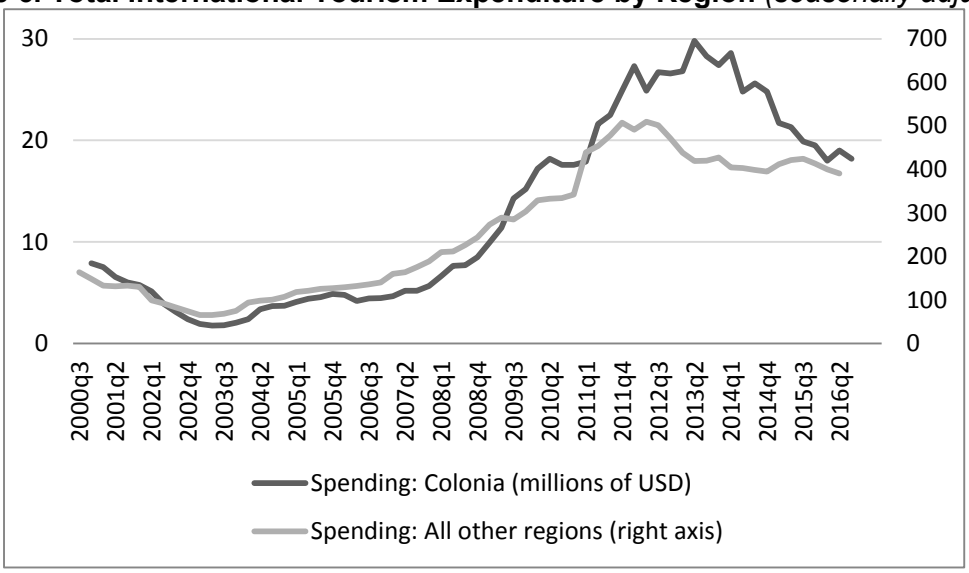
[7] We consider the year 2006 as the last pre-program year, since the plan for the Tourism Colonia cluster was approved in 2007 and the first structural project was approved in 2008.

Figure 5. Regional Participation in International Tourism to Uruguay, 2006 and 2009 *(in percent of expenditure)*



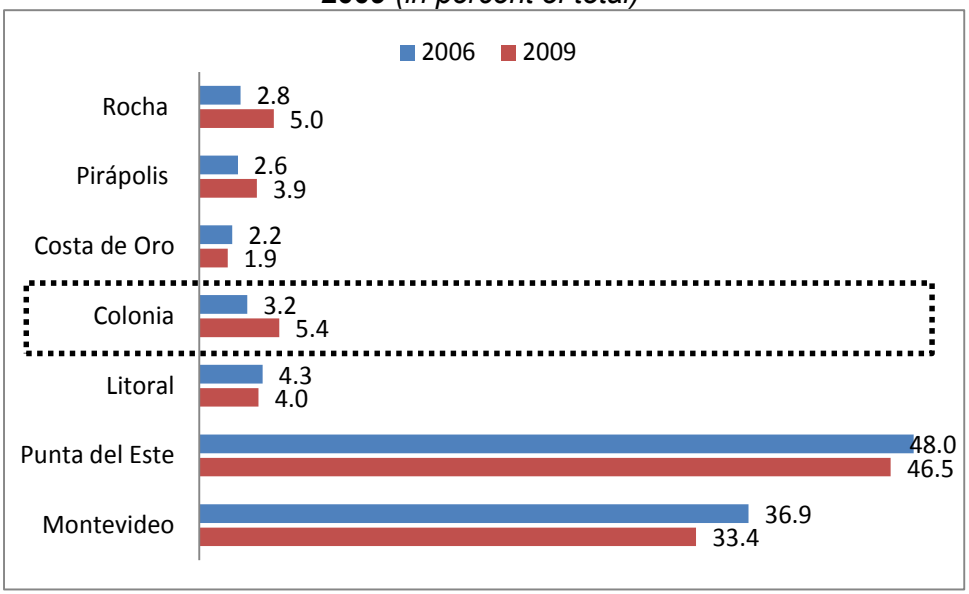
Source: Authors' elaboration based on information from the Ministry of Tourism.

Figure 6. Total International Tourism Expenditure by Region *(seasonally adjusted)*



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

Figure 7. Regional Participation in International Tourism to Uruguay, 2006 and 2009 *(in percent of total)*



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

5. Empirical Strategy

To analyze the impact of PACC on the tourism sector in Colonia, this study focuses on demand indicators. It is based on information provided by the Receptive Tourism Survey, specifically the number of international tourists and their expenditures. Since the treatment unit is a region and at the same time there is a group of aggregated units (or regions) that could serve as a potential control group, the synthetic control method appears to be an appropriate technique. Moreover, given the difficulty of applying traditional impact evaluation methods in this case, applying this method is e the only way to produce a rigorous quantitative impact evaluation.

Synthetic control methods have been used to study economic impacts caused by several different events. They were used, for example, to measure the effects of terrorists attacks (Abadie and Gardeázabal, 2003), natural disasters (Cavallo et al., 2013), particular economic regimes (García Ribeiro, Stein, and Kang, 2013), tobacco control policies (Abadie, Diamond, and Hainmueller, 2010), major sporting events (García Ribeiro et al., 2015), and tourism development policies (Castillo et al., 2015).

The synthetic control method assigns a weight to each unit in the control group according to an optimization process which minimizes the distance between vectors that contain information related to the variables of interest for the period before the intervention, for the treated and control units. Following Abadie, Diamond, and Hainmueller (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:

$$Y_{jt} = \alpha_{jt}D_{jt} + Y_{jt}^{N} \qquad (1)$$
$$= \alpha_{jt}D_{jt} + \left(\delta_t + \theta_t \mathbf{Z}_j + \lambda_t \mu_j + \varepsilon_{jt}\right)$$

where δ_t is a unknown common time effect, $\mathbf{Z}_j$ is a vector (*r*x1) of observed covariates not affected by the treatment, θ_t is a vector(1x*r*) of unknown parameters, λ_t is a vector (1x*F*) of observed common factors, μ_j is a vector (*F*x1) 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 $\{1, \ldots, \mathrm{J}+1\}$ where the first is the unit which receives treatment and the rest are "donors." Y_j is the results vector (*T*x1) for unit *j* and Y_0 is the results matrix (*T*x*J*) of all donors. **W** is a weights vector (*J*x1)of all donors observations, $(\omega_2, \ldots, \omega_{J+1})$, so$\sum_{j=2}^{J+1} \omega_j = 1and\omega_j \geq 0$. The weighted mean of donors is constructed as $Y_0\mathbf{W}$. $\mathrm{Y}_j = \left(\overleftarrow{\mathrm{Y}_\mathrm{j}} \backslash \overrightarrow{\mathrm{Y}_\mathrm{j}}\right)$ is the partition between pretreatment and posttreatment results vectors. Xrepresent the combination of k predictors, which include the r covariates $\mathbf{Z}$ y *M* linear combinations of $\overleftarrow{\mathrm{Y}_\mathrm{j}}$ (*k*=*r*+*M*). Analogous, X_0 is the matrix (*k*x*J*) of predictors for donors.

