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ASSESSING DIRECT AND INDIRECT EFFECTS OF PUBLIC SUBSIDIES TO TOURISM FIRMS

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SOMMARIO

The paper assesses the effect of public capital subsidisation on the competitiveness of firms in the hotel sector in a place-based subsidisation public policy. A Structural Marginal Model and Inverse Probability of Treatment Weighting (IPTW) estimation strategy is proposed in order to identify and estimate both the direct and the indirect average treatment effects of the policy over time. The empirical domain of analysis is the hotel industry in the Province of Trento (Italy) and the subsidies granted within the Provincial Law 6/99. The time window under scrutiny is 2002-2006 A positive effect of the policy is estimated on several hotel performance indicators. Moreover, we found that a hotel's performance depend on whether many or few hotels in its own destination are subsidised.

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1. Introduction[3]

In this paper we provide an attempt to evaluate the direct and indirect effect, due to spillovers and externalities, of public subsidies to micro and small hotels in the context of a regional law. Tourism is a clear example of the place-based approach to the regional development that can be motivated by positive spatial externalities (Neumark and Simpson, 2014; Barca *et al*., 2012) and several studies have addressed the importance of agglomeration externalities in the hotel industry (Baum and Mezias, 1992; Canina *et al.*, 2005; Chung and Kalnins, 2001; Kalnins and Chung 2004).

The empirical domain of analysis is the hotel industry in the province of Trento (Trentino), where almost all economic activity is run by micro and small independent tourist firms. Policies to tourism are implemented under the umbrella of the Provincial Law 6/99 (PL 6/99) which is a tool of intervention active in Trentino since the 1999 and directed to several sectors. Subsidies are categorized by objectives and include environmental and energy-saving, investment in fixed capital, research and development, entrepreneurship promotion, firms' internationalization to foster firms' quality and productivity. The form of intervention directed to tourism firms consists in co-financing firm investment in fixed capital and environmental investments. Importantly, firms can receive one or more subsidies over time.

We exploit a detailed and unique dataset on a large, representative sample of eligible hotels operating in the province over the period 2002-2006, obtained by integration of several data sources. The empirical domain of analysis has two important advantages: the local dimension of the context of analysis and the focus on a single narrowly defined sector reduce the *ex ante* heterogeneity of the firms analysed, and the firms in the region cannot receive grants from other institutions other than the Trentino province. This is because, in 2002, provincial law 6/99 was the only tool of intervention in the economic activities of the local government and therefore the only source of subsidies available to firms in the region. We considered several measures of hotel performance.

Our results highlight the direct positive effects of subsidies on hotel performance. We also found empirical evidence of SUTVA violation and indirect subsidy effects. Specifically, our results are consistent with heightened competition among hotels within destinations as a result of policy intervention.

The remainder of the paper is organised as follows. The next section discusses the theoretical and empirical background. Section 3 presents the econometric framework. Section 4 describes the context in which the analysis was carried out, the details on the data, and the variables used. Section 5 presents the results of the estimations. Section 6 concludes.

2. Background

In the last few decades several public policies with the intention to let tourism sector more competitive and able to meet the increasing globalization of demand and the need for

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sustainability has been implemented. To this aim, the provision of subsidies has been a key instrument of regional tourism policies. Indeed, subsidies given to the tourism industry were mentioned by 62 of the 97 members of the World Trade Association between 1995 and 2004 (WTO, 2006). However, the rationale for, as well as the effectiveness of public spending on tourism is still debated (Logar, 2010; Bernini and Pellegrini, 2013; Weiermair, 2006).

The Rubin's Causal Model (1974) is now the standard framework for quantitative evaluation studies (Imbens and Wooldridge, 2009). This model, based on the concepts of potential outcomes and assignment to a treatment mechanism, focuses on two fundamental assumptions: the Conditional Independence Assumption (CIA) to control for confounding factors which drive both assignment to treatment and potential outcomes, and the Stable Unit Treatment Value Assumption (SUTVA), which rules out any in uence of a unit's treatment status on another individual's potential outcomes (Rubin, 1986). The need to account for spillover and externalities, i.e., relaxing the SUTVA assumption allowing interactions between units, however, is increasingly viewed as a serious problem in economics applications.

Authors dealing with spillovers generated by policies considered as their unit of analysis aggregated areas, such as census areas (e.g., Hanson and Rohlin, 2013) or local labour systems (e.g., De Castris and Pellegrini, 2012). Cerqua and Pellegrini (2014) made one of the first attempts to address the issue of SUTVA and spillover estimation when the firm is the unit of analysis. In a different emerging strand of literature, mostly in the fields of epidemiology and social science, the standard SUTVA is relaxed by incorporating agents' interactions directly in the models. Papers in this literature have modelled unit outcomes as depending not only on individually received treatments, but also on treatments received by other units, in a two-stage randomisation approach in which interference occurs within pre-specified groups and interference between groups is ruled out (Hong and Raudenbush, 2006; Rosenbaum, 2007). Grounded on this two-stage setting Hudgens and Halloran (2008) developed general modelling under randomisation when interference is present. Tchetgen-Tchetgen and VanderWeele (2010) presented an inferential approach for observational studies assuming independence across groups. Differently, Cerulli (2014) moves along the line traced by econometric studies normally dealing with non-experimental settings where sample selection is the rule. He draws from the works dealing with treatment effect identification in the presence of externalities and in particular from Manski's (1993, 2013) approach.

All these approaches, however, are not directly applicable in contexts where firms are subjected to multiple treatment over time, for instance to such policies that allow firms to receive more than one subsidy over time.

In this paper, we consider the case of time-varying treatments, i.e., we examined the firms' history of treatments. In this setting, the treatment is no longer the receipt of a single treatment, but is a sequence of 0s and 1s of the treatment status over the years. Accordingly the counterfactual is a differing sequence of 0s and 1s of the treatment status. Drawing on previous literature (Hogan and Lancaster, 2004; Azoulay *et al.*, 2009), we consider a Marginal Structural Model and Inverse Probability of Treatment Weighting (IPTW) estimators. Under this framework of analysis, and building on contributions in the emerging strand of research that relaxes SUTVA in analysis (Hong and Raudenbush, 2006; Hudgens and Halloran, 2008;

Ferracci et al., 2013;), we proposed a framework which allows not only the identification and estimation of the direct average treatment effect but also estimation of the indirect effect of a policy. Suarez et al. (2008) extended the static IPTW estimation to multiple treatment settings, i.e. when subjects in a given time receipt more than one type of treatment. We propose, instead, a two-level longitudinal multiple treatment setting in which at each time *t* a units receives two treatment: one at unit level and the other at cluster (group) level.

