Taxing the ghosts: The public finance effects of curbing tax evasion*

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Abstract

This paper studies the public finance effects of fighting tax evasion. It focuses on the "Ghost Buildings" program: an anti-tax evasion policy carried out in Italy that detected more than 2 million of buildings not included in the land registry and thus hidden from tax authorities. The empirical strategy exploits cross-municipality variation in ghost buildings intensity and the staggered introduction of the program to implement a difference-in-differences analysis. Three main results are presented. First, a 1 standard deviation increase in municipality-level program intensity raises tax revenues by 2.3 percent: this corresponds to around four-fifth of the projected mechanical increase. Second, politicians increase local public goods provision, in particular for financing school facilities and, to a lower extent, security. Third, policy makers exploit the broader and more enforced tax base to raise the progressivity of local taxes on income and property. As a result of these policies, within-municipality inequality is gradually shrinking.

Keywords: tax evasion; tax enforcement; tax revenue; public spending; local taxes; inequality.

JEL Classification: H26; H71; H72

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1 Introduction

Whenever governments in past ages could insure that taxes would be collected only if they can *observe* the tax base - whatever it is. The government's ability to observe the tax base is crucial for the development of fiscal capacity (Besley and Persson, 2013), to prevent misallocation of resources in the economy (Skinner and Slemrod, 1985), and to set tax instruments more efficiently (Gordon and Li, 2009; Saez, Slemrod and Giertz, 2012; Best et al., 2015). If tax evasion could somehow be eliminated at null or low cost, the additional revenue could finance worthy government projects or cuts in tax rates that would benefit most compliant taxpayers. This paper provides empirical evidence on the public finance implications of tackling tax evasion from a nationwide policy instituted in Italy.

Tax evasion is a crucial challenge for Italy, where the informal sector accounts for a substantial share of the economy.[1] A major obstacle to enforce tax collection is the lack of an appropriate monitoring technique, a common feature of both the developed and developing world (Pomeranz and Vila-Belda, 2019). Italy has recently acquired the capability to electronically cross-check information on (taxable) buildings at a large scale. This allowed the *Agenzia del Territorio* - the Italian agency that monitors properties and real estates - to carry out the Ghost Buildings program: an anti-tax evasion policy aimed to identify buildings not registered on the land registry maps and thus missed from the tax base.

The program, started in 2006, consisted of two steps. First, land and registry maps are juxtaposed to obtain the Official Building Map. Then, Official Building Maps are overlapped with high-resolution aerial photographs of the entire country. A building is identified as "ghost" when it appears in the aerial photographs but not in the Official Building Map. Using this procedure, the government detected 2.238 million ghost buildings, representing a missing total cadastral rent of nearly 825 million of euros. The share of detected unregistered buildings - and thus the scope for collecting revenues - widely varies across municipalities (from 0 to 13 percent of the stock of total buildings).

I study the effect of the program on three public finance outcomes. First, from a policy perspective, it is crucial to evaluate how effective this large-scale program has been in raising tax revenues. The value of the buildings enters the tax base for the property tax (taxed at municipal level), income tax (taxed at central, regional and municipal level), and waste management tax (taxed at municipal level). The Italian Internal Revenue Agency (*Agenzia delle Entrate*) calculates that the mechanical increase in the tax

[1] Italians have been accused by some of making tax evasion a "national sport" (Povoledo, 2011). The tax gap is estimated at 34 percent by the European Commission (see *Study to quantify and analyse the VAT Gap in the EU Member States*, 2015) and at 30 percent by the Italian Ministry of Economy and Finance (see Annex 2 to the *Nota di Aggiornamento del documento di economia e finanza*, 2015). This translates into an average of 91.4 billion of euros per year, which are nearly 6.6 percent of the GDP. Moreover, Italy ranks among the lowest of all OECD countries on the *Paying Taxes* indicator (137th out of the 189 countries covered) and well below neighbouring and other large European Union member states.

base would generate additional revenues for a value of approximately 558.5 million of euros. Access to information on ghost buildings is crucial and necessary, but not sufficient for developing fiscal capacity. Other elements such as taxpayers' opportunity for substituting (illegal) evasion with (legal) tax avoidance (Slemrod, Blumenthal and Christian, 2011; Alstadsæter, Johannesen and Zucman, 2017; Carrillo, Pomeranz and Singhal, 2017), political constraints (Casaburi and Troiano, 2016) and corruption (Chander and Wilde, 1992) might raise less revenue than would otherwise be expected.[2]

Second, I study the effects on public spending composition. The national government established that any increase in municipality tax revenue engendered by the program is offset by a decrease in government grants (decrees 262/2006 and 81/2007). The implications of these decrees are twofold: i) the *total* effect on local revenue is expected to be null; ii) assuming a positive increase in tax revenue, then the *composition of local revenue* would change. Political agency models of public finance (e.g., Besley and Smart, 2007) predict that relying more on tax revenue (instead of transfers) decreases moral hazard and rent-seeking behaviors by politicians. Public spending financed more by tax revenues would thus reduces rents and improves the quality and provision of public goods. Italian local governments are a good context for investigating whether politicians spend tax revenue differently from non-tax revenue since municipalities are in charge of providing a large array of public goods and services to citizens, such as public transportation, school facilities, welfare, and manage public utilities.

The final analysis focuses on local marginal tax rates. The two main taxes levied by Italian municipalities are on personal income (where the marginal tax rates may differ across income brackets) and on properties different from the main residence (which is tax exempted), with the notable exception of luxury properties that are taxed even if reported as main residence. After the implementation of the program, local policy makers have two alternatives: to raise taxes to benefit from a broader and more enforced tax base or to cut them to compensate non-evaders and perhaps gain political consensus. How the optimal tax rate should vary when the tax base changed as a result of stricter enforcement is theoretically ambiguous (Keen and Slemrod, 2016) and the empirical literature is relatively scarce. At the one hand, an increase in the tax rate would result in a greater revenue increase for a given increase in the tax base, thus suggesting strategic complementarity between the tax base and the tax rate. However, stricter enforcement might also affect the behavioral response of taxpayers to the tax rate (e.g., Fack and Landais, 2016). In particular, if stricter enforcement makes taxpayers more responsive to changes in tax rates, then strategic complementarity may fail and policy makers would be less keen to increase taxes.

The empirical analysis is based upon administrative records, provided by the Italian Internal Revenue Agency, on the ghost buildings program. This database collects

[2]Gemmell and Hasseldine (2014) stress the importance that evaluations of anti evasion programs should not abstract from behavioral responses.

municipality-level information on the total number of buildings, the number of ghost buildings, and the program start date. I merge these information with data on tax revenues and public spending composition from municipal balance sheets and with local tax rates for each municipality over the 2001-2015 period. Then, using a difference-in-differences empirical strategy, I estimate the impact of the program by exploiting variation in ghost building intensity across municipalities, controlling for municipality, year $\times$ province, and year $\times$ election year fixed effects. *Ceteris paribus*, in places with a larger prevalence of ghost buildings, there is higher opportunity to increase tax revenues, adjust public spending composition, and change local marginal tax rates. The analysis is also complemented with a triple difference strategy, exploiting the fact that the policy was not implemented in the Trentino Alto-Adige region.

I find that the program has significantly increased tax revenue. A 1 standard deviation increase in the share of ghost buildings leads to a stable and persistent increase in tax revenue of nearly 2.3 percent of the pre-program mean. A back-of-the envelope calculation suggests that the increase in tax revenues is equal to around 77 percent of the projected mechanical variation in the tax base generated by the program. This discrepancy between predicted and actual revenue might arise from several channels. First, I find that the effect of the program is significantly lower in places with more *opportunity* for tax evasion (proxy by the share of self-employment income): this result is in line with the previous studies (*e.g.*, Slemrod, Blumenthal and Christian, 2001; Kleven et al., 2011) showing that effectiveness of anti-evasion policies depends not only on the intrinsic motivation of individuals to comply (i.e., their tax morale), but also on their opportunity to evade. Second, the impact was relatively larger where residents are more likely to blame tax evaders (using information from survey data), suggesting that cultural factors may stifle the collection of tax revenues (Besley and Persson, 2014). Third, I find that policy makers' ability (measured by their educational attainment) had a significant role in raising revenue: mayors without a college degree were relatively less successful (or willing to) induce ghost buildings registration, and, in turn, to raise tax revenue.

The analysis on public spending composition provides evidence that the way (local) governments are financed matter. Municipalities that benefited more from the program significantly raise educational spending and, to a lower extent, the share of spending in security activities (e.g., municipal police). In general, this result suggests that relying more on tax revenues instead of governmental transfers makes policy makers more likely to spend public resources toward budget items recommended by citizens. Yet, this shift in public spending composition depends on the degree of citizens' political engagement (proxied by the electoral turnout). I find that public spending on administration - a widely used proxy for political rents (Persson and Tabellini, 2000) - significantly increases in places with lower political participation. This underlines the role of information as a mechanism to exert pressure on politicians for reducing rent-seeking behaviors. At the individual-level, I find that the increase in spending for

school facilities is larger when the mayor is a woman, and that administrative spending significantly lowers in municipalities with high-skill politicians.

Policy makers took advantage of a broader and more enforced tax base to raise the progressivity of local taxes. This result holds both for the property and the income tax set by municipalities. I find a clear and gradual increase in the top marginal tax rate on personal income as well as on the property tax rate applied to buildings different from the main residence. By contrast, municipalities significantly cut the bottom marginal tax rate on personal income. This reduction in the tax burden for the poor is mostly implemented in places with a higher pre-program level of inequality (measured by the municipal pre-tax Gini index) and in places with relatively more left-wing political preferences (measured by the share of votes for left-wing parties on national elections), suggesting that the increase in tax progressivity was driven by both redistributive concerns and political preferences. Moreover, the increase in the top tax rate is substantially dampened where raising taxes would be significantly more costly (measured by the municipality tax base elasticity with respect to the net-of-tax rate). This finding has important implications for optimal tax policy: policy makers do discount for the expected behavioral response of taxpayers to tax rate changes in choosing tax policy.

In the final part of the paper, I study whether these policies have any impact on the distribution of incomes within a municipality. I use data on the income share held by the top decile of the pre-tax municipal income distribution as computed in Rubolino (2019) for each municipality and for every year during the period of interest. I find a gradual reduction in the income share held by the rich. While part of this effect might simply reflect measurement errors in computing income inequality over the pre-program period due to tax evasion (assuming that owners of ghost buildings were not equally distributed over the pre-program municipal income distribution), this result suggests that the Ghost Buildings program was successful both from an efficiency and equity perspective. By financing redistributive policies through a broader and more enforced tax base, the program turns out to be an effective policy to redistribute resources from evaders to non-evaders and from richer to poorer taxpayers.

1.1 Related literature

This paper contributes to several strands of the literature. First, it relates to the empirical literature studying the public finance effects of anti-tax evasion policy (see Slemrod and Weber, 2012, for a review) and, specifically, on the role of digitalization and third-party monitoring technique to tackle tax evasion (Gupta et al., 2017; Pomeranz and Vila-Belda, 2019). Casaburi and Troiano (2014) were the first to exploit the 'Ghost Buildings program to study whether fighting tax evasion increases the probability of re-election of mayors. The results offered by this paper provide several explanations (e.g., larger revenue, investments in school facilities and an increase in tax progressiv-

ity) for why curbing tax evasion is beneficial for electoral prospects.

Second, I contribute to the literature studying the effect of increases in tax revenues on public spending composition. Effects can be both positive or negative. One example of the adverse effect of government revenue on society is known as the "Dutch disease" hypothesis: windfall gains from natural resource can harm economic growth through market mechanisms, such as an appreciation of the real exchange rate. Another growing strand of the literature has focused on the perverse effect of government revenue on rent-seeking behavior of interest groups (as in the dynamic common pool models of Tornell and Lane, 1999 and Velasco, 1999). Combined together, this literature implies that any increase in government revenue make politicians more likely to engage in rent-seeking behaviors and, thus, have little impact on public goods provision (for empirical evidence see, e.g., Vicente, 2010; Brollo et al., 2013; and Gennari and Messina, 2014, for the case of Italy).[3] However, these studies exploit windfall gains from natural resources or increase in transfers from higher tiers of government, while this paper focuses on positive increases in *tax* revenues. As far as I know, this is the first study to consider the impact of tax revenues on public spending composition in the context of a high-tax evasion and developed country. Two recent notable exceptions are the papers by Martinez (2016) and Gadenne (2017), who reach a similar conclusion by investigating the effect of an exogenous increase in tax revenue on provision of public goods in the context of municipalities in Colombia and Brazil.

Third, I provide empirical evidence on complementarity between tax base broadness and tax progressivity. While a large empirical literature has studied taxable income responses to tax rates (see Saez, Slemrod and Giertz, 2012, for a survey of this literature; Rubolino, 2019, for Italy) or on how the legal definition of the tax base affects income reporting behavior (Kopczuk, 2005; Doerrenberg, Peichl and Siegloch, 2017), the novel contribution of this paper is to examine the effect of an exogenous increase in tax capacity on tax rates. This evidence relates to a recent work by Jensen (2019), which studies historical episodes of shifting from self-employment to wage labor in the US. Consistent with my finding, his results show that increasing information about individuals' income for the government substantially raised state-level income taxes.

The rest of the paper is organized as follows. Section 2 describes the Ghost Buildings program. Section 3 describes the data. Section 4 discussed the empirical strategy. Section 5 presents the main results of the analysis. Section 6 shows the effect of the program on the income distribution within a municipality. Section 7 concludes.

[3]Moreover, this literature shows that income tax revenues from broad-based sources, such as value-added tax and income taxes - are lower when there is a greater access to other forms of revenue. For instance, Jensen (2011) finds that a 1 percent increase in the share of natural resource rents lowers the share of taxation in GDP by 1.4 percent.

2 Background and conceptual framework

2.1 The "Ghost Buildings" program

In 2006, the Italian national government carried out the "Ghost Buildings" program: an anti-tax evasion policy aimed to identify buildings not registered on the land registry map.[4] The *Agenzia del Territorio* - the government agency managing the land registry - was in charge of implementing the program. The procedure consisted of two steps. First, land and registry maps are juxtaposed to obtain the Official Building Map. Then, Official Building Maps are overlapped with high resolution (50 cm) aerial photographs of the entire country.[5] A building is identified as "ghost" when it appears in the aerial photographs but not in the Official Building Map (see online appendix A for details on the procedure employed to detect ghost buildings).[6]

Using this procedure, the *Agenzia del Territorio* detected 2.238 million ghost buildings. These buildings include commercial, industrial, and residential stand-alone buildings, as well as any extensions of previously registered buildings not reported to the land registry. Over 1.260 million of buildings required to be reported to the registry and thus were missed from the tax base.[7] Among these, 35 percent are residences, 31 percent are warehouses, and 17 percent are garages.

To induce registrations of the ghost buildings, the *Agenzia del Territorio* started publishing information on the unregistered properties in the *Gazzetta Ufficiale della Repubblica Italiana* (i.e., the official journal of record of the Italian government). The publication process lasted three years (from August 2007 to September 2010) and it coded detailed information on the number of unregistered properties.[8] This difference in the year of publication among municipalities (and, thus, of the program start year) rests on the availability of digitized land registry maps. At the time the program started, only 60 percent of the land registry maps of the Italian territory was available. Then,

[4]The program cannot be attributed to a specific national government or party since politics were unstable in Italy when the program was carried out. Namely, a right-wing coalition (led by Silvio Berlusconi) governed during the first half of 2006, a left-wing government (led by Romano Prodi) operated until 2008, and then the right-wing government was again in charge between 2008 and 2011.

[5]The program did not cover the region of Trentino Alto-Adige since land registry maps are autonomously administered in that region.