The synthetic control method consists of finding the optimal weighting matrices Win such a way that the difference of the predictors' values of the treated and the counterfactual becomes as small as possible:

$$W^* = \arg\min_{W} \|\mathrm{X}_1 - \mathrm{X}_0\mathrm{W}\|_\mathrm{V} = \sqrt{(\mathrm{X}_1 - \mathrm{X}_0\mathrm{W})' V (\mathrm{X}_1 - \mathrm{X}_0\mathrm{W})} \qquad (2)$$

In this way, the treated region and its synthetic control are similar along the dimensions that matter to predict the outcome variable prior to the treatment. V is a nonnegative diagonal matrix (*k*x*k*) whose values represent the weights of the predictors, that is, the values that prioritize which predictor matches better in (2).[8] The inference process is valid for any set of predictor weights, but Abadie, Diamond, and Hainmueller (2010) suggest choosing the set of weights that minimize the root mean squared prediction error (RMSPE) in the pretreatment period.

$$V^* = \arg\min_{V} \left\| \overleftarrow{\mathrm{Y}_1} - \overleftarrow{\mathrm{Y}_0}\mathrm{W}(V) \right\|$$

[8] As matching may hold only approximately.

Under specific conditions, Abadie, Diamond, and Hainmueller (2010) show that the bias of $\widehat{\alpha}_1$ tends toward 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 posttreatment reflects what would have happened with the treated region in the absence of the intervention.

To determine statistical significance, placebo tests are performed. These consist of taking each region from the control group and applying the same method as if it were a treated unit (excluding the treated region from the respective synthetic control) 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 occurred by chance. This non-parametric test has the advantage of not imposing 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:

$$\text{p-value} = \Pr\left(\left|\hat{\alpha}_{jt}^{PL}\right| \geq |\hat{\alpha}_{1t}|\right)$$

$$= \frac{\sum_{j \neq 1} 1\left(\left|\hat{\alpha}_{jt}^{PL}\right| \geq |\hat{\alpha}_{1t}|\right)}{J}$$

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 inferences using these p-values can be overly conservative given that placebo effects may be large in cases where a good adjustment in the pretreatment period is not achieved for the placebo regions (i.e., a good synthetic control is not achieved). An alternative is to divide the effects $\widehat{\alpha}_{jt}$ by RMSPE in the pretreatment period ($\hat{s}_j$), and obtain a pseudo t-statistic for each posttreatment period, $\widehat{\alpha}_{jt}/\hat{s}_j$.

Similarly, both statistics can be defined for the entire post-intervention interval using the RMSPE in that interval ($\hat{s}_j$). Therefore, the p-value for the joint significance of the effects in all posttreatment periods is defined as the proportion of placebos which have $\vec{s}_j/\hat{s}_j$ at least as large as the treated unit:

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

6. Results

The posttreatment 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.[9] The pre intervention period is the interval of time that goes from the first quarter of 2001to the fourth quarter of 2007.

The set of predictor variables for the results shown below includes the average of outcome variables for each one of the years previous to the intervention, the average pre-intervention expenditures per tourist and the average pre-intervention total expenditure. We have also performed estimations for different sets of predictor variables including information obtained from the household surveys: average household income per year, people employed, rates of informality. The inclusion of these variables does not improve the synthetic control adjustment (judging by the RMSPE) and does not change the main conclusions (results are available upon request).[10]

The corresponding weighting scheme of predictors (i.e., V matrix) was estimated by using the so called nested optimization. This data-driven procedure searches among all the nonnegative diagonal matrix V and sets of w-weights for the best fitting between Colonia and a convex combination of the control units in terms of the pretreatment values of the outcome variable.[11]

6.1. Number of Tourists

The synthetic control for the number of tourists is a weighted average which includes the Costa de Oro region (0.81), Litoral (0.16), and Montevideo (0.03) and excludes Rocha, Punta del Este, and Piriápolis.

[9] The analysis with annual data is also available upon request. The results are very similar.
[10] 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.
[11] We use the "nested" option of the "Synth" package of Stata instead of the default regression based option.

Table 1. Regions Weights in Synthetic Colonia

Tourist region	Weights
Punta del Este	0.00
Montevideo	0.03
Costa de Oro	0.81
Piriápolis	0.00
Rocha	0.00
Litoral	0.16

Source: Authors' estimations based on information from the Ministry of Tourism.

It is important to note the weight of two regions which experience an increase in the number of tourists and expenditure after 2007, Litoral and Rocha. Litoral, with a positive weight in the synthetic Colonia, is a region bordering on Argentina that may have been affected by the bridge blockade, exchange rate controls, and spending restrictions imposed on Argentinean tourists in a similar way as Colonia. By contrast, Rocha, excluded from synthetic control, is one of the "sun and beach" travel destinations that has experienced significant growth in recent years.[12]

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. Quality of Match – Predictor Means for Colonia, Synthetic Colonia, and Donor Pool *(pretreatment period)*

	Colonia	Other tourist regions (avg)	Synthetic Colonia
Tourists (thousands)			
2001q1-2001q4	40.7	72.3	37.9
2002q1-2002q4	27.6	58.7	28.1
2003q1-2003q4	19.1	47.2	21.7
2004q1-2004q4	23.2	58.8	26.4
2005q1-2005q4	26.1	66.4	26.8
2006q1-2006q4	25.8	66.0	24.9
2007q1-2007q4	24.1	64.3	22.9
Spending per Tourist (USD)			
2001q1-2007q4	160.3	240.7	163.8
Total Spending (millions of USD)			
2001q1-2007q4	4.2	20.1	4.8

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

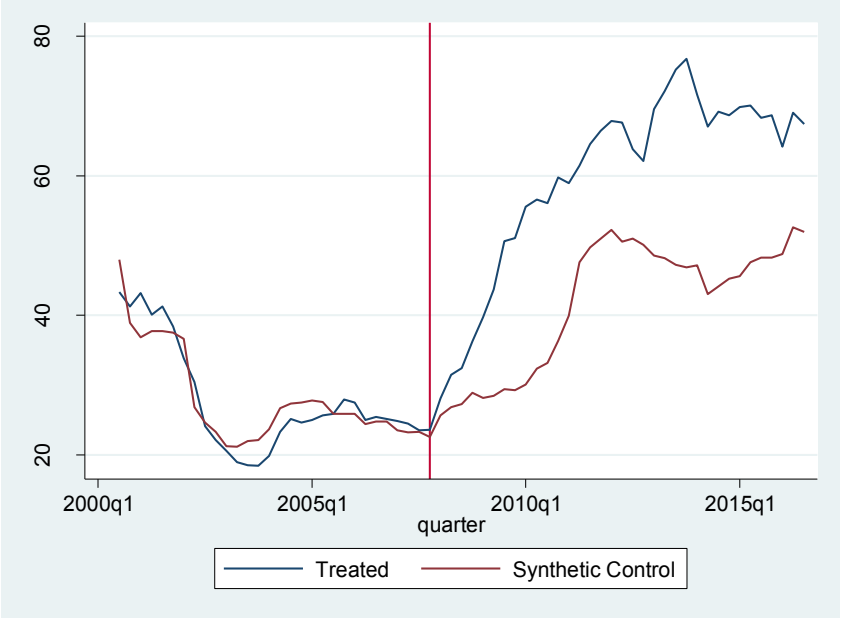
Figure 8 shows the evolution of the number of tourists in Colonia and the synthetic control. It can be appreciated a positive and persistent effect since the beginning of the cluster program. The point estimate of the impact between 2008 and 2015 implies an

[12] Rocha's coastline is a more pristine destination than its competitors, the coastlines of Maldonado (Pirápolis and Punta del Este) and Costa de Oro. In recent years, both domestic and international tourists have shown an increasing preference for this coastal region.

increase of 18 thousand tourists per quarter which represents an increase of 30 percent in the number of international tourists during the period.

