UNIVERSITÀ
DI SIENA
1240

**QUADERNI DEL DIPARTIMENTO**
**DI ECONOMIA POLITICA E STATISTICA**

**Emanuele Ciani**
**Guido de Blasio**
**Samuele Poy**

# A Freeway to Prosperity?
# Evidence from Calabria, South of Italy

**n. 820 – Febbraio 2020**

# A Freeway to Prosperity? Evidence from Calabria, South of Italy*

Emanuele Ciani,[a†] Guido de Blasio,[a] and Samuele Poy[b]

[a] Bank of Italy, Structural Economic Analysis Directorate, Rome, Italy

[b] LSA- Catholic University of Milan, Italy; IRES Piemonte, Turin, Italy; and University of Piemonte Orientale, Novara, Italy.

February 10, 2020

*ABSTRACT*

This paper investigates the impact of the freeway "Salerno-Reggio Calabria" on long-term local economic development. Built between 1962 and 1974, the freeway connected the southernmost region of the Italian peninsula (Calabria) to the national highway network. According to the original plan, the freeway could have been built along three different routes. The final choice was mostly influenced by powerful politicians who lobbied in favor of the path crossing their constituency (the town of Cosenza). In a dif-in-dif framework, we compare the growth of "inconsequentially" treated municipalities – traversed only because they lie on the route connecting Cosenza – with the one of municipalities on the two discarded paths. Our results suggest that the freeway caused a significant reorganization of both economic activity and population from untreated to treated locations. At the same time, the infrastructure does not seem to have helped the convergence of the overall region.

*JEL*: H54, R12, R42

*Keywords*: highways, transport infrastructure, local development

* We thank Leandra D'Antone, Marco Percoco, Francesco Ramella, and participants at the AREUEA conference (Milan, June 2019), the AIEL annual scientific conference (Novara, September 2019), and the AISRe annual scientific conference (L'Aquila, September 2019) for suggestions and comments. We also thank Stephan Huber and Christoph Rust for helping us with the calculation of travel distances and the *Centro di documentazione* of Milan Touring Club for granting us access to historical highway atlas. The views expressed in this paper are those of the authors and do not necessarily correspond to those of the Institutions they are affiliated.

† Corresponding author: emanuele.ciani@bancaditalia.it

*"After XXI centuries the road that Rome opened to unite the people of the South reopened today on the ancient footsteps from Salerno to Reggio Calabria to continue and complete the great route of traffic and work between the North and the South of Italy"*

Plaque set at the start of the Salerno-Reggio Calabria freeway

## 1. Introduction

While the commonsense suggests that transport infrastructures are a driver of growth, the impact of these investments on local development is far from being established.[1] The construction of new infrastructures influences not only the level of economic activity but also the distribution of firms and workers across space. For instance, high-speed highways may favor the decentralization of economic activity (Baum-Snow and Turner, 2017), but also disadvantage the most remote locations (Baum-Snow et al., 2019). More in general, the increased production around the new logistic nodes may come at the expenses of areas that become their periphery (Redding and Turner, 2015).

In this paper, we contribute to the literature on the impact of highways on economic activity by studying the long-term economic effects (over four decades) of the A3 freeway in Calabria (Italy). The freeway, which connected Salerno (South of Naples) to Reggio Calabria (on the Tyrrhenian coast in front of Sicily), was mostly built between 1962 and 1974, although part of it was completed only later on. Its construction was a radical change for Calabria, which is a small region at the southernmost point of the Italian peninsula. Calabria is the least developed region in Italy and one of the priority regions for the European Cohesion Policy since its start. It is therefore a suitable case study to understand the role of infrastructures in driving convergence.

To obtain credible estimates of the local effects of the freeway, we exploit the fact that according to the original plan the freeway could have been built along three different routes: on the Tyrrhenian coast, on the Ionic coast, or along the center of the region (Figure 1). The last one was chosen because of political pressure by very influential members of parliament

[1] As highlighted by Duranton and Venables (2018, p. 16): "No one would doubt that a completely isolated place will be poor, or that most rich places are well connected. But it does not follow from these observations that all well-connected places are rich or that improving connectivity necessarily bring developments."

elected in the local jurisdiction of Cosenza (see D'Antone, 2008). Because of the physical geography of the area, the three alternatives were the only possible routes. Apart from these three corridors, the region includes mountainous and rugged sites, which are implausible controls as they would have been excluded anyway by the transition to a modern economy between 1951 and 2001. On the contrary, the municipalities around the two discarded alternatives constitute a reasonable control group.

[Figure 1 approximately here]

Although the final route was the consequence of political pressure, the main motivation was to force the freeway to pass from Cosenza. The other municipalities on this route benefitted from being located along the only solution that included Cosenza. In a dif-in-dif framework, we compare employment and population growth in these municipalities with the growth in municipalities on the discarded paths. Our identification strategy holds under the parallel trends assumption that treated and control municipalities would have experienced a similar growth in the absence of the infrastructure. Since selection into treatment is driven by the lobbying of politicians from Cosenza, the effect of the selection bias on the treated is differentiated away by excluding Cosenza from the treated group (inconsequential units approach; see Chandra and Thompson, 2000). By the same token, our controls were the concrete alternatives to the route crossing Cosenza. Without the political pressures, they would have had the same chances as the treated of being located along to freeway.

Our investigation has a long-term perspective. We are able to look at what happens to local economic development over four decades from the opening of the freeway. In doing so, we are facilitated by the sluggishness of the modernization of the overall road network in Calabria (Costa and Mauro, 2005), which includes, beyond the freeway, state and provincial roads. With some exceptions, which we inspect in the sensitivity analysis, the network in place around the middle 1970s is still the one operating nowadays.

Importantly, we try to understand the extent to which the freeway caused a simple re-organization of economic activity or net benefits for the overall area. To this aim, we experiment using different samples of remote controls; that is, units not exposed to the local re-allocation of firms and workers. We select them from other Southern regions, which display pre-trends in economic activity and possibly post-1970s evolutions comparable to those of Calabria. Our results suggest relevant displacement effects in private employment (more

intense for tradables than non-tradables) and population. We also fail to find evidence that the freeway helped Calabria to converge towards more developed areas of Italy.

The paper is structured as follows. In Section 2 we discuss our identification strategy with regards to previous related literature. Section 3 provides the historical accounts referring to the beginning of the 1960s, when it was decided where to locate the Salerno-Reggio Calabria freeway. Section 4 introduces our identification strategy and presents the data. Section 5 describes the results. The final section discusses implications and caveats of our empirical investigation.

## 2. Comparisons with previous literature

The role of transport infrastructures in shaping local development and the growth of cities has been widely recognized. Some firms can benefit from a reduction in transportation costs, which allows them to access new markets and locations. At the same time, local businesses may be harmed by the increased competition from more developed places, where agglomeration externalities and/or productivity advantages are stronger. Changes in economic activity and transportation costs influence also population dynamics, through a reduction in commuting costs. More in general, the theory predicts that the impact of infrastructures on local growth depends on the complex interaction between transportation costs, local productivity and agglomeration forces. The prediction is therefore ambiguous and empirical evidence is crucial in evaluating single interventions.

Redding and Turner (2015) provide a comprehensive review of the empirical literature and note that, in most cases, population and economic activity tend to concentrate in the proximity of highways and railroads. However, the authors also underscore that people are likely to react differently than businesses and that firm responses are quite heterogeneous across sectors. On a similar note, Duranton and Venables (2018) highlight that no consensus has emerged as for the impact of transport improvements on local economic outcomes, because estimates vary by a big deal according to the context under analysis. Both papers stress the importance of disentangling displacement from net growth, which can be done only imposing additional identification assumptions.[2]

[2] At the macro level, Holmgren and Merkel (2017) provide a meta-analysis of 776 estimates and find that the average effect of infrastructures on economic growth is very close to zero.

Informed by the previous literature, we look at a number of local outcomes that refer to both population and private employment. As for the latter, we provide a breakdown of sectoral reactions, distinguishing tradable from non-tradable sectors and also highlighting the role of industries, such as transportation, more directly exposed to the road improvements. Finally, we provide some (admittedly suggestive) comparisons intended to shed light on whether the freeway caused displacement (re-organization) or net growth.

Studies of the effect of transport infrastructures are plagued by selection issues, because new infrastructures typically target specific areas, which are not randomly selected. The empirical literature has suggested two main solutions. The first consists of using planned or historical routes as an instrument for the actual/current transport infrastructures. The main underlying assumption of this strategy is that plans and historical paths are orthogonal to the characteristics that influence current economic activity, because they were designed to suit specific purposes (e.g. military) or old abandoned trade routes. Among the first to use this approach, Baum-Snow (2007) instruments the current US highway network with a 1947 plan, and finds that highway development caused a decline in central city population.[3] Other scholars have elaborated on historical routes. For instance, Duranton and Turner (2011), Duranton and Turner (2012) and Duranton et al. (2014) instrument access to interstate highways opened in 1983 in US with the 1947 routes of the interstate highway system and the 1898 railroads.[4] Closely related to the focus of this paper, Percoco (2016) evaluates the long run effects of the highways opened in Italy in the aftermath of World War II on employment and population dynamics. The author uses historical Roman roads to instrument for post-WWII Italian highway network.[5] His findings suggest a positive impact of highway proximity on local employment, particularly in the transport service and transport-intensive sectors. Noticeably, Percoco excludes Calabria from his analysis for the absence of relevant data for his estimation strategy.

The second solution, pioneered by Chandra and Thompson (2000), deals with selection issues by adopting an inconsequential units approach. This strategy exploits the fact that some

[3] Similar identification strategies are used by Michaels et al. (2012) for the US highways, Hsu and Zhang (2014) for expressways in Japan, Mayer and Trevien (2017) for France railways, Donaldson (2018) for the Indian railroad network, and Möller and Zierer (2018) for the German "autobahn" infrastructure.