Although general, our framework appears to be particularly appropriate for tourism-related industries. Tourist firms cannot be considered separately from the destinations in which they operate. Destination characteristics define the external environment in which hotel businesses operate and, consequently, drive their competitiveness in world markets (Murphy *et al.*, 2000). The resources and competences used to produce the goods and services composing the final destination product are related to the firms operating in a destination, making it necessary for individual firms to participate in the co-production of the destination product (Haugland *et al.*, 2011). Accordingly, the success of a destination and that of individual firms are closely connected and rely on the coordinated resources, products and services of individual firms (Beritelli *et al.*, 2007; Haugland *et al.*, 2011). Thus, the competitive position of a tourism destination depends on the joint decision of many firms that can underinvest in the improvement of their own facilities, but may gain from the externalities generated by other firms' investment.

For hotels, in particular, the relevant interactions are expected to be local, that is, among hotels within relatively compact, well-defined geographic areas (Baum and Mezias, 1992). In the hotel industry geographical proximity is likely to generate demand-side agglomeration externalities that may exist even without interconnections among hotels. For instance, even hotels whose managers never speak to each other and who share no information among themselves still receive the effect of demand-side agglomeration externalities generated by heightened demand (McCann and Folta, 2009). Production enhancements can create better quality products and services, which will in turn heighten demand once consumers are aware of them. For example, Baum and Ingram (1998) describe improved hotel labor practices that would enhance the quality of service experienced by visitors. Also improved capital endowment is a good indicator of higher quality of services delivered (Israely, 2002), and the room features and availability of a hotel's amenities and facilities play an important role in tourists' purchasing decisions (Kashyap and Bojanic, 2000; Choi and Chu, 1999). Renewed physical capital may thus enhance a hotel's competitiveness by achieving lower costs and higher-quality output (Orfila-Sintes and Mattsson, 2009). The quality improvement of a certain hotel can affect that of its neighbours (Calveras and Vera-Hernández, 2005). If in a certain neighbourhood, one hotel varies its quality, for instance, by restructuring its building and adding new facilities to its accommodation, this action by one hotel also changes the value of the neighbourhood: it may affect the quality of tourists' experience, their length of stay and likelihood of return, and may eventually have an effect on all providers of services and goods – including other hotels – in the neighbourhood. Therefore, if we considered hotels embedded in their own tourist destinations within a region and defined hotel outcomes as a function of hotel treatment and of that of other hotels in the same destination, thus we should be able to estimate the direct effect of hotel's history of treatment and the indirect effect at the destination level.

A positive effect of subsidies on hotel performance is expected. Investment in physical capital plays an important role in augmenting the productivity and competitiveness of tourist firms (Blake at al., 2006). The reduced cost of capital then makes subsidised hotels more competitive by increasing the demand for their services. On the one hand, being close to subsidised hotels may be beneficial also for non-subsidised ones, which can gain from enhanced demand due to the increased quality and attractiveness of the destination. On the other hand, however, subsidisation can increase market product rivalry. In this case, subsidisation increases competition among hotels: if destinations compete in attracting tourists (Buhalis, 2000; Murphy et al., 2000), once those tourists have selected a destination, hotels within it will compete to become the tourists' first choice (Molina-Azorin *et al.*, 2010; Zirulia, 2009). Therefore, if two hotels in the same destination are direct competitors but only one of them receives public aid, this will negatively affect the unsubsidised hotel's future competitiveness.

In the end, the bias in the estimated effect potentially introduced by considering the outcome of hotels to be independent of the support given to other hotels may act in both ways: the overall effect of the policy will be under-estimated (i.e., indirect effects will be positive) if positive spillovers stem from subsidies in supported hotels, but it will be over-estimated (i.e., the indirect effect will be negative) if some firms are damaged as they lose relative competitiveness with subsidised hotels.

3. The econometric model

The reference econometric method is a Marginal Structural Model (MSM) (Robins, 2000; Hogan and Lancaster, 2004).

Let us assume that, at each point in time $t = 1,\ldots, T$, for each unit i we observe (Y, Z, X) where Y, Z and X represent the outcome, treatment status and a vector of unit characteristics, respectively. It is possible to model the mean of the outcome variable as conditional on control covariates X and treatment history $\bar{Z}$ as (Hogan and Lancaster, 2004):

$$E\left[Y\left(\bar{z}_{it}\right) \mid \bar{Z}_{it}, X_{it}\right] = \beta_0 + \beta_1' X_{it} + \delta g\left(\bar{Z}_{it}\right) \qquad [1]$$

where $g(\cdot)$ is a known function of treatment history, i.e. the sequence of treatments received over time.

A consistent estimation of the causal effect is obtained by means of the IPTW estimator. Its reliability depends on the validity of the Sequential Conditional Independence Assumption (SCIA), which provides a formal way of extending the assumption of selection on observables to the case of dynamic treatment (Robins et al., 2000; Hogan and Lancaster, 2004):

$$Y\left(z_{it}\right) \perp Z_{it} \mid \bar{Z}_{it-1}, \bar{X}_{it-1}^{TVC}, \bar{X}_{it} \qquad [2]$$

where $\bar{X}_{it}$ is the history of unit-level variables and $\bar{X}_{it}^{TVC}$ the history of time-varying confounders (TCV) that are defined in the IPTW literature (see Azoulay *et al*., 2009) as a time-varying variables that (i) are correlated with future values of the dependent variable in question, (ii) predict selection into treatment, and (iii) are themselves predicted by past treatment history. Under SCIA the average treatment effect is identified and can be recovered by estimating:

$$y_{it} = \beta_0 + \beta_1^{'} X_{it} + \delta g\left(\bar{Z}_{it}\right) + \varepsilon_{it} \quad [3]$$

by weighted least squares, where the weights correspond to the inverse probability of following the actual treatment history of subsidies up to time *t* for hotel *i*. (Hogan and Lancaster, 2004; Azoulay et al., 2009).