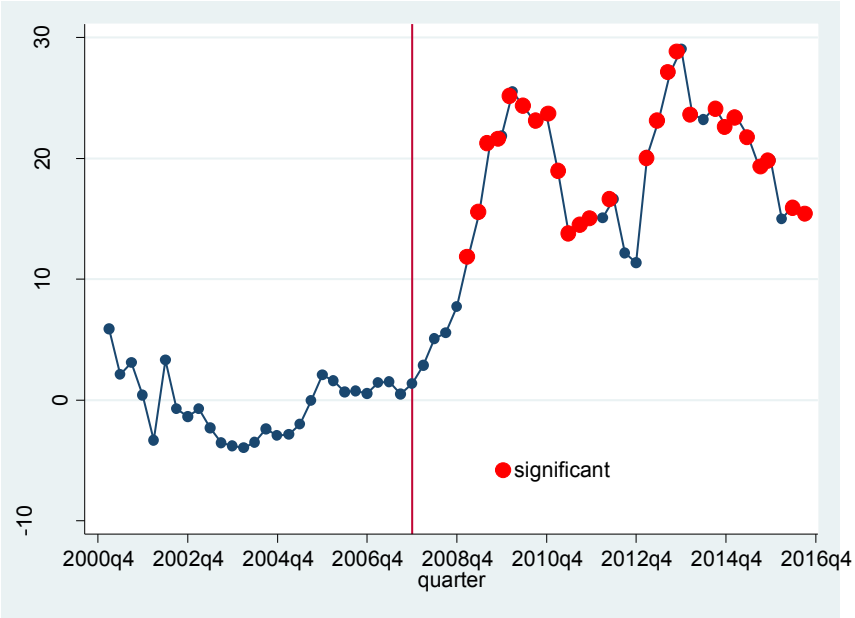
Figure 9 shows the difference between the number of tourists in Colonia and its synthetic control during the pre-intervention period, where it fluctuates around zero, and after the policy, where it shows a positive impact. The biggest impact is observed between 2009 and 2010 and between 2013 and 2014. In the years 2011 and 2012 the estimated impact decreases, coinciding with the episodes 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 tourism in Colonia was in fact a negative effect.

Figure 8. Number of Tourists: Colonia vs. Synthetic Control, 2001:01–2016:03



Source: Authors' estimations based on information from the Ministry of Tourism.

Figure 9. Number of Tourists: Estimated Impact



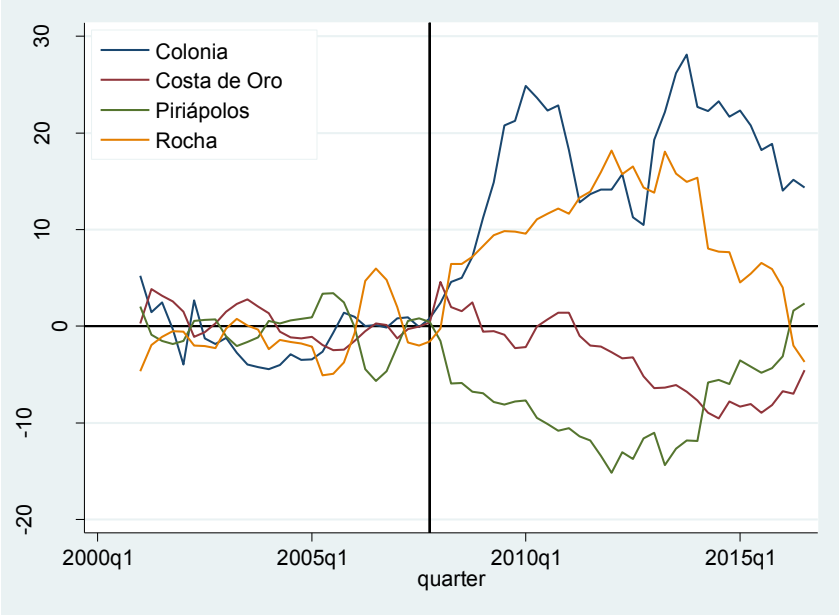
Source: Authors' estimations based on information from the Ministry of Tourism.Note: red markers indicates the significance of the impact based on the pseudo t-statistic $\widehat{\alpha}_{jt}/\widehat{s}_{j}$.

Next we will analyze, first, the significance of the estimated effect and second, the robustness of the effect to the length of the interval used for the synthetic control identification and the use of all lags of the yearly average of outcome variables as separate predictors.

Although the small number of donor regions does not necessarily imply a constraint on identifying a good synthetic control, it does represent a constraint on making inferences due to the reduced number of placebo effects which can be estimated. This weakness is increased if, as we will see in this case, we cannot find a good synthetic control for several placebos (regions); that is, if the adjustment for the pre-intervention period is not good. This could render the posttreatment period estimated effects for the placebos rather uninformative.

Taking into consideration an unadjusted p-value that considers only the number of placebo effects of absolute magnitude at least as large 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 (see Figure 9). Figure 10 shows the estimated effect for Colonia and the placebo effects, excluding three regions with bad pre-intervention adjustment (Litoral, Montevideo, and Punta del Este).

Figure 10. Estimated Effect for Colonia vs. Placebos



Source: Authors' estimations based on information from the Ministry of Tourism.

The following table presents the pretreatment and posttreatment RMSPE, and the ratio of the posttreatment and the pretreatment, for Colonia and the set of placebos against which the average treatment estimate is compared by inference. These last two measures can be used to analyze the significance of the estimated impact on the number of tourists in Colonia in the post-treatment period (i.e., between 2008 and 2015). The last two rows in Table 3 show the two alternative p-values. The first (second column) is the unadjusted p-value, of 0.5. The second one, adjusted by the prediction error prior to the treatment, has a p-value equal to 0. In other words, in this last case, after correcting the estimated impact of each region (Colonia and placebos) by the quality of the pretreatment adjustment of the synthetic control for each of them, we find that none of the placebos shows a higher impact than the one identified in Colonia (vis-à-vis their respective synthetic controls).

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

Region	Quality of the pretreatment matches $\hat{\bar{s}}_j$	Joint effect across all post-treatment periods $\hat{\bar{s}}_j$	Adjusted effect (Post/Pre RMSPE) $\vec{s}_j/\hat{\bar{s}}_j$
Colonia	**2.7**	**19.4**	**7.3**
Punta del Este	12.8	26.1	2.0
Montevideo	28.9	48.7	1.7
Costa de Oro	1.8	11.5	6.3
Piriápolis	2.6	11.4	4.4
Rocha	2.9	11.5	3.9
Litoral	17.9	26.7	1.5
p-values:			
$\sum_{j\neq 1} 1(\vec{s}_j \geq \vec{s}_1)/J$		**0.5**	
$\sum_{j\neq 1} 1(\vec{s}_j/\hat{\bar{s}}_j \geq \vec{s}_1/\hat{\bar{s}}_1)/J$			**0**

Source: Authors' estimations.

Robustness Checks

Given the available information, it is possible to conduct a robustness analysis of the impact we have found. First, we will see the sensitivity of the results to the exclusion of regions from the set of donors used for the construction of the synthetic control. Since the Litoral is a region that experienced a highly relative increase in the number of tourists since 2008, while Costa de Oro saw much more moderate growth, we can reasonably expect the magnitude of the impact to grow when the first region is excluded, and to decrease when Costa de Oro is excluded, and that this will have consequences in terms of the significance of the effect. This is precisely what happens. Table 4 shows the impact significance contrast when some regions are excluded from the synthetic control. The sign of the impact is always positive but is not significant if the Costa de Oro region or the Costa de Oro and Montevideo regions are excluded from the group of donors. However, it continues to be positive (and significant) in the remaining cases. Because there are only a few donors, the exclusion of some of them impacts the significance of the effects.