[4] A similar approach is used by Baum-Snow et al. (2017) for urban railroad and highways in China and by Martincus et al. (2017) for Peru (using pre-Columbian Inca roads).

[5] Similarly, Garcia-Lopez et al. (2015) and Holl (2016) exploit historical Roman roads as instrument for highways improvements in Spain.

locations end up being served by the infrastructure only because they accidentally lie on a route linking places that "have to" be connected for some (admittedly endogenous) motives, for instance because they are hubs of economic activities. The underlying assumption is that these locations are essentially similar to other areas that are not served by the infrastructure, and therefore they would have been developed similarly in the absence of the new transportation network. Examples of this identification strategy can be found in Banerjee et al. (2012), Datta (2012), Faber (2014), and Ghani et al. (2014).

In our paper we combine the two approaches. We start from planned routes, but we argue that, in our context, it is hard to assume that the original freeway plans were orthogonal to characteristics that influenced modern development. Indeed, all the three planned routes comprised only municipalities that were easier to access in the extremely rugged Calabrian surface. In fact, as we will show later, the municipalities along the discarded routes are more similar to those on the freeway than those locations that were never included in the plans. Although the selection of the final route was far from being random, we exploit the fact that it was driven by the political desire to make it pass from the town of Cosenza. Hence, following an "inconsequential units" approach, we exclude the local labor market of Cosenza, and compare municipalities that ended up being close to the freeway (only because they were on the route passing from Cosenza) with other municipalities along the planned routes.

## 3. The history of the freeway

This Section describes the main historical events related to the construction of the A3 "Salerno-Reggio Calabria". We concentrate on the aspects most relevant for the empirical analysis we propose below. A comprehensive historical scrutiny can be found in D'Antone (2008).

At the beginning of the 1950s a pressing concern of the Italian Government was that of connecting the North of the country with the less developed areas of the South. The Government had the ambition of making more progress than that achieved by railroads during the previous century. In this perspective, the highways were considered strategic public investments, also in connection with the government support granted to the largest Italian firm, i.e. FIAT, a car maker. As reported by historians (Castronovo, 1995; Ginsborg, 1989), the picture that best describes the Italian economic miracle of the 1950s and the 1960s is a highway full of small cars made by FIAT. The most important highway built in Italy in the aftermath of the World War II, the highway A1 "Autostrada del Sole", was originally intended to longitudinally connect Milan (the most developed city in the North of Italy) with the very end

of the peninsula. However, the A1 initially stopped in Naples, only 230 km south of Rome. Later on, in 1961, the Parliament finally approved the realization of a road infrastructure connecting Salerno (which had a highway connection with Naples since 1866) to Reggio Calabria. Since the aim was to enhance local development in the lagging part of the country, the access was kept free of charge (freeway). The cost of the freeway was entirely loaded on the public budget and the management of the infrastructure was reserved to a public agency (ANAS).

According to the original project, prepared by Prof. Ruiz from the University of Bari (Ruiz, 1962), the path connecting Salerno with the beginning of the Calabria followed the physical geography of the area, favoring the plain terrains (Valle del Sele, Valle del Tanagro, Vallo di Diano) at the expenses of mountainous and rugged areas. Crucially, from the section between Laino Borgo and Reggio Calabria (Figure 1) three different alternatives were envisaged. The one on the Tyrrhenian coast was the shortest one (shorter than 35 km with respect to the inner one), while that on the Ionic coast was the longest. Considering the physical characteristics of the terrains, the central path would have been the most expensive one due to the need of building tunnels and viaducts. As extensively documented (D'Antone 2008; Federazione Italiana della Strada, 1961), no cost-benefit analysis was even attempted to decide which route to select. All the local communities located along the three potential routes tried to lobby for having the infrastructure close to them. Obviously, all the local contenders tried to argue that the overall economic prospects of the Calabria and the surrounding regions were better served by the freeway crossing their areas. A bunch of other arguments were also proposed, ranging from the spectacular view that a driver could enjoy on the Ionic side or the historical value of picking the central path (Hannibal, the Carthaginian army general, chose the central corridor to conduct the operations that led to the occupation of Southern Italy in the second Punic War, 218-204 BC).

As widely recognized (D'Antone, 2008, p. 64), the key reason why the median lane was chosen was that of providing the town of Cosenza with the freeway. Cosenza was the hometown and constituency of two very powerful politicians: the socialist Giacomo Mancini and the Christian democratic Riccardo Misasi. Mancini, in particular, former MP and regional secretary of the Socialist party, was a prominent member of the national administration since 1963 (Ministry of Health, then Ministry of Public Works and President of the ANAS from 1964 to 1969, and finally as Ministry for the South of Italy in 1974).

The construction of the freeway started in 1962.[6] After 5 years only the initial tract, from Salerno to Lagonegro (still in the nearby region of Basilicata), was opened to the public. In 1968 also the section until Cosenza (in Calabria) was opened, followed one year later by the tract reaching Gioia Tauro (in the south of Calabria, almost 50 km from Reggio Calabria). Finally, the entire freeway until Reggio Calabria was completed in 1974. At the end of the nineties the government launched an investment plan aimed at improving the freeway, which however took almost two decades to be carried out.

## 4. Empirical specification and data

In the empirical investigation we exploit the historical events described in Sect. 2, and compare the municipalities that happen to be located on the route of the freeway – because Cosenza was the constituency of politicians Mancini and Misasi – with those located on the two discarded paths. In our preferred sample, we exclude the LLM (local labor market) of Cosenza from the sample of treated units, because other benefits might have accrued to its residents due to political patronage. For the remaining municipalities on the central path, it seems quite hard to argue that some of their unobservables characteristics might have driven selection into treatment. Essentially, we exploit the logic of the inconsequential units approach, as in Chandra and Thompson (2000), Banerjee et al. (2012), and Faber (2014). The municipalities on the discarded paths are likely to be reasonable controls units, because they were concrete alternatives to the route crossing Cosenza. Without the political pressures, they would have had the same chances as the treated of being located along to freeway. Very likely, if Mancini and Misasi were born in Crotone, on the East coast, now we would drive on the Ionic path to reach Reggio Calabria. It is also very important to note that, as for the choice of where to locate the infrastructure, economic considerations had basically no role. The selection of the final route among the feasible ones is, therefore, unlikely to be directly related to ongoing trends in economic activity.

Figure 2 shows the Calabrian municipalities and highlights those on the chosen and discarded path. Along the actual route we include municipalities whose centroid is in a bandwidth of 20 km from nearest access to the A3. The measure of distance between each

[6] This paragraph is based on the history of the freeway reported in the website of ANAS S.p.A. (*Azienda nazionale autonoma delle strade*, originally a public controlled firm owning the Italian road network); see https://www.stradeanas.it/sites/default/files/La%20storia%20della%20Salerno%20-%20Reggio%20Calabria.pdf (last retrieved: 09/09/2019).

municipality and the nearest access to the freeway is calculated using real travel distance (in km) as proposed by Huber and Rust (2016). The alternative routes are known, but the original plans did not include a list of possible freeway exits. We therefore include all municipalities that were along the two alternatives. The distance from an actual exit of the freeway is between 1 and 20 km for municipalities on the selected route (13 km on average, excluding Cosenza's LLM) and between 21 and 117 for the municipalities on the alternative routes (59 on average). We will show below that, in this subsample of municipalities (the ones 20 km away from the nearest actual access and the ones on alternatives), treated and controls are very similar, also in terms of pre-trends of economic activity. Given that the 20 km cutoff is an arbitrary choice, in subsection 4.1 we also show that results are similar if we use a 30 km cutoff.

By means of a difference-in-differences strategy, we compare the growth of employment and population in municipalities close to the freeway to those further away. Instead of working directly with a log-linear model, we start by specifying an exponential model where effects are multiplicative (notice that log-linearizing it we get the more standard linear dif-in-dif equation):

$$y_{it} = \exp(\alpha_i + \gamma_t + \sum_{l \in L} \beta_l 1[t = l] \times d_i + \sum_{l \in L} 1[t = l] \times \beta'_{xl} x_i)\eta_{it} \quad (1)$$

where $i$ indexed the municipalities, $y_{it}$ is the outcome (number of jobs – employment – and population size), $\alpha_i$ represents municipality fixed effects, $\gamma_t$ are calendar year fixed effects, $d_i$ is the distance (in km) from the nearest entrance to the A3 freeway (defined on the final route of the freeway), and $t \in \{1961, \dots, 2001\}$. The longitudinal dimension of the analysis is restricted by the structure of Censuses, which were carried out at the beginning of each decade. The reference year is 1961, which is just before the start of the freeway construction, and therefore $L = \{1971, 1981, 1991, 2001\}$. We stop in 2001 because the freeway was the subject of a massive – although rather slow – development project between 1999 and 2016, and therefore it would be more difficult to disentangle the effect of the new investments from the original infrastructure. In order to account for possible differential trends, we also include a set $x_i$ of fixed or predetermined covariates (measured in 1951) interacted with year dummies.

In order for the coefficients on $1[t = l] \times d_i$ to capture the causal effect of the freeway on local economic conditions we need to assume that:

$$E(\eta_{it} | \alpha_i, \gamma_t, d_i, x_i) = 1 \quad (2)$$

which implies that, net of differential trends captured by the interactions $1[t = l] \times \beta'_{xl} x_i$, municipalities closer to the freeway would have developed similarly to the ones further away. As argued, this assumption is more likely to hold when we include only municipalities along the three alternative routes (net of Cosenza LLM).

In equation (1) the effects are specified as semielasticities, hence $100 \times \beta_l$ can be interpreted as the percentage change in economic activity (in year *l*) associated with being one km away from the closest freeway entrance. Instead of log-linearizing, we estimate this equation by using Poisson Quasi-Maximum Likelihood. The main reason for using this approach is that the log linearization may lead to biased estimates in the presence of heteroscedasticity (see Santos-Silva and Tenreyro, 2006 and Ciani and Fisher, 2018, for the discussion of the issue in a dif-in-dif setting). In our context, this is extremely likely as the dispersion of economic activity increased significantly over the decades.