[6]The law requires buildings to be reported to the land registry within thirty days after their completion (*Legge 9 Marzo 2006 n.80 - Art.34-quinquies*). All buildings in Italy require a building permit before starting the construction. The building permit makes the new building part of the City Plan. However, granting a building permit does not imply registration of the building in the land registry, since the two processes are independently administered. If a building is not part of the City Plan, then the law requires its demolition (*Regio Decreto Legge 13 Aprile 1939*, N. 652).

[7]The following buildings do not enter the tax base and are not required to be registered: i) buildings that are incomplete; ii) buildings that are particularly degraded; iii) solar collectors; iv) greenhouses; v) henhouses or other buildings reserved for animals (Law *Decreto Ministero delle Finanze, 2 Gennaio 1998*, n. 28, Art. 3).

[8]The *Agenzia del Territorio* published information in the *Gazzetta Ufficiale della Repubblica Italiana* over six waves: i) August 2007; ii) October 2007; iii) December 2007; iv) December 2008; v) December 2009; vi) September 2010.

the *Agenzia del Territorio* digitized the remaining land registry maps proceeding by province (i.e., by simultaneously coding different municipalities in the same province). Therefore, the publication year mostly varies by province: only one-tenth of the municipalities has a program start year different from the one they would have based on the modal date of publication in the province.

Buildings' registration on the land registry was not automatic. To facilitate registration, local administrators were required to: a) disseminate information about the ghost buildings;[9] b) proceed, with the support of municipal police, to follow-up inspections and imputation of the tax base of properties not voluntarily registered;[10] c) collect overdue taxes; d) check whether the building was conform with the City Plan and local zoning restrictions. The initial legislation allowed owners to register the ghost buildings by April, 2011. The owners were also required to pay overdue taxes since 2007 (or from the construction date when later), and to pay penalties for delayed payments.[11] Moreover, they charged extra penalties and a fee for delayed registration.

2.2 Local public finance implications of the program

2.2.1 Tax revenues

The value of a building enters the tax base for the property tax (taxed at municipal level), income tax (taxed at central, regional and municipal level), and waste management tax (taxed at municipal level). As shown by Table B1 in the online appendix, the total cadastral rent of the ghost buildings was of nearly 825 million of euros, implying an average per building value of 665 euros. The Italian Internal Revenue Agency (*Agenzia delle Entrate*) calculates that the mechanical increase in the tax base would generate additional revenue for a value of approximately 558.5 million of euros, summing up nearly 444 million of euros for the property tax, about 137 millions of euros for the income tax (including both central and local taxes), and around 7.5 million of euros from registration fees.

Casaburi and Troiano (2016) calculate that the owner of a registered ghost building will face, on average, an additional yearly tax burden of nearly 528 euros, and that 65 percent of the burden is paid in local taxes. This implies an average annual increase in municipal tax revenue of 343.2 euros for each ghost building. If confirmed, it would raise total municipal tax revenues by 3.7 percent of the pre-program sample mean. Using cross-municipality variation in the share of ghost buildings, this estimate

[9] To convince Italians to register undeclared homes in the land registry so that taxes could be levied on them, the publication process was further reinforced by nationwide advertisements on television broadcasts. The *Agenzia del Territorio* reports that the number of visits on its website substantially soared every time the advertisement was aired (Povoledo, 2011).

[10] In the case the owner of the building complaints with the imputed rental value of the building, he or she can file an appeal by 16 October, 2012.

[11] Penalties for delayed payments ranged from a minimum of 258 euros to a maximum of 1,032 euros until 2011. The decree 23/2011 - Art. 2 comma 12 increased them to 1,032 and 8,264 euros, respectively.

implies that, *ceteris paribus*, a 1 standard deviation increase in the share of ghost building would raise municipal tax revenues by 3 percent of the sample mean. To provide some examples, the program would increase tax revenues in the city of Rome - where 3,990 ghost buildings were detected - by around 1.4 million of euros. The town with the largest share of detected ghost-buildings - Isola di Capo Rizzuto (Calabria) - would experience an increase in tax revenues of two-thirds of its average pre-program level of tax revenues (around 1 million of euros).

However, all these estimates are only based on the *mechanical* variation in the tax burden faced by the owner of a registered ghost building. This imputed increase in tax revenue might not correspond with the actual observed variation for two reasons. First, taxpayers may respond to stricter enforcement for property income by making offsetting adjustments on less enforced tax bases, thereby reducing the total effect on tax revenue (Saez, Slemrod and Giertz, 2012; Slemrod and Gillitzer, 2013; Carrillo, Pomeranz and Singhal, 2017). For instance, if the increase in reported property income is substantially offset by an increase in tax avoidance or by hiding incomes from other sources, then the effect of the program on total revenue is ambiguous.[12] In short, the program might simply shift the taxpayer from evading to (legally) avoiding.[13] On the other hand, measures to reduce tax evasion might also increase real activity and, thus, total revenues (e.g., by limiting corruption or through network effects).[14]

Second, it depends on whether politicians consider worthwhile to fight tax evasion. Anti-tax evasion policies are canonical examples of policies that are asymmetric in their concentration of costs and benefits (Tullock, 1959; Olson, 1965). As shown by Casaburi and Troiano (2016), the incentives of political agents to curb tax evasion depend on their expectations on how the program would affect their probability to be re-elected. If politicians are less willing (or not able) to curb tax evasion, then registration rates

[12] In the canonical Allingham and Sandmo (1972) model, this assumption would allow the parameter that captures the probability that evasion is detected (p) to vary by taxable bases. In other words, the Ghost Buildings program would set $p_i \approx 1$ for property income, but, as far as the enforcement system for other tax bases is not perfect (i.e., $p_j < 1$ for $i \neq j$), then taxpayers might adjust reported incomes on other tax bases to keep net-of-tax income unchanged.

[13] Alstadsæter, Johannesen and Zucman (2018) study the relation between tax evasion and tax avoidance at the top of the wealth distribution. If evasion and avoidance are not very substitutable, fighting evasion by the rich might be an attractive way to boost tax collection, increase the progressivity of the tax system, and ultimately reduce inequality. But if they are very substitutable, the net effect on total revenues might be small or even negative. For instance, Slemrod, Blumenthal and Christian (2001) study taxpayers' reported income response to an increased probability of audit from a controlled experiment in the US. They find that the treatment effect - taxpayers are informed by letters that the returns they were about to file would be "closely examined" - depends on taxpayers' *opportunity* to evade (i.e., whether they have self-employment or farm income). Intuitively, taxpayers with different income sources can minimize their tax liability by shifting incomes from a more to a less enforced tax base. Consistent with this finding, Rubolino and Waldenström (2019) show that income shifting from a more to a less taxed tax base is particularly notable at the top of the income distribution.

[14] Maiselman (2018) investigates the impact of message content in communication with income tax nonfilers on the behavior of untreated neighbors and find no evidence of geographic network effects. On the other hand, Alstadsæter, Kopczuk and Telle (2018) provide suggestive evidence of tax avoidance across family networks, highlighting the role of social interactions in understanding enforcement and tax avoidance behavior.

and tax revenue would be lower than in the case all the buildings were registered.

Finally, a discrepancy between projected and actual revenues can arise because of measurement errors in estimating the mechanical variation in the tax base. These errors might be due, for instance, when policy makers had to impute of the rental value of buildings not voluntarily registered. Given the nature of the imputation process, some measurement errors are likely to arise, but owners of the building had the right to appeal for a re-evaluation of the rental value. Therefore, I would expect that these errors are, if any, negligible.

2.2.2 Public spending

The decrees 262/2006 and 81/2007 established that any increase in tax revenue brought about the program is offset by a decrease in government grants. The public finance implications of these decrees are twofold. First, the *total* effect on local revenue is expected to be null. Second, assuming a positive increase in tax revenue, then the *composition of local revenue* would change as a result of the program.[15] This change on how municipalities are financed raises the second question of interest: Do municipalities spend tax revenue differently from non-tax revenue?

Several mechanisms could explain why tax revenue are spent differently from non-tax revenue (see, e.g., Martinez, 2016, and Gadenne, 2017, for empirical evidence in the context of municipalities in Colombia and Brazil). First, it may reflect an information problem: tax increases are obviously visible by taxpayers, while an increase in revenues from government transfers might not be observed at all by citizens. Political agency models of public finance predict that politicians provide less public services and increase their rents when there are asymmetries of information over items of the public budgets (Besley and Smart, 2007). Therefore, assuming a positive increase in tax revenues, this model implies that the Ghost Buildings program would change the composition of public spending in favour of more public goods provision and lower rents.[16]

Second, an increase in taxes paid by citizens could make them more willing to demand more from politicians.[17] Intuitively, citizens paying more taxes might be more likely to monitor the politicians in order to check how their money are spent.[18] On the other hand, an increase in non-tax revenues does not have any (direct) cost on citizens and, thus, does not affect their behavior towards politicians. Therefore, an increase in tax revenue might induce politicians to divert public goods provisions toward budget

[15] These two statements are validated by the empirical analysis.

[16] Moreover, if politicians maximize public budget, then a positive shock in the share of revenues coming from taxes would increase public goods investments if they expect that these investments will increase the tax base in the next period (Weingast, 2009).

[17] Political scientists formulate this hypothesis as "no representation without taxation" (Ross, 2004; Moore, 2007).

[18] For instance, Weigel (2019) show that citizens demand better public infrastructure and more inclusive governance in exchange for larger taxes.

items that are recommended by citizens.[19]

To shed light on the link between how municipalities are financed and how they choose to allocate public resources, Figure 1 looks at the relative use of municipal capital spending in administration and education by the share of revenue from local taxes. Arguably, administrative and education spending are two opposite polar cases: spending in education is admittedly a policy preferred by the majority of voters. The cross-sectional correlation shown in the figure corroborates the predictions of political agency model discussed above: allocation of resources depends on how (local) governments are financed. In places where the share of revenues from local taxes is larger, share of spending in education is larger. By contrast, where municipalities are mostly financed through government transfers, the share of spending in administration is relatively larger.[20]

[Figure 1 about here]

2.2.3 Marginal tax rates

The third public finance effect of the Ghost buildings program analyzed is on local marginal tax rates. The main taxes levied by Italian municipalities are on income (on top of the tax rates set by the national and regional governments) and on property. Municipalities have power to set different income tax rates across income brackets (with a cap on 0.9 percent) and to decide the property tax rate that applied to second homes and to luxury properties reported as main residence (the main residence is tax exempted).

How policy makers would react to the program in setting local tax rates is not obvious. Intuitively, the increase in the tax base brought about by tighter enforcement increases the mechanical benefit (i.e., revenue gain) of increasing the statutory tax rate. Using a simple framework to analyze efficient level of tax administration, Keen and Slemrod (2016) show that the relation between tax base and tax rate is towards strategic complementarity.[21] However, a potential additional margin of adjustment in response to reduced level of tax evasion could be a tax cut to compensate non-evaders and gain political consensus. In this case, the relation between tax base and tax rate would be of strategic substitutability, and most of the gain from tackling evasion would be shifted from the evaders to the non-evaders.

Therefore, it is not *a-priori* obvious whether the tax rate and the tax base are strategic complements or substitutes. That is, whether an increase in the tax base - brought

[19] The notion that increases in tax revenue lead to more accountable and efficient public spending is also emphasized in the literature on the emergence of representative governments in developed countries (North and Weingast, 1989; Lindert, 2003).

[20] The figure focuses on spending *shares*, thus controlling for differences in total size of local government across places.

[21] A potential ambiguity of the positive relationship between tax base and tax rate is introduced by the impact that tighter enforcement has on the responsiveness of evasion to the tax rate (i.e., the cross-effect ϵ_{ta} in Keen and Slemrod, 2016, model).

about by stricter enforcement - would imply a higher or lower optimal tax rate. A broaden tax base would result in a greater revenue increase for a given increase in the tax rate. This suggests unambiguous strategic complementarity between tax base and optimal tax rate with respect to the revenue effect alone. However, stricter enforcement also changes the responsiveness of evasion to the tax rate. If stricter enforcement means that evasion is more responsive to the tax rate, then strategic complementarity may fail.

3 Data and descriptive evidence

3.1 Data

Ghost Buildings program. The analysis is based upon administrative records, provided by the Italian Internal Revenue Agency, on the Ghost Buildings program. This database collects municipality-level information on the total number of parcels, the number of parcels containing ghost buildings, and the program start date.[22] These information allow to define the *ghost buildings intensity* indicator as the share of ghost buildings detected (as a share of total buildings).

Cross-municipality variation in ghost buildings intensity is presented in Figure 2. The indicator varies from 0 to 13 percent and it has a mean (median) value of 1.8 (1.4). At the geographical level, tax evasion is significantly higher in the South and, although to a lesser extent, in the Center.

[Figure 2 about here]

To validate this indicator as a proxy for tax evasion, Figure 3 compares ghost buildings intensity (y-axis) with two regional-level estimates of the tax gap (x-axis).[23] The left-hand side graph compares ghost buildings intensity with Galbiati and Zanella (2012)'s estimate of the tax gap, which use data from tax audits of self-employed individuals (small individual businesses, including farmers and professionals) at the end of the 1980s. The right-hand side graph relates my indicator with a measure of evasion developed by Carfora, Vega Pansini and Pisani (2018) by using data from the Internal Revenue Agency over the 2001-2011 period and calculating the tax gap as the ratio between potential and actual tax revenue. The figure shows that both these two proxies for tax evasion are positively associated with the ghost buildings indicator (coefficients of correlation equal to 0.57 and 0.62).

[Figure 3 about here]

[22] Differently from Casaburi and Troiano (2016), which obtain data on registered ghost buildings up to April 2011, the dataset used in this paper is based on the final update on the program (October 2013).

[23] In this figure, the ghost building intensity indicator is computed as the municipal population-weighted regional average.

Municipal balance sheets. The empirical analysis links ghost building intensity for each municipality with data on tax revenue and public spending from the balance sheets of Italian municipalities. These are annual reports provided by the Italian Ministry of Interior (*Ministero degli Interni*) over the 2001-2015 period. Municipal balance sheets have been introduced with the aim to better monitor local public spending in the frame of the internal stability pact. The current accounting models authorized by the Italian Ministry of Interior are homogeneous both across municipalities and over the period of interest.[24] They include information on each of the following sources of revenues: local taxes; transfers from the central, regional or provincial government; transfers from the European Union; revenues from fees or fines; sales of public assets; loans.

To estimate the effect of the program on revenue, I focus only on revenue stemming from local taxes. They represent around one-fourth of the total municipal revenue. The share of revenue coming from taxes has increased over the period of interest by two-thirds (from 15 percent in 2001 to 25 percent in 2015), underlining the ongoing process of fiscal federalism. In nominal terms, average municipal tax revenue have increased from 1.4 billion euros in 2001 to 2.4 in 2015. Tax revenue have an average (median) value of nearly 2 (0.5) billion euros.

On average, poor municipalities have much lower tax intakes. To illustrate this, left-hand side graph in Figure 4 plots the overall share of revenues from local taxes against the log of the tax base. This cross-sectional evidence clearly shows that municipalities with a narrower tax base relies relatively less on local taxation to finance their public spending (and thus more on government transfers).[25] The right-hand side graph in Figure 4 shows that this correlation is not (just) the mechanical result of relying on a larger tax base, but it is rather a policy choice: richer municipalities set a relatively larger top statutory marginal tax rate (summing up both the income and property tax rate). These correlations might be due to several factors. First, it may simply underline a spurious correlation between overall level of growth and preferences for taxation. Second, municipalities with a narrower tax base might be less incline to raise taxes to avoid tax base flee. The latter hypothesis might be particularly important in this case, given that poorer municipalities are also those with larger tax evasion.