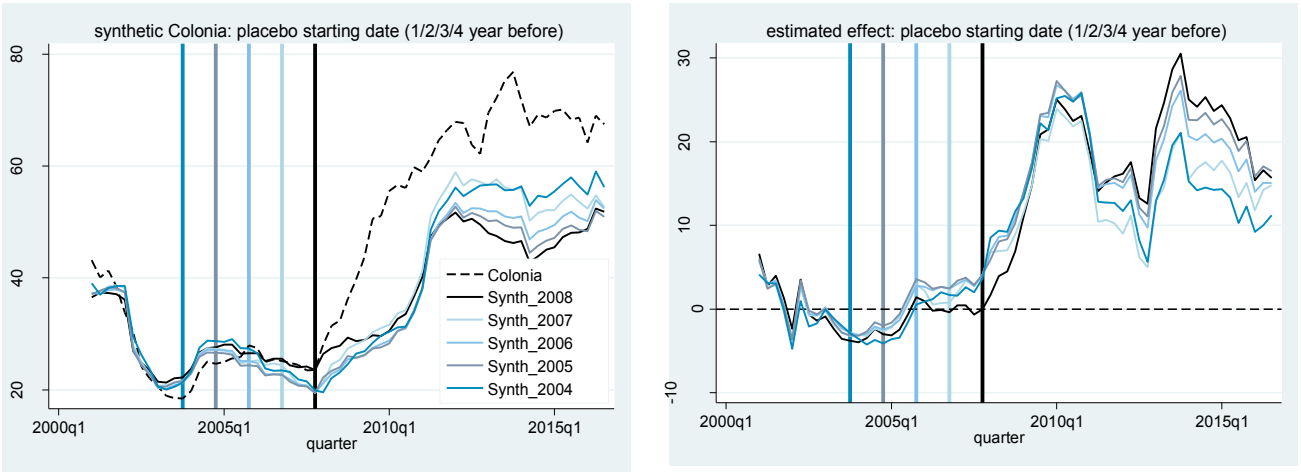
Table 4. Robustness of Impact Excluding Regions from Donor Group

Excluding from donors	Average effect (thousands of tourists)	$\vec{s}_j/\tilde{s}_j$
Costa de Oro	12.7	0.5
Litoral	21.4	0.0
Montevideo	15.5	0.0
Costa de Oro, Litoral	19.9	0.0
Costa de Oro, Montevideo	6.8	0.5
Litoral, Montevideo	20.7	0.0
Costa de Oro, Litoral, Montevideo	18.6	0.0

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

A second robustness analysis is related to the date established to determine the pre- and post-program period for the empirical exercises. Up to this point, the first year after the intervention was 2008. This will now be changed. The exercise consists of replicating the same analysis but assuming alternative starting dates: 2007, 2006, 2005, and 2004. This exercise is interesting to analyze whether events that occurred in those years may be the real cause of the estimated effect after 2008. For example, it could be useful to discover whether the blockade of the bridge, which began in 2005 and escalated in 2006, could be the real event behind the positive effect found after 2008, or at least one of its causes. The results (Figure 11) show that even when a different starting date is used, it is not until 2008 that a positive gap for Colonia was observed. In other words, the previous estimated effect does not change significantly if we estimate and "release" the synthetic control well before 2008.

Figure 11. Impact on the Number of Tourists, Assuming Different Starting Dates of the Intervention



Source: Authors' estimations based on information from the Ministry of Tourism.

A final aspect to be considered is related to the decision regarding the selection of predictors. First, it should be noted that we only have two covariates to be used as additional predictors of lagged values of outcome. Kaul et al. (2016) demonstrate that using all outcome lags as separate predictors renders all other covariates irrelevant. This holds regardless of how important these covariates are in accurately predicting posttreatment values of the outcome, threatening the estimator's unbiasedness.

We will show the sensitivity of the results to alternative restrictions on the outcome variable lags. Following Kaul et al. (2016), we analyze two alternatives for the outcome variable: (i) including only the pre-intervention average of the outcome variable; and (ii) using only the last pretreatment value of the outcome variable.

Previously, in Table 2, we observed the average adjustment achieved between Colonia and the synthetic control. Table 5 shows how this adjustment improves if we consider alternative versions of inclusion of the outcome variable as a predictor. Naturally, the average of regions that make up the synthetic control is different in each case, although in all cases the preponderance of Costa de Oro and Litoral is maintained (see footnote in Table 5).

Figure 12 presents the estimated effect according to the three previous alternatives for the outcome variable. The impact is positive in all three cases, although it is not significant in the option in which only the first lag of the outcome variable is considered as a predictor.

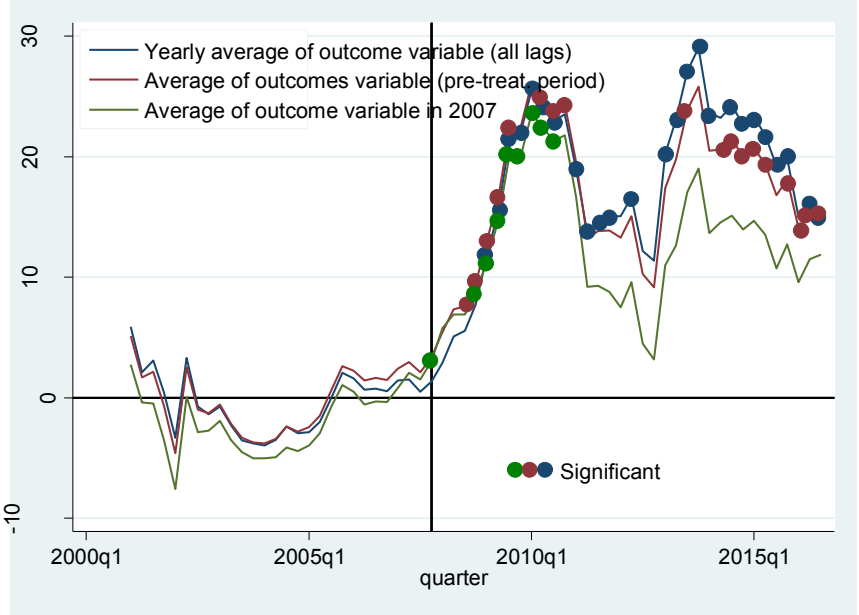
Table 5. Covariates (Predictors) Means before Treatment under Alternative Forms of Inclusion of Outcome Variable as a Predictor: Colonia vs. Synthetic Colonia

		Synthetic Colonia		
	Colonia	Yearly average of outcome variable(all lags included) (a)	Average of outcome variable (pretreatment period) (b)	Average of outcome variable in 2007 (c)
Spending per tourist (USD) 2001q1-2007q4	160.3	163.8	160.4	160.3
Total spending (millions of USD) 2001q1-2007q4	4.2	4.8	4.2	4.2
RMSPE (s.)		*2.5*	*2.6*	*3.2*

Source: Authors' estimations based on information from the Ministry of Tourism.

Note: The respective synthetic controls are formed by the following regions (weights): (a) Montevideo (0.03), Costa de Oro (0.81) and Litoral (0.16); (b) Costa de Oro (0.72), Piriápolis (0.02), Rocha (0.02) and Litoral (0.24); **(c)** Costa de Oro (0.58), Rocha (0.12), and Litoral (0.30).