Distance from the freeway is defined as the travel distance by road from the nearest access to the A3, measured in km. We calculate it as the current distance at the time of writing. This implies that *(i)* we ignore the evolution of the freeway over the decades and that *(ii)* we use the current road structure to calculate distance from the freeway. Given that our main aim is to study the evolution in the long run, we prefer this choice as it implies that the treatment variable ($d_i$) is fixed over time and therefore we can also check pre-existing trends before the freeway was built. Nevertheless, in the sensitivity analysis we also assess whether results are affected by the freeway further developments and by other changes in the local road network.

The main outcome variables refer to private employment in local plants and resident population, as recorded by the Census at the beginning of every decade. From Census data we also collect a vector of covariates, measured in 1951, which aim at accounting for pre-existing differences in sectoral composition (share of employment in tradable, share of plants in tradable), human capital (share of population with a high school diploma), demography (masculinity ratio, the aging index), urban structure and wealth (non-urbanized fraction of the municipality surface, the homeownership rate), and initial levels (log population and log total employment). Because of the peculiar orographic structure of the region we also include elevation and steepness of municipalities among these covariates.

Descriptive statistics are reported in Table 1. The maximum distance from the freeway is 124 km, the median 32. Calabrian municipalities were quite small on average in 1951, with an average population of 4,900 inhabitants. The region started from low level of development,

as shown by the very limited fraction of population with at least a high school diploma (less than 2 per cent of population aged 6 years or more).

[Table 1 approximately here]

Table 2 shows differences in the characteristics of municipalities belonging to different groups. Strong differences are found between municipalities located on the actual route excluding the LLM of Cosenza (column 2) and the municipalities outside the three possible routes according to the original project (column 3). This supports the idea that the latter municipalities would be implausible controls, as they were located in more elevated and steeper areas. Indeed, apart from geomorphic differences, the latter municipalities were smaller in terms of population and employment (but actually slightly larger in terms of surface) and the population had lower educational levels. Differently, municipalities on the discarded path (column 4) are more similar to those on the actual path (column 2), although some differences remain because the final route was chosen to cross the Calabrian Apennine, and therefore municipalities closer to the freeway are more elevated.

The fact that the group of municipalities outside the three possible paths are very different from those along the routes is also the reason why we do not use planned routes as instrument, as done in some of the previous literature. If we followed this strategy, we would had to assume that being on a hypothetical route is as good as random.

[Table 2 approximately here]

# 4. Results

We first analyze (4.1) the effect of the freeway "Salerno-Reggio Calabria" on long-term local economic development. Then, we propose (4.2) some – admittedly suggestive – calculations to shed lights on whether the new infrastructure triggered only a re-organization of the economic activity or more significant gains in terms of economic growth for the region.

### 4.1 Comparison between municipalities close and far from the freeway

The credibility of the difference in differences strategy outlined in Section 3 hinges on the plausibility of parallel trends assumption. In Table 3 we assess whether there is evidence of differential trends in the decade before the construction of the freeway. Looking at the entire region (Panel A), some pre-existing trends are detected for population, with municipalities far from the (not yet built) freeway displaying a stronger growth in the number of residents. When

we focus only on the alternative routes, which are expected to be similar, the estimated pre-trend in population growth becomes negligible and not-statistically significant. No differential trends are detected for private employment.

[Table 3 approximately here]

Table 4 shows the main results. Given that in the estimating equation (1) the reference year is always 1961, the coefficients on $1[t = l] \times d_i$ capture the effect of distance from the freeway on the cumulative growth between 1961 and year *t*. We start again from the sub-optimal sample in which we include all municipalities in Calabria (Panel A). In the decades starting from 1971 decades the municipalities that are further away from the freeway started growing less than those located close to it. We also observe a weaker population growth in municipalities further away from the freeway.

Results are qualitatively similar if we focus only on municipalities along the three possible routes, including Cosenza LLM (Panel B) or excluding it (Panel C). However, they become smaller in size. The contraction in the size of the coefficients is in line with our expectations that the other municipalities outside the routes, which also ended up being further from the freeway, do not constitute a good control group, because they were already located in more remote areas that were likely to exhibit more negative trends.

[Table 4 approximately here]

Overall, the results confirm that the freeway led to a stronger performance for those municipalities that ended up being closer to it. The difference in the long run is not negligible. Moving from the 1$^{st}$ (2 km) to the 75$^{th}$ percentiles (60 km) of distance implies approximately 17 percentage-point difference in private employment between 1961 and 2001. The effect on the number of jobs is stronger than that referring to the size of the population (8 percentage points), and therefore the proximity to the freeway also increases the employment rate. This is consistent with previous evidence showing that the local reactivity of population to labor demand shocks is quite limited in Italy (Ciani et al., 2019).

The differential growth started from the tradable sector, where the positive effect of freeway proximity materialized in the first decade and did not produce further growth in the following ones. According to the estimates, the decrease in tradable-jobs growth associated with an additional km of distance over 40 years (0.0073) is only slightly larger than the one over the 1961-71 decade (0.0043). Differently, the positive effect spread to non-tradable employment only later in time. In this sector, the differential growth is negligible and not

statistically significant over the first two decades, while it becomes larger and significant when we consider the entire period. A similar trend is observed for jobs in the transportation and telecommunication sector – which we considered separately from other services because it is more likely to be directly affected by the presence of the freeway – and for resident population.

A possible reason why part of the effect materialized only later on is that the final tract (from Goia Tauro to Reggio Calabria, almost 52 km) was completed later, in 1974. Furthermore, four exits were opened between 1981 and 2001.[7] As a consequence, some municipalities became closer to the freeway in the final decades. Our main specification uses current distance and ignores these changes, hence in the early decades these municipalities are assumed to be closer to the freeway than they actually were. As long as the effect of proximity is truly positive, the results for the first decades might therefore underestimate the true effect. By using old maps of the freeway obtained from the Italian Touring Club, we calculated the change in distance from the nearest exit between 1971 (the first year in the sample after the highway opened) and 2001. In Table 5, Panel A, we run the regressions on our favorite sample (municipalities along the three potential routes, excluding Cosenza LLM) excluding also municipalities for which the reduction in distance was larger than 5 km. The excluded municipalities (43) are mostly located in the Southern part of the region, close to the tract that was opened in 1974. As expected, the effect becomes stronger, because we now look only at municipalities for which the distance to the nearest exit has remained the same since the freeway opened. Although now the impact on employment in the non-tradable sector is significant since the first decade, the effect still becomes stronger over time, as in the main results. Also the increase in the impact on the transportation and telecommunication sector and population is confirmed.

Another issue is that the distance from the A3 freeway might also be related to the distance to other highways that had already been built. For instance, municipalities located in the North of Calabria could more easily get access to the rest of the national highway network. Furthermore, the development of the road network (other than the freeway) might have led some areas to get closer to the rest of the country independently from the A3. Therefore, they might have benefited from being closer to more developed areas, irrespective of their distance

[7] According to historical Atlas the exit of Laino Borgo was opened in the 1990s, the exit of Altomonte, S. Mango d'Aquino and S. Trada in the 1980s.

from the freeway. In Table 5, Panel B, we include as additional controls in baseline regression the distance from other highways and the travel distance from Naples (the biggest city north of Calabria) calculated without the use of highways (both interacted with all the year dummies, as for the main treatment variable).[8] Focusing on our preferred sample, results are quantitatively very similar, apart from the coefficient on population which becomes smaller and non-significant.

A related issue is that proximity to the A3 freeway also depends on the rest of the network. Although most of it did not change significantly between 1961 and 2001, there were two significant developments that improved the connection between some municipalities and the freeway by creating faster speed roads. One regarded the local road between Catanzaro (on the Jonic coast) and Lamezia (where an exit of the freeway is located), and the other the tract connecting Rossano and Sibari (also on the Jonic coast) to Castrovillari (near another A3 exit). These developments improved the access to the freeway for several municipalities on the Jonic coast. In Table 5, Panel C, we include as additional controls the distances from these two tracts (both interacted with all the year dummies). In this way we should partial out the effect of the freeway mediated by these other road improvements. As expected, the estimated effects are smaller. This highlights that the freeway effect strongly depends on whether the local road network also facilitates access to the infrastructure.

Our favorite estimator is Poisson-QMLE. It is nevertheless reassuring that results for the long period growth are similar when using a more traditional OLS estimator on the log-linearized model (Table 5, Panel D). Using OLS on the log-linearized model, however, we do not recover significant effects in the shorter run.

In our favorite sample selection we included all municipalities in the actual route within 20 km from a highway entry, as well as all the municipalities on the alternative routes. We tried an alternative definition of 30 km for selecting the municipalities on the actual route. Panel E shows that the main results are confirmed with this sample selection. The effects on non-tradables and population become non-significant, but they are not much different in size from the main estimates. However, with a 30 km cutoff there is evidence of pre-trends in population (results available on requests), as in the estimates including all Calabrian municipalities (Table 3, panel A). For this reason we prefer the 20 km cutoff for the analysis.

[8] Both distances are calculated on current maps, as for the main treatment variable.

Finally, considering the characteristics of the region, the distance in km might not properly capture the transportation costs, given that some roads are steeper. We therefore re-estimated the model using distance in hours instead of km. Results are quite similar (Table 5, panel F). Although the long-run effects on population is not statistically significant, estimated coefficients are quite similar to the main estimates when we calculate the effects of switching from the municipality on the 5$^{th}$ percentile of distance to the one at the 75$^{th}$.