[Figure 4 about here]

Municipalities are in charge of providing a large array of public goods and services to citizens, such as public transportation, school facilities, welfare, and manage public utilities. The balance sheets provide detailed information on how municipalities invest their revenues among several budget items. For the purpose of the analysis, I

[24] Balance sheets are approved by the town council by the 30th of April of the following year. The Ministry of Economy and Finance regulates the accounting models through the T.U.E.L. (*Testo Unico Enti Locali*).

[25] Besley, Ilzetki and Persson (2013) provide a similar evidence in a cross-country historical perspective.

compute the share of capital spending for the following items: administration (e.g., financial administration, economic planning, performance audit); development (e.g., tourist events, public fairs and markets); education (e.g., providing school facilities, school buildings); environment protection (e.g., waste disposal, parks administration); security (e.g., municipal police); social, cultural and sport activities (e.g., museums, library, stadium maintenance); public transports and roads (e.g., local transports, urban road maintenance).[26] Figure 5 illustrates the share of municipal capital spending for each of these budget items, and its evolution over time. The bulk of municipal spending is concentrated into administration (24 percent), environment (23 percent), and transportation (23 percent) spending, while the remaining expenses are for cultural, social and sport activities (11 percent), education (8 percent), development (3 percent) and security (2 percent). The composition of spending has been quite stable over time.

[Figure 5 about here]

Local tax rates. The last part of the analysis studies the effect of the anti tax evasion program on local tax rates. Municipalities in Italy are in charge of collecting and setting tax rates of two main local taxes: the property tax and the income tax. The Italian Ministry of Economy and Finance (*Ministero Economia e Finanza*) reports data on the municipal surtax on personal income (or the multiple rates in the case of a graduated tax scheme). For the property tax, the Italian Institute of Finance and Local Economy (*Fondazione IFEL*) provide information on the rate applied to luxury properties reported as main residence and the rate levies on second homes.

Other data. In addition to the core data, I collect municipality-level and time-varying information on demographical and socio-economic data (i.e., population, share of 65+, share of 15-, share of foreign, unemployment rate) from the Italian National Statistical Office (ISTAT). Moreover, I complement this information with individual-level data from the Italian Department of the Interior (*Ministero degli Interni*) on politicians in town councils, and municipality-level information on taxable income (Ministry of Economy and Finance), inequality (Rubolino, 2019), elections and turnout (*Ministero degli Interni*), survey information on tolerance toward tax cheaters at regional-level (*European Values Survey*), and property characteristics, housing prices and number of transactions (Internal Revenue Agency) for each municipality over the period of interest.

The final dataset targets the population of more than 90 percent of the Italian municipalities (7,381 of the 8,092 Italian municipalities). This discrepancy is due to the exclusion of municipalities located in Trentino Alto-Adige region (that was excluded

[26]For clarity, these seven categories have the following 4-digit code in the municipal balance sheets (2014 format): administration (4190); development (4290 and 4357); education (4240); environment protection (4125); security (4225 and 4230); social, cultural and sport activities (4080, 4090, and 4150); public transportation and roads (4110 and 4180). These categories are consistent both over time and across municipalities.

from the program) and those that have experienced modifications to their administrative border or without full data on balance sheets over the period of interest. The summary statistics are illustrated in the online appendix Table B1.

3.2 The determinants of tax evasion

This section studies the correlates of tax evasion by exploiting cross-municipality variation in ghost buildings intensity.[27] Empirical analyses of tax evasion suggest what factors determine the extent and nature of evasion. In the deterrence model (Allingham and Sandmo, 1972) only a few variables matters: i) the probability of getting caught and penalized for evading; ii) the penalty for detected evasion; iii) the tax rate; iv) risk aversion. Nondeterrence models, on the other hand, allow for a range of other factors to matter, such as tax morale, perceptions of fairness and altruism (see Luttmer and Singhal, 2014, for a review of this literature). The main argument against the deterrence model of tax evasion is that taxpayers may decide to comply with the tax authority because of a sense of civic duty regardless of, or in addition to, the possible monetary gains.

I collect several municipality-level information to examine the correlates of tax evasion. Table 1 shows the result of this exercise. My preferred specification (column 5) also controls for province fixed effects, so to exploit within-province variation in ghost building intensity and in the covariates of interest. In line with predictions from the deterrence model, I find that: i. tax rates (sum of income and property municipal tax rate) are positively correlated with tax evasion; ii. places with higher attitude towards risky activities (approximated by per-capita spending in gambling activities and the share of self-employees) have a higher prevalence of tax evasion.

[Table 1 about here]

Total income per capita does not have any significant effect on tax evasion, but *how* income is distributed seems to matter. Namely, the share of ghost buildings is significantly larger in municipality where the rich (i.e., those in the top decile of the pre-tax municipal income distribution) own a larger share of total income. Likewise, individuals are more likely to conceal properties in places where the distribution of property ownership is more skewed.

Measures of civic capital and social trusts are also significantly correlated with the extent of tax evasion. Places with a higher share of non-profit association present, on average, a lower level of ghost building intensity. Interestingly, municipalities where the share of women in town council is larger have a relatively lower level of tax evasion. These findings are in line with existing negative correlation between tax compliance and several measures of civic capital relative to the Italian case.[28]

[27] This analysis was first performed by Casaburi and Troiano (2016). My additional contribution is to broad the set of covariates used to analyze the determinants of ghost buildings intensity.

[28] Cannari and D'Alessio (2007) provide evidence of a negative correlation between tax compliance and

At the geographical level, tax evasion is significantly lower in the Northern part of Italy and in municipalities with larger population size; it is relatively larger in places where the geographical features make easier to hide the buildings (e.g., places where the surface is hilly).

Finally, I study how ghost buildings intensity relates with characteristics of the housing market. As graphically shown by Figure 6, ghost buildings are relatively more common where housing prices are larger. By contrast, the volume of transactions is relatively lower where there are more ghost buildings. This link - which is obtained by exploting within-province variation - does not change when I separately analyze the effect on rental vs selling prices (panel c) or on central vs sub-central property prices (panel d). One interpretation is that the economic benefits deriving from not registering the building are higher in local markets where housing rents are larger and the market is not thick.

[Figure 6 about here]

4 Empirical strategy

The aim of the paper is to identify the effects of the Ghost Buildings program on tax revenue, composition of public spending and local marginal tax rates. For this end, I implement a difference-in-differences empirical strategy that exploits cross-municipality variation in ghost buildings intensity to compare the outcomes of interest before and after the staggered implementation of the Ghost Buildings program. Formally, I run regressions as the following:

$$log(y_{i,t}) = \beta(Post_{i,t} \times GB_i) + \gamma X_{i,t} + \delta_i + \epsilon_{p(i),t} + \eta_{e(i),t} + u_{i,t}, \quad (1)$$

where the dependent variable $y_{i,t}$ is tax revenue, spending share for a specific budget item or a tax rate in municipality i at year t. The dummy $Post_{i,t}$ is equal to 1 for each year t after the beginning of the Ghost Buildings program in municipality i. GB_i is the ghost buildings intensity (i.e., the ratio between detected ghost-buildings and the total number of building) in municipality i. The coefficient of interest, β, thus captures the differential impact of the Ghost Buildings program on the outcomes of interest by ghost buildings intensity. $X_{i,t}$ controls for demographic characteristics (population, share of population 65+, share of population 15-, share of foreign), unemployment rate, and individual-level characteristics of the mayor and other members of the town council (i.e., gender, age and years of education of the mayor and average value of the same

unemployment, social capital, criminality and education in Italy using survey data. Di Caro and Nicotra (2014) find that tax evasion is significantly correlated with regional structural factors such as the labor market and personal aspects such as social capital. Marino and Zizza (2012) provide estimates on the extent of tax evasion in Italy by gender and find that it is around 7 percentage points larger for men than women (17 and 10 percent of their income, respectively). Barone and Mocetti (2011) find that tax compliance is higher when public resources are spent more efficiently.

variables within the town council). Some specifications also allow the effect of the control variables to differ before and after the program inception, i.e., by controlling for $Post_{i,t} \times X_{i,t}$. The inclusion of municipality fixed effects, δ_i, province $\times$ year fixed effects, $\epsilon_{p(i),t}$, and election year $\times$ year fixed effects, $\eta_{e(i),t}$, allows to capture a plethora of fixed socio-economic factors and general trends, which are likely to affect tax revenues, public spending composition or tax rates (e.g., tax morale, corruption or preference for redistributive policies, electoral cycle in public finance outcomes as well as any change in national, regional or provincial policy). Finally, $u_{i,t}$ is the error term. Throughout the analysis, I cluster the standard errors at the province level (# = 110), allowing for an arbitrary covariance structure within municipalities over time and across municipalities in the same province.

Timing of program original date might represent a potential threat to the identification strategy. If municipalities had influence over when the program would start, original date of the program could be a response to economic shocks. For example, starting the program earlier could be a response to a local recession that depresses tax revenue. Whether program original data is driven by time-varying shocks is crucial for the analysis since the empirical specification exploit variations across years and municipalities. If this is the case, then β would capture a selection effect.

However, as discussed in Section 2.1, the timing of the program was highly clustered at the provincial level and relies on the availability of digital land registry. Indeed, nearly one-tenth of the post-program dummies have values different from the one they would have based on the modal date of publication in the province. To deal with this discrepancy, I follow Casaburi and Troiano (2016) to implement an instrumental variable approach. I compute the modal year when the program started for each province and I instrument the actual $Post_{i,t}$ dummy with this binary at the provincial level. This instrument is valid since it is unlikely to be influenced by specific municipality fiscal characteristics and any correlation between the modal inception year at the provincial level and historical characteristics of municipalities in the province would be captured by the municipality fixed effects.

The identification of the effects of interest relies on the critical assumptions of the absence of contemporary policy events and on the presence of parallel trends in the outcome variable. I assess the validity of the estimated results by running several placebo exercises.

First, I include leads and lags of the program dummy to the main empirical specification. Formally, I run regressions as the following:

$$log(y_{i,t}) = \sum_{j=-m}^{q} \beta_j (Post_{i,t} \times GB_i)(t = m + q) + \gamma X_{i,t} + \delta_i + \epsilon_{p(i),t} + \eta_{e(i),t} + u_{i,t}. \quad (2)$$

In this model instead of a single treatment effect, I have now also included m "leads"

and q "lags" of the Ghost Buildings program. β_j is the coefficient on the jth lead or lag. The parallel trend assumption holds if $\beta_j = 0 \; \forall j < 0$, that is when the coefficients on all leads of the Ghost Buildings program are zero.

Second, I exploit the fact that the program was not implemented in Trentino Alto-Adige region to implement a triple difference strategy. In this case, I augment the main empirical specification with the difference between the outcomes of interest of the control region before and after the program. Formally, the effects of interest are estimated from a model as the following:

$$log(y_{i,t}) = \beta(Post_{i,t} \times GB_i \times D_i) + \gamma X_{i,t} + \delta_i + \epsilon_{p(i),t} + \eta_{e(i),t} + u_{i,t}, \tag{3}$$

where D_i is a binary indicator equal to one in municipalities i that are not in the Trentino Alto-Adige region, and to zero otherwise.

5 Results

This section sets out the main findings on the effects of the Ghost Buildings program on tax revenue (Section 5.1), public spending (Section 5.2), and tax rates (Section 5.3).

5.1 Tax revenues

Baseline results. Figure 7 shows the results from the estimation of equation (1). To construct the figure, I regress the log of tax revenue on municipality fixed effects, year $\times$ province fixed effects, election year $\times$ year fixed effects, time-varying municipality characteristics and the interaction between the control variables with the post-program dummy to obtain the residuals. The right-hand side variable (i.e., the interaction between ghost buildings intensity and post-program dummy) is residualized in a similar manner. The positive slope suggests that, on average, municipalities with a higher share of ghost buildings experience a larger increase in tax revenue.

[Figure 7 about here]

More formally, Table 2 presents the coefficient of interest and the estimated standard errors. I start from a basic model including municipality and year fixed effects (column 1), and then I add time-varying municipality-specific controls (column 2), election year $\times$ year fixed effects (column 3), and province $\times$ year fixed effects (column 4). In column 5 (my preferred specification), the coefficient of interest is estimated from a two-stage least squares (2SLS) model where the dummy for the actual program start year is instrumented by the the province modal year. This table shows that the impact of the program on tax revenue is consistently positive for each specification, and that the estimated effect does not significantly vary between OLS and 2SLS models. In

the last column, I exploit the fact that the program was not implemented in Trentino Alto-Adige region to run a triple difference analysis. The coefficient estimate captures the differential impact of the Ghost Buildings program on the outcomes of interest by ghost buildings intensity and with respect to the variation in tax revenues in the control region. The estimated effect remains almost unchanged..

[Table 2 about here]

The estimated baseline effect implies that a 1 standard deviation increase in the municipality-level program intensity raises tax revenue by 2.3 percent of the sample mean, which corresponds, on average, to nearly 46,000 euros of extra revenue every year. A back-of-the envelope calculation suggests that the actual increase in tax revenuesis equal to around 77 percent of the projected mechanical (i.e., 2.3 percent instead of the predicted 3 percent) generated by the program. This provides indirect evidence of a negative behavioral response to the anti evasion program.

Figure 8 presents the dynamic impact of the policy on tax revenue and allows to check the parallel trend assumption. The figure plots the estimated β_j coefficients from equation (2): each point on the solid line shows the effect of having implemented the Ghost Buildings program for j years (if $j > 0$) or of starting the policy in j years (if $j < 0$) relative to the year the program started. There are no pre-existing differences across municipalities in terms of tax revenue: the β_j are not significantly different from zero for at least five pre-program years. Tax revenue has started to increase exactly from the time the program was put in force. This increase in tax revenue is sharp, stable and persistent up to five years after the implementation of the program.

[Figure 8 about here]

As in any study using a difference-in-differences estimation strategy, the identification of the effect of interest relies on the assumption of the absence of contemporary events that might differently affect municipalities with different levels of ghost building intensity. I address this concern by presenting regressions as in (1) but on different outcomes in the online appendix Table B2. The result of this test provides evidence that is the additional tax enforcement induced by the program that drives the variation in tax revenues and not any other municipality-year shock. As expected, I find a positive and significant effect on the municipal tax base (column 1), but the effect on *total* revenue (column 2) is not statistically significant, confirming that any additional increase in tax revenue was offset by government transfers. Indeed, the estimated coefficient reported in column (3) implies almost a 1-1 relationship between increase in tax revenues and decrease in government transfers (as established by decrees 262/2006 and 81/2007). Finally, column (4) shows that international organizations did not target systematically municipalities depending on their share of ghost buildings for their public funding allocation over the period of interest.

Mechanisms. The discrepancy between expected and actual revenue might arise from several channels. In the following, I investigate mechanisms likely to explain why there are missing revenue. Table 3 presents coefficient estimates from regressions where the post-program ghost buildings intensity variable, $Post_{i,t} \times GB_i$, is interacted with three groups of binary variables.

First, I investigate whether the effectiveness of the program in raising revenues depended on opportunities for tax evasion. Following the previous literature (e.g., Slemrod, Blumenthal and Christian, 2001; Kleven et al., 2011), I use the share of self-employment income (as a share of total municipal taxable income) as reported in tax returns data as a proxy for taxpayers opportunity for tax evasion. I create the dummies $HighSelf_i$ and $LowSelf_i$, which are equal to 1 for municipalities with a share of self-employment income that lies in the top or bottom decile, respectively, of the national distribution; 0 otherwise. Column (1) in Table 3 shows that the effect of the program on revenue was significantly lower in places where a substantial share of income stems from self-employees. One interpretation of this result is that effectiveness of anti-evasion policy depends not only on the intrinsic motivation of individuals to comply (i.e., their tax morale), but also on their opportunity for shifting incomes across taxable bases or simply substituting (illegal) evasion with (legal) tax avoidance.