The weights (w_{it}) for the IPTW estimation procedure for each unit *i* at time *t* are computed as follows:

$$w_{it} = \prod_{\tau=0}^{t} \frac{1}{\Pr\left(Z_{i\tau} \mid \bar{Z}_{i\tau-1}, \bar{X}_{i\tau-1}^{TVC}, \bar{X}_{i\tau}\right)} \quad [4]$$

Each element in the denominator of equation (4) represents the probability that the unit *i* received it own observed treatment (either subsidized or not subsidized) at time *t*, conditional on past treatment history and its past history of confounder variables. Therefore, the denominator of w_{it} represents the conditional probability that a unit followed its own treatment history up to time *t*. The probabilities in the denominator of equation (4) may vary significantly when time-varying confounders are strongly associated with the receipt of a subsidy, and the resulting IPTW estimator will have a very large variance. Thus the weights are generally replaced with "stabilised weights" ($sw_{i,t}$) computed, as follows:

$$sw_{it} = \prod_{\tau=0}^{t} \frac{\Pr\left(Z_{i\tau} \mid \bar{Z}_{i\tau-1}, \bar{X}_{i\tau}\right)}{\Pr\left(Z_{i\tau} \mid \bar{Z}_{i\tau-1}, \bar{X}_{i\tau-1}^{TVC}, \bar{X}_{i\tau}\right)} \quad [5]$$

The use of stabilized weights increases IPTW efficiency without influencing its consistency (Hernan *et al.*, 2000).

Let T_1 denote the set of years in which the hotel received at least one subsidy and T_2 the set of years during which the hotel *i* receives no subsidies. The denominator of sw_{it} is then estimated as:

$$\prod_{t\in T_1} \hat{p}_{it}^{den} \prod_{t\in T_2} \left(1 - \hat{p}_{it}^{den}\right) \quad [6]$$

where $\hat{p}_{it}^{den}$ is the probability of being subsidised at time *t*, conditional on past treatment history and its past history of confounder variables. This probability are obtained by estimating a pooled cross-sectional logistic regression on the whole dataset as follows:

$$\hat{p}_{it}^{den} = \Pr\left(Z_{it} = 1\right) = \gamma_0 + \gamma_1 Z_{it-1} + \gamma_2 Z_{it-2} + \gamma_3 X_{it-1}^{TVC} + \gamma_4 X_{it} + \zeta_t \quad [7]$$

The numerator of sw_{it} is defined in a similar way, except that the time-varying confounders are omitted from the list of covariates in model (7).

3.1 The extended framework to account for the indirect effect

Although the use of MSM is a suitable way to cope with the problem of dynamic treatments, it does not solve the issue of the estimation of indirect effects. Overcoming this problem makes it necessary to relax the assumption of SUTVA, i.e. to allow subsidisation to interfere across units.

In particular, the potential outcomes of an hotel must be allowed to change when the treatment status of its neighbours changes.

The first step is that of providing a generalization of the potential outcomes. We follow Hong and Raudenbush (2006) and define Y as function of the treatment statuses of the units targeted by the policy: $Y_{it}(\mathrm{z}_t)$ where z_t is the vector of treatment status of the N units. In this setting, hotel i has 2^N potential outcomes, $Y_{it}(\mathrm{z}_t)$, corresponding to all possible treatment assignment combinations of N hotels. The effect of z_t on the hotel's potential outcome may be viewed as operating through z_{it} and a many-to-one function $v(\mathrm{z}_t)$ (Hong and Raudenbush, 2006). The N-dimensional space is thus reduced to a 2-dimensional space. Hence:

$$Y_{it}(\mathrm{z}_t) = Y_{it}(z_{it}, \mathrm{z}_{-it}) = Y_{it}[z_{it}, v(\mathrm{z}_{-it})]. \qquad [8]$$

We assume that each hotel's subsidy in a destination has the same effect on the potential outcome of hotel i. Hence, we define $v(\mathrm{z})$ as a function of the share of treated hotels in a destination. Formally, $v(\mathrm{z})$ is as follows:

$$v\left(\mathrm{z}_{-it}\right) = v = \begin{cases} 1 & \text{if } n^{-1}\left(\mathrm{z}_{-it}^{T}\mathrm{z}_{-it}\right) \geq Me \\ 0 & \text{otherwise} \end{cases} \qquad [9]$$

where Me is the median of the distribution of the intensity of treatment across destinations.

Therefore, the treatment become a binary treatment:

$$Y_{it}\left(z_{it}, v_{it}\right) \quad z_{it} \in \{0,1\},\ v_{it} \in \{0,1\} \qquad [10]$$

in each period t, a unit belongs to one of the following treatment status, depending on the treatment status (treated/non-treated) of the unit and the treatment status (high/low intensity of treatment) of its destination: ($Z_t = 1$, $V_t = 1$), ($Z_t = 1$, $V_t = 0$), ($Z_t = 0$, $V_t = 1$), e ($Z_t = 0$, $V_t = 0$). To each of these treatment status is associated a probability.