[Table 5 approximately here]

### 4.2 Disentangling the relocation from the aggregate effect

The divergent trends might be a sign of positive growth effects of the freeway on the municipalities next to it, but they can also be the result of the relocation of economic activity from more distant locations. As discussed by Redding and Turner (2015) and Duranton and Venables (2018), one way to understand whether this is the case is to exploit a third area, unaffected by the construction of the freeway. This area could be used as a control for all Calabrian municipalities.

How to select the "third area" in the case of Calabria is a daunting task. Using regional economic accounts, we can start from an illustrative comparison of the region with its natural counterpart, i.e. the other regions that compose the South of Italy. These regions share a similar history and were characterized by a similar level of development compared to the rest of the country. All of them received substantial regional aid. In Figure 3, which compares their GDP growth during the second half of the twentieth century, Calabria appears as the worst performer.[9]

[Figure 3 approximately here]

To improve on this comparison and find the most suitable "third area", we resort to a synthetic control approach (Abadie et al, 2010). Among the Southern regions, we select the areas that are more similar to Calabria in terms of pre-1967 trends of economic activity and other pre-determined characteristics.[10] The synthetic control method assigns a positive weight

[9] In Section 4.1 we find that municipalities closer to the freeway grew more both in terms of employment and population. In line with our previous analysis, we focus here on overall GDP and not on GDP per capita.

[10] We do not include Abruzzo and Molise in the donor pool, because the two regions were a single one until 1963, and there is evidence that the secession brought economic benefits for both (see Dalmazzo et al, 2018). For the construction of the synthetic-control counterpart we use: the level of GDP, past GDP growth rate, the investment-

to Basilicata (0.171), Campania (0.027) and Sardinia (0.802). Still using regional economic accounts, Figure 4 shows the GDP performance of Calabria vs the "synthetic Calabria" built as a weighted average of these other regions. Calabria overall performed worse than its synthetic counterpart. In 2001, almost 40 years after the open of the freeway, the cumulated difference amounted to around 80 percentage points.[11]

[Figure 4 approximately here]

Therefore, Calabria as a whole seems to have been characterized by divergent economic fortunes with respect to similar regions. To try disentangling the relocation (within Calabria) from the aggregate effect of the freeway, we build on our main dif-in-dif strategy by adding municipalities from other Southern regions that have not been affected by the freeway. Among the possible candidates – the three regions that were given positive weights in the synthetic control – Basilicata and Campania were connected with the nationwide network thanks to the A3. The remaining region selected as part of the synthetic control – the island of Sardinia – seems to be a better control group, and also received the largest weight. We therefore include its municipalities as a "third area" comparison group. Moreover, Sardinia is the only Italian region were highways were never built.

In order to compare Calabrian municipalities at different distances from the highway to the "third area" ones, we modify our main specification as follows:

$$y_{it} = \exp(\alpha_i + \gamma_t + \sum_{l \in L} \beta_{cl} 1[t = l] \times 1[Calabria] +$$

$$+ \sum_{l \in L} \beta_{dl} 1[t = l] \times (d_i - \bar{d}) + \sum_{l \in L} 1[t = l] \times \beta'_{xl} x_i) \eta_{it} \qquad (3)$$

and we estimate it on the sample including all municipalities in Calabria and Sardinia, imposing for the Sardinian municipalities that $d_i = \bar{d}$ (the average distance from freeway within Calabria). In this specification, $\beta_{cl}$ captures the average difference in growth between Calabria and Sardinia, while $\beta_{dl}$ identifies how this difference changes for municipalities in Calabria at

to-GDP ratio, the share of highly educated as a proxy for human capital, population density, net imports-to-GDP ratio, the sectoral composition of value added (agriculture, industry, market service), and a measure for local minimum wage. The balancing properties are shown in the Appendix Table A1.

[11] To speculate on the statistical significance of the estimated impact, we follow the suggestion of Abadie, Diamond, and Hainmueller (2010) and perform placebo studies by replicating the same exercise for each of the regions in the donor pool. In the Appendix Figure A1 we plot the estimated impact for the Calabria region and all placebo tests, showing that the effect is peculiar (negative) in consideration of Calabria.

different distances from the freeway. Assuming that Sardinia is a good comparison group, that would have evolved similarly to Calabria in the absence of the freeway, then $\beta_{cl}$ captures the average effect of the freeway on Calabrian municipalities, while $\beta_{dl}$ the relocation effect between them.

Results are shown in Table 6. First, in Panel A, column (1) we show that there were no differential trends before the freeway was built (accounting for trends depending on covariates, as captured by $\sum_{l \in L} 1[t = l] \times x_i$). Panel B, column (1) instead shows that, at the average, Calabrian municipalities did worse than Sardinia in the following forty years. This is depicted as a blue line in Figure 5, Panel a. With respect to this average negative effect, those municipalities closer to the A3 did better, but still worse than the Sardinian counterpart, suggesting that most of the effects are driven by relocation of economic activity within the region.

We also assess whether results are different if we extend the comparison group by including other Southern areas far away from any highway. We selected only municipalities in the South of Italy located at least 130 km away from any highway, which is more than the maximum distance from the A3 for Calabrian municipalities (see Table 2). Essentially, we assume that 130 km is the maximum limit at which we expect freeway effects (including displacement) to be present. Albeit arbitrary, this limit is reasonable for this sensitivity check, which aims at understanding whether results are driven by some specificities of the Sardinian "third area" sample.[12] This selection adds municipalities from the South-East of the country, i.e. the bottom of the Apulia region. Results are shown in Table 6 in column (2) and in Figure 5, Panel b. Qualitatively, the comparison is similar and suggests negative effects on average as well as for Calabrian municipalities at whatever distance. If anything, the negative effects are even stronger.

[Table 6 approximately here]

[Figure 5 approximately here]

This evidence has important limitations, as the overall regional growth might be affected by other factors that we are not able to control. However, it suggests that relocation, rather than net growth, was the most likely upshot of the freeway.

[12] Increasing the limit will lead to a very small addition to the "third area" sample, so that the estimates would be by construction indistinguishable from panel a.

## 5. Conclusions

This paper examines the economic effects of a main road infrastructure over the long run. Our focus is on the least developed and peripheral region (Calabria) of the Italian peninsula, in which the infrastructure was envisaged to spur local economic growth. Our identification strategy exploits the fact that the route was chosen, among three possible planned alternatives, in order to serve the constituency of highly influential politicians. The results suggest that significant local relocation materialized, favoring municipalities closer to the infrastructure. Nevertheless, we fail to find relevant gains referring to the overall region, which continued on a path of divergence with respect to similar underdeveloped areas.

Our evidence can be deemed as specific to the case of an underdeveloped region within a richer country and therefore cannot it seems hard to be extrapolated either to the case of developing countries, or to that of advanced regions. Nevertheless, Redding and Turner (2015) remind us that empirically the impact of infrastructure seems to be similar across economies at different stage of development. Crucially, transport infrastructure investment has received lot of attention in the current debate on the use of EU cohesion funds. Our results highlight that such investment might not accomplish the general objective of regional convergence.

## References


Abadie, A.; Diamond, A.; Hainmüller, J. (2010). "Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program". Journal of the American Statistical Association. 105 (490): 493–505.

Banerjee, A., Duflo, E., and Qian, N. (2012). "On the road: Access to Transportation Infrastructure and Economic Growth in China*".* National Bureau of Economic Research, w17897.

Baum Snow N. (2007) "Did highways cause suburbanization?", Quarterly Journal of Economics, 122: 775-805.

Baum-Snow, N., Brandt, L., Henderson, J. V., Turner, M. A., and Zhang, Q. (2017). "Roads, Railroads, and Decentralization of Chinese Cities." *Review of Economics and Statistics*, 99(3), 435-448.

Baum-Snow N., Henderson J. V., Turner M., Zhang Q., and L. Brandt (2019). "Does Investment in National Highways Help or Hurt Hinterland City Growth?." *Journal of Urban Economics,* forthcoming.

Baum-Snow N. and M. Turner (2017). "Transport Infrastructure and the Decentralization of Cities in the Peoples' Republic of China." *Asian Development Review*, 34(2): 25-50.

Chandra, Amitabh, and Eric Thompson (2000). "Does Public Infrastructure Affect Economic Activity? Evidence from the Rural Interstate Highway System." *Regional Science and Urban Economics*, 30(4):457–490.

Castronovo V. (1995). *Storia Economica d'Italia: dall'Ottocento ai Giorni Nostri*. Torino, Einaudi.

Ciani E. and P. Fisher (2018). "Dif-in-Dif Estimators of Multiplicative Treatment Effects." *Journal of Econometric Methods*, 8(1).

Ciani E., David F. and G. de Blasio (2019). "Local Responses to Labor Demand Shocks: A Re-assessment of the Case of Italy." *Regional Science and Urban Economics*, 75: 1-21.

Costa, E., Mauro, G. C. (2005). "Infrastrutture, Città, e Territori: Contributo della Sezione Calabria", conference proceedings XXV INU annual conference. Available at: http://www.inu.it/?dl_id=1179

D'Antone L. (2008). *Senza pedaggio. Storia dell'autostrada Salerno-Reggio Calabria*. Donzelli, Roma.

Dalmazzo, A., de Blasio, G., and Poy, S. (2018). "Local Secessions, Homophily, and Growth. A Model with Some Evidence from the Regions of Abruzzo and Molise (Italy, 1963)." *Journal of Economic Behavior & Organization*, 151, 284-306.

Datta, S. (2012). "The Impact of Improved Highways on Indian Firms. " *Journal of Development Economics*, 99(1), 46-57.

de Blasio, G., and Poy, S. (2017). "The Impact of Local Wage Regulation on Employment: A Border Analysis from Italy in the 1950s." *Journal of Regional Science*, *57*(1), 48-74.

Donaldson, D. (2018). "Railroads of the Raj: Estimating the Impact of Transportation Infrastructure." *American Economic Review*, 108(4-5), 899-934.

Duranton, Gilles and Matthew A. Turner (2011). "The Fundamental Law of Road Congestion: Evidence from US cities." *American Economic Review*, 101(6), 2616–2652.