Second, I exploit cross-region heterogeneity in tolerance toward tax cheating behavior using data from European Values Survey to construct the dummies $LowTaxCheat_i$ and $HighTaxCheat_i$, that are equal to 1 in places where the average score is in the bottom or top decile, respectively, of the national distribution; 0 otherwise. Column (2) in Table 3 shows that the program was significantly more successful in municipalities with a lower level of tolerance for tax cheaters. By contrast, places where residents are less likely to blame tax evaders have significantly lower tax intakes as a result of the Ghost Buildings program. Considering together these two sources of heterogeneity presented so far, it turns out that both policy parameters - such as opportunity for evasion - and preference parameters - as preference for blaming tax evaders - might play a role for successfully curbing tax evasion.

Finally, I investigate whether policy makers' ability had any impact in raising revenues. As discussed in Section 2, local policy makers were actively involved in the registration process by disseminating information about the program and by proceeding to follow-up inspections and imputation of the tax base of ghost buildings not voluntarily registered. As shown by Casaburi and Troiano (2016), the effort that the mayor and other member of the incumbent party would decide to offer will depend on how their choices will be perceived by the electorate. Politicians will consider whether it is profitable to curbing tax evasion for their chance to be re-elected. Whether it is worthwhile to offer larger efforts to induce buildings registration might depend on the ability of policy makers to translate extra revenue in worthy government projects. To test this hypothesis, I create the dummies $LowAbility_i$ and $HighAbility_i$, equal to 1 for municipalities where the share of graduated in town council lies in the bottom or top decile,

respectively, of the national distribution; 0 otherwise. Column (3) in Table 3 shows that low ability policy makers were relatively less successful in induce registration of the buildings and, in turn, in raising revenue. This finding might suggest that translating tax capacity investments in government revenue is not an automatic mechanical process, but might depend on the ability (and willingness) of policy makers.

[Table 3 about here]

5.2 Public spending composition

Baseline results. Having shown that the Ghost Buildings program significantly raised tax revenues and thus changed the composition of local revenue, we can analyze the impact of the program on the composition of municipal capital spending. Throughout the analysis, the outcome variable will be the (log of) share of total spending for a specific budget item of a municipality in a given year.

First, I focus on the effect of the program on the share of spending in administration vs education. As previously discussed, if the composition of revenue affects how public resources are allocated, then the shift from government grants to tax revenue generated by the program would increase (decrease) the share of spending for more (less) desirable budget items. This hypothesis rests on the assumption that politicians provide less public services and increase their rents when there are asymmetries of information over items of the public budgets (Besley and Smart, 2007). Figure 9 presents the effect of the Ghost Buildings program on the share of capital spending in administration (left-hand side graph) and education (right-hand side graph) by running regressions as in (1). Consistent with predictions from political agency models of public finance, the figure shows a negative relationship between ghost buildings intensity (and, thus, scope for a tax revenue increase) and the share of spending in administration. By contrast, the portion of capital spending allocated for financing education positively increases by ghost buildings intensity.

[Figure 9 about here]

Table 4 extends the analysis to each budget item. The table reports the β coefficients obtained controlling for municipality, province $\times$ year and election year $\times$ year fixed effects and time-varying municipality characteristics. The impact of the Ghost Buildings program turns out to be significant and large on the share of spending in education (column 3) and, although to a lower extent, on security activities (column 5). On average, a 1 point increase in the ghost building intensity raises the share of public spending in education by 16.7 percent and in security by 8.8 percent. The estimated effect implies that a unit increase in ghost buildings intensity would raise the share of spending for education by 1.43 percentage points (from a sample mean of 8.4 percent), which corresponds to an average annual increase of roughly 4,690 euros (sample mean

of 27,600 euros). The increase in spending for security activities is statistically significant but small in a economic sense: the estimated effects would imply an increase of about 0.2 percentage points, which are nearly 315 euros. This increase was obviously offset by a reduction in other budget items, in particular in administration (column 1) and in public transportation (column 7). However, the estimates are not very precisely estimated and the coefficients are not significantly different from zero. These results are substantially similar when estimated from a triple difference empirical strategy, that exploits the fact that the program was not implemented in Trentino Alto Adige region (see online appendix Table B3).[29]

[Table 4 about here]

Figure 10 reports β_j coefficients estimated by running equation (2) and allows to test the parallel trend assumption and how the estimated effect for education (top panel) and security spending (bottom panel) has evolved over time. The graph shows that the coefficients on all the lags of the anti-tax evasion policy were zero in both cases. Then, the share of capital spending for education gradually increase up to 3 years after the program inception year.

[Figure 10 about here]

Mechanisms. The intuition behind this observed change in public spending allocation is that any revenue increase obtained through higher taxes is obviously visible by taxpayers, while an increase in revenue financed by government transfers might not be observed at all by citizens. As a result, any increase in tax revenue would make politicians more accountable and ultimately leads to a more efficient public spending allocation. However, if this is true, then political choices on public budget allocation would depend on how much voters are informed, over and above other politician- or electorate-specific preferences for public spending and ability in public goods provision. Table 5 casts light on the mechanisms behind the observed effects by studying heterogeneous responses regarding i) voters' likelihood to be informed; ii) politicians' ability; iii) mayor's gender.

[Table 5 about here]

Panel a explores heterogeneity effects with respect to voters' likelihood to be informed about how public spending is allocated, proxied by the electoral turnout for the national election in 2013 (data provided by the Italian Ministry of Internal Affairs).

[29] A confounding factor can be represented by a reallocation of public resources between current and capital spending. Although unlikely in practice (politicians does not have much power for changing current spending decisions), this possibility is tested in columns (5)-(7) in the online appendix Table B2. The table shows that, as expected, total government spending remains unchanged and there is no significant change between current vs capital spending.

Intuitively, places where citizens are less informed and less active in the political debate might be less willing to monitor local politicians and, thus, to limit rent-seeking behaviors. Consistent with this view, I find that the share of spending in administration significantly increases in municipalities where political participation is lower. This result would suggest that information is a crucial mechanism to exert pressure on politicians for providing an efficient allocation of the public budget. This finding is in line with Gadenne (2017), showing that improvements in the quality of public expenditures as a result of tighter enforcement was particularly strong in areas with a local radio station.

The increase in the tax burden faced by ghost buildings owners could make them more willing to demand more from politicians. Politicians ability to translate extra revenues in worth government spending might be crucial to accommodate the electorate. Panel b in Table 5 shows that municipalities where town council's members are more able (proxied by the share of members with a college degree) are more likely to reduce the share of spending allocated to administration as a result of the Ghost Buildings program. This spending cut was mostly used to finance spending in environmental protection (column 4).

Finally, panel c tests whether the gender of the mayor matters for public spending decision. I find that municipalities where the mayor is a woman are almost two times more likely to finance school facilities (column 3). This evidence makes plausible that women politicians might promote redistributive public policies if they are less corrupt (Brollo and Troiano, 2014) or if they are more effective than men to spur economic growth through public spending (Edlund and Pande, 2002; Edlund, Haider and Pande, 2005).

5.3 Tax rates

Baseline results. This section studies whether the tax base broadening engendered by the Ghost Buildings program had any effect on the tax rates set by municipalities. I focus on four outcomes: i) the top marginal tax rate on personal income; ii) the bottom marginal tax rate on personal income; iii) the property tax rate applied to luxury properties reported as main residence; iv) the property tax rate applied to properties different from the main residence.

First, I present the results graphically by running regression as in (1). Top graphs in Figure 11 show the effect on income taxes, while bottom graphs depict the effect on property taxes. Overall, the figure shows that municipalities where there the share of ghost buildings is larger are more likely to increase the progressivity of local taxes over the post-program period. The positive slopes estimated for the top income tax rate and the property taxes imply that local governments attempt to redistribute resources by taxing more the rich. By contrast, extra revenue were used to cut taxes on poorest residence.

[Figure 11 about here]

Table 6 presents the estimated effects of the Ghost Building program on local tax rates. The estimated coefficient implies that a unit increase in ghost building intensity raises the income tax rate by 36 percent (0.13 percentage points). By contrast, the bottom income tax rate was significantly cut. The increase in the property tax rates was of nearly 16 percent for both the two types of taxes. These results suggest that relying on a broader and partially more enforced tax base induces policy makers to raise the progressivity of local taxes. Results are confirmed also by the triple difference empirical strategy (see Table B4).

[Table 6 about here]

Panel a of Figure 12 shows that the top marginal tax rate has started to gradually increase just after the Ghost Buildings program. Likewise, the tax rate applied to luxury properties (panel c) and properties not reported as the main residence (panel d) increase steadily over time. By contrast, panel b shows a decrease in the bottom tax rate on income, but the post-reform trend is not as sharp as in the previous cases. It is also worth noting that, in this last case, in some pre-program years the parallel trend assumption was violated, since there is a significant and positive relationship between ghost buildings intensity and the bottom tax rate on income.

[Figure 12 about here]

Mechanisms. The increase in local tax progressivity as a result of a broader and more enforced tax base can be rationalized by both redistributive concerns and political purposes. In the following, I interact the post-program ghost buildings intensity variable with three groups of variables.

First, I study whether the increase in tax progressivity was driven by an attempt to redistribute resources and to limit increasing inequality. I use data on the Gini index, computed in Rubolino (2019) from fiscal data for each municipality over the period of interest. Then, I divide municipalities depending on their pre-program level of income inequality to construct the dummies Low_i and $High_i$, that are equal to 1 if a municipality presents a level of the Gini index that lies in the bottom decile or top decile, respectively, of the Gini index distribution over the pre-prgram period; 0 otherwise. Panel a in Tabel 7 shows that the decision to raise taxes on rich and lower the bottom marginal tax rate on income was partly driven by redistributive concerns: the top marginal tax rate on income was significantly smaller in places where inequality was lower (column 1). Likewise, municipalities where a larger share of incomes was held by the rich significantly increased the property tax rate applied to luxury properties (column 3). By contrast, column (2) shows the tax cut for the poor was mostly implemented in places with a higher level of inequality. By engendering a change in the distribution of the tax burden within a municipality, one indirect effect of the Ghost Buildings program

might be to shrink within-municipality inequality. I will investigate this possibility in Section 6, where I will study the effect of the program on the income share held by the top decile.

An alternative story can be that politicians were driven by electoral purposes in setting tax rates after the implementation of the program to gain political consensus. Depending on local preference toward redistributive policies and tax progressivity, politicians can capture votes by aligning their tax policy to the preference of the median voter (Meltzer and Richard, 1981). The Ghost Buildings program offer them room for adjusting how the tax rate is distributed across voters in a salient and sharp manner. I study this possibility by interacting the post-program ghost buildings intensity variable with a dummy variable that attempts to reveal municipality preferences for left-wing policies.[30] I create the dummy $Left_i$ that is equal to 1 in municipalities where the share of votes in 2013 national election for center left-wing parties was larger than the share of votes for center right-wing parties; 0 otherwise. Panel b in Table 7 shows that the tax cut for the poor was significantly larger in places where votes are more likely to support left-wing party. However, I do not find any significant effect on the top marginal tax rate on income and on the property tax rate applied to luxury properties. Moreover, the negative coefficient estimated for the property tax rate applied to second homes seems contradicting. One interpretation is that $Left_i$ might not necessarily capture *local* preferences for redistribution and tax progressivity, but it summarizes how much votes may care about these policies at the *national* level. Another possibility is that preferences of voters for tax progressivity and redistribution are not fully revealed by their likelihood to vote for center-left parties as opposed to center-right parties in national election, and thus $Left_i$ would measure local preferences for redistribution with some noise.

Finally, I study whether local policy makers do account for the expected behavioral response of taxpayers when changing the tax rates. If, for instance, the richest taxpayers in a municipality have access to better technology to evade or avoiding taxes or their labor supply is more sensitive to tax rate changes, then policy makers might account for this possibility in choosing tax policy. To summarize how much taxpayers are likely to respond to a tax rate change, I estimate the tax base elasticity of a municipality with respect to its net-of-tax rate. This elasticity incorporates all the behavioral responses of taxpayers to any tax rate change set by municipalities (Saez et al., 2012) and it measures the efficiency cost of raising taxes in terms of missing revenue.[31] Using the estimated elasticity, I create the dummy $Large_i$, equal to 1 if the cost of raising taxes

[30] Here I am implicitly assuming that redistribute policies are more likely to be pursued by left-wing governments.

[31] Empirically, the tax base elasticity is estimated as the β parameter from regressions of the following form: $log(y_{i,t}) = \beta log(1-\tau_{i,t}) + \gamma X_{i,t} + \delta_i + \epsilon_{p(i),t} + \eta_{e(i),t} + u_{i,t}$, where the outcomes is the tax base of municipality i at year t; τ is the tax rate (the top marginal tax rate, the bottom marginal tax rate or the property tax rate depending on the specification). All the other parameters have the same notation as in equation (1).

is larger than the median value; 0 otherwise. Panel c in Table 7 shows that local policy makers do discount for the expected behavioral response of taxpayers when deciding whether to change tax rates. The increase in the top marginal tax rate is substantially dampened in places with larger tax base elasticity, suggesting that the threat of tax base flee prevents policy makers by changing taxes. Likewise, the tax rate reduction is significantly larger in places where taxpayers are more sensitive to the tax rate. This might suggest that policy makers attempt to spur economic growth by raising the tax burden faced by the poor. By contrast, I do not find any heterogeneity for the property tax. This is consistent with the fact that the property base is not elastic to tax rate changes and, as a result, policy makers are not threatened by possible perverse effect in raising taxes on properties.

[Table 7 about here]

6 Fighting tax evasion to reduce inequality

The results presented so far have shown that the Ghost Buildings program triggered different types of redistributive policies. It is consequential then to ask whether these policies had any effect on the distribution of income within a municipality. Using the same empirical strategy implemented so far and data on the (pre-tax) municipality Gini index, the income share held by the bottom 90 percent of the municipality income distribution, and the income share held by the top decile, this section analyzes whether the Ghost Buildings program affected inequality.

Figure 13 presents the β coefficient estimated from regressions as in (1) on the income share held by the bottom 90 percent (top panel) and the top 10 percent (bottom panel). These graphs show that the program was successful in reduced inequality: income share at the top of the municipal distribution reduces in the post-program period in places where more ghost buildings were detected.

[Figure 13 about here]

The results are formally reported in Table 8. While there is no significant effect on the Gini index, there is a positive and significant increase in the share of (pre-tax) income held by taxpayers in the bottom 90 percent of the municipal income distribution and, obviously, a reduction in the top 10 percent. On average, a 1 standard deviation increase in ghost buildings intensity reduced the share of income held by the rich by around 0.5 percent. These results are similar to those estimated from a triple difference strategy (see Table B5).

[Table 8 about here]

Figure 14 shows that the β_j coefficients estimated from equation (2): the effect appears to steadily grow over time. The average β_j was equal to -0.2 in the year just

after the program inception; the same coefficient was around two times larger when measured 5 years after the implementation of the program.

[Figure 14 about here]

7 Conclusions

How successful are nationwide anti-tax evasion policies in raising revenues? Do politicians react to exogenous increase in revenues by raising rents or public goods provision? What is the effect of curbing tax evasion on tax progressivity? This paper aims to answer these questions by focusing on the Ghost Buildings program: a low-stake anti-tax evasion program implemented in Italy that detected more than 2 million of buildings hidden from tax authorities.

I find a stable and persistent increase in tax revenue, corresponding to nearly three-fourth of the projected mechanical increase in the tax base. These extra revenue were mostly used to finance school facilities and security activities to prevent future illegal behaviors. Moreover, I show a significant gradual increase in the progressivity of local income and property marginal tax rates as a result of a broader and more enforced tax base.

