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The effects of tax incentives for dwelling renovations: the case of Italy

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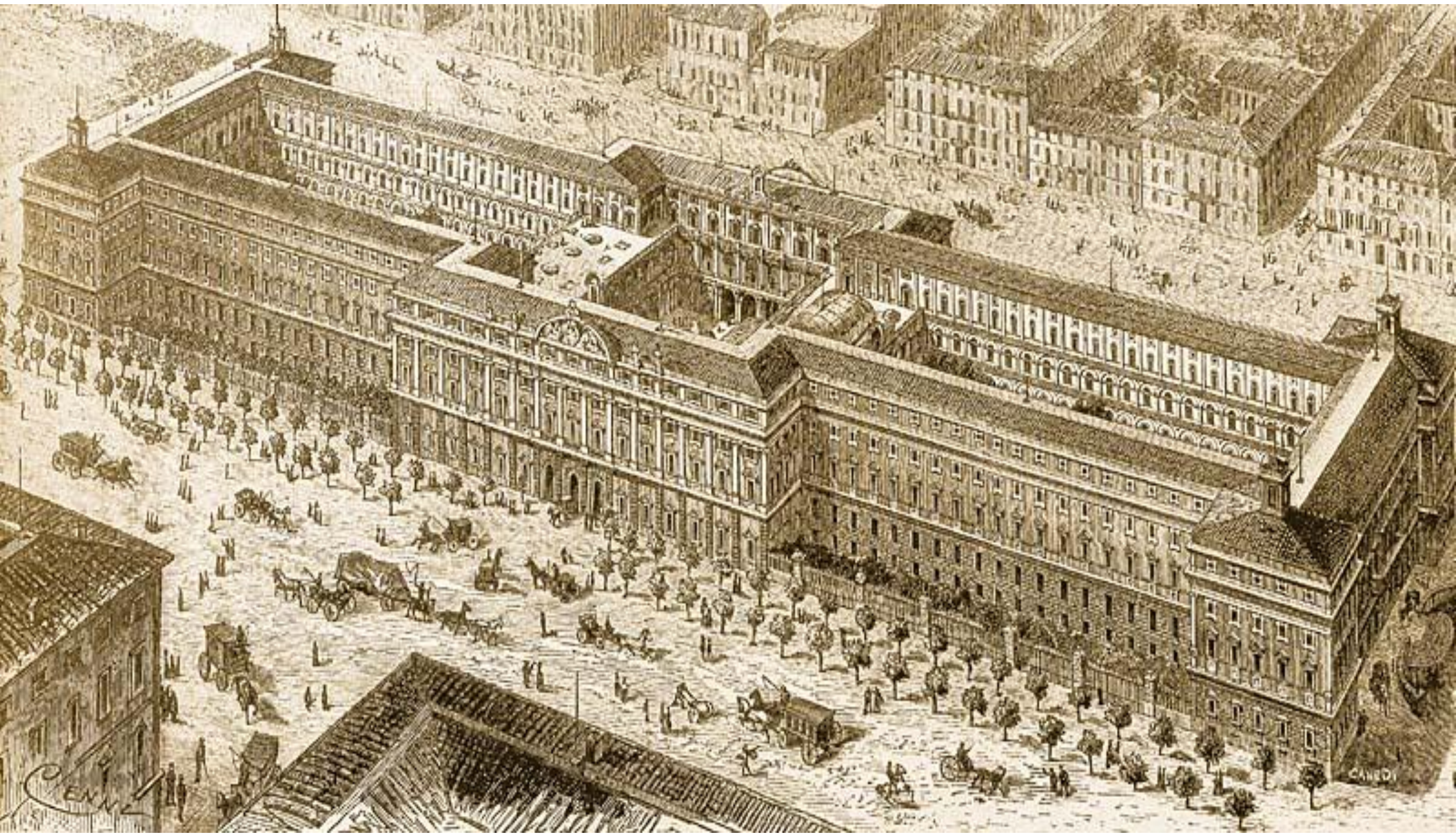

Working Papers

Indice

The effects of tax incentives for dwelling renovations: the case of Italy

Carlo Cignarella[a], Paolo D'Imperio[b]

Abstract

The Superbonus denotes a generous tax credit for the energy-efficiency renovation of residential buildings that was introduced in Italy during the Covid-19 pandemic. The Superbonus is characterized by a tax credit higher than the cost of the renovation (110%) and by its transferability to third parties ‑ both of which to our knowledge were unprecedented features within the Italian tax system. Shortly before the pandemic, another tax credit had been introduced, the so-called Facades Bonus, designed for outside redecoration and repair of buildings, with a 90% tax incentive. Over the period covered by our study, 2020-2023, the take-up of the two incentives was €186 billion (9% of GDP). We use a synthetic control method to assess the combined additive effect of these two tax credits and indirectly evaluate their performance as a counter-cyclical fiscal policy tool. Our results suggest that the incentives generated a significant amount of additional investment in residential construction, around €116 billion, that would not have taken place otherwise, thereby providing a significant stimulus to the economy. However, we estimate that close to €70 billion of the expenditure related to subsidised investments would have been carried out anyway, thanks also to pre-existing and less generous incentives for dwelling renovations. As such, our analysis casts serious doubts on the cost-effectiveness of the incentives, which also raise significant concerns in terms of distributional impacts and fairness.

Keywords: Superbonus, programme evaluation, synthetic control method, dwelling investments, dwelling energy efficiency.

JEL Classification: H2, H3, H5, E3, R3.

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1 Introduction

Residential and non-residential buildings account for 36% of energy-related greenhouse gas emissions and 40% of total energy consumed in the European Union (European Commission 2021). The EU and its Member States have been undertaking a number of policy actions to reduce energy demand in buildings since the 1970s, including the design of financial incentives to encourage energy-efficiency upgrades (Economidou et al. 2020).[1]

Tax credits for building renovations - which may lead to substantial energy and emission savings - require sizeable public resources to be implemented. From a microeconomic perspective, the evaluation of these programs primarily concerns the responsiveness of households to incentives or, put differently, a comparison between their size and the increased propensity to invest in energy-efficiency upgrades. There is no conclusive assessment so far, as the empirical evidence is mixed (Villca-Pozo and Gonzales-Bustos 2019; Hassett and Metcalf 1995; Walsh 1989), and theoretical studies highlight potential barriers to this kind of investments, such as information asymmetries (Giraudet 2020) and split incentives (Charlier 2015). Yet, some recent evidence suggests that, although tax credits may have little impact on the decision to renovate, they do lead to an increase in expenditures (Risch 2020). Moreover, these programs may be successful in encouraging the substitution of the heating equipment with more efficient one (Alberini and Bigano 2015; Germeshausen, Graevenitz, and Achtnicht 2022).

The macroeconomic literature, instead, mainly focuses on energy-efficiency policies in a broader sense. Such policies may affect both consumers and producers: investments stimulate demand for goods and services in the sectors targeted by the measures and, at the same time, energy savings reduce spending and increase the disposable income (Hartwig et al. 2017). The overall effects should be positive, provided that the rebound effect is limited - that is, the

[1]The first legal acts issued at a community level on the topic were primarily concerned with the security of energy supply after the two oil crisis in the 1970s. Later on, more stringent energy efficiency standards for buildings gained momentum with the rising awareness of the need to mitigate climate change. The first cohesive European legal act was the Energy Performance of Buildings Directive (2002). At the same time, Member States issued national policies: among the financial incentives to encourage investments in the energy efficiency of existing buildings, there were low or zero interest loans (e.g. in Germany and France) and fiscal schemes (grants, tax deduction, white certificates) in Italy, France, and Spain.

reduction in energy consumption induced by efficiency improvements is not offset by the possible greater demand, driven by the lower price of energy (Barker, Dagoumas, and Rubin 2009). Positive returns on economic growth and employment are expected in the medium and long term, as suggested by some empirical evidence from Germany (Hartwig et al. 2017; Kronenberg, Kuckshinrichs, and Hansen 2012) and Switzerland (Yushchenko and Patel 2016).