Duranton, Gilles and Matthew A. Turner (2012). “Urban Growth and Transportation.” *Review of Economic Studies,* 79(4), 1407–1440.

Duranton, G., Morrow, P. M., and Turner, M. A. (2014). “Roads and Trade: Evidence from the US.” *Review of Economic Studies*, 81(2), 681-724.

Duranton G., Venables A. J. (2018). “Place-Based Policies for Development.” NBER Working Papers 24562, National Bureau of Economic Research.

Faber, B. (2014) “Trade Integration, Market Size, and Industrialization: Evidence from China's National Trunk Highway System.” *Review of Economic Studies* 81(3), 1046-1070.

Federazione italiana della strada (1961), Notiziario, November-December.

Garcia-López, M. À., Holl, A., and Viladecans-Marsal, E. (2015). “Suburbanization and Highways in Spain when the Romans and the Bourbons Still Shape Its Cities. “*Journal of Urban Economics*, 85, 52-67.

Ghani, E., Goswami, A. G., and Kerr, W. R. (2016). “Highway to Success: The Impact of the Golden Quadrilateral Project for the Location and Performance of Indian Manufacturing.” *The Economic Journal*, 126(591), 317-357.

Ginsborg P. (1989). *Storia d’Italia dal dopoguerra a oggi*. Einaudi, Torino.

Holl, A. (2016). “Highways and Productivity in Manufacturing Firms.“ *Journal of Urban Economics,* 93, 131-151.

Holmgren, J., and Merkel, A. (2017) “Much ado about nothing? A meta-analysis of the relationship between infrastructure and economic growth.” *Research in Transportation Economics* 63: 13-26.

Hsu, W. T., and Zhang, H. (2014). “The Fundamental Law of Highway Congestion Revisited: Evidence from National Expressways in Japan.” *Journal of Urban Economics, 81*, 65-76.

Huber S. and C. Rust (2016). “Calculate Travel Time and Distance with OpenStreetMap Data Using the Open Source Routing Machine (OSRM).” *The Stata Journal*, 16(2): 416-423.

Imbens, G.M., and Wooldridge, J.M. (2009).”Recent Development in the Econometrics of Program Evaluation.” *Journal of Economic Literature* 47(1), 5-86.

Martincus, C. V., Carballo, J., and Cusolito, A. (2017). "Roads, Exports and Employment: Evidence from a Developing Country." *Journal of Development Economics*, *125*, 21-39.

Mayer, T., and Trevien, C. (2017). "The Impact of Urban Public Transportation: Evidence from the Paris Region.", *Journal of Urban Economics*, *102*, 1-21.

Michaels, G., Rauch, F., and Redding, S. J. (2012). "Urbanization and Structural Transformation." *The Quarterly Journal of Economics*, 127(2), 535-586.

Möller, J. and Zierer, M. (2018). "Autobahns and Jobs: A Regional Study Using Historical Instrumental Variables." *Journal of Urban Economics*, *103*, 18-33.

Percoco M. (2016), "Highways, Local Economic Structure and Urban Development.", *Journal of Economic Geography*, 16(5): 1035-1054.

Redding S. and M. Turner (2015). "Transportation Costs and the Spatial Organization of Economic Activity." *Handbook of Urban and Regional Economics*, 5, Elsevier,

Ruiz S. (1962). "L'autostrada Salerno-Reggio Calabria." *Autostrade. Rivista di tecnica e informazioni autostradali*, 4: 9.

Santos Silva, J.M.C. and S. Tenreyro (2006). "The Log of Gravity." *Review of Economics and Statistics*, 88(4): 641–658.

# Figures

**Figure 1: Map of the freeway; the black line is the actual freeway, while the blue and red lines are the alternative routes.**

**Figure 2: Municipalities selected along the different routes.**

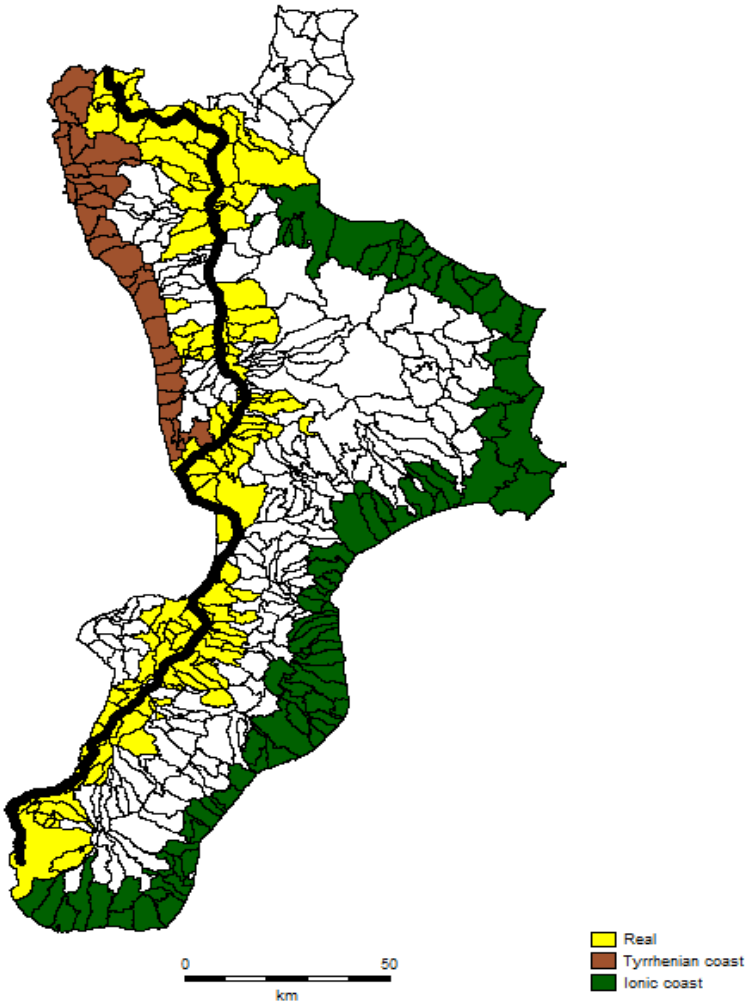
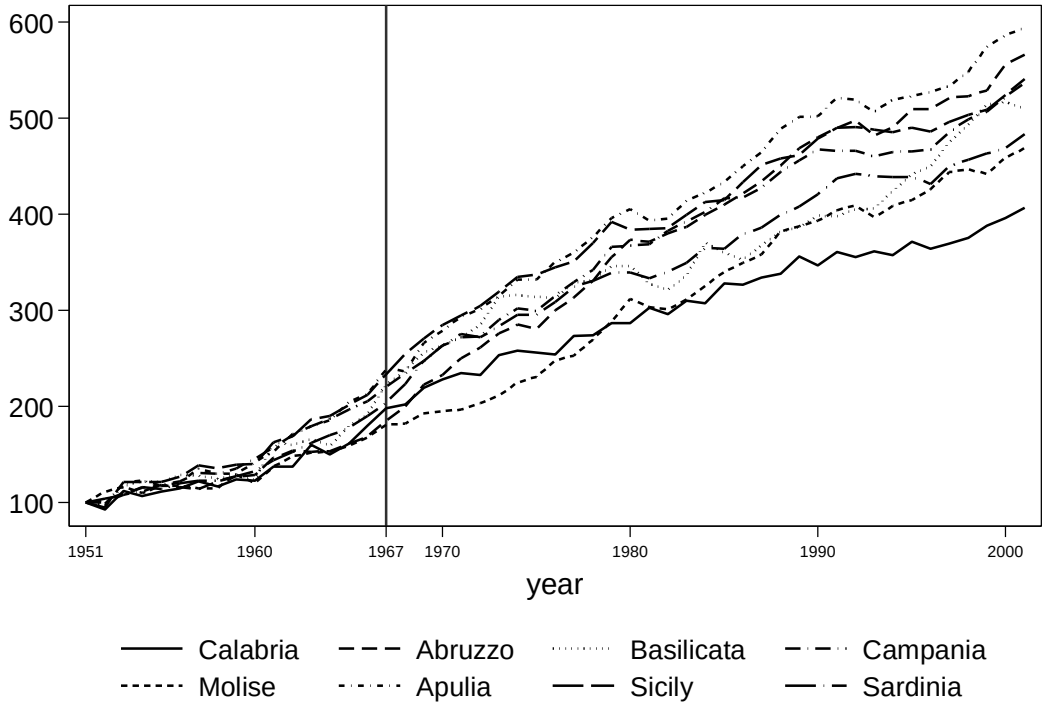
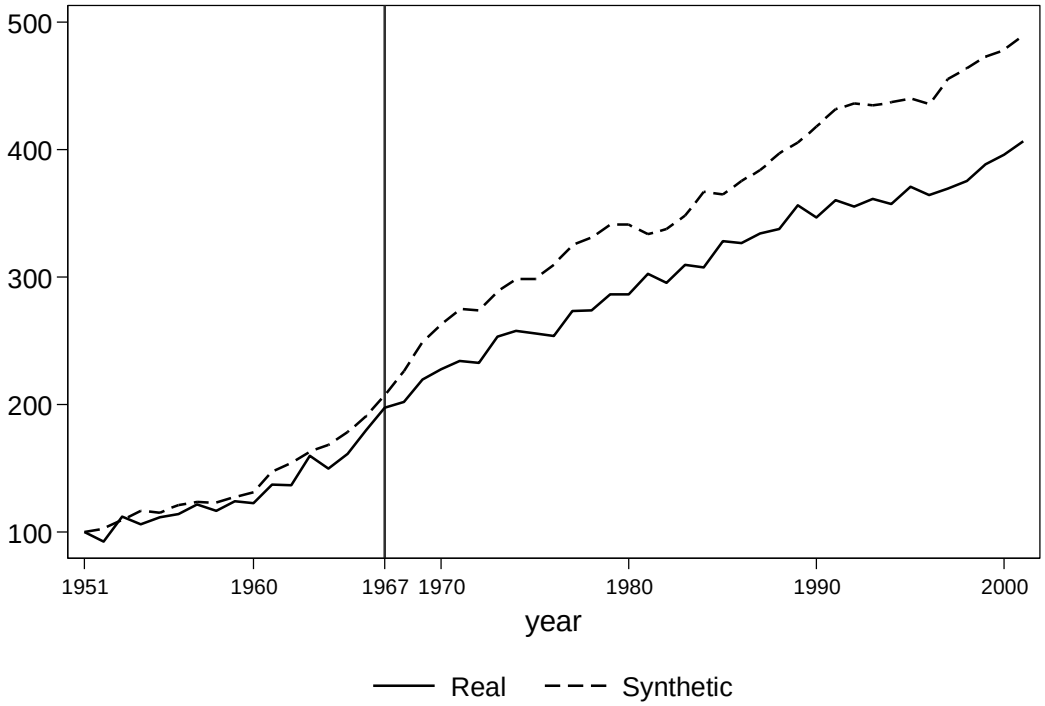


**Figure 3: GDP in Calabria and in all other Southern regions (index 1951=100).**




Notes: data are taken from CRENoS.