Taken together, these results make the Ghost Buidings program a *fiscal-capacity investment* (Besley and Persson, 2009; 2011). Governments in both the developed and developing world make decisions about the broadness of their tax base and what administrative and compliance structures to put in place. The view provided by this article is that the decision to tackle tax evasion is an investment that: i. increases revenue; ii. changes the incentives for policy makers for rent-seeking behaviors and makes them more likely to increase public goods provision; iii. reduces the leakage from raising taxes due to base broadening. If these results have also long-term consequences, these insight would suggest that anti-tax evasion policies can be thought as (partly) strategic and forward looking.

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Tables

Table 1: The correlates of ghost buildings

	Ghost buildings (%)				
	(1)	(2)	(3)	(4)	(5)
Tax rate (%)	0.573***	0.580***	0.374*	0.132	0.173*
	(0.212)	(0.209)	(0.207)	(0.171)	(0.095)
Taxable income per-capita (€1,000)	-0.155***	-0.152***	-0.166***	-0.081***	-0.017
	(0.022)	(0.021)	(0.020)	(0.025)	(0.014)
Top 10 (%)	0.167***	0.164***	0.129***	0.079***	0.029***
	(0.016)	(0.015)	(0.012)	(0.013)	(0.007)
Population (1,000)		0.002	0.000	-0.001**	-0.002***
		(0.001)	(0.001)	(0.001)	(0.001)
Foreign residents (%)		-0.014	-0.014	-0.011	-0.003
		(0.014)	(0.014)	(0.013)	(0.006)
Gambling per-capita (€)			0.017***	0.009***	0.007***
			(0.004)	(0.003)	(0.002)
Non-profit associations (%)			-0.028***	-0.012*	-0.015***
			(0.007)	(0.006)	(0.003)
Women in local councils (%)			-0.013***	-0.010**	-0.004**
			(0.004)	(0.004)	(0.002)
Self-employees (%)			-0.029***	-0.003	0.006*
			(0.008)	(0.007)	(0.003)
Owned-occupied properties (%)			-2.521***	-2.418***	-1.681***
			(0.898)	(0.782)	(0.378)
Nord (0/1)				-1.077***	-1.572***
				(0.214)	(0.101)
Town area size (sq km)				0.001	0.002***
				(0.001)	(0.001)
Altitude index (1/5)				0.235***	0.224***
				(0.031)	(0.028)
Urban (0/1)				0.084	-0.088
				(0.171)	(0.093)
Observations	7,381	7,381	7,381	7,381	7,381
Province FE	NO	NO	NO	NO	YES
Mean dependent (%)	1.840	1.840	1.840	1.840	1.840

Note: The dependent variable is the share of ghost buildings detected in a municipality. Right-hand side variables are averaged over the pre-program period. The sample covers 7,381 municipalities. Standard errors clustered at province level in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 2: Baseline effects on tax revenues

	log(Tax revenue)					
	OLS	OLS	OLS	OLS	2SLS	2SLS & DDD
	(1)	(2)	(3)	(4)	(5)	(6)
$Post_{i,t} \times GB_i$	2.114***	1.996***	1.878***	1.398***	1.274***	1.218***
	(0.608)	(0.646)	(0.642)	(0.403)	(0.435)	(0.437)
Observations	110,715	110,715	110,715	110,715	110,715	115,620
Municipality FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Controls	NO	YES	YES	YES	YES	YES
Controls $\times Post_{i,t}$	NO	YES	YES	YES	YES	YES
Election year $\times$ year FE	NO	NO	YES	YES	YES	YES
Province $\times$ year FE	NO	NO	NO	YES	YES	YES
Mean dependent (€1,000)	1,999	1,999	1,999	1,999	1,999	1,949

Note: This table shows the effect of the ghost buildings program on tax revenue. $Post_{i,t} \times GB_i$ is the interaction between a dummy for the (municipality-specific) post-program period and the share of ghost buildings in a municipality. Each specification includes municipality and year fixed effects. Column (5) reports estimates from an instrumental variable approach where the post-program dummy is instrumented by the provincial modal year of the program inception. Column (6) combines the 2SLS approach with a triple difference approach that exploits the fact that one region did not participate into the program. The sample covers 7,381 municipalities (7,708 in last column) over the 2001-2015 period. First-stage coefficient is 0.960 (0.008). Standard errors clustered at province-level. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Heterogeneous effects on tax revenues

	log(Tax revenue)		
	(1)	(2)	(3)
$Post_{i,t} \times GB_i$	1.317***	0.766**	1.316***
	(0.430)	(0.344)	(0.464)
$Post_{i,t} \times GB_i \times LowSelf_i$	0.097		
	(1.139)		
$Post_{i,t} \times GB_i \times HighSelf_i$	-1.658***		
	(0.602)		
$Post_{i,t} \times GB_i \times LowTaxCheat_i$		3.651***	
		(0.973)	
$Post_{i,t} \times GB_i \times HighTaxCheat_i$		-2.570**	
		(1.291)	
$Post_{i,t} \times GB_i \times LowAbility_i$			-2.173***
			(0.668)
$Post_{i,t} \times GB_i \times HighAbility_i$			0.328
			(0.488)
Observations	110,715	110,715	110,715
Municipality FE	YES	YES	YES
Year FE	YES	YES	YES
Controls	YES	YES	YES
Controls $\times Post_{i,t}$	YES	YES	YES
Election $\times$ year FE	YES	YES	YES
Province $\times$ year FE	YES	YES	YES
Model	2SLS	2SLS	2SLS
Mean dependent (€1,000)	1,999	1,999	1,999

Note: This table studies heterogeneous responses of the ghost buildings program on tax revenue. The interaction between the dummy for the post-program period and the share of ghost buildings in a municipality, $Post_{i,t} \times GB_i$, is interacted with dummy variables for municipalities with a low or high share of self-employees (column 1), low or high tolerance toward tax cheating behaviors (column 2), and politicians with low or high ability as measured by the town council's average years of education (column 3). A municipality is classified as a high (low) level of a specific indicator if it has a value in the top (bottom) decile of the national distribution of that indicator. The sample covers 7,381 municipalities over the 2001-2015 period. First-stage coefficient is 0.960 (0.008). Standard errors clustered at province-level. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Baseline effects on public spending composition

	(log of) Share of municipal public spending on:						
	Adm	Dev	Edu	Env	Sec	Soc	Tra
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	a. OLS						
$Post_{i,t} \times GB_i$	-0.142	-0.039	0.153**	-0.025	0.077*	-0.041	0.146
	(0.120)	(0.053)	(0.068)	(0.159)	(0.045)	(0.101)	(0.138)
	b. 2SLS						
$Post_{i,t} \times GB_i$	-0.050	-0.062	0.167**	-0.030	0.088*	-0.108	0.164
	(0.129)	(0.061)	(0.079)	(0.177)	(0.052)	(0.105)	(0.159)
Observations	110,715	110,715	110,715	110,715	110,715	110,715	110,715
Municipality FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES
Election × year FE	YES	YES	YES	YES	YES	YES	YES
Province × year FE	YES	YES	YES	YES	YES	YES	YES
Mean dependent (%)	24.404	3.243	8.390	23.611	1.834	11.197	22.734

Note: This table displays the effect of the ghost buildings program on municipal capital spending composition. The dependent variable is the (log of) share of municipal spending in: (1) administration; (2) development; (3) education; (4) environment; (5) security; (6) social services; (7) transportation. The sample covers 7,381 municipalities over the 2001-2015 period. Standard errors clustered at province-level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 5: Heterogeneous effects on public spending composition

	(log of) Share of municipal public spending on:						
	Adm	Dev	Edu	Env	Sec	Soc	Tra
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	a. By political participation						
$Post_{i,t} \times GB_i$	-0.103	-0.072	0.174**	-0.018	0.089*	-0.092	0.203
	(0.136)	(0.064)	(0.087)	(0.182)	(0.050)	(0.097)	(0.176)
$Post_{i,t} \times GB_i \times Low_i$	0.288*	0.059	-0.038	-0.063	-0.008	-0.087	-0.215
	(0.149)	(0.070)	(0.128)	(0.160)	(0.079)	(0.131)	(0.218)
	b. By politicians' ability						
$Post_{i,t} \times GB_i$	0.013	-0.051	0.183**	-0.081	0.093*	-0.124	0.142
	(0.141)	(0.062)	(0.081)	(0.169)	(0.052)	(0.104)	(0.156)
$Post_{i,t} \times GB_i \times High_i$	-0.575*	-0.100	-0.144	0.466*	-0.046	0.151	0.194
	(0.303)	(0.094)	(0.101)	(0.280)	(0.065)	(0.179)	(0.242)
	c. By mayor's gender						
$Post_{i,t} \times GB_i$	-0.031	-0.048	0.141*	-0.009	0.086	-0.101	0.132
	(0.127)	(0.061)	(0.079)	(0.171)	(0.052)	(0.104)	(0.160)
$Post_{i,t} \times GB_i \times Woman_i$	-0.193	-0.139	0.254*	-0.203	0.018	-0.064	0.312
	(0.284)	(0.089)	(0.143)	(0.200)	(0.098)	(0.176)	(0.193)
Observations	110,715	110,715	110,715	110,715	110,715	110,715	110,715
Municipality FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES
Election × year FE	YES	YES	YES	YES	YES	YES	YES
Province × year FE	YES	YES	YES	YES	YES	YES	YES
Model	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Mean dependent (%)	24.404	3.243	8.390	23.611	1.834	11.197	22.734

Note: This table studies heterogeneous responses of the ghost buildings program on public capital spending composition. The dependent variable is the (log of) share of municipal public spending in: (1) administration; (2) development; (3) education; (4) environment; (5) security; (6) social services; (7) transportation. The post-program ghost buildings intensity indicator is interacted with a dummy variable for municipalities with low or high political participation (panel a), a dummy for those where the average number of years of education of town council's members is larger than the median (panel b), and a dummy for municipalities where the mayor is a woman (panel c). The sample covers 7,381 municipalities over the 2001-2015 period. Standard errors clustered at province-level. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Baseline effects on local marginal tax rates

	log(Income tax) Top rate (%)		log(Income tax) Bottom rate (%)		log(Property tax) Luxury pr. (%)		log(Property tax) Second pr. (%)	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Post_{i,t} \times GB_i$	0.324**	0.356**	-0.369**	-0.423**	0.137***	0.159***	0.143***	0.156***
	(0.139)	(0.160)	(0.178)	(0.199)	(0.035)	(0.040)	(0.034)	(0.039)
Observations	110,715	110,715	110,715	110,715	110,715	110,715	110,715	110,715
Municipality FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Election × year FE	YES	YES	YES	YES	YES	YES	YES	YES
Province × year FE	YES	YES	YES	YES	YES	YES	YES	YES
Mean dep. (%)	0.352	0.352	0.277	0.277	0.495	0.495	0.677	0.677

Note: This table presents the effect of the ghost buildings program on marginal tax rates set by municipalities. The outcome variable is the (log of) top marginal tax rate on personal income (columns 1 and 2), bottom marginal tax rate on personal income (columns 3 and 4), property tax rate applied to luxury properties reported as main residence (columns 5 and 6), and the property tax rate applies to properties different from the main residence (columns 7 and 8). The sample covers 7,381 municipalities over the 2001-2015 period. Standard errors clustered at province-level. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Heterogeneous effects on local marginal tax rates

	log(Income tax) Top rate (%) (1)	log(Income tax) Bottom rate (%) (2)	log(Property tax) Luxury pr. (%) (3)	log(Property tax) Second pr. (%) (4)
	a. By pre-program inequality level			
$Post_{i,t} \times GB_i$	0.403**	-0.310	0.145***	0.155***
	(0.161)	(0.208)	(0.040)	(0.039)
$Post_{i,t} \times GB_i \times Low_i$	-0.470*	-0.290	-0.023	-0.009
	(0.265)	(0.261)	(0.062)	(0.066)
$Post_{i,t} \times GB_i \times High_i$	-0.227	-1.062***	0.175***	0.017
	(0.152)	(0.341)	(0.054)	(0.042)
	b. By political preferences			
$Post_{i,t} \times GB_i$	0.442**	-0.239	0.173***	0.189***
	(0.185)	(0.217)	(0.046)	(0.044)
$Post_{i,t} \times GB_i \times Left_i$	-0.273	-0.554***	-0.040	-0.103***
	(0.203)	(0.178)	(0.049)	(0.038)
	c. By cost of raising taxes			
$Post_{i,t} \times GB_i$	1.345***	0.827***	0.157**	0.206***
	(0.251)	(0.278)	(0.066)	(0.061)
$Post_{i,t} \times GB_i \times Large_i$	-1.347***	-1.618***	0.003	-0.062
	(0.207)	(0.310)	(0.062)	(0.061)
Observations	110,715	110,715	110,715	110,715
Municipality FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Election × year FE	YES	YES	YES	YES
Province × year FE	YES	YES	YES	YES
Model	2SLS	2SLS	2SLS	2SLS
Mean dependent (%)	0.352	0.277	0.495	0.677

Note: This table studies heterogeneous responses of the ghost buildings program on local marginal tax rates. The interaction between the dummy for the post-program period and the share of ghost buildings in a municipality, $Post_{i,t} \times GB_i$, is interacted with dummy variables for municipalities with a low or high level of pre-program Gini index (panel a), those where the share of votes for left-wing parties in national election is larger than the median value (panel b), and for those where the tax base elasticity with respect to the net-of-top tax rate on income is larger than the median value (panel c). The sample covers 7,381 municipalities over the 2001-2015 period. Standard errors clustered at province-level. *** p<0.01, ** p<0.05, * p<0.1.

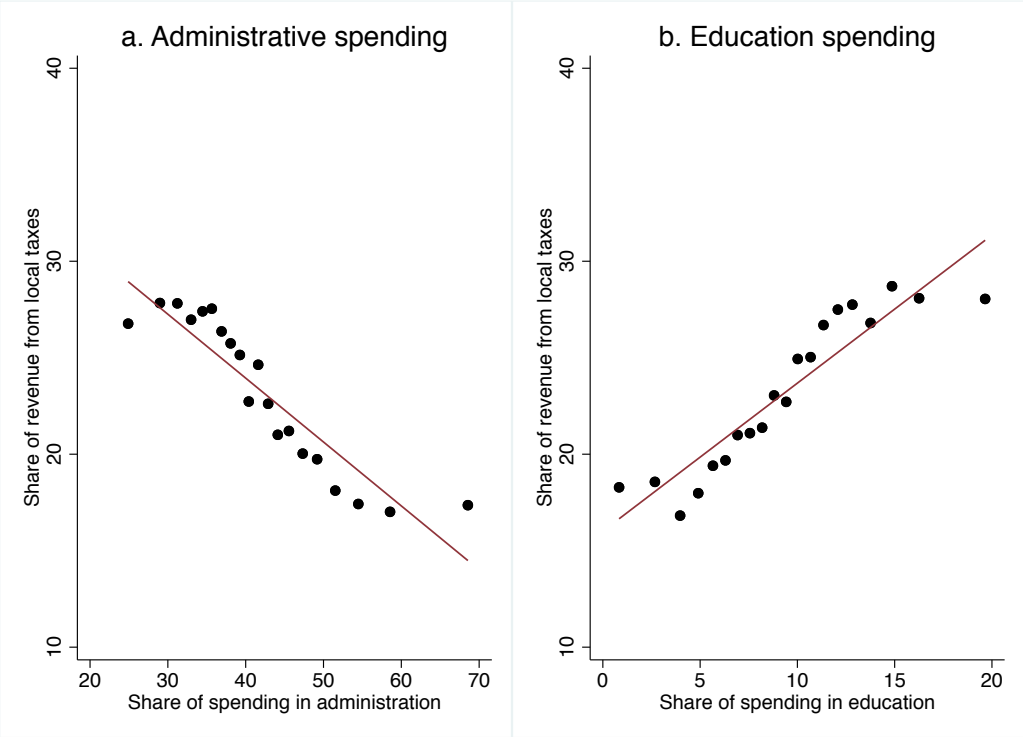
Table 8: The impact on within-municipality inequality

	log(Gini index)		log(P0-90)		log(P90-100)	
	OLS	2SLS	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
$Post_{i,t} \times GB_i$	0.041	0.043	0.048***	0.056***	-0.246***	-0.286***
	(0.050)	(0.059)	(0.013)	(0.015)	(0.070)	(0.080)
Observations	110,715	110,715	110,715	110,715	110,715	110,715
Municipality FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES
Election × year FE	YES	YES	YES	YES	YES	YES
Province × year FE	YES	YES	YES	YES	YES	YES
Mean dependent	0.396	0.396	67.649	67.649	32.351	32.351