A relatively unexplored area, however, is the short-term impact of incentives on the business cycle, especially of those that encourage the construction of new energy-efficient buildings or the renovation of existing ones. These measures might have a strong impact on the construction industry and its largely domestic supply chain. At the same time, tax credits might have more rapid aggregate effects compared with other public expenditures, such as investments in public infrastructures, facing longer time to spend and time to build (Ramey 2020). To shed light on these issues, we exploit the recent introduction of the so-called *Superbonus 110%* and *Facades Bonus* in Italy as a case study to quantify the short-term impact of energy-efficiency and other residential renovation incentives and indirectly evaluate their performance as a counter-cyclical fiscal policy tool.

The *Superbonus 110%* is a fiscal incentive introduced in May 2020 to support the construction sector in the wake of the Covid-19 pandemic and to enhance the energy efficiency (*Super Ecobonus*) and anti-seismic performance (*Super Sismabonus*) of residential buildings. The measure granted a particularly generous tax credit - up to the 110% of the cost of the intervention, to be cashed in in five years - and the possibility to transfer the tax credit to third parties. To our knowledge, both features were unprecedented within the Italian tax system. The *Superbonus 110%* was only one of the several fiscal measures introduced by the Italian Government to deal with the economic crisis triggered by the Covid-19 pandemic. However, by the end of December 2023, the gross cost of the measure has been quantified at €160.2 billion, being the single most expensive fiscal measure introduced after the pandemic (Italian Chamber of Deputies 2024).[2]

[2]The amount is gross of cancellations resulting from seizures, errors, and duplications.

The *Facades Bonus*, introduced shortly before the pandemic, consisted of a tax credit to be divided into 10 annual installments, equal to 90% of the expenses incurred in 2020 and 2021, and 60% of the expenses sustained in 2022, for outside redecoration and repair of buildings. As the pandemic crisis broke out, the possibility of transferring the tax credit to third parties was also granted to this incentive scheme. The gross cost of the measure has been quantified at 25.7 billion (Italian Chamber of Deputies 2024).

In this study we address the question of which part of the investments in residential buildings over the period 2020-2023 was realized thanks to the two aforementioned tax incentives, and would have not been realized in absence of them. More precisely, we attempt to quantify the additive impact of these two fiscal schemes on investments in residential buildings - our target variable - by applying the synthetic control method first introduced by Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010), a popular technique in the policy evaluation literature. This method is particularly useful to study interventions at an aggregate level, when there are few suitable control units available.

Our results suggest that the additive impact of the two fiscal incentives on the construction sector has been significant and that the measures successfully stimulated additional investments in residential buildings, thereby providing a significant stimulus to the economy. In particular, the *Superbonus* and the *Facades Bonus* together activated about €116 billion of additional investments over the period 2020-2023, against a total take-up of around €186 billion (close to 9% of GDP). The flip side of the coin is that close to €70 billion of the expenditure related to subsidised investments would have been carried out even without the *Superbonus* and the *Facades Bonus*, thanks also to pre-existing and less generous incentives, such as the 50% tax incentive for housing renovations (*Bonus Casa*) and the 50%-85% incentive for energy-efficiency interventions (*Ecobonus*).

Although the estimation of the net effects of the two incentives on public finances and private welfare is outside the scope of this paper, our analysis casts serious doubts on their cost-effectiveness, which also raise significant concerns in terms of distributional impacts and fairness. On the other hand, we do not consider the positive effects on government revenues and energy efficiency triggered by the additional investments financed by the *Superbonus* and the *Facades Bonus*.

The rest of the paper is organized as follows. In the next section, we provide some background on the *Superbonus*, the *Facades Bonus*, and the other fiscal incentives; we then review the literature on the synthetic control method (Section 3) and explain the setup and the data we use in our study (Section 4). In Section 5 we present and discuss the results. Section 6 concludes.

2 Tax incentives for home improvements and residential investment

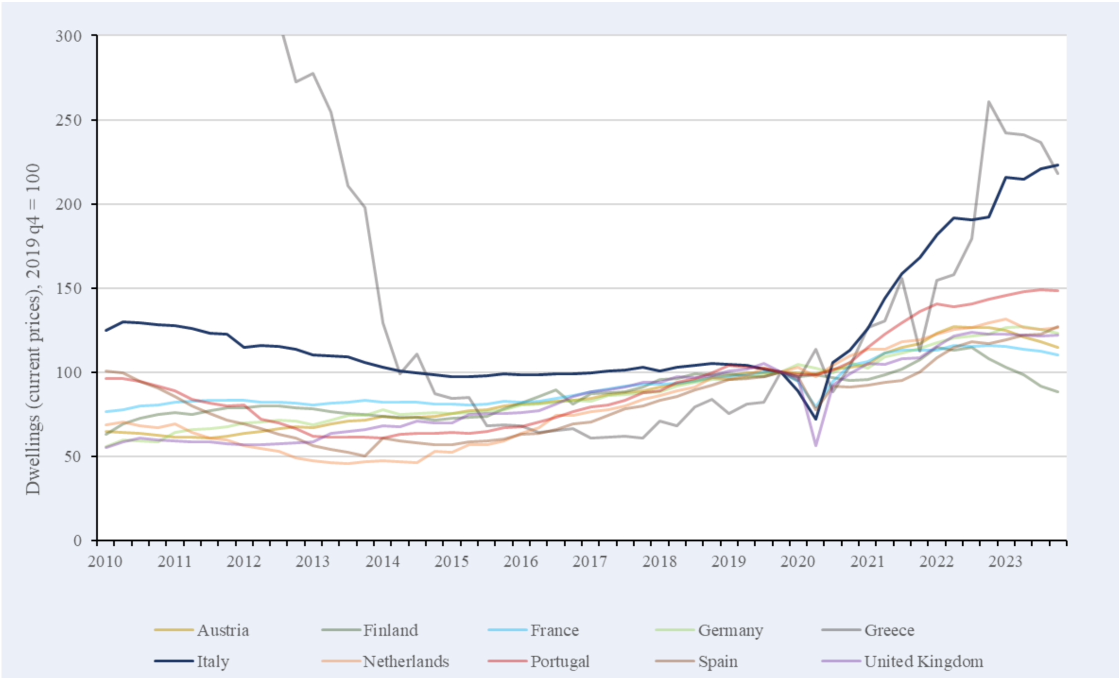
Figure 1 shows the time series of investments in residential buildings in Italy and other selected OECD economies.[3] As the pandemic worsened, construction investments fell strongly to varying degrees in all the economies in the sample. Since 2021, residential investments recovered, moving back approximately to the trends observed before the recession. In this respect, the dynamic of residential investments in Italy is utterly anomalous. The Italian series was almost flat before the pandemic, then it took a much steeper positive turn after the recovery. A similar behaviour is observed in Greece, yet its series shows greater fluctuations. Figure A1 in the appendix shows the same series in volumes: when clearing out the price effect, the relative divergence of Italy is even more pronounced. The main question this study wants to answer is which part of the peculiar acceleration in investments in Italy can be attributed to the new incentives for energy efficiency and home renovation introduced during the pandemic, namely the *Superbonus 110%* and the *Facades Bonus*.

The *Superbonus 110%* was introduced by a Decree Law - the so called *Decreto Rilancio*[4]

[3] They include Austria, Finland, France, Germany, Greece, Netherlands, Portugal, Spain, and UK, the control units that we use in our analysis.

[4] D.l. 19^{th} May 2020, n. 34.

Figure 1: Gross fixed investment in residential buildings, 2010-2023, current prices.



Notes: The figure reports the gross fixed investment in residential buildings Italy and other OECD countries (Austria, Finland, France, Germany, Greece, Netherlands, Portugal, Spain, and UK). Source: own elaborations on OECD data (updated to October 2024).

- shortly after the first wave of Covid-19 pandemic, in May 2020. The corresponding implementing decrees were issued in early August 2020. Among other emergency measures, article 119 of the Decree established a 110% tax credit on expenses to improve the energy efficiency of residential buildings and their anti-seismic features. Thus, the Government would cover the entire cost of the works, plus an additional 10% of the total amount as an incentive to carry out the works or to cover the interest on the restructuring loan.