Figure 12. Estimated Impact on Number of Tourists under Alternative Predictors



Source: Authors' estimations based on information from the Ministry of Tourism.

Finally, we cannot rule out the possibility of spillover effects on other regions. For example, marketing Colonia as a tourist destination abroad could have a positive impact on tourism in other regions; therefore, the impact that we are estimating could be downward biased. There could also be a stealing effect of tourists from other regions. Even though we cannot rule out this last hypothesis, one reason to think that this effect could be small is that tourism in Colonia is cultural heritage tourism that is different from tourism in the other regions, with positive weights in the synthetic control (more related to sun and beach tourism).

6.2. Total Expenditure

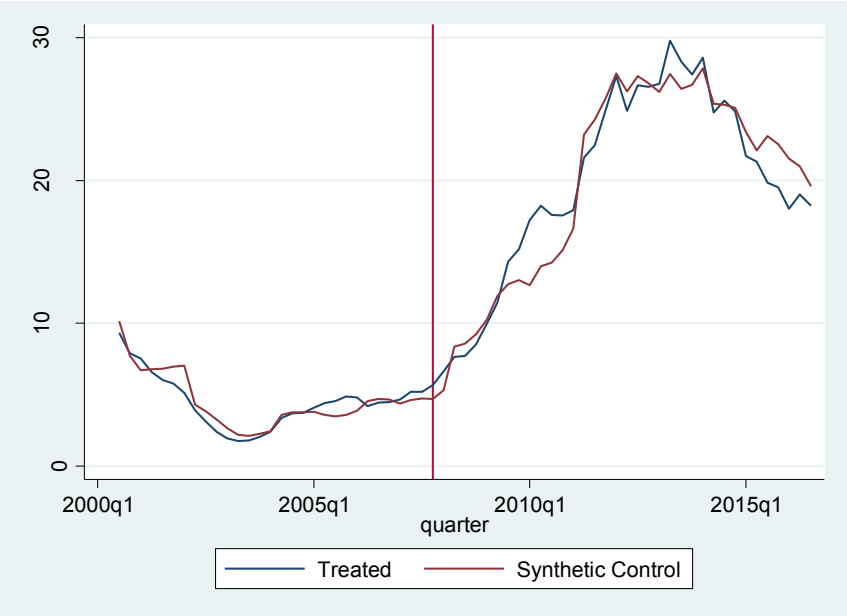
The same exercise described in the previous section was performed with the variable "total expenditure" by tourists in Uruguay. In this case, we do not find a significant difference between Colonia and the synthetic control (Figure 13). The gap between them oscillates around 0 (Figure 14). The differences in each year, sometimes positive and sometimes negative, is never significant considering the placebo tests (see right-hand panel, Figure 15). As a result, the impact in the entire posttreatment period is not significant (Table 6).

Therefore, although a positive impact on the inflow of tourists to Colonia was identified, there is no evidence of an increase in their total expenditure. This conclusion remains unchanged if the period of time used to identify the synthetic control is modified (see Figure 15).

The positive impact previously estimated on the number of tourists and the null impact on total expenditure imply that average expenditure per tourist decreased in the posttreatment period. In the Appendix, the results obtained from repeating the same exercises as above for the variables “average expenditure per tourist,” “average length of stay,” and “average daily expenditure per tourist: are presented (Figures A.6–A.8). A negative gap is observed for the three variables, even though the results were not statistically significant in any of the cases.

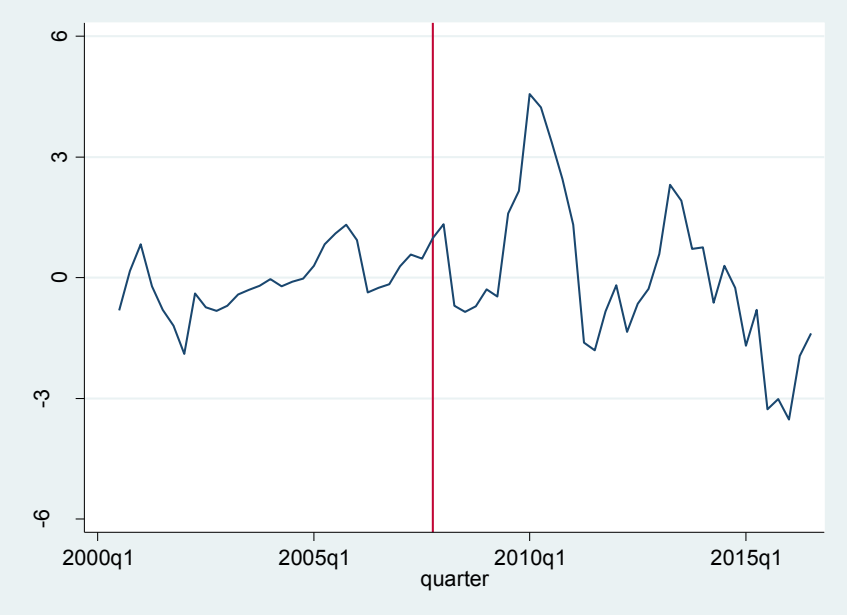
A possible hypothesis to explain the decrease in the average expenditure per tourist is that the demand induced by the program may have captured a different type of tourist that spends less (i.e., from different socioeconomic strata, having different habits, etc.).

Figure 12. Expenditure: Colonia vs. Synthetic Control, 2000:01–2016:03



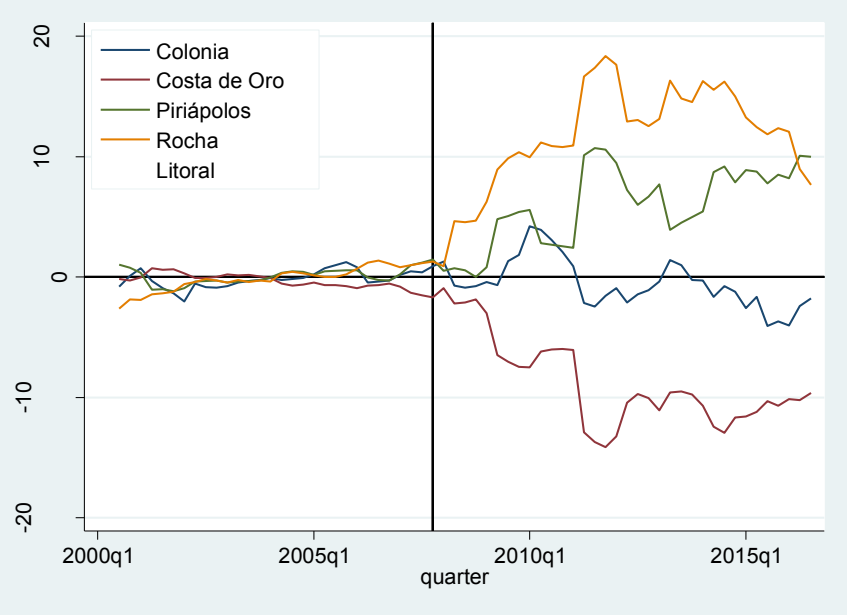
Source*:* Authors’ estimations based on information from the Ministry of Tourism.