The aim is that of estimating the treatment effect on the outcome at time t, taking into account also the history of treatment at the destination level. Assuming linearity and additivity of the effects, the regression model to estimate is an augmented version of (3), where an additional term in introduced, which is linked to the history if treatment at the destination level:

$$y_{it} = \beta_0 + \beta_1^{'}X_{it} + \beta_2^{'}W_{it} + \delta g\left(\bar{Z}_{it}\right) + \lambda h\left(\bar{V}_{it}\right) + \varepsilon_{it} \qquad [11]$$

The identifying conditions are obtained by extending the SCIA to the 2-dimensional treatmemt (2-level SCIA).

$$Y\left(z_{it}, v_{it}\right) \perp\!\!\!\perp Z_{it}, V_{it} \mid \bar{Z}_{it-1}, \bar{V}_{it-1}, \bar{X}_{it-1}^{TVC}, \bar{W}_{it-1}^{TVC}, \bar{X}_{it}, \bar{W}_{it} \qquad [12]$$

Under 2-level SCIA, outcome and treatment are independent, given the treatment history at both unit and destination level and the history of TVC at unit (Z, X) and destination level (V, W), and the treatment effect is estimated by IPTW estimation where the system of weights represents the probability of following the actual history of treatment at the unit and the destination level. Formally, the stabilised weights are defined as follow:

$$sw_{it}^{2-level} = \prod_{\tau=0}^{t} \frac{\Pr\left(Z_{i\tau}, V_{i\tau} \mid \bar{Z}_{i\tau-1}, \bar{V}_{i\tau-1}, \bar{X}_{i\tau}, \bar{W}_{i\tau} \right)}{\Pr\left(Z_{i\tau}, V_{i\tau} \mid \bar{Z}_{i\tau-1}, \bar{V}_{i\tau-1}, \bar{X}_{i\tau-1}^{TVC}, \bar{W}_{i\tau-1}^{TVC}, \bar{X}_{i\tau}, \bar{W}_{i\tau} \right)} \qquad [13]$$

where $\bar{X}_{it}$ and $\bar{X}_{it}^{TVC}$ are hotel-level covariates and time-varying confounder histories up to time *t*, respectively. Similarly, $\bar{W}_{it}$ and $\bar{W}_{it}^{TVC}$ are destination-level covariates and time-varying confounder histories up to time *t*. respectively.

Following the laws of probability and after some algebraic manipulations, the stabilised weights can be rewritten as follows:

$$sw_{it}^{2-level} = \prod_{\tau=0}^{t} \frac{\Pr\left(V_{i\tau} \mid \bar{V}_{i\tau-1}, \bar{W}_{i\tau} \right) \times \Pr\left(V_{i\tau} \mid \bar{Z}_{i\tau-1}, \bar{V}_{i\tau-1}, \bar{X}_{i\tau}, \bar{W}_{i\tau} \right)}{\Pr\left(V_{i\tau} \mid \bar{V}_{i\tau-1}, \bar{W}_{i\tau-1}^{TVC}, \bar{W}_{i\tau} \right) \times \Pr\left(Z_{i\tau} \mid \bar{Z}_{i\tau-1}, \bar{V}_{i\tau-1}, \bar{X}_{i\tau-1}^{TVC}, \bar{W}_{i\tau-1}^{TVC}, \bar{X}_{i\tau}, \bar{W}_{i\tau} \right)} \qquad [14]$$

Each element in the denominator in (14) is the conditional probability that the hotel *i* received the *2*-dimensional treatment, which is composed by its own observed treatment (either subsidised or not-subsidised) and the aggregate treatment received by the other hotels within the destination (destinations with either high or low intensity of subsidisation) at time *t*. Moreover, each element is decomposed as the product of two probabilities. The first, $\hat{p}V_{jt}^{D} = \Pr\left(V_{i\tau} \mid \bar{V}_{i\tau-1}, \bar{W}_{i\tau-1}^{TVC}, \bar{W}_{i\tau} \right)$, is the probability that the destination where the hotel *i* is located received its own observed treatment (either high or low intensity of subsidisation) at time *t* conditional on its past treatment history and past history of destination level confounders; the second, $\hat{p}Z_{it}^{D} = \Pr\left(Z_{i\tau} \mid \bar{Z}_{i\tau-1}, \bar{V}_{i\tau-1}, \bar{X}_{i\tau-1}^{TVC}, \bar{W}_{i\tau-1}^{TVC}, \bar{X}_{i\tau}, \bar{W}_{i\tau} \right)$, is the probability that the hotel *i* received its own observed treatment (either subsidised or non-subsidised) at time *t* conditional on its own past treatment history and its past history of confounder variables, and the past treatment history and past history of destination confounders.

Table 1. Numerator and denominator for calculating stabilised weights.

Treatment status	*Numerator*	*Denominator*
(Z_t = 1, V_t = 1)	$\hat{p}Z_{it}^{N} \times \hat{p}V_{jt}^{N}$	$\hat{p}Z_{it}^{D} \times \hat{p}V_{jt}^{D}$
(Z_t = 1, V_t = 0)	$\hat{p}Z_{it}^{N} \times \left(1 - \hat{p}V_{jt}^{N}\right)$	$\hat{p}Z_{it}^{D} \times \left(1 - \hat{p}V_{jt}^{D}\right)$
(Z_t = 0, V_t = 1)	$\left(1 - \hat{p}Z_{it}^{N}\right) \times \hat{p}V_{jt}^{N}$	$\left(1 - \hat{p}Z_{it}^{D}\right) \times \hat{p}V_{jt}^{D}$
(Z_t = 0, V_t = 0)	$\left(1 - \hat{p}Z_{it}^{N}\right) \times \left(1 - \hat{p}V_{jt}^{N}\right)$	$\left(1 - \hat{p}Z_{it}^{D}\right) \times \left(1 - \hat{p}V_{jt}^{D}\right)$

Let T_1 be the set of periods in which the hotel received a subsidy in a destination with high intensity of treatment, T_2 the set of periods in which the hotel received a subsidy in a destination with low intensity of treatment, T_3 the set of periods in which it did not receive any subsidy in a destination with high intensity of treatment, and T_4 the set of periods in which it did not receive any subsidy in a destination with low intensity of treatment. The calculation

denominator and denominator for obtaining stabilised weights is reached by multiplying the quantities of interest at time t by their lagged values. Formally, for the denominator we have:

$$\prod_{t\in T_1} pZ_{it}^D \times pV_{jt}^D \prod_{t\in T_2} pZ_{it}^D \times \left(1-pV_{jt}^D\right) \prod_{t\in T_3} \left(1-pZ_{it}^D\right) \times pV_{jt}^D \prod_{t\in T_4} \left(1-pZ_{it}^D\right) \times \left(1-pV_{jt}^D\right) \quad [15]$$

The probabilities in the above equation were estimated through a logit models as follow:

$$\hat{p}V_{jt}^D = \Pr\left(V_{jt}=1\right) = \gamma_0 + \gamma_1 V_{jt-1} + \gamma_2 V_{jt-2} + \gamma_3 W_{jt-1}^{TVC} + \gamma_4 W_{jt} + \zeta_t \quad [16]$$

$$\hat{p}Z_{it}^D = \Pr\left(Z_{it}=1\right) = \gamma_0 + \sum_{q=1}^{2} \gamma_q Z_{it-q} \sum_{p=1}^{2} \varphi_p V_{jt-1} + \omega_1 X_{it-1}^{TVC} + \omega_2 X_{it} + \omega_3 W_{jt-1}^{TVC} + \omega_4 W_{jt} + \zeta_t \quad [17]$$

The numerator of $sw_{it}^{2-level}$ is defined in a similar way, except that one omits the time-varying confounders from the list of covariates.