Besides its 110% coverage rate, the characteristic feature of this tax credit scheme was the possibility to get an upfront benefit instead of a tax credit from future income taxes, through the transfer of the credit to third parties, including banks and insurance companies (art. 121 of *Decreto Rilancio*). Alternatively, it was also possible to obtain an invoice discount directly from the construction company after selling the credit to it.

The measure originally interested interventions from July 2020 to December 2021, and was later extended to 2022 and most of the works carried out in 2023. Subsequent revisions extended the time horizon of the incentive to 2025, reducing its coverage rate to 70% of total costs in 2024 and 65% in 2025, with a few exceptions in which the original rate still applies. Moreover, with the *Decreto Cessioni*[5] issued in February 2023, the Government stopped the possibility of transferring the credit to third parties.

Prior to the introduction of the *Superbonus*, Italy already had a number of tax incentives for the renovation and the energy efficiency of buildings, as well as for seismic risk reduction, with varying coverage rates.[6] Accordingly, the *Superbonus* can be seen as a boosted version of already existing fiscal incentives, with a higher coverage rate.[7] At the same time, the possibility of credit transfer allowed also low-income households - whose tax base would have been insufficient to enjoy full detraction of the expenses - to access the incentives. In this respect, the *Superbonus* was an absolute novelty.

The original purpose of the *Superbonus* was twofold (MEF and Finance 2023). In the short term, it was to act as an instrument of countercyclical fiscal policy, capable of stimulating the economy after the deep recession caused by the pandemic. In the medium term, the aim was to generate a structural impact on the energy efficiency of buildings and the related energy costs. Potentially, the overall value of buildings could also increase, thereby raising households' net worth, which in turn could lead to higher consumer spending.

A fiscal measure somewhat similar to the *Superbonus* was the *Facades Bonus*, introduced with the Budget Law for 2020 and designed for the outside redecoration and repair of buildings, including industrial ones. It provided a tax credit of 90% in 2020 and 2021, which was reduced to 60% in 2022 and ceased to apply in 2023. The possibility to transfer the tax credit to third parties was valid also for this measure as of October 2020.

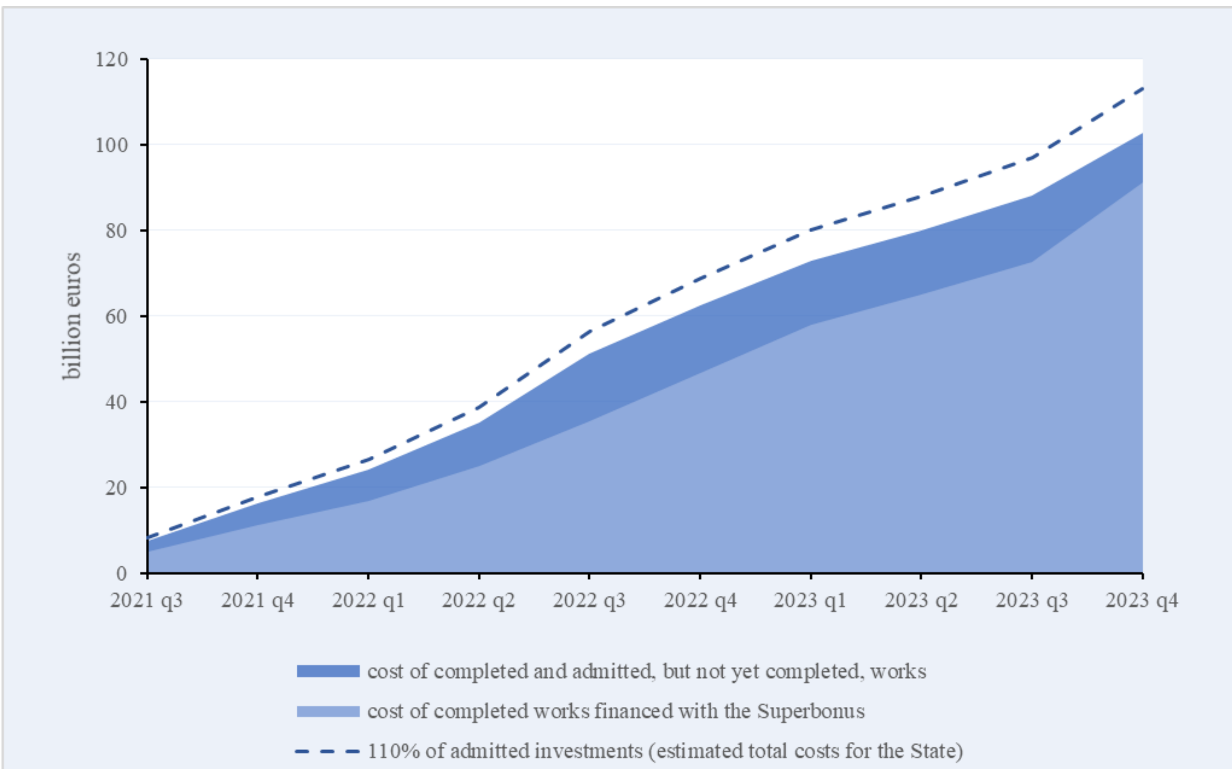
[5] d.l. 17^{th} February 2023, n. 11.

[6] Among others, we must mention the *Ecobonus* (since 2008, 50-85% coverage rate depending on the specific energy-efficiency intervention), the *Sisma bonus* (since 2017, 50% coverage rate, buildings in seismic risk areas), the *Bonus Casa* (since 2018, 50% coverage rate for house renovations).

[7] The Italian fiscal revenue authority (Agenzia delle Entrate) provides an overview of the fiscal incentives related to home renovation already existing before the introduction of the *Superbonus* 110%, available at https://www.agenziaentrate.gov.it/portale/web/guest/aree-tematiche/casa/agevolazioni .

Before going any further, it should be emphasised that our analysis cannot disentangle the distinct effects of each of the two tax incentives, given their similar coverage rates and their temporal overlap. Accordingly, what we aim to measure is not the effect of the *Superbonus* or the *Facades Bonus* alone, but rather the combined, additive, effect of the two measures, which began to unfold their effects almost simultaneously, once the first waves of the Covid-19 pandemic allowed the construction sector to plan and resume its activities.

Figure 2: Investments related to the *Superbonus 110%* program (*Super Ecobonus* component), 2021-2023, current prices.



Notes: The Figure shows the cumulative quarterly investments in residential buildings financed with the Superbonus incentive, for the works implying an energy-efficiency upgrade (excluding anti-seismic interventions, the so called Super Sismabonus). The lighter-blue area represents the completed investments financed through the Superbonus, the darker blue area the completed works plus the admitted (but not yet completed) works. The black dotted line corresponds to the 110% of the admitted works, thus representing a measure of the expected State costs for this measure. Monitoring only started in the third quarter of 2021. Source: own elaborations on ENEA data.

To give a sense of the dynamic, Figure 2 shows the evolution of investments admitted to be financed through the *Super Ecobonus* (the branch of the *Superbonus 110%* related to energy efficiency interventions) scheme since the third quarter of 2021.[8] By September 2021, a year after the implementation, admitted investments amounted to €5.1 billion. Since then, expenses increased strongly, also in response to a) the gradual recovery from the pandemic crisis and the phasing out of containment measures (MEF and Finance 2023) and b) the soaring costs affecting the construction sector as many others (the price index of production in the construction sector rose on average by 3.7% in 2021, 8.2% in 2022 and 1.3% in 2023, after years of moderate growth). The pace of *Super Ecobonus* investments only slowed down in the second quarter of 2023, also due to the restrictive normative changes described above, but they surged again in the last quarter of the year, consistently with the expected cut in the coverage ratio in 2024. By the end of December 2023, total investments admitted in detraction have reached €102.7 billion, of which €91.1 billion for completed works. The estimated gross burden for the State is the 110% of the former data point (the dashed line in Figure 2).

3 Literature review

The synthetic control method (SCM) was originally proposed to estimate the effects of particular events or policy interventions on a specific variable of interest when a small number of large units is observed, and one of them is treated while the others are not. In a nutshell, the idea is to take the variable of interest (target variable) associated to the treated unit and use a weighted average of the control group of non-treated units (*donor pool*) to build a synthetic time series that matches the real one in the pre-intervention periods. The synthetic series can then be used to build a counterfactual representing how the outcome variable in the treated unit would have performed in post-intervention periods in absence of any treatment. The strength and credibility of synthetic controls depend on a number of contextual and technical requirements, which are discussed in the following section.