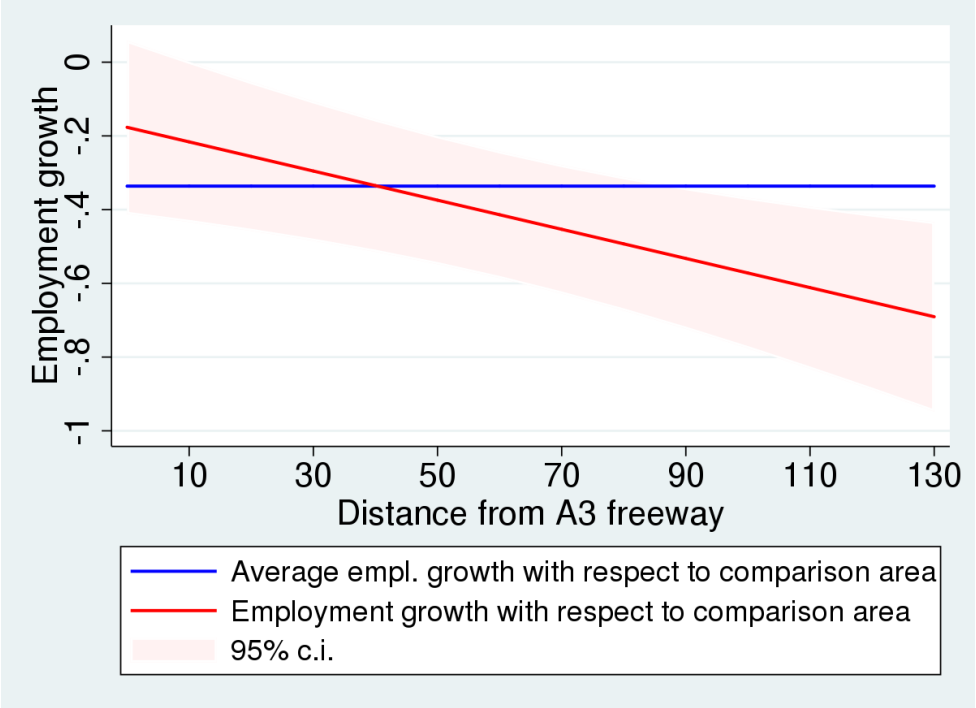
**Figure 4: Calabria GDP with respect to a synthetic control region (index 1951=100)**




Notes: Data are taken from CRENoS and ISTAT. The weights used to build the synthetic controls are: Basilicata (0.171), Campania (0.027) and Sardinia (0.802). The weights are chosen to minimize the distance between treated and synthetic control units in terms of pre-1967 GDP (1963-1966), annual GDP growth rate (1951-1966), population (1963-1966), area, investment-to-GDP ratio (1963-1966), share of high educated (1951 and 1961), population density (1951-1966), net imports-to-GDP ratio (1963-1966), agriculture share of VA (1963-1966), Industry share of VA (1963-1966), Market services share of VA (1963-1966), local minimum wage index (1951-1966). GDP in millions, Euros at 1990 constant prices.

**Figure 5: Overall 1961-2001 private employment growth in Calabrian municipalities with respect to a third area, by distance in km from the A3 freeway.**

(a) Comparison area: Sardinia




(b) Comparison area: Sardinia and Puglia (only municipalities more than 130 km away from any highway)


Note: the blue line correspond to $\beta_{c2001}$ in equation (3), while the red line is $\beta_{c2001} + \beta_{d2001}(d_i - \bar{d})$.

# Tables

### Table 1. Descriptive statistics

| Variable | mean | sd | p50 | min | max | N |
|---|---|---|---|---|---|---|
| Share of employment in tradable (1951) | 0.517 | 0.132 | 0.520 | 0.083 | 0.849 | 403 |
| Share of plants in tradable (1951) | 0.516 | 0.099 | 0.513 | 0.239 | 0.759 | 403 |
| Share of pop. with high school diploma (1951) | 0.018 | 0.010 | 0.016 | 0.004 | 0.100 | 403 |
| Non-urbanized fraction of the surface (1951) | 0.217 | 0.190 | 0.157 | 0.000 | 0.854 | 403 |
| Homeownership rate (1951) | 0.627 | 0.140 | 0.643 | 0.199 | 0.928 | 403 |
| Masculinity (1951) | 0.942 | 0.051 | 0.942 | 0.783 | 1.081 | 403 |
| Aging index (1951) | 0.243 | 0.069 | 0.239 | 0.095 | 0.548 | 403 |
| (ln) elevation | 5.795 | 0.912 | 6.001 | 1.609 | 6.985 | 403 |
| (ln) steepness | 6.605 | 0.578 | 6.677 | 4.431 | 7.722 | 403 |
| (ln) surface | 3.309 | 0.767 | 3.341 | 0.824 | 5.633 | 403 |
| (ln) population (1951) | 8.144 | 0.708 | 8.030 | 6.783 | 11.855 | 403 |
| (ln) total employment (1951) | 5.105 | 0.901 | 4.990 | 3.091 | 9.562 | 403 |
| Distance from the A3-freeway (km) | 40 | 26 | 32 | 1 | 124 | 403 |
| Distance other highways (km) | 280 | 83 | 282 | 95 | 473 | 403 |
| Distance from Naples (km) | 387 | 68 | 395 | 229 | 558 | 403 |
| Employment | 437 | 1503 | 159 | 10 | 23933 | 2418 |
| Employment tradables | 128 | 374 | 49 | 1 | 5908 | 2418 |
| Employment non tradables | 309 | 1155 | 103 | 8 | 19094 | 2418 |
| Employment transports & telec. | 53 | 317 | 11 | 1 | 6294 | 2418 |
| Population | 4839 | 10980 | 2659 | 375 | 180353 | 2418 |

Note: All Calabrian municipalities (403). The last five rows refer to time-varying variables (outcomes) and they are calculated on the entire 1951-2001 sample of Calabrian municipalities.

**Table 2. Balancing test.**

| | (1) | (2) | (3) | (4) | *Standardized difference (greater than 0.25 in bold)* | | | |
|---|---|---|---|---|---|---|---|---|
| | Near the freeway (<=20 km) and in the area of Cosenza | Near the freeway (<=20 km) and not in the area of Cosenza | Far from the freeway (>20 km) and not on alternative routes | On alternative routes | 1 vs 3 | 2 vs 3 | 1 vs 4 | 2 vs 4 |
| Share of employment in tradable (1951) | 0.491 | 0.530 | 0.519 | 0.506 | -0.199 | 0.081 | -0.099 | 0.167 |
| Share of plants in tradable (1951) | 0.496 | 0.521 | 0.524 | 0.499 | **-0.313** | -0.029 | -0.029 | 0.208 |
| Share of pop. with high school diploma (1951) | 0.025 | 0.019 | 0.016 | 0.019 | **0.542** | **0.418** | **0.327** | 0.055 |
| Non-urbanized fraction of the surface (1951) | 0.481 | 0.194 | 0.189 | 0.251 | **1.510** | 0.032 | **1.093** | **-0.295** |
| Homeownership rate (1951) | 0.467 | 0.625 | 0.656 | 0.600 | **-1.459** | -0.229 | **-0.995** | 0.188 |
| Masculinity ratio (1951) | 0.937 | 0.934 | 0.946 | 0.941 | -0.214 | **-0.250** | -0.101 | -0.148 |
| Aging index (1951) | 0.212 | 0.241 | 0.246 | 0.242 | **-0.618** | -0.075 | **-0.463** | -0.005 |
| (ln) elevation | 6.120 | 5.749 | 6.102 | 5.280 | 0.038 | **-0.504** | **0.975** | **0.467** |
| (ln) steepness | 6.678 | 6.478 | 6.689 | 6.556 | -0.022 | **-0.355** | 0.218 | -0.122 |
| (ln) surface | 3.009 | 3.207 | 3.330 | 3.387 | **-0.385** | -0.158 | **-0.475** | -0.244 |
| (ln) population (1951) | 8.368 | 8.230 | 8.046 | 8.216 | **0.396** | **0.260** | 0.175 | 0.018 |
| (ln) total employment (1951) | 5.289 | 5.165 | 4.934 | 5.321 | **0.323** | **0.256** | -0.028 | -0.162 |
| N | 13 | 88 | 189 | 113 | | | | |

Note: Imbens and Wooldrige (2009) suggest that a standardized difference greater than 0.25 is indicative of imbalance.