In the end, the direct and indirect effects are obtained by estimating the regression model (11) by means of WLS estimation.

4. The case study: the policy, data and variables

The Trentino is an Alpine province in north-east Italy. The Province spans more than 14 tourist destinations with quite different environmental conditions. Differences among tourist districts are not only due to their endowment in natural resources, because they are community-type destinations (Beritelli et al., 2007), i.e., areas with a variety of autonomous tourist operators, in which destination marketing is managed by several local agencies *(Aziende di Promozione Turistica*). In these areas, hotels are the predominant tourism firms which play a fundamental role in achieving an overall destination image and increasing destination package tours.

4.1 The policy: Provincial Law 6/99

A distinguishing feature of the institutional setting is that firms operating in the province of Trento can apply only for subsidies awarded by the local government. In this setting, Provincial Law 6/99 (hereafter, PL6) provides guidelines on the economic incentives to firms operating in the province. It comprises a large set of incentive schemes which are meant to foster fixed investments, research and development expenditure, firm restructuring, the adoption of production processes to safeguard the environment, and re-location of firms within the province.

All firms operating in the province of Trento can apply for PL6 grants by submitting a project to the local authority. Although there is no deadline for submission during the calendar year, since a first-in-first-out criterion is used to assign financial resources, some firms may be refused once the budget is exhausted. There are two types of evaluation mechanism, basically determined by the magnitude of the investment: selective and automatic. Through the selective mechanism, once a hotel applies for a grant, its application is examined for its economic

viability and financial sustainability. Only if the project receives a positive assessment can it be co-financed by the local government. Instead, automatic subsidies are granted only after examination of applications.

4.2 Database

We relied on several sources to construct the database. Administrative archives, held by the local government, are the primary source of information on hotels receiving grants. In particular, primary data on firms' applications for public subsidies come from the APIAE (*Agenzia provinciale per l'incentivazione attività economiche*), the administrative body that manages the subsidisation programme on behalf of the local government. The APIAE archives (DBApiae database) allowed us to recover all the applications (2774) filed from 1999 to 2011 concerning tourism-related industries: accommodation (hotels, camp-sites, etc.), restaurants, travel agencies and other recreational activities. For each application it was possible to retrieve information on: name of the applicant (ragione sociale), tax code, address of the applicant (sede lagale), description of economic activity, date of submission and of assessment/approval of application, type of subsidization procedure (selective or automatic), final outcome of the application assessment (obtained, rejected, other outcomes). We consider subsidies granted through both selective and automatic procedure.

Data collected through subsidy applications are not sufficient for conducting an impact evaluation, mainly because they do not comprise information on firm characteristics and their financial performance. In our context, only about 15% of hotels are limited liability firms. In fact, only limited liability firms are obliged to make publicly available their annual balance sheet, the main source of information at firm level. Therefore, in order to obtain information on hotels in the province we could not rely on publicly available databases.

We overcome this limitations using the DBhotelTN database, an extensive repertoire built in partnership with the Statistical Office of the Trentino province and already used in previous analysis of the hotel sector in the Trentino province (see Corsino et al., 2011). The database contains information on hotel characteristics (e.g., revenue and cost figures, legal form, structural characteristics, location, etc.) for a representative sample of the population of hotels operating in the province. Because of constraints on the time span over which hotel-level data are available in the DBhotelTN database, we focus our analyses on the period from 2002 to 2006. The final database (BDevalHTN) contains data for 426 subsidised and 410 non subsidised hotels over the period 2002-2006.

The hotels can receive one or more subsidy during the observed period (2002-2006). Figure 2 plots the distribution of number of subsidies for the hotels in our sample.

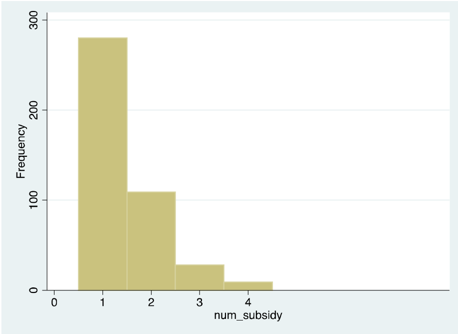

Figure 2 Subsidies for hotel in the DBevalHTN database

The figure shows that most of the treated hotels received one subsidy throughout the observed period. However, the number of hotels which obtained two or three was not negligible. In a few cases, more than three subsidies were even granted. In the final database we consider also 372 non-subsidised hotels.[4]

4.3 Outcome variables

Mapping the expected effects of public subsidies with observed variables, which properly measure firm outcome, is not always straightforward. Competitiveness is ultimately related to the perceived quality of services and goods, and to how resources and competences are combined to produce them. At firm level, as far as subsidies to physical capital investment are concerned, productivity growth is one of the most direct outcomes studied (Bergstrom, 2000; Harris and Trainor, 2005; Skuras et al., 2006; Tzelepis and Skuras, 2004; Bernini and Pellegrini 2011). In tourism, the effective and efficient use of available resources is a major concern in establishing, raising and sustaining the competitiveness of tourist firms and destinations (Tsai et al., 2009), so that hotel productivity is the preferred measure of hotel competitiveness.