Note: This table reports the effect of the ghost buildings program on within-municipality pre-tax distribution of income. The outcome variable is the (log of) the Gini index (columns 1 and 2), the income share held by the bottom decile of the pre-tax municipal income distribution (columns 3 and 4), and the income share held by the top decile of the pre-tax municipal income distribution (columns 5 and 6). The sample covers 7,381 municipalities over the 2001-2015 period. Standard errors clustered at province-level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

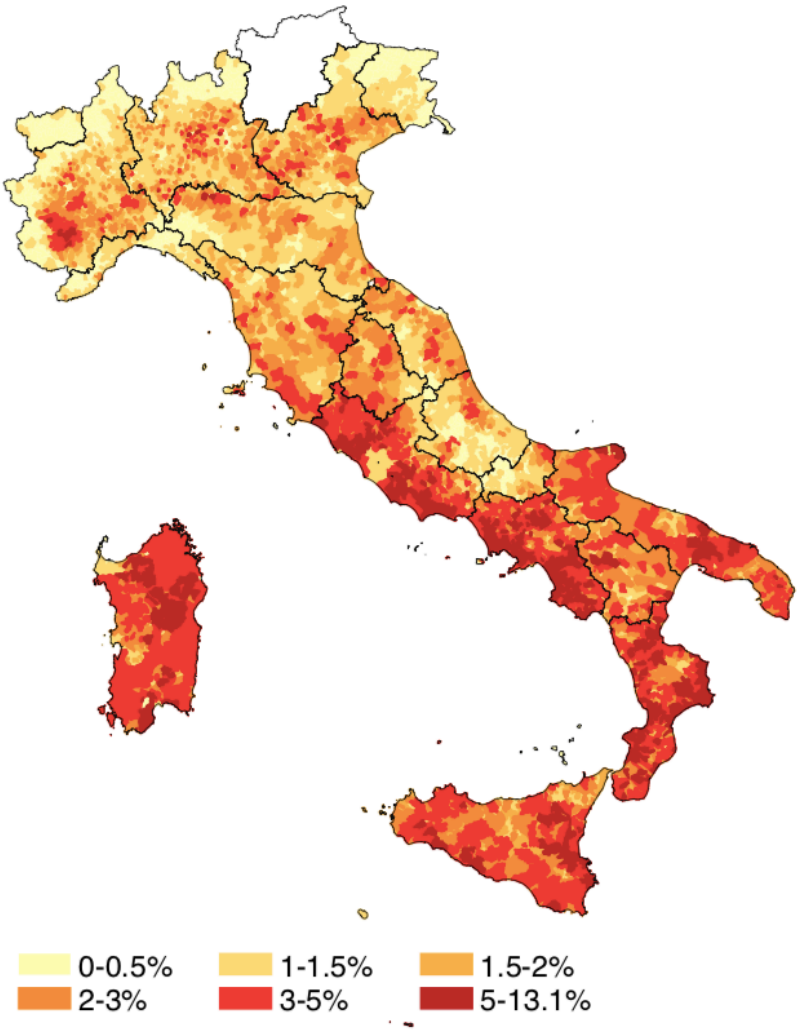
Figures

Figure 1: Sources of municipality revenue and public spending allocation



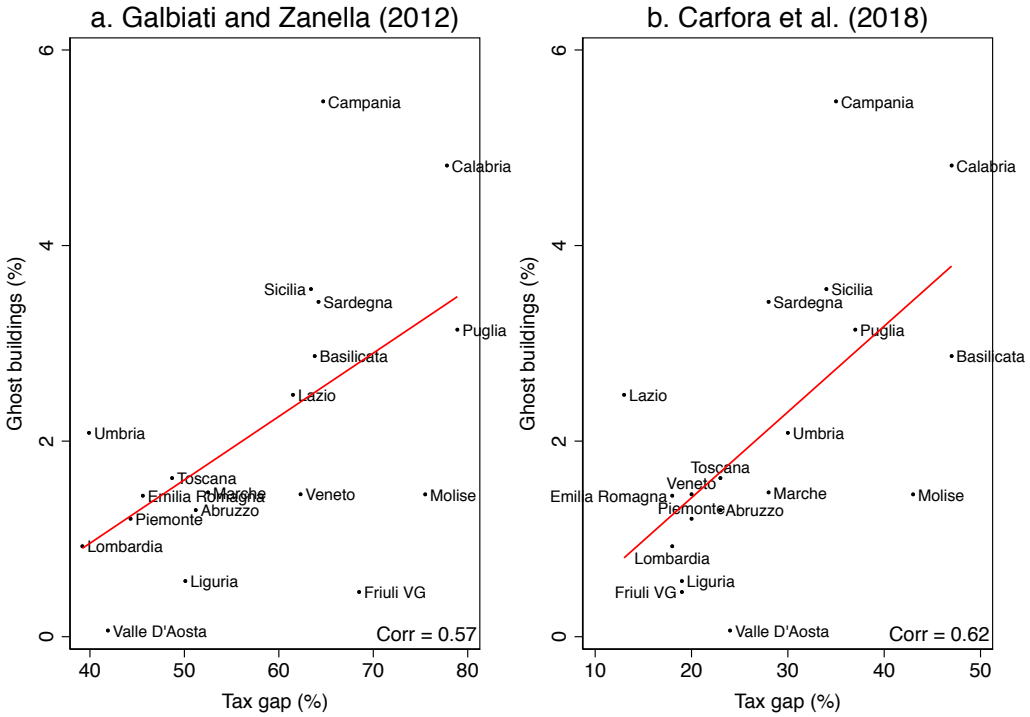
Note: This figure compares the share of municipal public spending on administration (right-hand side) and education (left-hand side) with the share of revenue from local taxes. The figure plots equal sized bins and shows the line of best fit. The sample is composed of 7,381 municipalities over the 2001-2015 period.

Figure 2: Geographical representation of ghost buildings



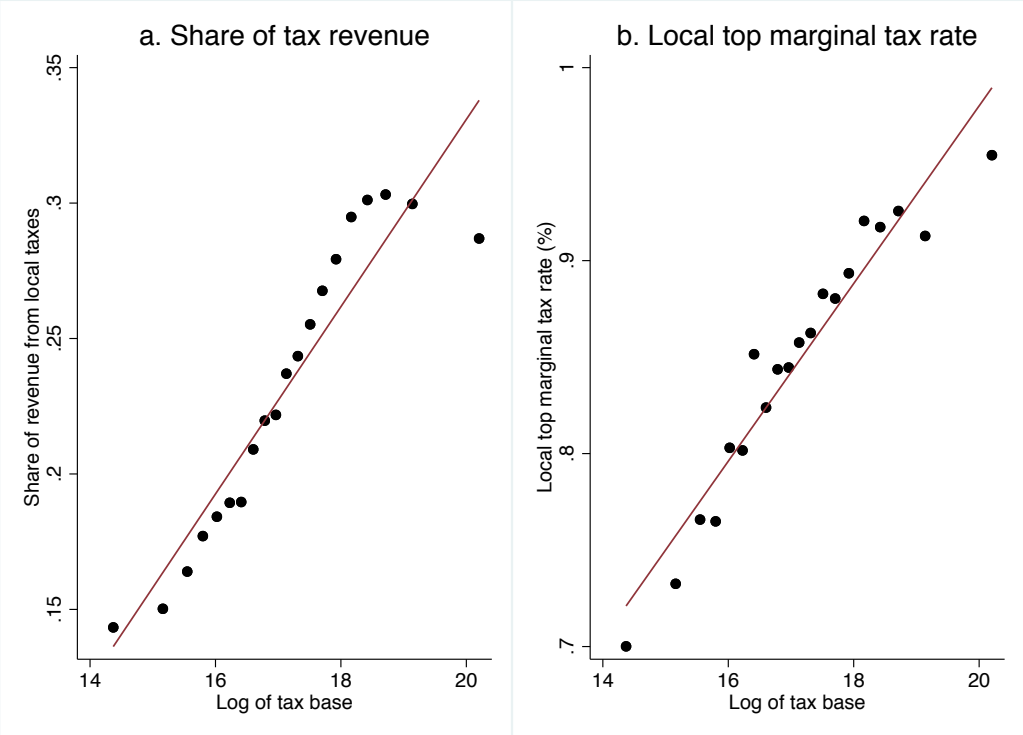
Note: This figure presents the ghost buildings intensity indicator (i.e., detected ghost buildings as a share of total building): a measure of tax evasion at municipality-level. Yellow (red) area depicts municipalities with a lower (larger) share of ghost buildings. The black line refers to regional boundaries. Data from the Italian Internal Revenue Agency (*Agenzia delle Entrate*). Missing values are imputed with the provincial average. Trentino Alto-Adige region (the white area in North-East) did not participate into the program.

Figure 3: Comparison with other estimates of tax evasion



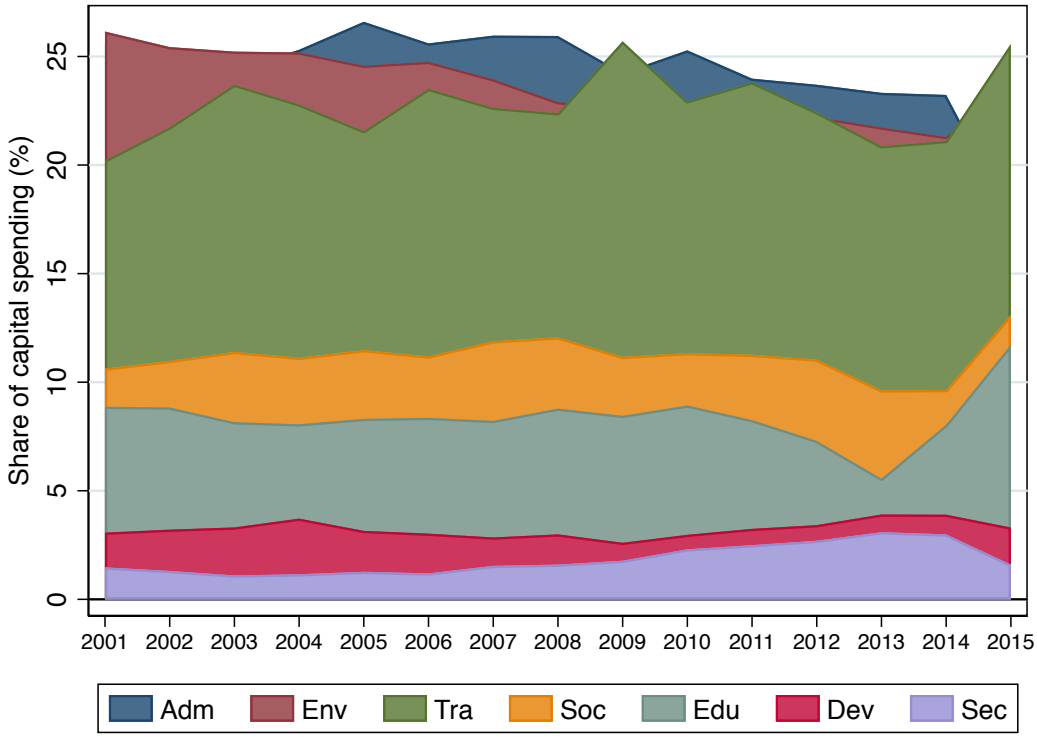
Note: This figure compares the ghost building intensity indicator (y-axis) with regional-level measures of the tax gap (x-axis) as computed by Galbiati and Zanella (2012) and Carfora, Pansini Vega and Pisani (2018). The ghost building indicator is the municipal population weighted regional average.

Figure 4: Tax base, tax revenue and marginal tax rate



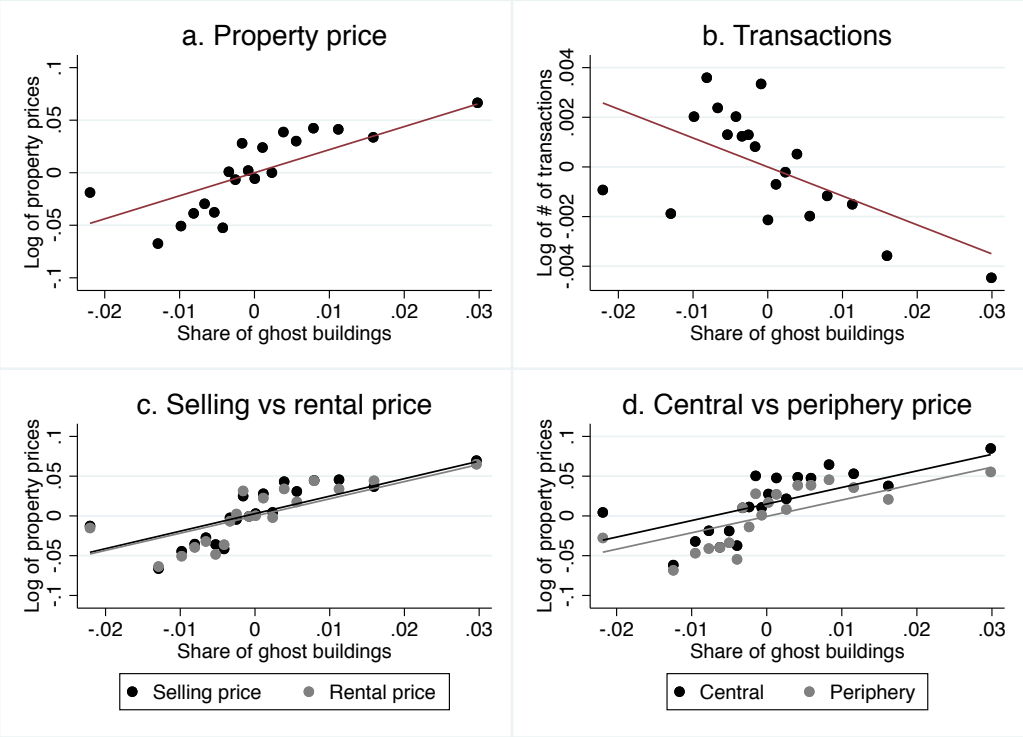
Note: This figure compares the log of municipal tax base (x-axis) with the share of municipal revenue from local taxes (left-hand side) and the sum of the local top marginal tax rate on income and on property (left-hand side). The figure plots equal sized bins and shows the line of best fit. The sample is composed of 7,381 municipalities over the 2001-2015 period.