[8]The monitoring activity by ENEA started in August 2021, and it only accounts for the cost of energy-efficiency renovations.

The technique was first introduced by Abadie and Gardeazabal (2003) to estimate the effects of the thirty-years-long terrorist activity by ETA on the economic growth of the Basque Countries. In a subsequent work, the authors investigate the effectiveness of Proposition 99, a large scale tobacco control program launched in California in 1988 (Abadie, Diamond, and Hainmueller 2010). They also linked synthetic controls with comparative case studies, a branch of the literature that evaluates the effects of certain events comparing similar entities. An example is the research by Card and Krueger (1994), confronting the evolution of employment in New Jersey and its neighbour Pennsylvania, after an increase in New Jersey's minimum wage.

In recent years, synthetic controls have become popular and have been applied to a wide range of events, such as large-scale natural disasters (Cavallo et al. 2013), a law to deter the hiring of unauthorized immigrant workers in Arizona (Bohn, Lofstrom, and Raphael 2014), the German reunification (Abadie, Diamond, and Hainmueller 2015), the decriminalization of sex work in Rhode Island (Cunningham and Shah 2018), and a post-pandemic official debt relief program designed to ease financial constraints and reduce bond spreads in low-income countries (Lang, Mihalyi, and Presbitero 2023). Much closer to our paper is the recent study by Accetturo, Olivieri, and Renzi (2024), who also look at the impact of tax incentives for dwelling renovations in Italy after the pandemic.

In case more than one unit is affected by the event of interest, the same method can be applied. Bifulco, Rubenstein, and Sohn (2017) use synthetic controls to evaluate the effect on enrollments and graduation rates of a district-wise school reform in Syracuse, New York, which introduced full-tuition scholarships and student support services; Acemoglu et al. (2016) try to explain the outstanding performance of some financial firms after Timothy Geithner was appointed Secretary of the Treasury in October 2008. In this case, the "treated" units were those firms whose executives had met or collaborated with Mr. Geithner, former president of the FED of New York, suggesting the relevance for policy makers of the advice from a small number of trusted experts in periods of great turmoil. Another study involving multiple treated units links the disruption of trade access due to the closure of the Grand Canal to the social unrest that followed in XIX century China (Cao and Chen 2022).

4 Methodology and data

Consider a group of $J+1$ units, where $j=1$ is the unit affected by the policy and $j=2,...,J+1$ are the unaffected control units, or *donor pool*. Assume to observe the units for T periods and the policy intervention occurs at T_0. For each unit, there are data about the outcome of interest Y_{jt} and a set of k predictors $(x_{1j},...,x_{kj})$ which may include lagged values of the outcome. The $k\times 1$ vector $\mathbf{X}_1$ contains the predictors of unit 1, and the matrix $\mathbf{X}_0=[\mathbf{X}_2,...,\mathbf{X}_{J+1}]$ collects the same vector for each control unit. Define also Y^I_{jt} and Y^N_{jt} as the outcome of unit j under and in absence of the treatment, respectively. Then, the effect of the intervention for the treated unit is:

$$\alpha_{1t}=Y^I_{1t}-Y^N_{1t}, \qquad t>T_0. \tag{1}$$

Unit 1 is exposed to the intervention at period T_0: it follows that $Y_{1t}=Y^I_{1t}$. The challenge is to estimate Y^N_{1t}: a synthetic control estimator for it is a weighted average of the outcome observed in unaffected units (equation 2). In fact, a synthetic control should reproduce the characteristics of the treated unit better than every other individual available comparison unit. This is often the case when the observed units are aggregate entities, such as countries, and there may be no single unit sufficiently "similar" to the treated one to provide a good comparison.

$$\hat{Y}^N_{1t}=\sum_{j=2}^{J+1}w_jY_{jt} \tag{2}$$

Hence, the quantitative appraisal of the policy intervention is the difference between the actual evolution of the outcome in the affected unit and an estimate of how it would have evolved in absence of intervention (equation 3). Notice that such effect may vary over time.

$$\hat{\alpha}_{1t} = Y_{1t} - \hat{Y}^N_{1t}, \qquad t > T_0. \tag{3}$$

The next step is to determine the weights $(w_2, ..., w_{J+1})$. Indeed, two vectors are needed: $\mathbf{W}$ $(1 \times J)$ and $\mathbf{V}$ $(1 \times k)$ contain the weights that reflect, respectively, the contribution of each unit in the donor pool to the construction of the synthetic series and the relative importance of each variable in approximating Y^N_{1t} in post-treatment periods, which is based on pre-treatment data. The computation of weights involves a quadratic programming routine.

As suggested by Abadie (2021), the choice of $\mathbf{W}$ results from the minimization of the difference between pre-intervention predictors of the treated unit and the synthetic control. The problem is solved by taking $\mathbf{V} = (v_1, ..., v_k)$ as a vector of constants; each different choice of $\mathbf{V}$ yields a synthetic control $\mathbf{W}(\mathbf{V})$. The only restriction is that the weights are postitive and sum to one.

There are a few alternatives to choose $\mathbf{V}$, including running an out-of-sample validation. Here, we stick to Abadie's early works (Abadie and Gardeazabal 2003; Abadie, Diamond, and Hainmueller 2010), where $\mathbf{V}$ is selected such that $\mathbf{W}(\mathbf{V})$ minimises the root mean squared prediction error (RMSPE) with respect to Y^N_{1t} over pre-treatment periods (see equations A1 and A2 in the Appendix for details).

The solution is the optimal $1 \times k$ vector $\mathbf{V}^* = (v^*_1, ..., v^*_k)$. Notice that $\mathbf{W^*} = \mathbf{W}(\mathbf{V}^*)$, so the weights assigned to variables directly influence the values of the weights assigned to control units. In the end, in each period t the synthetic series responds to the estimator:

$$\hat{Y}^N_{1t} = \sum_{j=2}^{J+1} w^*_j Y_j t \quad , \quad t = 1, ..., T \quad , \quad w^* \in \mathbf{W}^*. \tag{4}$$

To assess the validity of the proposed heuristic procedure, an immediate way is to observe whether $\mathbf{X}_1 \approx \mathbf{X}_0\mathbf{W}^*$ and $Y_{1t} \approx w_2(\mathbf{V}^*)Y_{2t} + ... + w_{J+1}(\mathbf{V}^*)Y_{J+1t}$ for $t \leq T_0$. Much of the credibility of the synthetic control method relies precisely on these two conditions over the pre-treatment period. First, the weighted average of predictors in control units should be close to the average of the corresponding variables in the treated unit, that is, the characteristics of the treated unit and the synthetic control are similar. Second, the synthetic series should match with the greatest possible precision the historical one; it follows that the longer the period over which the synthetic control is able to replicate the outcome of the treated variable, the stronger the results, despite no perfect match on predictors (Botosaru and Ferman 2019).

A more subtle observation is required. The computation of weights involves a two-fold problem, the minimization of both the distance between the series of the outcome and the difference between each predictor and its weighted counterpart. Yet, no regression is run to relate the outcome and its predictors. Still, a data-generating process should be assumed, to check that the donor pool shares the same drivers of the treated unit, and study the potential bias of the synthetic control estimator. Following Abadie, Diamond, and Hainmueller (2015), consider the linear factor model:

$$Y_{jt}^{N} = \delta_t + \theta_t \mathbf{Z}_j + \lambda_t \mu_j + \epsilon_{jt} \tag{5}$$

where $\mathbf{Z}_j$ and μ_j capture the observed and unobserved predictors of the outcome (*factor loadings*), respectively, while the coeffients θ_t and λ_t are the *common factors*. Despite model 5 is never estimated, it is pretty useful to characterise the bias of the estimator: the source of bias is the vector of unobserved loadings μ_j. Let $\mathbf{X}_1$ contain $\mathbf{Z}_1$ and the outcome $\mathbf{Y}_1$ in all pre-intervention periods for the treated variable, while $\mathbf{X}_0$ contains the same variables for control units. The prediction is that the lower the ratio between unit-specific shocks ϵ_{it} and number of pre-intervention periods T_0, the lower the bias. The intuition is the following. If $\mathbf{X}_1 = \mathbf{X}_0\mathbf{W}^*$ (which rarely holds exactly, but is a necessary condition to rely on the method, as stated above), then the synthetic control matches $\mathbf{Z}_1$. If this happens, but there is large heterogeneity due to unobserved loadings μ_j, the estimator can be unbiased only if the differences in unobserved factors is compensated by large individual shocks ϵ_{jt}. Hence, the ratio ϵ_{jt}/T_0 controls for the bias (the lower, the better): as mentioned before, also a longer pre-intervention series is an indicator of low bias.