Figure 13. Expenditure: Estimated Impact



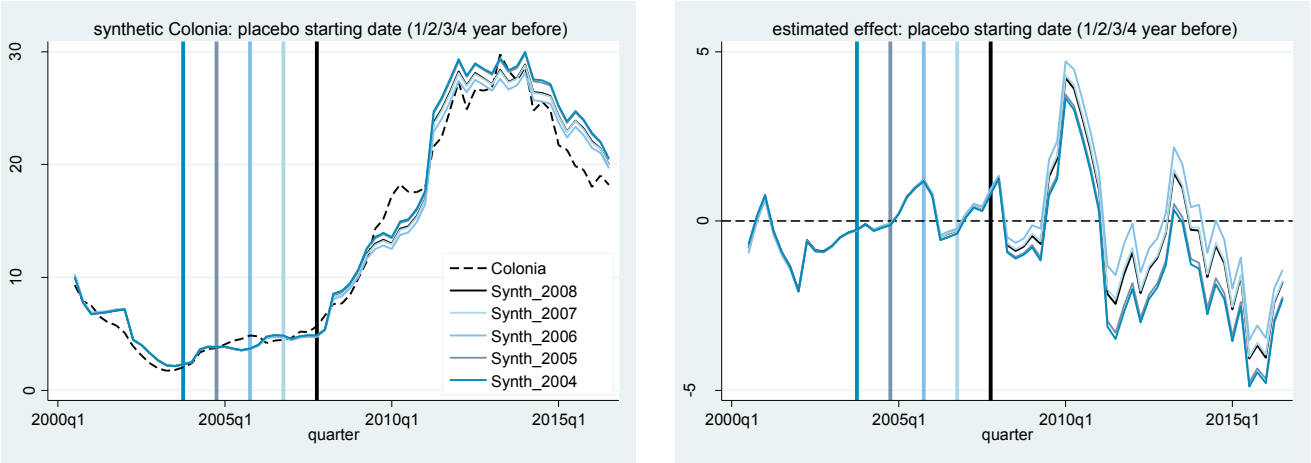
Source: Authors' estimations based on information from the Ministry of Tourism.

Figure 14. Estimated Impact on Expenditure: Colonia vs. Placebos (left) and Significance Tests (right)



Source: Authors' estimations based on information from the Ministry of Tourism.

Figure 15. Impact on Expenditure Assuming Different Starting Dates for the Intervention



Source: Authors' estimations based on information from the Ministry of Tourism.

Table 6. Root Mean Square Prediction Error of Total Expenditure: Colonia vs. Placebos

Region	Quality of the pretreatment matches: $\vec{s}_j$	Joint effect across all post-treatment periods: $\vec{s}_j$	Adjusted effect (Post/Pre RMSPE) $\vec{s}_j/\vec{s}_j$
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:			
$\sum_{j\neq 1} 1(\vec{s}_j \geq \vec{s}_1)/J$		**1**	
$\sum_{j\neq 1} 1(\vec{s}_j/\vec{s}_j \geq \vec{s}_1/\vec{s}_1)/J$			**0.66**

Source: Authors' estimations based on information from the Ministry of Tourism.

7. Conclusions

This paper analyzes the impact of a cluster tourism policy in the region of Colonia, Uruguay. A comparative analysis between Colonia and other tourism regions of the country was performed applying a synthetic control method. This method of identifying the counterfactual is especially useful in comparative case studies where there are a limited number of control units. The synthetic control method assigns a weight to every unit of the donor group according to an optimization process that minimizes the distance between vectors that 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 14,000 tourists per quarter between 2008 and 2015, a 24 percent increase in the number of tourists in the period.

Regarding the significance of the impact in the years following the start of the program, the evidence shows that the impact was always significant except for 2011 and 2012, when the difference between Colonia and its counterfactual is not significant. This may be attributable to the capital controls imposed by the Argentinean government on Argentinean tourists.

We did not find a significant impact on total expenditure by tourists. This could be explained by a composition effect in the total number of tourists arriving to Colonia. We have different hypotheses for this. First, the incremental number of tourists could have been concentrated in segments of lower relative income. Second, the program may have attracted tourists who were less interested in the attractions of Colonia than those who had visited Colonia in the past but who, swayed by the marketing campaigns, decided to visit Colonia for only few days. Alternatively, border mobility and foreign exchange restrictions in Argentina may have adversely affected the quality of tourism to Colonia (i.e., length of stay in Colonia was less and/or spending was lower).

Given these results, it is interesting to ask whether the program benefited the private sector. Without raising income, the program could have had a positive impact on firms' profits if it reduced costs. Unfortunately, this study did not yield enough data to know if this is indeed the case. However, some program activities, such as worker training and management improvement, may have had an impact on costs.

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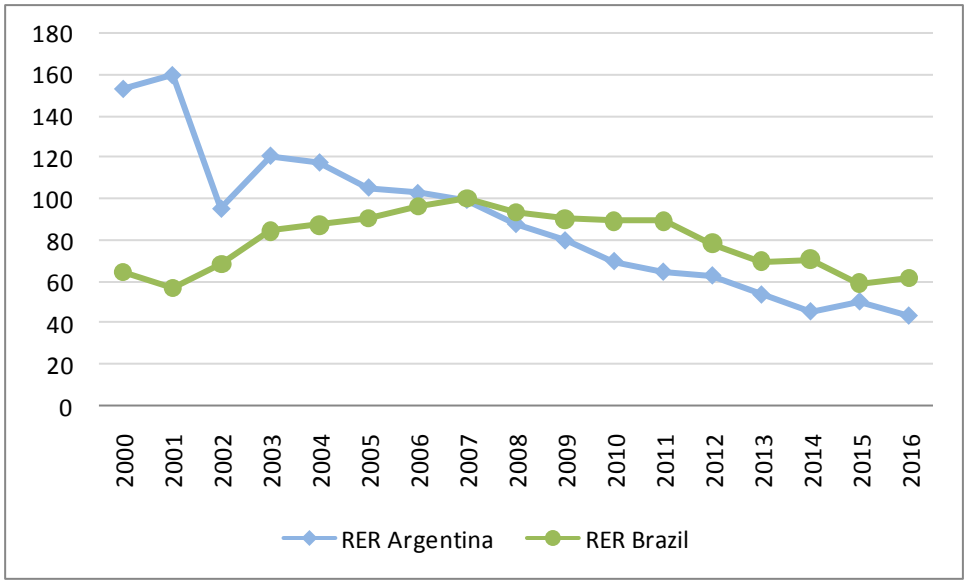
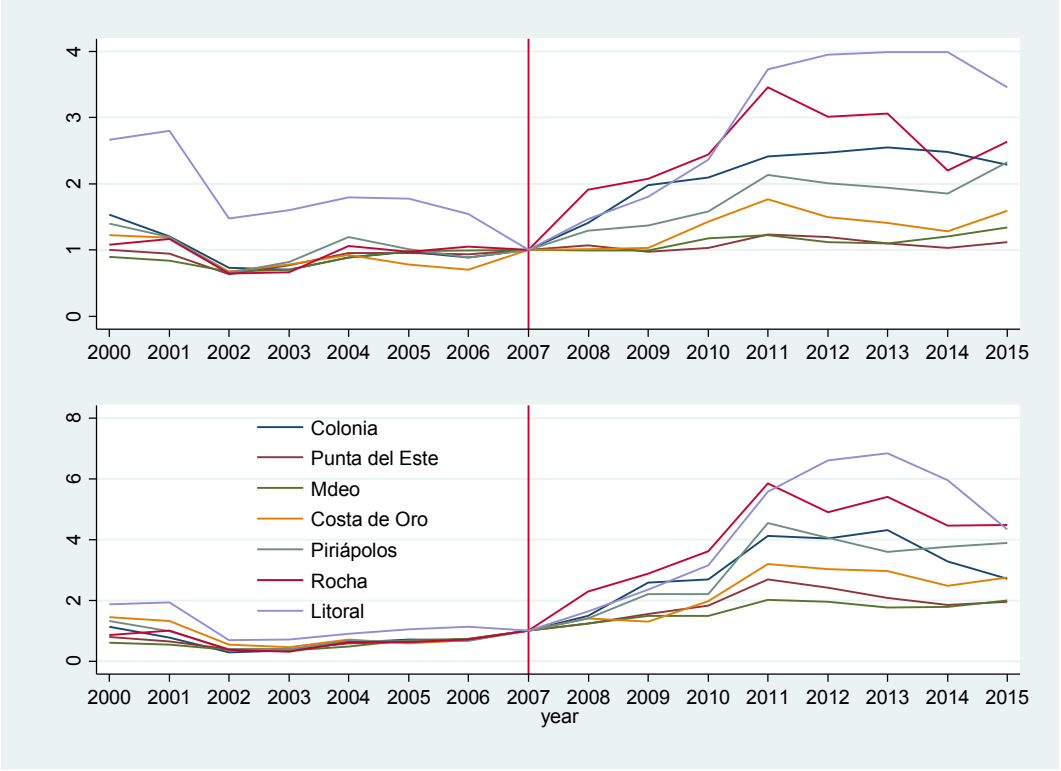
Appendix