Figure 5: Public spending composition



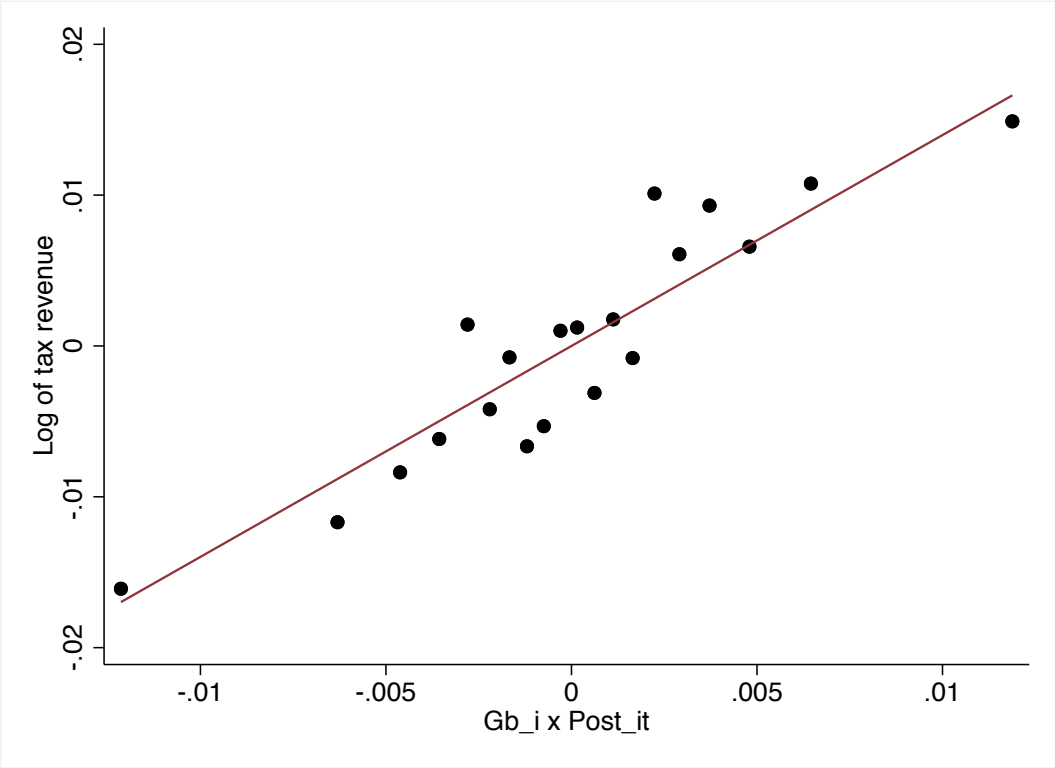
Note: This figure depicts the evolution in the composition of municipal capital spending (% of total capital spending). The following budget items are illustrated: administration ("Adm"); development ("Dev"); education ("Edu"); environment protection ("Env"); security ("Sec"); social, cultural and sport activities ("Soc"); public transportation and roads ("Tra"). Author's computation on data from municipal balance sheets.

Figure 6: Ghost buildings and the housing market



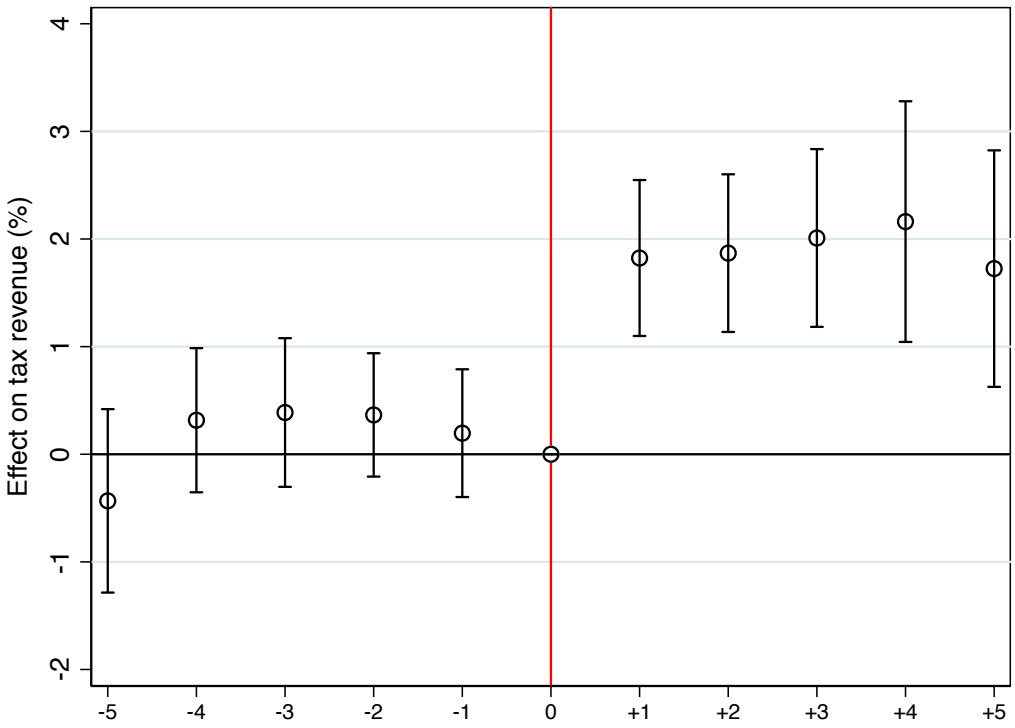
Note: This figure depicts the correlation between housing market characteristics and ghost buildings intensity. The outcome variables are (log of) municipality average property price (panel a), (log of) average transactions volume in the housing market in a year (panel b), (log of) municipal average selling and rental property price (panel c), (log of) property price in central and perhyperal areas within a municipality (panel d). All regressions control for province fixed effects. The figure plots equal sized bins and shows the line of best fit. The sample includes 7,381 municipalities over the 2005-2015 period. Data on housing market from Internal Revenue Agency.

Figure 7: The effect of the Ghost buildings program on tax revenue



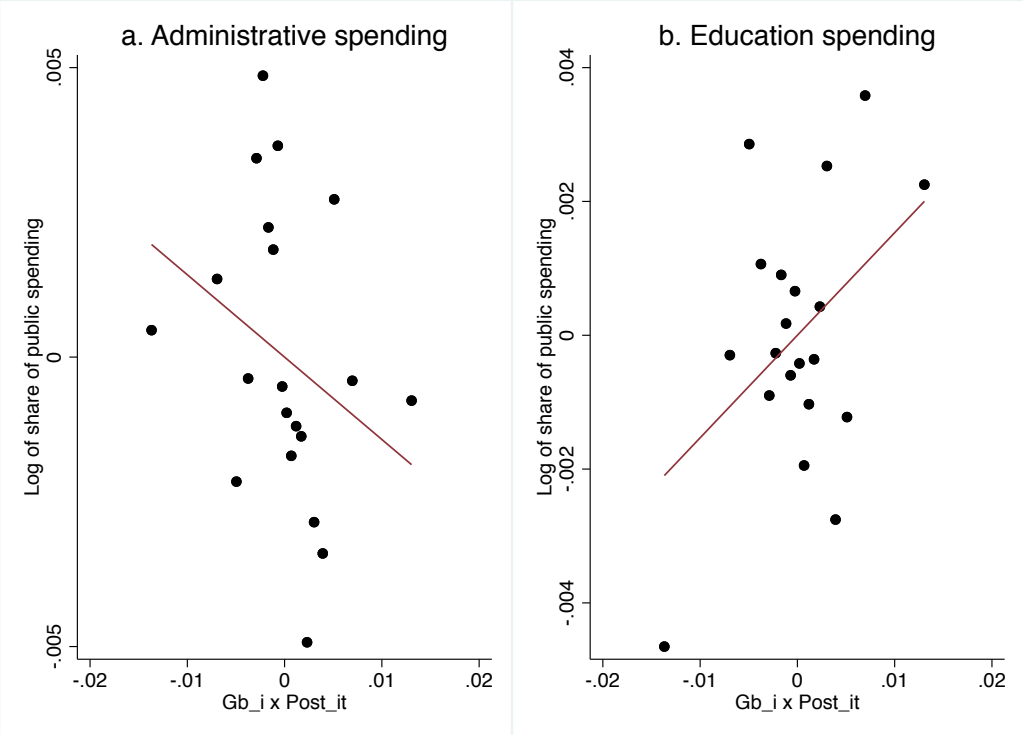
Note: This figure shows the effect of the Ghost buildings program on the (log of) local tax revenue. To construct the figure, I regress the log of revenue on municipality fixed effects, year $\times$ province fixed effects, election year $\times$ year fixed effects, time-varying municipality characteristics and the interaction between the control variables with the post-program dummy to obtain the residuals. The right-hand side variable (i.e., the interaction between ghost building intensity and post-program dummy) is residualized in a similar manner. The positive slope suggests that, on average, municipalities where more ghost buildings were detected experienced a larger increase in tax revenue. The sample includes 7,381 municipalities over the 2001-2015 period.

Figure 8: The dynamic effect on tax revenue



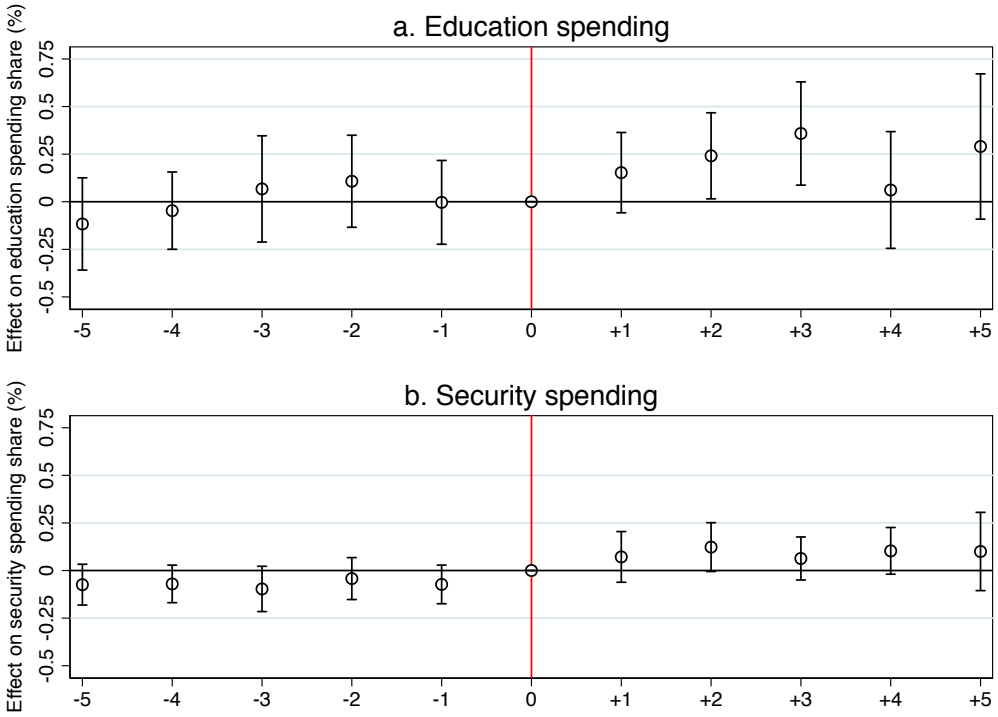
Note: This graph presents the effects of the Ghost buildings program on tax revenues. The figure plots the estimated β_j coefficients from equation (2) and the confidence intervals: each point on the solid line shows the effect of having implemented the Ghost Building program for j years (if $j > 0$) or of starting the policy in j years (if $j < 0$) relative to the year the program started. The empirical specification includes municipality fixed effects, province $\times$ year fixed effects, election year $\times$ year fixed effects and time-varying municipality characteristics. Standard errors clustered at province level.

Figure 9: The effect of the Ghost buildings program on public spending composition



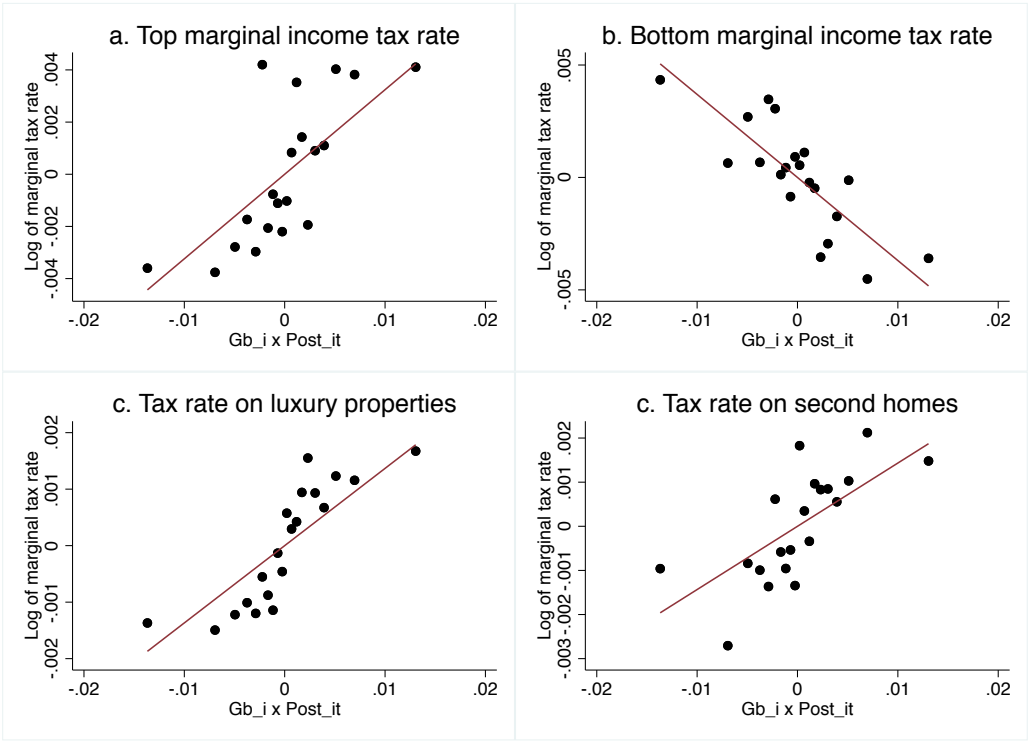
Note: This figure presents the effect of the Ghost buildings program on the (log of) municipal capital spending on administration (left-hand side graph) and education (right-hand side graph). To construct the figure, I regress the outcomes on municipality fixed effects, year $\times$ province fixed effects, election year $\times$ year fixed effects and time-varying municipality characteristics to obtain the residuals. The right-hand side variable (i.e., the interaction between ghost building intensity and post-program dummy) is residualized in a similar manner. The figure plots equal sized bins and shows the line of best fit. The opposite slopes indicate that the program re-allocates public resources from administration to education-related activities. The sample includes 7,381 municipalities over the 2001-2015 period.

Figure 10: The dynamic effect on public spending composition



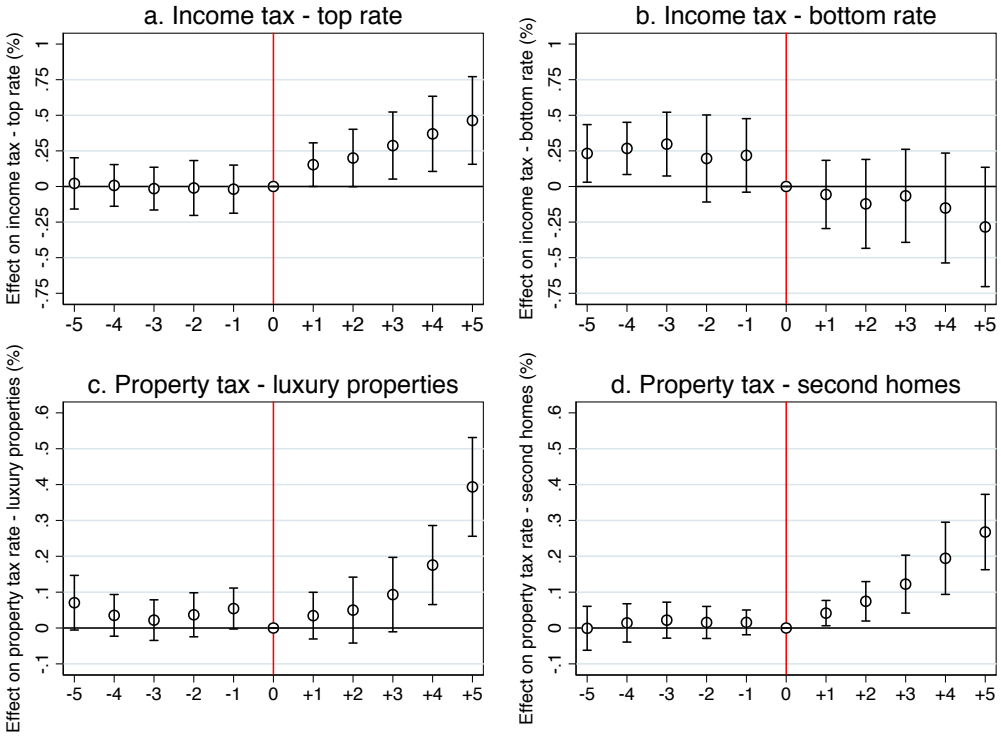
Note: This graph presents the effect of the Ghost buildings program on share of municipal capital spending in education (top panel) and security (bottom panel). The figure plots the estimated β_j coefficients from equation (2) and the confidence intervals: each point on the solid lines show the effect of having implemented the Ghost Building program for j years (if $j > 0$) or of starting the policy in j years (if $j < 0$) relative to the year the program started. The empirical specification includes municipality fixed effects, province $\times$ year fixed effects, election year $\times$ year fixed effects and time-varying municipality characteristics. Standard errors clustered at province level.