**Table 3. Pre trends, within Calabria comparison, 1951-1961; reference year 1951.**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | | Private employment: | | | |
| | Overall | Tradables | Non tradables | Transports & telec. | Population |
| Panel A: All municipalities in Calabria | | | | | |
| distance(km)×1961 | 0.0006 | 0.0008 | 0.0008 | 0.0013 | 0.0006*** |
| | (0.0008) | (0.0012) | (0.0009) | (0.0011) | (0.0002) |
| Observations | 806 | 806 | 806 | 806 | 806 |
| Panel B: Only municipalities along the three alternative routes | | | | | |
| distance(km)×1961 | -0.0002 | -0.0007 | 0.0005 | 0.0012 | 0.0003 |
| | (0.0008) | (0.0013) | (0.0010) | (0.0011) | (0.0003) |
| Observations | 428 | 428 | 428 | 428 | 428 |
| Panel C: Only municipalities along the three alternative routes, excluding the LLM of Cosenza | | | | | |
| distance(km)×1961 | -0.0000 | -0.0004 | 0.0004 | 0.0013 | 0.0003 |
| | (0.0008) | (0.0013) | (0.0010) | (0.0012) | (0.0002) |
| Observations | 402 | 402 | 402 | 402 | 402 |

Note: * p < 0.10, ** p < 0.05, *** p < 0.01; clustered standard errors (by municipalities) in parentheses. All the specifications include municipality fixed effects, year fixed effects, and a set of covariates interacted with year dummies (share of employment in tradable in 1951, share of plants in tradable in 1951, share of population with high school diploma in 1951, non-urbanized fraction of the municipality surface in 1951, homeownership rate rate in 1951, masculinity ratio in 1951, aging index in 1951, ln elevation, ln steepness, ln surface, ln population in 1951, ln employment in 1951.

**Table 4. Main results, within Calabria comparison, 1961-2001; reference year 1961.**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | | Private employment: | | | |
| | Overall | Tradables | Non tradables | Transports & telec. | Population |
| | Panel A: All municipalities in Calabria | | | | |
| distance(km)×1971 | -0.0018** | -0.0043*** | -0.0008 | -0.0006 | -0.0001 |
| | (0.0009) | (0.0016) | (0.0008) | (0.0012) | (0.0003) |
| distance(km)×1981 | -0.0022* | -0.0049** | -0.0014 | -0.0009 | -0.0001 |
| | (0.0012) | (0.0019) | (0.0011) | (0.0016) | (0.0004) |
| distance(km)×1991 | -0.0037*** | -0.0049*** | -0.0034*** | -0.0032 | -0.0014** |
| | (0.0012) | (0.0016) | (0.0012) | (0.0020) | (0.0006) |
| distance(km)×2001 | -0.0046*** | -0.0073*** | -0.0037*** | -0.0078*** | -0.0020*** |
| | (0.0014) | (0.0020) | (0.0014) | (0.0026) | (0.0007) |
| Observations | 2015 | 2015 | 2015 | 2015 | 2015 |
| | Panel B: Only municipalities along the three alternative routes | | | | |
| distance(km)×1971 | -0.0021** | -0.0050*** | -0.0011 | -0.0010 | -0.0002 |
| | (0.0011) | (0.0019) | (0.0008) | (0.0013) | (0.0003) |
| distance(km)×1981 | -0.0018 | -0.0047** | -0.0012 | -0.0025 | -0.0003 |
| | (0.0014) | (0.0023) | (0.0012) | (0.0018) | (0.0005) |
| distance(km)×1991 | -0.0025* | -0.0032 | -0.0026** | -0.0046** | -0.0014** |
| | (0.0013) | (0.0019) | (0.0013) | (0.0022) | (0.0007) |
| distance(km)×2001 | -0.0033** | -0.0047** | -0.0031* | -0.0110*** | -0.0017** |
| | (0.0016) | (0.0023) | (0.0016) | (0.0026) | (0.0008) |
| Observations | 1070 | 1070 | 1070 | 1070 | 1070 |
| | Panel C: Only municipalities along the three alternative routes, excluding the LLM of Cosenza | | | | |
| distance(km)×1971 | -0.0020* | -0.0045** | -0.0010 | -0.0016 | -0.0001 |
| | (0.0010) | (0.0018) | (0.0008) | (0.0012) | (0.0003) |
| distance(km)×1981 | -0.0014 | -0.0040* | -0.0007 | -0.0026* | 0.0001 |
| | (0.0014) | (0.0022) | (0.0011) | (0.0015) | (0.0005) |
| distance(km)×1991 | -0.0021* | -0.0032* | -0.0020* | -0.0043** | -0.0010 |
| | (0.0012) | (0.0019) | (0.0012) | (0.0017) | (0.0006) |
| distance(km)×2001 | -0.0029** | -0.0047** | -0.0025* | -0.0106*** | -0.0013* |
| | (0.0014) | (0.0023) | (0.0013) | (0.0020) | (0.0007) |
| Observations | 1005 | 1005 | 1005 | 1005 | 1005 |

Note: * p < 0.10, ** p < 0.05, *** p < 0.01; clustered standard errors (by municipalities) in parentheses. All the specifications include municipality fixed effects, year fixed effects, and a set of covariates interacted with year dummies (share of employment in tradable in 1951, share of plants in tradable in 1951, share of population with high school diploma in 1951, non-urbanized fraction of the municipality surface in 1951, homeownership rate rate in 1951, masculinity ratio in 1951, aging index in 1951, ln elevation, ln steepness, ln surface, ln population in 1951, ln employment in 1951.

**Table 5. Sensitivity analysis, within Calabria comparison, 1961-2001, only municipalities along the three alternative routes excluding the LLM of Cosenza**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | | Private employment: | | | |
| | Overall | Tradables | Non tradables | Transports & telec. | Population |
| Panel A: Excluding municipalities whose distance from the A3 freeway reduced by more than 5 km between 1971 and 2001 | | | | | |
| distance(km)×1971 | -0.0038*** | -0.0070*** | -0.0022** | -0.0032** | -0.0005 |
| | (0.0011) | (0.0021) | (0.0009) | (0.0013) | (0.0004) |
| distance(km)×1981 | -0.0032* | -0.0075*** | -0.0015 | -0.0047*** | -0.0006 |
| | (0.0017) | (0.0026) | (0.0014) | (0.0017) | (0.0006) |
| distance(km)×1991 | -0.0035** | -0.0049** | -0.0029** | -0.0050** | -0.0019** |
| | (0.0014) | (0.0024) | (0.0013) | (0.0022) | (0.0008) |
| distance(km)×2001 | -0.0041** | -0.0065** | -0.0033** | -0.0112*** | -0.0019** |
| | (0.0018) | (0.0027) | (0.0016) | (0.0023) | (0.0009) |
| Observations | 775 | 775 | 775 | 775 | 775 |
| Panel B: Including distance from other highways and distance from Naples without highways among controls | | | | | |
| distance(km)×1971 | -0.0026*** | -0.0050*** | -0.0016** | -0.0017 | -0.0000 |
| | (0.0010) | (0.0018) | (0.0008) | (0.0012) | (0.0003) |
| distance(km)×1981 | -0.0009 | -0.0034 | -0.0003 | -0.0030* | 0.0004 |
| | (0.0013) | (0.0021) | (0.0012) | (0.0016) | (0.0004) |
| distance(km)×1991 | -0.0019 | -0.0032 | -0.0017 | -0.0048*** | -0.0007 |
| | (0.0013) | (0.0020) | (0.0013) | (0.0018) | (0.0006) |
| distance(km)×2001 | -0.0024* | -0.0049** | -0.0018 | -0.0114*** | -0.0009 |
| | (0.0014) | (0.0025) | (0.0014) | (0.0023) | (0.0007) |
| Observations | 1005 | 1005 | 1005 | 1005 | 1005 |
| Panel C: Including also distance from improved tracts among controls | | | | | |
| distance(km)×1971 | -0.0013 | -0.0034* | -0.0005 | -0.0018 | 0.0002 |
| | (0.0011) | (0.0019) | (0.0009) | (0.0013) | (0.0003) |
| distance(km)×1981 | -0.0000 | -0.0022 | 0.0005 | -0.0025 | 0.0007 |
| | (0.0014) | (0.0023) | (0.0011) | (0.0017) | (0.0004) |
| distance(km)×1991 | -0.0013 | -0.0021 | -0.0013 | -0.0036* | -0.0001 |
| | (0.0013) | (0.0021) | (0.0012) | (0.0019) | (0.0006) |
| distance(km)×2001 | -0.0025* | -0.0042* | -0.0021 | -0.0096*** | -0.0004 |
| | (0.0014) | (0.0024) | (0.0014) | (0.0020) | (0.0007) |
| Observations | 1005 | 1005 | 1005 | 1005 | 1005 |