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



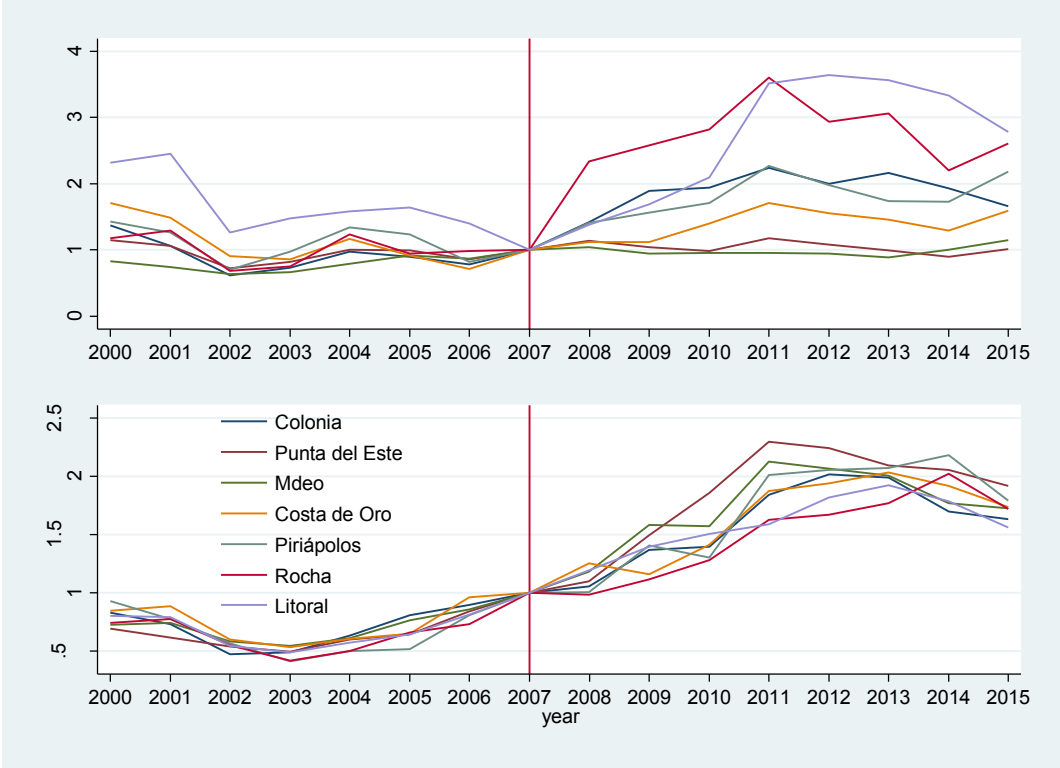
Source: Authors' elaboration based on information from the Central Bank of Uruguay.

Figure A.2. Number of Tourists and Expenditure by Region (2007=1)



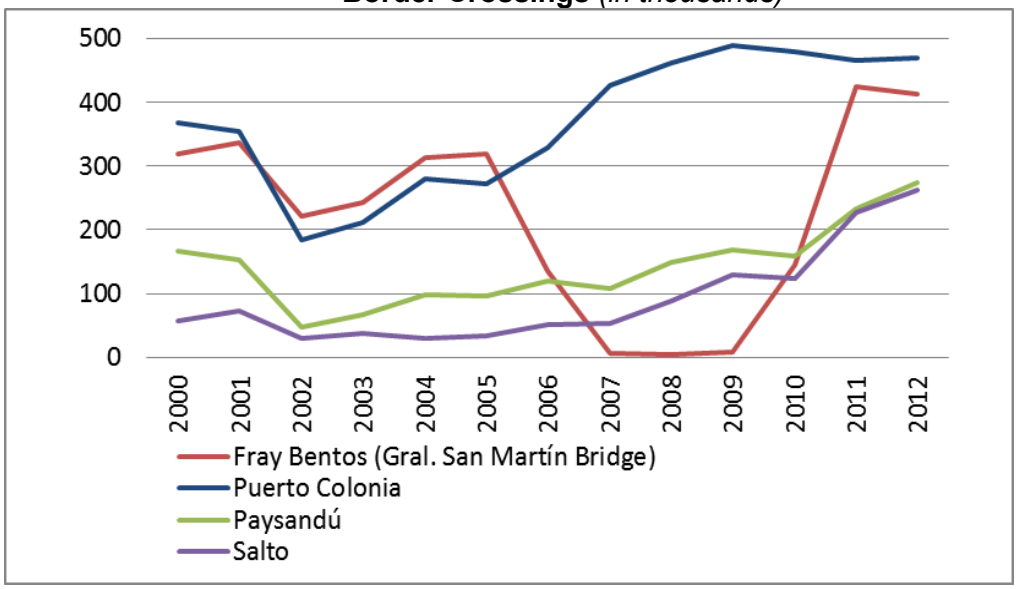
Source: Authors' elaboration based on information from the Ministry of Tourism.

Figure A.3. Average Length of Stay and Spending per Tourist by Region (2007=1)



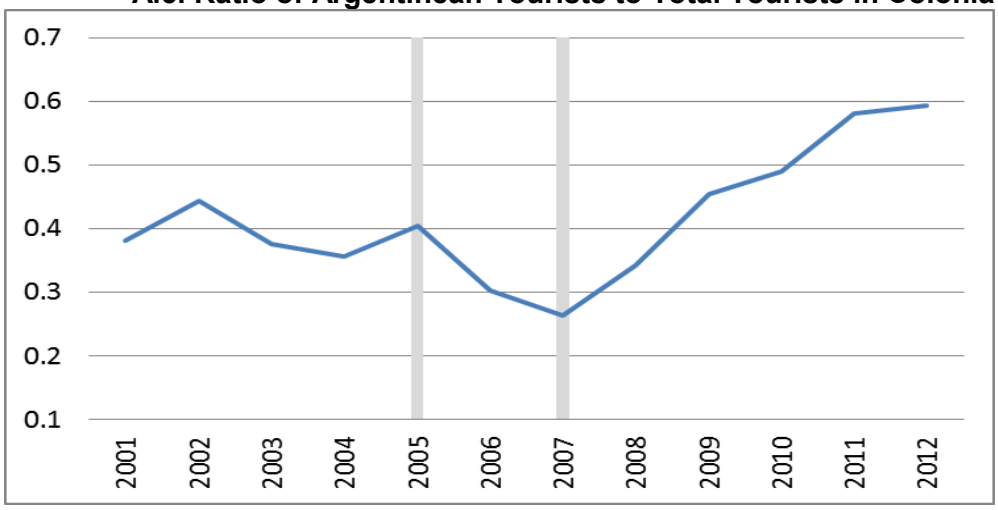
Source: Authors' elaboration based on information from the Ministry of Tourism.