A number of questions may arise about the opportunity to adopt a more standard linear regression approach, such as a panel setup, instead of a synthetic control method. There are at least three reasons why the latter should be preferred (Abadie 2021). First, the linear factor model (equation 5) allows for time-varying unit effects, that is, the impact λ_t of unobserved variables (μ_j) may change over time: this is contrast with panel models, which requires unit-specific unobserved effects to be time-invariant ($\lambda_t = \lambda$).

The second reason to prefer synthetic controls is their simple interpretability, as the contribution of each control unit is captured by its weight. Hence, the construction of the "counterfactual" is particularly transparent, and the sparsity of synthetic controls (most units in the donor pool are often assigned a null weight) allows for interpretations and evaluations based on field knowledge.

Moreover, if the effect of an intervention is estimated trough a regression, it is usually restricted to be constant. On the contrary, the synthetic control estimator for $\hat{\alpha}_{it}$ (equation 3) allows such effect to vary across post-intervention periods. This detail is particularly relevant in case of the fiscal incentives considered here, as will be clear in the following sections.

4.1 Data and treatment

Our policy (treatment) of interest is the introduction of the unprecedented incentives for dwelling renovations, which started to deploy their effects in 2020. The outcome variable is the level of investments in dwellings per capita, in nominal terms: such variable includes the amount of residential investments financed by the two incentives under analysis.

The selected control units for Italy are a group of countries sharing a similar economic cycle. Accordingly, we first consider all countries that are members of both the OECD and the Euro Area (EA), plus the United Kingdom because of its strong links with the EA economies. From this set, we exclude Belgium, Estonia and the Slovak Republic because some of the necessary time series are not available; Latvia, Lithuania and Slovenia because of their late EA membership; and Luxembourg and Ireland because of the peculiarities of their economy. We end up with nine control units: Austria, Finland, France, Germany, Greece, the Netherlands, Portugal, Spain, and the United Kingdom.

The main hypotheses for the synthetic control method to be valid and suitable for identifying a counterfactual are the so-called standard stable unit treatment value (SUTVA), the non-anticipation of the treatment, and the absence of similar treatments in the other control units. The first hypothesis is only valid if the treatment in question does not affect the outcome variables in other countries of the donor pool. Given that the housing renovation sector is strongly linked to the domestic economy, it is unlikely that the treatment under analysis had a significant impact on non-Italian dwellings investments. To motivate the second hypothesis, it suffices to say that households and firms could not anticipate the treatment, being part of the fiscal response to the Covid-19 crisis. Finally, to substantiate the validity of the third hypothesis it is necessary to demonstrate that similar policies have not been implemented by other countries in the donor pool. Upon reviewing the primary fiscal measures adopted to address the challenges of the Covid-19 pandemic, it can be concluded that analogous schemes introduced in other donor pool countries were not comparable in terms of coverage rates (90-110%), amount of resources (close to 9% of GDP), and the possibility for households to accrue and sell the tax credit to third parties, such as banks, to obtain liquidity for renovation works.[9] This ensures that our policy of interest was an *unicum* during the period considered and that the outcome variable in the control units was not affected by an analogous treatment.

Table 1 reports an overview of the variables contained in our dataset. As outlined, our main goal is to assess the combined impact of the *Superbonus 110* and the *Facades Bonus* on the gross fixed investment in residential constructions, our target variable. The choice of

[9]The French program *MaPrimeRénov*, introduced in 2020 had a budget allocation of 0.6 billion in 2020, 2 billion in 2021 and 2.4 billion in 2022. Spain, Portugal, Greece, and Germany have a budget of 11.8 billion, 6 billion, 2.6 billion, 2.6 billion, respectively, for energy efficiency expenditures in buildings financed though the Next Generation Eu resources (European Commission 2024). Similarly, Accetturo, Olivieri, and Renzi (2024), also stress that there was no equivalent massive support to restructuring activities in other EU countries.

the control variables, acting as predictors in the construction of the counterfactual, is mainly based on the relevant literature and in particular on a recent work on housing investment by Canizares Martinez, Bondt, and Arne (2023).[10] Following their study, selected data used as predictors for the target variable include time series related to the economic cycle (private consumption, gross fixed investment net of the residential component), demography (total population), credit conditions and housing market (total loans to households, short-term interest rate, house price index, residential building permits). We also add the Containment and Health Index developed by the University of Oxford to account for the heterogeneous severity of the Covid-19 shock across the countries in our sample.[11] It is useful to recall here that covariates in the SCM do not directly build the counterfactual series, but they only enter the optimization algorithm to assign the weights to the control units.

Both the target variable and the preditors are collected for the ten aforementioned countries (including Italy) and span from 2010q1 to 2023q4. As reported in Table 1, all the variables are at quarterly frequency; those in euros are expressed in per-capita, nominal terms and are seasonally adjusted. All the data are publicly available and sourced from the OECD (Dwellings, Net investment, Consumption, Population, Loans, Shoer-term rates, House price), Eurostat (Building permits), an the Oxford University (Covid-19 index). The time series on Dwellings, Net investment, and Consumption are from quarterly National Accounts.

[10]The study applies a model averaging approach to forecast housing investment using a wide set of short and long-run determinants of this variable related to house prices, busyness cycle, income, credit, mortgage interest rates, demography, and unemployment. We follow their scheme selecting the combination of variables that allows us to better fit the data.

[11]The Containment and Health Index is a composite measure based on thirteen policy response indicators including school closures, workplace closures, travel bans, testing policy, contact tracing, face coverings, and vaccine policy. If policies vary at the subnational level, the index is shown as the response level of the strictest sub-region.

Table 1: Dataset

Variable	Definition	Unit	Frequency
Dwellings	Gross fixed investment in residential buildings (dwellings)	Euros per capita, current prices	Quarterly
Net investment	Gross fixed investment minus dwellings	Euros per capita, current prices	Quarterly
Consumption	Private consumption	Euros per capita, current prices	Quarterly
Population	Total population	Millions	Quarterly
Loans	Total loans to households and NPISH	Euros per capita, current prices	Quarterly
Short-term rates	Short-term interest rate	Percentage	Quarterly
House price	Nominal House Price Index, divided by consumption deflator	Index, 2015 = 100	Quarterly
Building permits	Residential building permits, m^2 of surface area	Index, 2015 = 100	Quarterly
Covid-19 index	Containment and Health Index	Index/1000	Quarterly

Notes: The table describes the variables included in the dataset. Those expressed in euros are at current prices, seasonally and calendarly adjusted; all variables are at quarterly frequency. NPISH are non-profit institutions serving households.

As mentioned, we set the starting period of our analysis back at the first quarter of 2010, right after the financial crisis which produced a structural break in the series. We end up with fourty-two pre-treatment periods.[12] A long pre-treatment span may complicate the computation of a suitable synthetic series, but at the same time strengthens the validity of the counterfactual: as the observed series of the treated unit is replicated for a longer time, the post-treatment divergence from the counterfactual can be attributed to the treatment itself with greater confidence. Moreover, extending the pre-treatment period allows to capture a more dynamic (declining) trend of housing investment in Italy, that remained, instead, almost flat (and, thus, mostly uninformative) over the period 2015-2019 (see Figure 1).