*(continued on next page)*

*(continued from previous page)*

| | | | | | |
|---|---|---|---|---|---|
| Panel D: Log linear estimator | | | | | |
| distance(km)×1971 | -0.0009 | -0.0008 | -0.0012 | -0.0022 | 0.0001 |
| | (0.0012) | (0.0021) | (0.0011) | (0.0015) | (0.0003) |
| distance(km)×1981 | -0.0013 | -0.0032 | -0.0008 | -0.0016 | 0.0003 |
| | (0.0015) | (0.0025) | (0.0015) | (0.0021) | (0.0005) |
| distance(km)×1991 | -0.0021 | -0.0019 | -0.0019 | -0.0043* | -0.0006 |
| | (0.0014) | (0.0023) | (0.0015) | (0.0024) | (0.0007) |
| distance(km)×2001 | -0.0034** | -0.0063** | -0.0023 | -0.0060** | -0.0012 |
| | (0.0017) | (0.0027) | (0.0017) | (0.0023) | (0.0008) |
| Observations | 1005 | 1005 | 1005 | 1005 | 1005 |
| Panel E: Including also municipalities within 30 km from an A3 freeway entry | | | | | |
| distance(km)×1971 | -0.0017* | -0.0041** | -0.0008 | -0.0016 | 0.0000 |
| | (0.0010) | (0.0018) | (0.0008) | (0.0011) | (0.0003) |
| distance(km)×1981 | -0.0011 | -0.0035 | -0.0004 | -0.0019 | 0.0002 |
| | (0.0013) | (0.0022) | (0.0012) | (0.0015) | (0.0005) |
| distance(km)×1991 | -0.0022* | -0.0036** | -0.0017 | -0.0041** | -0.0007 |
| | (0.0012) | (0.0018) | (0.0012) | (0.0017) | (0.0006) |
| distance(km)×2001 | -0.0029** | -0.0051** | -0.0022* | -0.0093*** | -0.0012 |
| | (0.0013) | (0.0023) | (0.0013) | (0.0021) | (0.0007) |
| Observations | 1325 | 1325 | 1325 | 1325 | 1325 |
| Panel F: Using distance in terms of time (hours) | | | | | |
| distance(hours)×1971 | -0.1655** | -0.3392*** | -0.0914* | -0.1296* | -0.0119 |
| | (0.0662) | (0.1196) | (0.0511) | (0.0776) | (0.0201) |
| distance(hours)×1981 | -0.1071 | -0.3171** | -0.0411 | -0.1980** | -0.0018 |
| | (0.0959) | (0.1589) | (0.0775) | (0.0978) | (0.0318) |
| distance(hours)×1991 | -0.1691** | -0.2698** | -0.1398* | -0.3203*** | -0.0729* |
| | (0.0836) | (0.1284) | (0.0787) | (0.1120) | (0.0404) |
| distance(hours)×2001 | -0.2177** | -0.3871** | -0.1637* | -0.7344*** | -0.0952** |
| | (0.0950) | (0.1543) | (0.0894) | (0.1304) | (0.0462) |
| Observations | 1005 | 1005 | 1005 | 1005 | 1005 |
| Impact of moving from 5th to 75th percentile of distance on 1961-2001 growth calculated from regressions using distance in terms of: | | | | | |
| Hours (Tab. 5, Panel D) | -0.218 | -0.387 | -0.164 | -0.734 | -0.095 |
| Km (Tab. 4, Panel C) | -0.168 | -0.273 | -0.145 | -0.615 | -0.075 |

Note: * p < 0.10, ** p < 0.05, *** p < 0.01; clustered standard errors (by municipalities) in parentheses. All specifications include municipality and year effects, and a set of covariates interacted with year dummies (see notes to Table 4). Panel b also includes distance (km) from other highways and from Naples using roads other than the highways, interacted with year dummies. Panel c includes distances (km) from the two improved road tracts discussed in the text. The 1th and 75th percentiles of distance are 0.10 hours (2 km) and 1.1 (60), respectively.

**Table 6. Comparison with a third area, all Calabrian municipalities plus comparison area, 1951-2001.**

| | (1) | (2) |
|---|---|---|
| | Overall private employment | |
| | Comparison area: Sardinia | Comparison area: Sardinia and Apulia (only municipalities more than 130 km away from any highway) |
| Panel A: pre-trends 1951-1961; reference year 1951 | | |
| Calabria ×1961 | -0.0294 | -0.0591 |
| | (0.0529) | (0.0539) |
| Calabria×distance(km)×1961 | 0.0002 | 0.0008 |
| | (0.0008) | (0.0009) |
| Observations | 1472 | 1636 |
| Panel B: freeway effects 1961-2001; reference year 1961 | | |
| Calabria ×1971 | -0.1512** | -0.2157** |
| | (0.0726) | (0.0988) |
| Calabria ×1981 | -0.1017 | -0.2676** |
| | (0.0846) | (0.1295) |
| Calabria×1991 | -0.2905*** | -0.4729*** |
| | (0.0782) | (0.1404) |
| Calabria×2001 | -0.3362*** | -0.5949*** |
| | (0.0914) | (0.1652) |
| Calabria×distance(km)×1971 | -0.0015 | -0.0038** |
| | (0.0013) | (0.0018) |
| Calabria×distance(km)×1981 | -0.0005 | -0.0039 |
| | (0.0014) | (0.0024) |
| Calabria×distance(km)×1991 | -0.0036*** | -0.0059*** |
| | (0.0013) | (0.0021) |
| Calabria×distance(km)×2001 | -0.0040*** | -0.0077*** |
| | (0.0014) | (0.0024) |
| Observations | 3680 | 4090 |

Note: * p < 0.10, ** p < 0.05, *** p < 0.01; clustered standard errors (by municipalities) in parentheses. All the specifications include municipality fixed effects, year fixed effects, and a set of covariates interacted with year dummies (share of employment in tradable in 1951, share of plants in tradable in 1951, share of population with high school diploma in 1951, non-urbanized fraction of the municipality surface in 1951, homeownership rate rate in 1951, masculinity ratio in 1951, aging index in 1951, ln elevation, ln steepness, ln surface, ln population in 1951, ln employment in 1951. Here distance (km) is demeaned (see eq. 3).

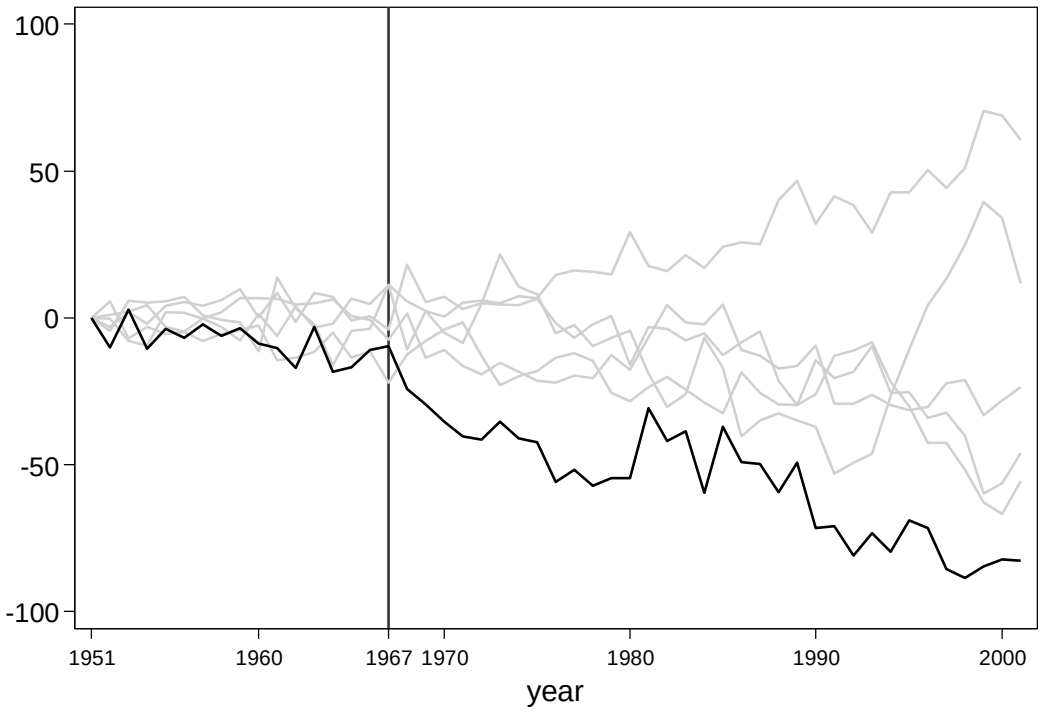
# Appendix: Additional Tables and Figures

**Table A1. Balancing properties between Calabria and its synthetic counterpart**

| | Real | Synthetic |
|---|---|---|
| GDP | 6944.0 | 5701.4 |
| Annual GDP growth rate | 0.043 | 0.045 |
| Population | 2032.0 | 1390.4 |
| Area | 15083.0 | 21396.0 |
| Investment-to-GDP ratio | 0.305 | 0.377 |
| Share of high educated | 0.034 | 0.033 |
| Net imports-to-GDP ratio | 0.164 | 0.207 |
| Agriculture share of VA | 0.148 | 0.127 |
| Industry share of VA | 0.215 | 0.302 |
| Market services share of VA | 0.409 | 0.329 |
| Local minimum wage index | 79 | 81 |

Notes: Data are taken from CRENoS and ISTAT. The weights used to build the synthetic controls are: Basilicata (0.171), Campania (0.027) and Sardinia (0.802). The weights are chosen to minimize the distance between treated and synthetic control units in terms of pre-1967 GDP (1963-1966), annual GDP growth rate (1951-1966), population (1963-1966), area, investment-to-GDP ratio (1963-1966), share of high educated (1951 and 1961), population density (1951-1966), net imports-to-GDP ratio (1963-1966), agriculture share of VA (1963-1966), Industry share of VA (1963-1966), Market services share of VA (1963-1966), local minimum wage index (1951-1966). GDP in millions, Euros at 1990 constant prices. Population in thousands. Area in km2. Share of high educated is the percentage of people with upper secondary degree or higher level of education over population with 6 years or more. The local minimum wage index is a measure for contractual wages paid at the regional level (its maximum value – 100 – is set at the level of the Lombardy region, North of Italy; additional details can be found in de Blasio and Poy, 2017).

**Figure A1: GDP gaps in Calabria and placebo gaps in other Southern regions (index 1951=100).**




Notes: The black solid line represents the Calabria region. Data are taken from CRENoS and ISTAT. The weights are chosen to minimize the distance between treated and synthetic control units in terms of pre-1967 GDP (1963-1966), annual GDP growth rate (1951-1966), population (1963-1966), area, investment-to-GDP ratio (1963-1966), share of high educated (1951 and 1961), population density (1951-1966), net imports-to-GDP ratio (1963-1966), agriculture share of VA (1963-1966), Industry share of VA (1963-1966), Market services share of VA (1963-1966), local minimum wage index (1951-1966). GDP in millions, Euros at 1990 constant prices.