Figure A.4. Inflow of Argentinean Tourists by the Port of Colonia and Three Other Border Crossings *(in thousands)*



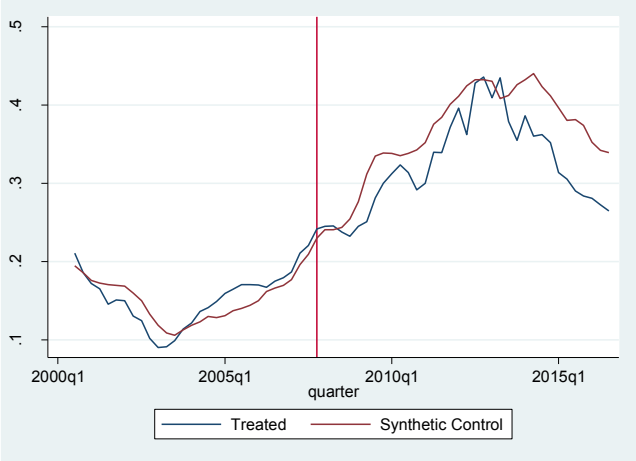
Source: Authors' elaboration based on information from the Ministry of Tourism.

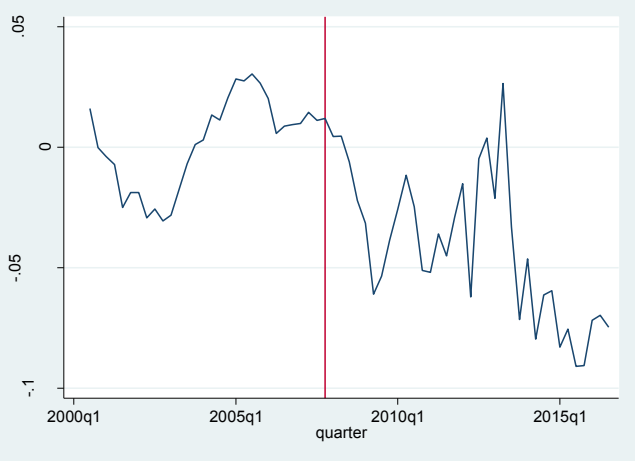
A.5. Ratio of Argentinean Tourists to Total Tourists in Colonia



Source: Authors' elaboration based on information from the Ministry of Tourism.
Note: Gray lines indicate the period when the blockade of the Gral. San Martín bridge took place.

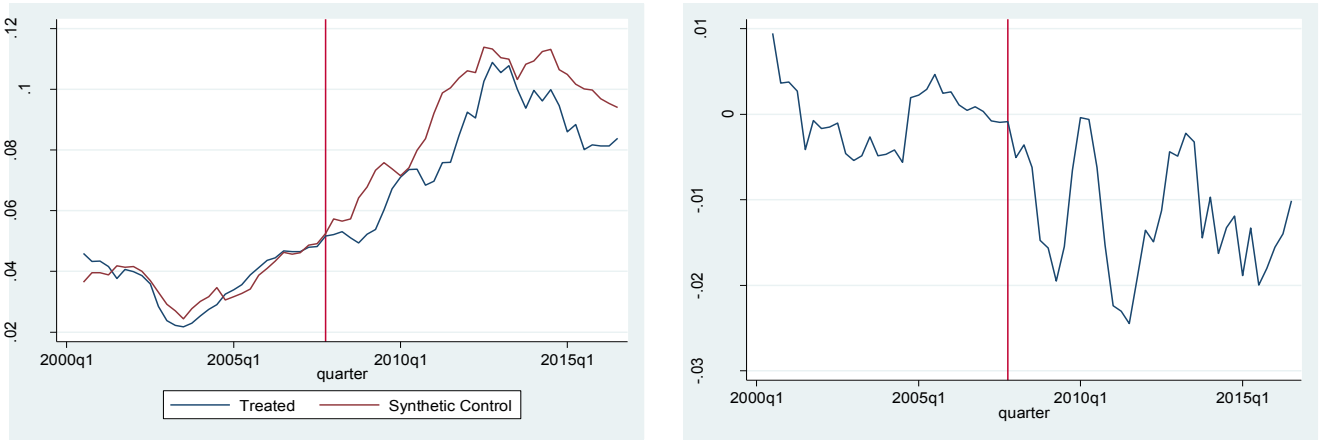
Figure A.6. Impact on Spending per Tourist in Colonia vs. Synthetic Control





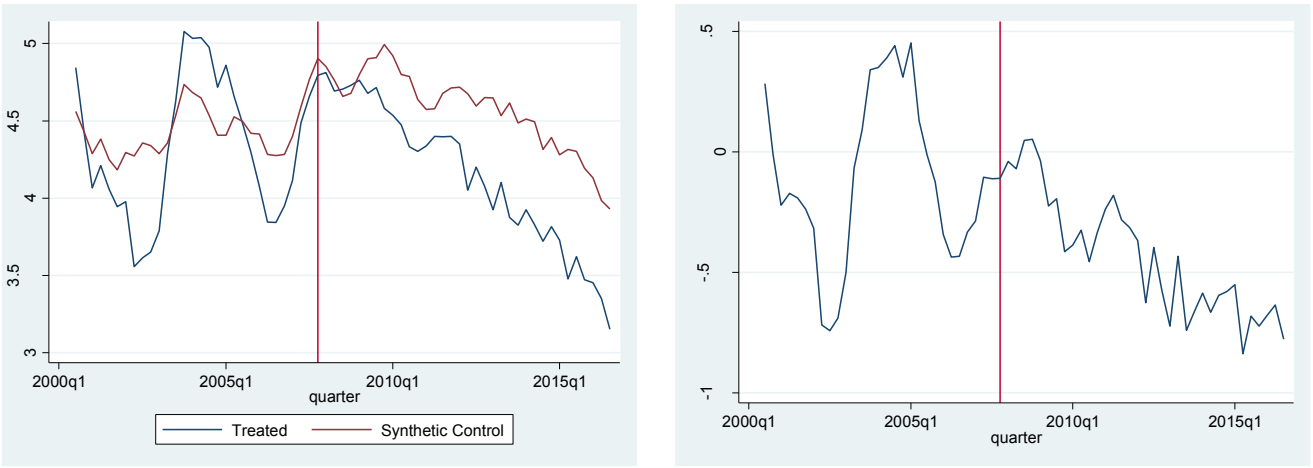
Source: Authors' estimations based on information from the Ministry of Tourism.

Figure A.7. Impact on the Average Number of Days of Stay in Colonia vs. Synthetic Control



Source: Authors' estimations based on information from the Ministry of Tourism.

Figure A.8. Average Expenditure per Tourist per Day in Colonia vs. Synthetic Control



Source: Authors' estimations based on information from the Ministry of Tourism.