We used several measures of hotel productivity. Labour productivity, measured as the ratio of total deflated revenue to total employment (*lab_prod*). A second proxy of labour productivity was obtained as the ratio of value added to total employment (*lab_prod_2*). Moreover, we consider the occupancy rate (*occ_rate*), defined as the ratio of total guest nights spent in a year to the number of beds available, multiplied by the number of days the hotel was operative. The occupancy rate is an index of the hotel's level of activity. This measure has the advantage of being widely used among hotels. It is also regarded as a performance indicator in the hotel industry (Orfila-Sintes and Mattsson, 2009; Sainaghi, 2010) and performance heterogeneity among hotels stems from the different ability of hotels to transform a given capacity into sold nights and services (Yu and Lee, 2009). Finally, the revenue per available room (*revpar*), obtained as the ratio of the (deflated) yearly revenue to the number of rooms,

[4] We do not consider non-subsidised hotels that show very low propensity to invest, i.e. we discarded those non-subsidised hotels with negative changes of amortization cost on tangible assets over the entire period under analysis.

multiplied by the number of days the hotel was operative; it is considered as a proxy of capital productivity and is widely used as measure of performance in the hotel industry.

A desirable complementary aim of a public policy should be that of achieving sustainable growth (Schwab, 2012). As argued by scholars in this field (Ritchie and Crouch, 2000), the competitiveness of tourist destinations is in fact illusory without sustainability. Smoothing demand variability over time (i.e., reducing seasonality), especially when tourist demand increases, is one of the main challenges in achieving the policy objective of overall sustainability in this sector (see, for instance, the "Agenda for a sustainable and competitive European tourism", Commission of the European Communities, 2007). As the hotel industry faces high fixed costs, which make the occupancy break-even level quite high, demand fluctuation becomes very problematic for hotel management. Hotels can partly benefit from destination management policies aimed at promoting the destination by adding new services or attractions during off-peak seasons (Baum and Hagen, 1999). Despite this, hotels which invest in renewing their buildings still face challenges of increased capital intensity. Therefore, receiving subsidies is linked to reduced demand variability, to the extent that the investment increases the attractiveness of the hotel during off-peak months, allowing better use of installed capacity. We use a measure of variability of the level of activity over time (*occ_var*), defined as the coefficient of variation of the number of monthly arrivals over the year. An increase in this variable (i.e., increased demand variability) may be highly detrimental for service firms (Morikawa, 2012).

4.4 Covariates: Confounders and exogenous variables

We consider the following set of confounders. The legal form, which indicates the attitude of the firm towards risk and also the chance of entering public subsidisation programmes (Almus and Czarnitzki, 2003). By using a limited liability legal form, for instance, owners can minimise their risk up to a certain amount and thus have higher incentives to pursue more risky projects. In addition, legal forms may signal the varying quality of firms. Hence, we used a categorical variable *legal_form* , which classifies hotels into sole proprietorship, partnership, and limited liability forms. Both different levels of subsidies and different performance may depend on firm size. Firm size is also a useful predictor of financial constraints (Hadlock and Pierce, 2010), and the capacity of receiving external finance (e.g., bank loans) is correlated with firm size. In accordance with the literature on hotels (De Jorge and Suárez, 2013), we used hotel size (*size*) as a proxy for the number of available beds. Hotel category indicates the level and complexity of services provided. Higher categories comprise more services, equipment complexities and organisational aspects. In our context, hotel category is informative about the "type" of hotelier. In fact there is a sharp polarization of the distribution of "active" and "passive" entrepreneurs across hotel categories: only 7% to 12% of active entrepreneurs belong to 1 and 2 star categories, while only 8% to 12 % of passive entrepreneurs belong to 3 and 4 stars categories (see PAT – Servizio Statistica, 2006). Category cross-comparison can thus explain an important part of the unobserved differences in entrepreneurial behaviour and hotel performance. We defined a variable (*category*) with two values: high for

three- and four-star hotels, and low for one- and two-star ones. Hotels which are attractive to international tourists are expected to be more productive (Assaf and Cvelbar, 2011). The international trade literature also supports this claim, arguing that rms which can sell their products to foreign customers are more productive than domestically oriented ones. Hotels operating in foreign markets are also able to generate new knowledge from international tourists and may be more interested in restructuring and improving their equipment and facilities than hotels mainly operating in the domestic market. A high percentage of international sales may also be considered as an indirect measure of quality of management and employment: hosting foreign customers requires higher skills and competences (e.g., knowledge of foreign languages). We defined a measure of internationalisation (*int*) for each hotel as the ratio of the number of nights spent by foreign guests to the total number of nights over the year. Hotels may have different investing propensity as well as profitability. Firms with smaller capital intensity are expected to have smaller 'operating leverage', and therefore smaller volatility of earnings, given the same demand fluctuations (Lev, 1983; Baginski et al, 1999). We used as a proxy of capital intensity (*cap*), the ratio of amortisation of tangible capital to revenue (Baginski et al, 1999; Cheng, 2005; Asthana and Zhang, 2006).

Moreover, we consider also set of exogenous variables. It is reasonable to consider that proximity to physical and natural amenities makes hotels differently attractive to tourists. We used a measure of "proximity" (*prox*), so that the impact of attraction points decreases with distance from the hotel, like the market-potential function (Harris, 1954). As attraction points we considered ski areas, touristic lakes and well-known beauty spots. Formally, our measure of market potential was defined as the decreasing function of the distance from the selected attraction points, as follows:

$$prox_i = \sum_{j=1,\dots,n} \left[d_{ij} \right]^{-1} \qquad [18]$$

where d_{ij} is the (Euclidean) distance between hotel *i* and attraction point *j*, $j = 1,\dots,n$. Co-location may affect hotel performance as well as hotel managers' choice to apply for subsidies. Co-location may provide opportunities for frequent interactions, exchanges of information among hotel managers and reduced monitoring costs (Gan and Hernandez, 2011). As a consequence, co-location may increase the chances that hotel behaviour, with respect to subsidy opportunities, may be influenced by other existing hotels which are planning to apply for subsidies. We controlled for the co-location effect by using an index (*co_loc*), which is a decreasing function of the distance of a hotel from all other hotels (as in the case of the *prox* variable):

$$co-loc_i = \sum_{j=1,\dots,m} \left[q_{ij} \right]^{-1} \qquad [19]$$

where q_{ij} is the (Euclidean) distance between hotel i and hotel *j*, $j = 1,\dots,m$.