We set the initial treatment period at the third quarter of 2020. The *Superbonus* was approved in May 2020, but the actual implementation started few months later, in August, when the related implementing decrees were issued. The *Facades Bonus* was approved in December 2019. However, the economic activity in Italy in the first half of 2020 was severely

[12]This is in line with most of the analogous exercises in the literature: for instance, Abadie, Diamond, and Hainmueller (2015) observe 30 pre-intervention years, similarly do Cavallo et al. (2013) with 38 periods.

limited by the pandemic containment measures. Accordingly, it seems appropriate to set the treatment period at the third quarter of 2020, the first in which both incentives were formally available and the containment measures were less restrictive.

5 Results

The synthetic series is built following the procedure described in the previous section. The weights estimated for the control units are summarized in Table 2, while those for the covariates are reported in the Appendix A2 (Table A1). Only three countries are assigned positive weights: namely, France, Greece, and the United Kingdom.

Table 2: Synthetic control weights for Italy

Country	**Weight**				
Austria	0	Germany	0	Portugal	0
Finland	0	Greece	0.476	Spain	0
France	0.469	Netherlands	0	United Kingdom	0.055

Notes: The table reports the synthetic control weights ($\mathbf{w}_j$) assigned by the optimization algorithm discussed in Section 4, equation 4.

The first and second column in Table 3 report a comparison between the pre-treatment predictors averages for Italy and its synthetic control. Net investment, private consumption and loans are averaged over the whole pre-treatment period 2010q1-2020q2, just as the short-term rates and the House Price Index. The lagged target variable (dwellings) is included in the set of predictors and is only averaged over the latest two pre-treatment periods (2020q1-2020q2), to allow the synthetic series to better fit the drop of observed residential investment (figure 5c shows what happens when dwellings are removed from controls). Building permits are averaged over an *ad hoc* time span, 2015q1-2020q2, contributing to build a more suitable counterfactual. The Covid index enters the estimation only for the two quarters preceding the treatment.

Ideally, the two values for each indicator should be equal, as the predictors of the synthetic Italy should match the observed ones. In practice, the synthetic averages only approximate the observed values ($\mathbf{X}_1 \approx \mathbf{X}_0\mathbf{W}^*$, see Section 4). A qualitative measure of the precision of this approximation can be found by comparing the synthetic predictor values contained in the second column with those that would be obtained by simply averaging the indicators of the whole set of countries in the donor pool (third column). In most cases, the methodology produces a vector of predictors ($\mathbf{X}_0\mathbf{W}^*$) which is closer to the observed one ($\mathbf{X}_1$) with respect to the simple average of the nine countries in the donor pool. The only variables which are poorly replicated by the synthetic control are private consumption and the Covid-19 index.

Table 3: Dwellings predictor means before the introduction of the fiscal incentives

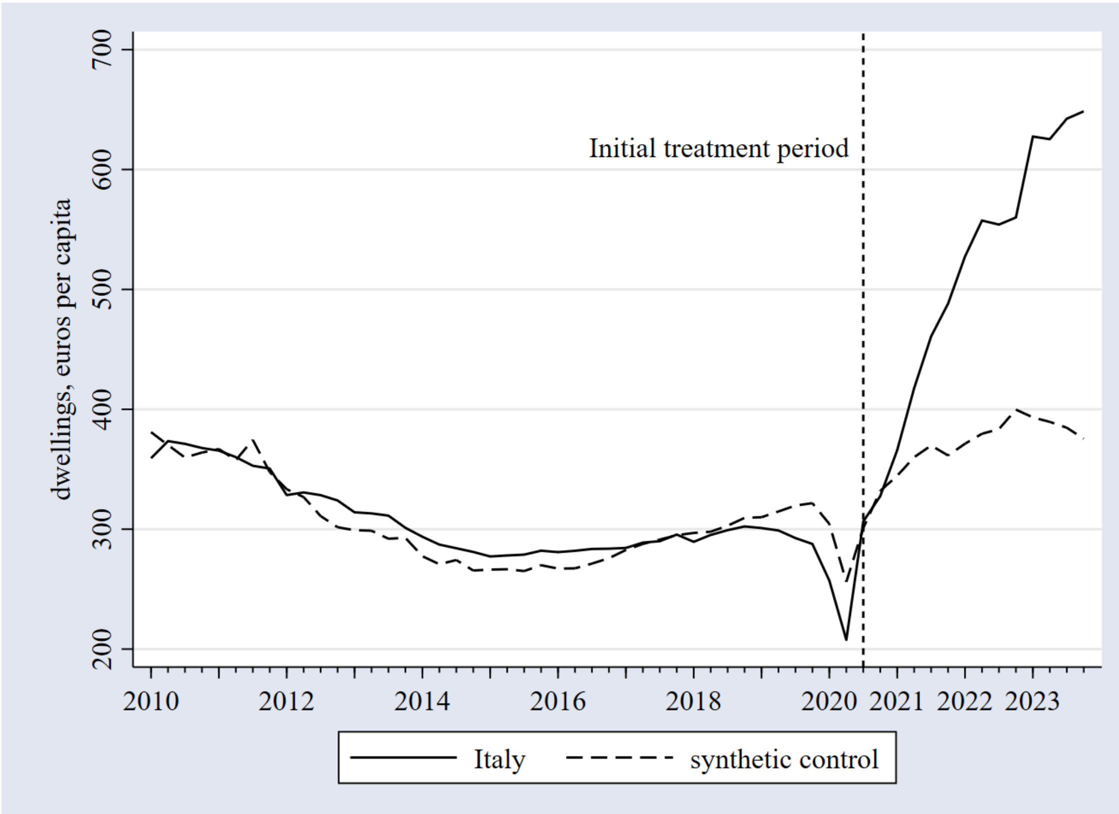
Variable	**Italy**	**Synthetic Italy**	**Control units average**
Dwellings (2020q1-2020q2)	232	280	455
Net investments	958	856	1,621
Private consumption	4,225	3,827	4,393
Loans	11,767	15,584	22,423
Short-term interest rates	0.17	0.19	0.22
Building permits (2015q1-2020q2)	1.16	1.30	1.30
House Price Index	1.07	1.08	1.06
Covid index (2020q1-2020q2)	5.4	3.6	3.5

Notes: The first column reports $\mathbf{X}_1$, the second column reports $\mathbf{X}_0\mathbf{W}^*$, the third column reports a simple average of $\mathbf{X}_j$ for the nine countries in the donor pool.

Figure 3 shows the main result of our analysis. The distance between the observed time series of residential investment (in nominal per capita terms, solid line) and its synthetic control (dashed line) provides an estimate of the additive investment in dwellings over time. Following our previous discussions, the latter corresponds to the investments which would have not been carried out in absence of the *Superbonus* and the *Facades Bonus*. The dynamic of the two series follows a similar pattern before the treatment in 2020q3; later they rapidly diverge, suggesting that the two incentives proved effective in boosting investment with respect to the counterfactual scenario with no incentives.

Their impact is not constant over time. Additive investments are almost null until the end of 2020; then the gap widens progressively before it peaks for the first time in mid-2022, at a value around 47% higher than the synthetic level. After this it stabilizes for a few quarters and then increases again, abruptly, at the beginning of 2023: at the end of the observed

Figure 3: Observed and synthetic (counterfactual) residential investment, 2010q1-2023q4, current prices, euros per capita.



Notes: The figure compares the time series of quarterly per capita residential investment (solid line) and its synthetic control in a counterfactual scenario with no fiscal incentives (dashed line). See Section 4 for details about the calculation of the synthetic series.

period, the level of residential investment is more than 1.7 times higher than it would have been in the counterfactual scenario.

By cumulating the quarterly difference between the observed and the counterfactual quarterly series, we find that by the end of 2023 the two incentives would have triggered almost €116 billion of additive residential investment out of the €186 billion of public resources used to finance them.[13] This result suggests that, on the one hand, the policy succeeded in boosting investments beyond a natural rebound effect following the 2020 recession. On the other hand, it generated a considerable deadweight loss, namely the amount of investment

[13]To compute the cumulated value in billions, we take the difference between the observed and the synthetic series in each post-treatment period, multiply it by the Italian population in the corresponding period, and cumulate the quarterly results over the post-treatment period.

financed by the *Superbonus* and the *Facades Bonus* that would have been carried out even without the introduction of the two incentives, i.e. €70 billion out of €186 billion.