Figure 11: The effect of the Ghost buildings program on local marginal tax rates



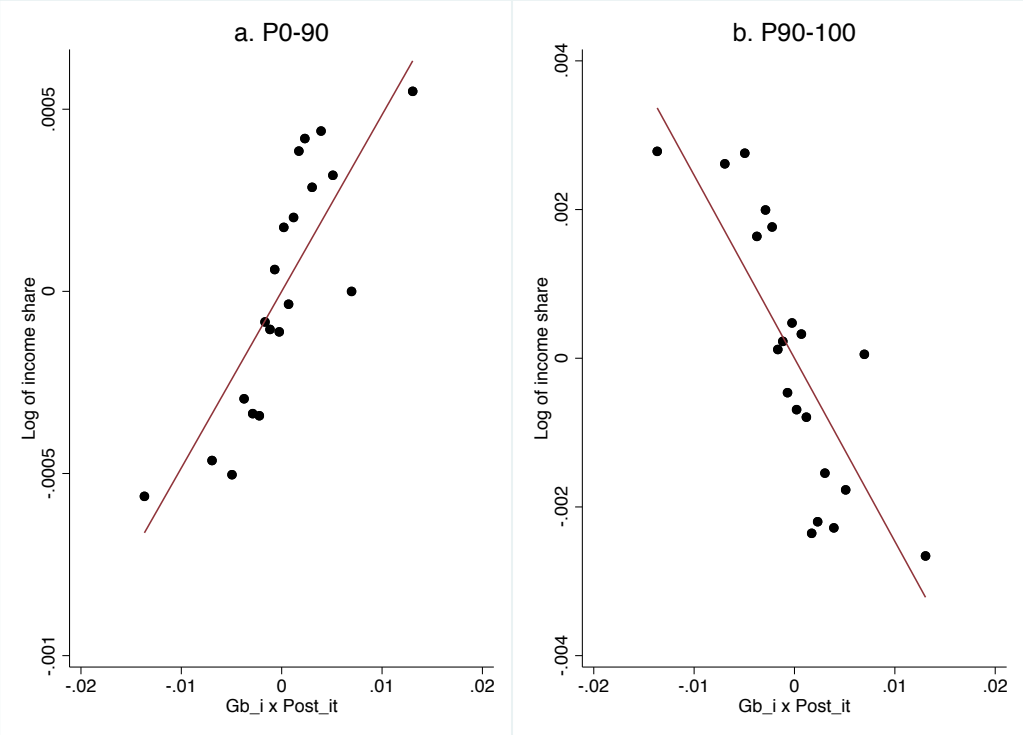
Note: This figure shows the effect of the Ghost buildings program on the (log of) municipal income tax rates (top figures) and property tax rates (bottom figures). To construct the figure, I regress the outcomes on municipality fixed effects, year $\times$ province fixed effects, election year $\times$ year fixed effects and time-varying municipality characteristics to obtain the residuals. The right-hand side variable (i.e., the interaction between ghost building intensity and post-program dummy) is residualized in a similar manner. The figure plots equal sized bins and shows the line of best fit. The sample includes 7,381 municipalities over the 2001-2015 period.

Figure 12: The dynamic effect on local marginal tax rates



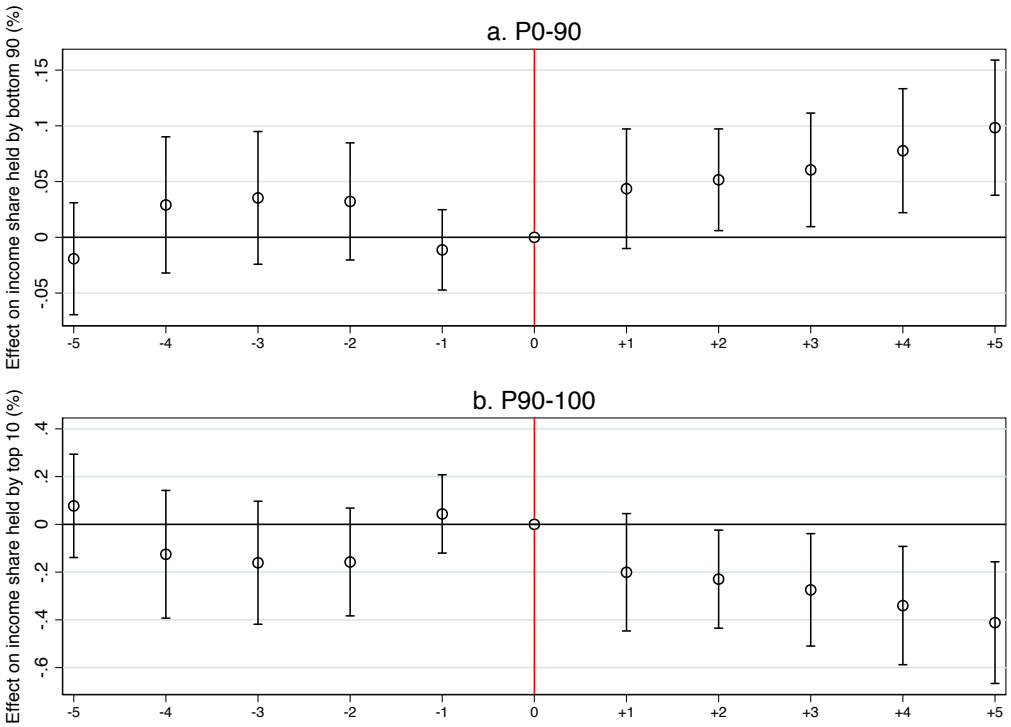
Note: This graph presents the effects of the Ghost buildings program on local tax rates. The figure plots the estimated β_j coefficients from equation (2) and the confidence intervals: each point on the solid line shows the effect of having implemented the Ghost Building program for j years (if $j > 0$) or of starting the policy in j years (if $j < 0$) relative to the year the program started.

Figure 13: The effect of the Ghost buildings program on within-municipality inequality



Note: This figure shows the effect of the Ghost buildings program on the (log of) income share held by the bottom 90 percent of the pre-tax municipality income distribution (left-hand side graph) and top 10 percent (right-hand side graph). To construct the figure, I regress the outcomes on municipality fixed effects, year $\times$ province fixed effects, election year $\times$ year fixed effects and time-varying municipality characteristics to obtain the residuals. The right-hand side variable (i.e., the interaction between ghost building intensity and post-program dummy) is residualized in a similar manner. The figure plots equal sized bins and shows the line of best fit. The sample includes 7,381 municipalities over the 2001-2015 period.

Figure 14: The dynamic effect on within-municipality inequality



Note: This graph presents the effects of the Ghost Buildings program on the income share held by the bottom 90 percent (top panel) and the top 10 percent of the pre-tax municipality income distribution (bottom panel). The figure plots the estimated β_j coefficients from equation (2) and the confidence intervals: each point on the solid line shows the effect of having implemented the Ghost Buildings program for j years (if $j > 0$) or of starting the policy in j years (if $j < 0$) relative to the year the program started.

Appendix A: The Ghost buildings program

[Work in progress]

Table A1: The Ghost Buildings program

Building type	# of registered buildings	Total rental value (euros)	Average rental value (euros)
Residential	446,093 (35%)	181.337.943 (22%)	407
Warehouse	395,482 (31%)	60,447,057 (7%)	153
Garage	215,601 (17%)	28,887,614 (3%)	134
Other	203,920 (16%)	554,592,000 (67%)	2,721
Total	1,261,096	825,624,614	655

Note: This table presents information on the type of buildings detected by the Ghost Buildings program and subject to registration requirement. Data from the Italian Internal Revenue Service (*Agenzia delle Entrate*).

Appendix B: Data and additional results

Table B1: Summary statistics

	Obs (1)	Mean (2)	Std. Dev. (3)	Min (4)	Max (5)
a. Tax revenues and spending shares					
Tax revenues (€1,000)	110,715	1,999	18,765	0	1,751,331
Administration spending (%)	110,715	24.405	30.216	0	100
Development spending (%)	110,715	3.246	12.920	0	100
Education spending (%)	110,715	8.390	18.351	0	100
Environment spending (%)	110,715	23.608	30.583	0	100
Security spending (%)	110,715	1.841	8.524	0	100
Social spending (%)	110,715	11.197	20.409	0	100
Transportation spending (%)	110,715	22.733	18.351	0	100
b. Tax rates					
Income tax - top rate (%)	110,715	0.352	0.264	0	0.900
Income tax - bottom rate (%)	110,715	0.277	0.254	0	0.800
Property tax - luxury properties (%)	110,715	0.495	0.090	0	0.860
Property tax - second properties (%)	110,715	0.677	0.152	0.300	1.110
c. Ghost Buildings program					
Ghost buildings	110,715	0.018	0.017	0	0.131
Post (0/1)	110,715	0.546	0.498	0	1
Ghost buildings × Post	110,715	0.010	0.015	0	0.131
d. Demographic and geographical variables					
Population	110,715	7,492	41,602	30	2,872,021
Population 65+ (%)	110,715	22.576	6.137	4.364	66.379
Population 15- (%)	110,715	13.082	2.801	0	26.459
Foreign residents (%)	110,715	4.847	4.182	0	43.973
Nord (0/1)	110,715	0.549	0.498	0	1
Area (sq km)	110,715	36.705	49.650	0	1,285
Altitude index (1/5)	110,715	3.070	1.526	1	5
Urban (0/1)	110,715	0.112	0.315	0	1
e. Political and economic variables					
Gini index	110,715	0.396	0.037	0.240	0.765
Income held by Bottom 90 (%)	110,715	67.649	4.489	28.274	92.174
Income held by Top 10 (%)	110,715	32.351	4.489	7.826	71.726
Gambling (€ per-capita)	110,715	3.690	9.514	0	199.951
Self-employees (%)	110,715	18.611	5.113	0	75
Non-profit organizations (%)	110,715	7.348	5.012	0	57.143
Owner occupied properties (%)	110,715	76.999	7.130	29.268	100
Unemployment rate (%)	110,715	8.910	5.307	1.873	31.456
Mayor age	110,715	49.133	9.743	19	94
Mayor sex (0/1)	110,715	0.104	0.301	0	1
Mayor graduated (0/1)	110,715	0.427	0.490	0	1
Average age in town council	110,715	44.210	4.161	26	77
Women in town council (%)	110,715	19.521	12.025	0	100
Graduated in town council (%)	110,715	25.793	16.380	0	100

Note: The sample covers 7,381 municipalities over the 2001-2015 period.

Table B2: Alternative outcomes

	Tax base (1)	Total revenue (2)	Total transfers (3)	Intern. transfers (4)	Total spending (5)	Current spending (6)	Capital spending (7)
$Post_{i,t} \times GB_i$	0.380***	0.585	-1.842*	-1.200	0.153	0.093	1.022
	(0.110)	(0.356)	(0.999)	(1.471)	(0.308)	(0.192)	(2.605)
Observations	110,715	110,715	110,715	110,715	110,715	110,715	110,715
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls $\times Post_{i,t}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Election year $\times$ year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province $\times$ year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dependent (€1,000)	94,953	8,734	1,559	2	6,209	5,110	1,099

Note: The sample covers 7,378 municipalities over the 2001-2015 period. Standard errors clustered at province-level. *** p<0.01, ** p<0.05, * p<0.1.

Table B3: Triple difference approach for the effects on public spending composition

	(log of) Share of municipal public spending on:						
	Adm	Dev	Edu	Env	Sec	Soc	Tra
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	a. OLS						
$Post_{i,t} \times GB_i$	-0.138	-0.034	0.149**	-0.024	0.079*	-0.039	0.140
	(0.119)	(0.053)	(0.068)	(0.160)	(0.045)	(0.102)	(0.138)
	b. 2SLS						
$Post_{i,t} \times GB_i$	-0.046	-0.056	0.162**	-0.029	0.089*	-0.105	0.157
	(0.129)	(0.060)	(0.080)	(0.178)	(0.052)	(0.105)	(0.160)
Observations	115,620	115,620	115,620	115,620	115,620	115,620	115,620
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Election × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dependent (%)	24.248	3.384	8.357	23.540	1.784	11.385	22.913

Note: This table displays the effect of the ghost buildings program on municipal capital spending composition. The dependent variable is the (log of) share of municipal spending in: (1) administration; (2) development; (3) education; (4) environment; (5) security; (6) social services; (7) transportation. The sample covers 7,708 municipalities over the 2001-2015 period. Standard errors clustered at province-level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table B4: Triple difference approach for the effects on marginal tax rates

	log(Income tax) Top rate (%)		log(Income tax) Bottom rate (%)		log(Property tax) Luxury pr. (%)		log(Property tax) Second pr. (%)	
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Post_{i,t} \times GB_i$	0.331**	0.364**	-0.372**	-0.426**	0.141***	0.165***	0.147***	0.161***
	(0.139)	(0.161)	(0.178)	(0.199)	(0.035)	(0.040)	(0.034)	(0.039)
Observations	115,620	115,620	115,620	115,620	115,620	115,620	115,620	115,620
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Election × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep. (%)	0.337	0.337	0.265	0.265	0.492	0.492	0.671	0.671

Note: This table presents the effect of the ghost buildings program on marginal tax rates set by municipalities. The outcome variable is the (log of) top marginal tax rate on personal income (columns 1 and 2), bottom marginal tax rate on personal income (columns 3 and 4), property tax rate applied to luxury properties reported as main residence (columns 5 and 6), and the property tax rate applies to properties different from the main residence (columns 7 and 8). The sample covers 7,708 municipalities over the 2001-2015 period. Standard errors clustered at province-level. *** p<0.01, ** p<0.05, * p<0.1.

Table B5: Triple difference approach for the effects on within-municipality inequality

	log(Gini index)		log(P0-90)		log(P90-100)	
	OLS	2SLS	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
$Post_{i,t} \times GB_i$	0.040	0.042	0.123***	0.143***	-0.244***	-0.284***
	(0.050)	(0.059)	(0.034)	(0.039)	(0.070)	(0.081)
Observations	115,620	115,620	115,620	115,620	115,620	115,620
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Election × year FE	Yes	Yes	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean dependent	0.397	0.397	67.704	67.704	32.296	32.296

Note: This table reports the effect of the ghost buildings program on within-municipality pre-tax distribution of income. The outcome variable is the (log of) the Gini index (columns 1 and 2), the income share held by the bottom decile of the pre-tax municipal income distribution (columns 3 and 4), and the income share held by the top decile of the pre-tax municipal income distribution (columns 5 and 6). The sample covers 7,708 municipalities over the 2001-2015 period. Standard errors clustered at province-level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.