5. Results

This section reports the results of estimating model (11). We considered time-variant confounders to be the pre-treatment value of the hotel size (*size*), capital intensity index (*cap_int*), legal form (*legal_form*), hotel category (*cat*) and degree of internationalization (*int*). As control variables in the outcome model we considered the co-location index (*co_loc*), proximity index (*prox*), contemporaneous category, legal form, size, internationalization, and capital intensity. Variables at level 2 (i.e. at destination level) may be cluster level variables or cluster aggregates of individual level variables (Hong and Raudenbush, 2006). Here, we used the aggregate value of hotel-level variables at the destination level. In particular, as time varying-confounders we used the aggregated nights spent, the aggregated revenue, the aggregated employment, and the average touristic rate of the destination. As control variables we used the total amount of beds, the average proximity of hotels to attraction points and the average distance among hotels in the destinations. The analysis was carried out on the several outcome variables defined in section 4.3, i.e., the varying level of capacity utilisation (*occ_var*), average occupation rate (*occ_ratio*), revenue per available room (*revpar*), and the two proxies of labour productivity (*lab_prod* and *lab_prod_2*). Results were obtained under two parameterisations of functions $g(\cdot)$ and $h(\cdot)$ for each outcome variable considered.

The interpretation of is the average direct effect of the receipt of a subsidy on hotel outcome, s represent the indirect average effect on hotel outcome linked to belonging to a touristic destination with high instead of low intensity of subsidization. Therefore, if the value of s differs from zero, violation of SUTVA is indicated. In particular, positive values of would be consistent with the hypothesis of positive externality, meaning that the hotels enjoy the positive externalities stemming from being located in a destination, the quality and attractiveness of which is increased by the public subsidisation policy. In this case, hotels enjoy the benefits due to the overall increased quality of the destination even without improving their own quality. Instead, negative values of are consistent with the hypothesis that subsidization activates competition among hotels and negative externalities are generated.

Table 3 lists the results when parameterisation 1 of both functions $g(\cdot)$ and $h(\cdot)$ is applied. In this case, it is only the cumulative subsidisation which is assumed to play a role. The direct effect of subsidies is still positive and significant. Likewise, there is evidence of SUTVA violation consistent with the competition hypothesis, according to which subsidisation has indirect negative effects.

Table 3. Weighted least square estimates, parameterisation 1

Variables	*Treatment history parameterisation*		*occ_var*	*occ_ratio*	*revpar*	*lab_prod*	*lab_prod_2*
g(Z)	$\delta(Z_t+Z_{t-1}+Z_{t-2})$						
		(δ)	-0.081***	0.039***	5.205***	1,098.480	608.719
			(0.019)	(0.007)	(0.811)	(1,135.456)	(575.548)
h(V)	$\lambda(V_t+V_{t-1}+V_{t-2})$						
		(λ)	0.034*	-0.019**	-1.718**	-729.757	-174.052
			(0.020)	(0.008)	(0.871)	(1,220.335)	(618.572)
Controls							
co-loc			0.004	0.001	-0.202	-297.484	-59.890
			(0.003)	(0.001)	(0.134)	(187.479)	(95.031)
prox			0.071	0.036*	3.622*	3,982.847	3,947.330***
			(0.049)	(0.019)	(2.050)	(2,870.403)	(1,454.970)
Legal_form_2			-0.130***	0.042***	5.926***	5,645.511***	1,926.547**
			(0.029)	(0.011)	(1.200)	(1,680.105)	(851.623)
Legal_form_3			-0.040	0.074***	15.408***	9,795.078***	3,070.663**
			(0.044)	(0.017)	(1.844)	(2,582.132)	(1,308.849)
cat			-0.149***	0.059***	5.094***	7,073.073***	3,366.029***
			(0.031)	(0.012)	(1.282)	(1,794.543)	(909.631)
size			-0.016	0.027***	-1.978*	3,356.654**	3,670.209***
			(0.026)	(0.010)	(1.081)	(1,513.446)	(767.146)
ext			-0.054	0.055**	-6.298***	-1,092.897	146.158
			(0.058)	(0.022)	(2.397)	(3,356.775)	(1,701.505)
cap			0.264**	-0.160***	-19.103***	9,548.197	12,783.280***
			(0.117)	(0.045)	(4.880)	(6,833.681)	(3,463.903)
tot_beds			-0.000***	0.000***	0.001***	0.857**	0.976***
			(0.000)	(0.000)	(0.000)	(0.391)	(0.198)
ave_attr			-0.106	-0.129**	1.622	6,495.994	5,713.596
			(0.133)	(0.050)	(5.526)	(7,738.465)	(3,922.527)
ave_alb			-0.017	0.024***	1.170	-1,576.950	-909.040
			(0.022)	(0.009)	(0.935)	(1,309.071)	(663.551)
ave_tur			0.220***	-0.007	-6.564**	2,789.114	-1,237.334
			(0.067)	(0.025)	(2.789)	(3,905.761)	(1,979.779)
Observations			798	798	798	798	798
R-squared			0.147	0.336	0.249	0.142	0.234
R_adj			0.132	0.324	0.236	0.127	0.221
F			9.639	28.30	18.58	9.287	17.11

Estimated coefficients when parameterisation 2 is assumed are listed in table 4. Now $_1$ represents the contemporaneous effect on the hotel outcome of belonging to a destination where a high proportion of hotels receive subsidies, $_2$ represents the additive indirect effect of the hotel being in a context with high intensity of subsidization during the year prior to outcome evaluation, and $_3$ has the same meaning, but when two time lags are considered.