Some caveats must be considered before going any further. After a brief acceleration that began in 2018, residential investment started to decline even before the pandemic, a peculiar dynamic compared to other countries in the control group. This should explain the imperfect fit of the two series in the quarters immediately preceding the adoption of the tax incentives.

The second caveat relates to the fact that our study only focuses on the effects of the two incentives on residential buildings. We therefore ignore the effects on commercial buildings that may have benefited from the measures, especially from the *Facades Bonus*, which was also targeted at the commercial real-estate sector. In this sense, the estimation approach may partially underestimate the additive effects on construction investment.

It should also be noted that public incentives for building renovation have been in place in Italy since 1998, albeit with less generous coverage ratios; and they continued to be in effect during the treatment period. Accordingly, we interpret the counterfactual (synthetic) dynamic of residential investment as the level of investment that would have occurred in the absence of the two *new* fiscal incentives: in this scenario, households would have continued to benefit from the pre-existing tax incentive schemes, as they did in the other countries included in the counterfactual.

Finally, it is likely that the two incentives under analysis had a crowding-out effect on planned investments due to higher prices or the lack of supply for construction works. Although we are not able to disentangle the crowding-out of investments, the difference between the synthetic and the observed series takes this into consideration, to the extent that the crowding-out did not happen in the donor pool countries.

5.1 Placebo and robustness tests

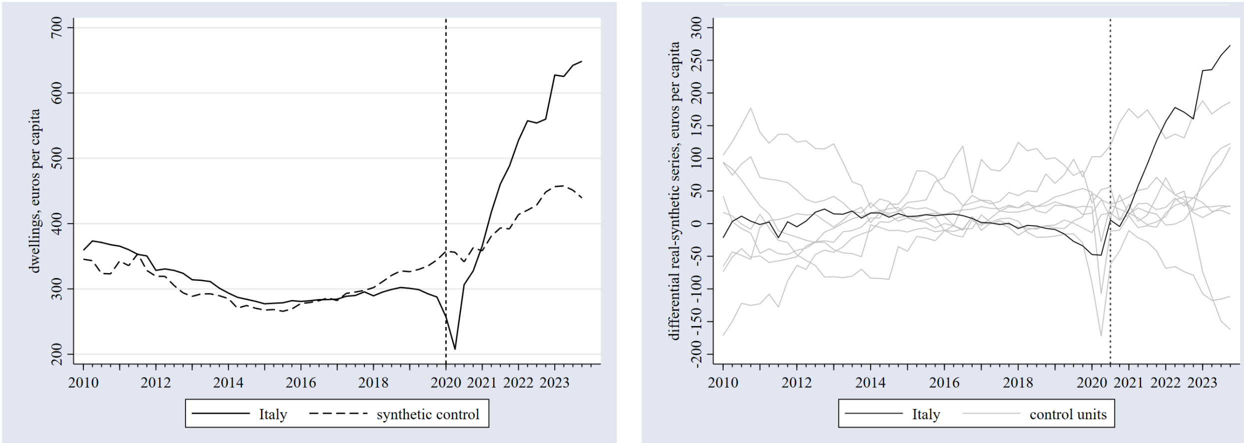
A number of validation techniques exist to test the results obtained from the application of the synthetic control method (see Abadie 2021 for an overview). Two of the most common consist in moving the treatment either in time or across units. In fact, this is equivalent to performing a placebo test: the original result should be compared with those obtained when the policy is artificially backdated or re-assigned as if it was adopted in a country which was indeed unaffected or in a period without actual treatment. A significant effect stemming from the placebo would be a warning that the observed discrepancy between the real and the synthetic series of the unit of interest may not be caused by the treatment itself.

First, we anticipate the treatment by two quarters, setting it to the first quarter of 2020 (Figure 4a), when the *Facedes Bonus* started to be formally available. We expect no considerable changes in the post-treatment dynamics, otherwise, if the effect was anticipated vis-a-vis the one observed in figure 3, we would suspect that the combination of the *Superbonus* and the *Facades Bonus* was not its ultimate trigger. Figure 4a indeed confirms the validity of our main result and strengthens the choice of the treatment period, as the dynamic of the counterfactual after the real treatment is similar even when backdating the intervention. In other words, the counterfactual series of residential investment started to diverge significantly from the historical series after our assumed initial treatment period, and not earlier. If anything, the amount of additive investment is smaller in the time placebo setting, because the synthetic series fails to catch the drop observed in Italy during the pandemics.

As a second test, we assign the treatment to a country in the donor pool different from Italy, compute its synthetic control, and repeat the procedure for each control unit. The distribution of the effects measured as the deviation of the real series from the synthetic ones are reported in figure 4b. We conclude that the effect of the fiscal incentives in Italy far outreaches all the placebo bonuses elsewhere, especially from mid-2021.

In addition, we exploit the transparency of the synthetic control to test the robustness of the results to changes in the composition of the donor pool and in the set of predictors. We repeat the estimation dropping from the control group each time one of the two countries that were assigned the greatest weights in the original exercise (see table 2), namely France and Greece - results are reported in figure 5. The quality of the fit inevitably deteriorates, with

Figure 4: Placebo tests, backdating the initial treatment and re-assigning it across units.



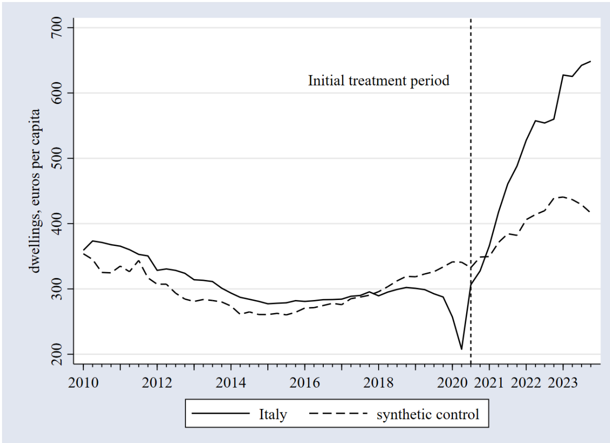
(a) In-time placebo.

(b) In-space placebo.

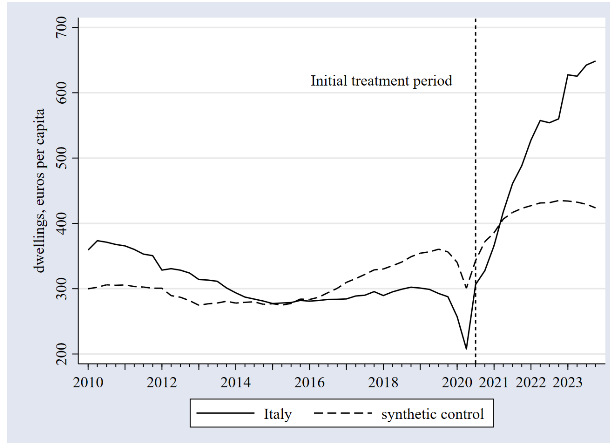
some differences: when excluding France, the series fails to capture the drop corresponding to the pandemics crisis (figure 5a); leaving out Greece implies a considerable loss in terms of Root Mean Square Percentage Error (RMSPE) (figure 5b). However, in any of these tests the general validity of the result is undermined, as the gap between the real and the synthetic series after the treatment is always sizeable and appears after the two fiscal incentives were fully available. Table A3 in the Appendix summarises the vectors of weights assigned to units in each different configuration.