Table 4. Weighted least square estimates, parameterisation 2

Variables	*Treatment history parameterization*		*occ_var*	*occ_ratio*	*revpar*	*lab_prod*	*lab_prod_2*
g(Z)	$\delta_1 Z_t+\delta_2 Z_{t-1}+\delta_3 Z_{t-2}$						
		(δ_1)	-0.019	0.039***	5.279***	338.961	503.717
			(0.035)	(0.013)	(1.463)	(2,055.437)	(1,040.697)
		(δ_2)	-0.119***	0.036***	5.019***	1,752.395	874.968
			(0.033)	(0.013)	(1.391)	(1,954.737)	(989.711)
		(δ_3)	-0.105***	0.043***	5.424***	1,217.246	454.374
			(0.034)	(0.013)	(1.409)	(1,978.697)	(1,001.843)
h(V)	$\lambda_1 V_t+\lambda_2 V_{t-1}+\lambda_3 V_{t-2}$						
		(λ_1)	-0.087**	0.045***	1.761	1,395.224	490.217
			(0.041)	(0.016)	(1.725)	(2,423.160)	(1,226.881)
		(λ_2)	0.033	0.007	-2.684	-2,681.575	-1,942.913*
			(0.039)	(0.015)	(1.641)	(2,305.189)	(1,167.150)
		(λ_3)	0.125***	-0.065***	-4.383***	-2,504.492	-825.611
			(0.033)	(0.013)	(1.389)	(1,951.464)	(988.054)
Controls							
co-loc			0.004	0.001	-0.216	-315.163*	-72.454
			(0.003)	(0.001)	(0.134)	(187.943)	(95.158)
prox			0.068	0.035*	3.501*	3,957.926	3,893.919***
			(0.049)	(0.019)	(2.049)	(2,877.748)	(1,457.045)
Legal_form_2			-0.110***	0.032***	5.408***	5,353.317***	1,869.987**
			(0.029)	(0.011)	(1.223)	(1,717.399)	(869.544)
Legal_form_3			-0.031	0.065***	15.207***	9,916.745***	3,270.803**
			(0.044)	(0.017)	(1.861)	(2,613.887)	(1,323.448)
cat			-0.147***	0.055***	5.057***	7,126.378***	3,435.639***
			(0.031)	(0.012)	(1.288)	(1,809.163)	(916.005)
size			-0.014	0.028***	-1.985*	3,320.082**	3,648.710***
			(0.026)	(0.010)	(1.078)	(1,515.024)	(767.078)
ext			-0.111*	0.079***	-4.319*	477.906	972.710
			(0.060)	(0.023)	(2.494)	(3,503.377)	(1,773.810)
cap			0.269**	-0.159***	-18.962***	9,513.090	12,781.818***
			(0.116)	(0.044)	(4.876)	(6,850.025)	(3,468.265)
tot_beds			-0.000**	0.000***	0.001***	0.675*	0.856***
			(0.000)	(0.000)	(0.000)	(0.406)	(0.206)
ave_attr			-0.080	-0.067	-1.940	380.025	473.900
			(0.162)	(0.061)	(6.767)	(9,506.790)	(4,813.423)
ave_alb			0.002	0.005	0.928	-1,294.442	-459.882
			(0.026)	(0.010)	(1.088)	(1,528.437)	(773.870)
ave_tur			0.164**	0.029	-5.088*	3,391.988	-1,272.604
			(0.070)	(0.026)	(2.911)	(4,089.850)	(2,070.749)
Observations			798	798	798	798	798
R-squared			0.164	0.355	0.257	0.146	0.239
R_adj			0.145	0.340	0.240	0.126	0.222
F			8.510	23.83	14.99	7.391	14.00.00

The results indicate that the contemporaneous (i.e. at time *t*) indirect effect of being in a destination where many instead of few hotels in are subsidized is positive and statistically significant when *occ_var* and *occ_ratio* are considered as outcomes, and is positive but not statistically significant for the other outcomes. This evidence is consistent with the hypothesis that the policy activates a process of quality improvement which generates positive externalities. However, the additional effect attributable to past exposure at time *t-1* to high density of

subsidization is in general lower than the contemporaneous one. This effect become negative, and for *occ_var*, *occ_ratio*, and *revpar* also statistically significant, at time *t*-2. Moreover, the magnitude of $_3$ generally more than counterbalances the positive direct effect ($_3$) on hotel outcomes, leading to a negative net effect of subsidization at time *t*-2. Instead, for *revpar*, the net effect is positive.

In summary, it seems that the policy had a positive direct impact on hotel outcomes. The only exception is for labour productivity, in which the sign of the causal parameter is positive but not statistically significant. Less clear is the effect due to potential externalities generated by the different intensity of subsidization of hotel's neighbours in the destination. However, the trend of the indirect effect over time, which is negative at time *t-2* and positive at *t*, is consistent with a process in which the policy first increases competition among hotels, but after generates positive externalities consistent with the increased attractiveness of destinations.

6. Concluding remarks

Whether or not industrial public policies have an effect on private firm performance and eventually on aggregate economic growth is still an open question. The main purpose of this paper was to contribute to the debate on public policy effectiveness by assessing the direct as well as the indirect effect of capital subsidies on firms' performance, especially micro and small firms in the hotel industry.

Evaluation with non-experimental data usually relies on two critical assumptions: the similarity of treated and control units (except for their treatment status; the Conditional Independence Assumption), and no interference between unit outcomes, i.e., an individual's outcome should not depend on other individuals' treatment status (the SUTVA assumption). However, the most important consequence of the SUTVA assumption was that, if the policy generates externalities, their effect on hotel performance cannot be measured. We tackled this issue by defining a new estimation framework which allowed for interference between hotels in the dynamic treatment setting. We found that SUTVA may be violated, since a hotel's potential outcomes depend on whether many or few hotels in its own destination are subsidised. In particular, when the proportion of subsidised firms is high, the effect on the potential outcomes of the focal hotel is negative, consistent with increased competition within destinations.

Some final remarks are necessary. The use of a dichotomous variable to measure the indirect effect of the policy has some limitations. For instance, it can lead to considering as equivalent a destination with treated firms only and a destination with a treated/non-treated ratio slightly above the median. In future works, the framework could be improved by considering continuous variable. Also, it remains open the issue of how to separate the effect due to spatial proximity of the hotels from the spillover effect associated with the subsidies. What should be done is then to clearly identify the net spatial effect of subsides considering spillover effect that cannot be attributed to policy intervention (see e.g. De Castris and Pellegrini, 2012). Lastly, the analysis showed that the effect of time seems to be important: the longer is the period after which the effect is evaluated, the higher is the effect observed. In this regard widening the time-span of the analysis would be beneficial.

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