Similarly, we check for the robustness of the result when excluding the lagged values of the target variable (*dwellings*) from the set of predictors. The resulting synthetic series is qualitatively similar to the previous exercise that excluded Greece (Figure 5c). Hence, including lagged dwellings is determinant to obtain a better counterfactual, but the post-treatment effect is robust to variations in the choice of predictors. As a final robustness exercise, we shorten the pre-treatment period, setting the start in 2015, after the sovereign debt crisis, to check that such macroeconomic shock does not affect the computation of our counterfactual. In fact, the quality of the fit shown in figure 5d is comparable to our baseline result (figure 3): on one hand, it better captures the drop of investment during the pandemic, while on the other hand it suggests a sort of ”anticipatory effect” which is very unlikely to

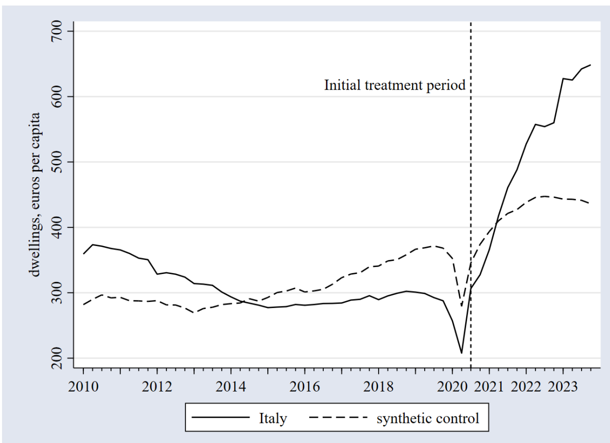
Figure 5: Robustness tests on the donor pool, on predictors, and on the pre-treatment period.



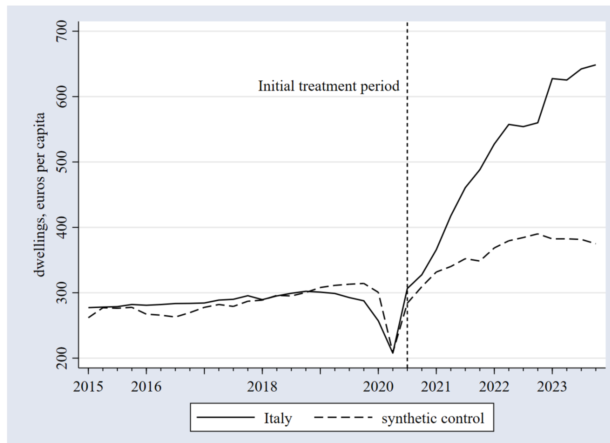
(a) No France



(b) No Greece



(c) No dwellings



(d) 2015q1-2023q4

have been in place, because the synthetic series is above the historical one already on the treatment period, when the incentives were still almost unused.

6 Conclusion

This study provides an understanding of the impact on the Italian residential construction sector of the *Superbonus 110%* and the *Facades Bonus*, two generous tax credits for the energy-efficiency renovation and for the outside redecoration and repair of buildings, whose effects began to unfold during the Covid-19 pandemic.

We apply a synthetic control method to isolate the effect of these fiscal incentives in stimulating investment beyond what would have occurred in a counterfactual scenario, thus indirectly evaluating their performance as a counter-cyclical fiscal policy tool.

Our results confirm that the *Superbonus 110%* and the *Facades Bonus* led to a significant increase in residential investment, amounting to about €116 billion additional investments between 2020 and 2023, compared to a gross cost of about €186 billion. This effect corresponds to the marked divergence of the observed Italian residential investment time series from its synthetic control after the treatment period, and highlights the additive effect of the two fiscal incentives on the economy. The flip side of the coin is that almost €70 billion of the expenditure related to subsidised investments would have occurred even without the introduction of the two tax credits, also thanks to the less-generous incentives for dwelling renovations already in place before 2020.

Our study casts serious doubts on the cost-effectiveness of the incentives, which also raise significant concerns in terms of distributional impacts and fairness. Moreover, the study does not deal with their effectiveness in terms of energy efficiency and seismic improvements, as well as their effects on prices. We leave the analysis of these important issues to future research.

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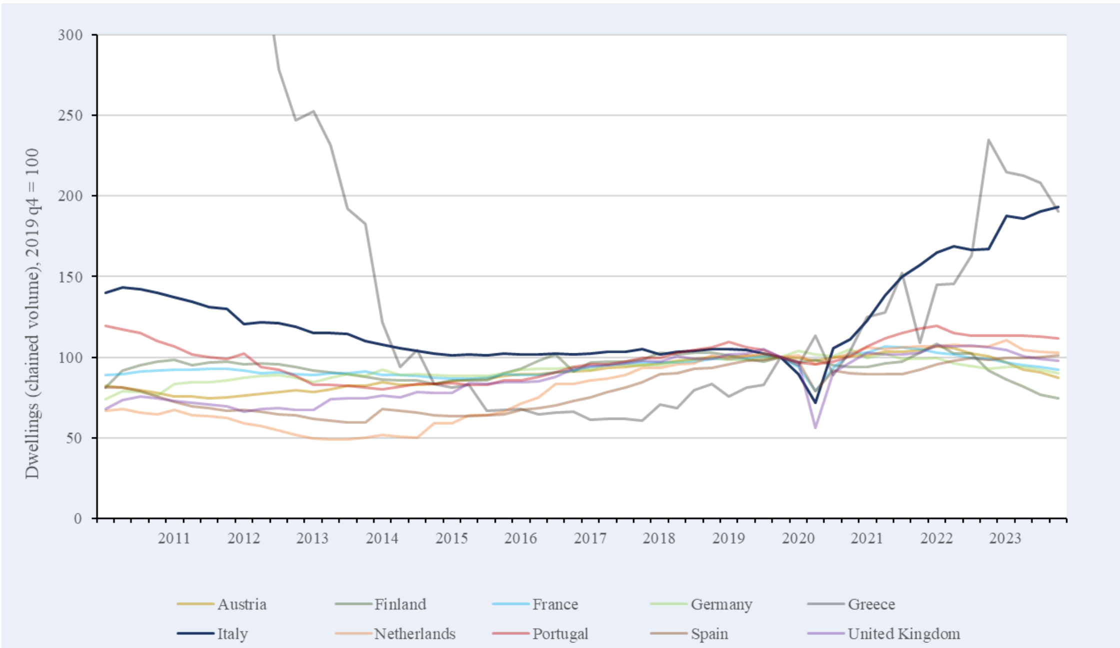
A Appendix

A.1 Investments in residential buildings, chained volumes

Figure A1: Gross fixed investments in residential buildings, chained volumes, 2010-2023.



Notes: The figure reports the gross fixed investments in residential buildings Italy and other OECD countries (Austria, Finland, France, Germany, Greece, Netherlands, Portugal, Spain and UK). Source: own elaborations on OECD data (updated to October 2024).

A.2 Synthetic control method, additional details

A.2.1 Minimization problem

Minimization problems to compute the vectors of optimal weights associated to control units (equation A1) and to predictors (equation A2).

$$\min_{w \in \mathbf{W}} \quad \|\mathbf{X}_1 - \mathbf{X}_0 \mathbf{W}\| \quad = \quad \left(\sum_{h=1}^{k} v_h (X_{h1} - w_2 X_{h2} - \ldots - w_{J+1} X_{hJ+1})^2 \right)^{1/2}$$
$$\text{s.t.} \quad w \geq 0, \sum w = 1 \tag{A1}$$

$$\min_{v \in \mathbf{V}} \sum_{t \in [1, T_0[} (Y_{1t} - w_2(\mathbf{V}) Y_{2t} - \ldots - w_{J+1}(\mathbf{V}) Y_{J+1t})^2 \tag{A2}$$

A.2.2 Additional Results

The tables below report additional results on the application of the synthetic control method to the introduction of the fiscal incentives in Italy. In particular, Table A1 reports the weights for predictors in the main exercise, while tables A2 and A3 refer to the robustness tests.

Table A1: Predictors weights v_k in the synthetic control

variable	v_k				
Dwellings	0.347	Short-term rate	0.174	House Price Index	0.040
Net investments	0.004	Loans	0.204	Covid index	0.020
Private consumption	0.204	Building permits	0.006		

Table A2: Predictors weights v_k in placebo test without lagged dwellings

variable	v_k				
Net investments	0.164	Loans	0.057	Covid index	0.146
Private consumption	0.405	Building permits	0.080		
Short-term rate	0.015	House Price Index	0.132		

Table A3: Country weights w_j in robustness tests (Figure 5)

	UK	France	Greece	Austria	Germany	Portugal	Other
original (Table 2)	0.055	0.469	0.476	0	0	0	0
no France	0	-	0.537	0.169	0.294	0	0
no Greece	0	0.435	-	0	0	0.565	0
no dwellings	0.266	0.327	0	0	0	0.406	0
2015q1-2023q4	0.664	0	0.	0	0	0.336	0

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