'Hold that ghost': Local government cheating on transfers

Dirk Foremny* Jordi Jofre-Monseny† Albert Solé-Ollé‡

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Abstract

We study the incentives of local governments to misreport the information needed to implement a formula transfer. We focus on population, in theory the easiest variable to verify by the grantor. We analyze the Spanish case, and show how a switch from the use of Census to Registered population (which is administered by the municipalities) led to a manipulation of population numbers. As a result, the Register included a proportion of 'ghost citizens', that is people with no trace of residing in the municipality. We identify the effects of transfers on population over-reporting taking profit of notches in the transfer scheme, which is based on weighted population with weights increasing at specific population thresholds. We document an excess mass of municipalities at the right of the notch threshold and a density hole at the left. We found no anomalies in the density distribution of Census population, and cheating disappears after an improvement of enforcement. This reinforces the idea that cheating, instead than real population responses, is the mechanism at work.

Keywords: intergovernmental transfers, notches, fraud

* Institut d'Economia de Barcelona (IEB), University of Barcelona, email: foremny@ub.edu
† Institut d'Economia de Barcelona (IEB), University of Barcelona, email: jordi.jofre@ub.edu
‡ Institut d'Economia de Barcelona (IEB), University of Barcelona, email: asole@ub.edu

1. Introduction

Local governments across the globe receive a substantial share of their revenues in the form of transfers from higher level governments. In 2010, this share has been as high as approximately 70% in the United Kingdom and The Netherlands, while other countries use less transfers and grant more autonomy over own resources to their local governments (Foremny, 2014). In Spain, nearly 40% of all local revenues are grants, still enough to warrant special attention.

How these transfers are allocated to cities and municipalities differs across countries. The optimal allocation of transfers has been discussed extensively from a theoretical point of view (see Oates, 1972, 1999; Wildasin, 1986; Bird and Smart, 2002, for surveys). A common result is that grants should be allocated as unconditional block grants such that local spending and taxation decisions will not be distorted. At the same time, grants should be formula based to avoid negative effects of discretionary policy bargaining (Dixit and Londregan, 1995; Persson and Tabellini, 2002). Most formulas, however, will be vulnerable to manipulation as information about the applied criteria is distributed asymmetrically between levels of government (Bordignon, Manasse, and Tabellini, 2001; Huber and Runkel, 2006).[1] These problems are not usually considered in the academic literature, but are a concern for policy makers and consultants advising on the design of these formulas (see, e.g., Boex and Martinez-Vazquez, 2007).

It has often been argued that the less distortionary and manipulable way of allocating grants are transfers based on numbers of inhabitants. However, if the collaboration of local governments is needed for the collection of population information, even this variable might be potentially manipulated. This type of problem may be specially acute in developing countries, where the central government lacks the capacity to monitor effectively population in the field (see again Boex and Martinez-Vazquez, 2007).[2] In practice, any government wishing to base the allocation of transfers on population will face a trade off between accuracy and manipulability. Increasing accuracy by relying on reporting by local governments might create incentives to cheat on reported population, unless the central government undertakes enough effort in ensuring compliance.

In Spain - our case of study - municipalities are responsible for the administration of

[1]Note that grantors using equalization formulas relying on measures of tax capacity need to be able to obtain this information; if tax collection is in the hands of local governments, there might be incentives to under-report the tax base to the higher layer authorities. Specially vulnerable to incentives to withdraw information might be the complex calculations of spending needs used in some countries (e.g., Australia and the UK); in these cases there might be a trade off between accuracy (i.e., getting an appropriate measure of service users) and manipulability (i.e., ensuring the information can be collected directly without interference of the local government)

[2] It is also a concern in developed countries; why if not some developed countries (e.g., as the U.S., see Larcinese, Rizzo, and Testa, 2013) still use decennial Census data to allocate transfers and other spending programs territorially, with the implied inequities created?.

population registers *(Padrón municipal de habitantes)* which are continuously coordinated and monitored by the Spanish statistical office, a central government agency . Since 1998, transfers from the central government to municipalities are allocated using these population registers. For an extended number of years, the monitoring by the central government was far from perfect and registered population has been systematically inflated. The Population Censuses have uncovered huge amounts of 'ghost' residents, which are the ones for which there is no evidence of residing in the municipality. Moreover, there have been several scandals where the city council has been accused of systematically manipulating population numbers. The most prominent one took place in Sta. Cruz de Tenerife (the main city in the Canary Islands). In an audit released in 2009 the Spanish statistical office found nearly 15,000 'ghost' residents, with evidence of fraudulent use of ID documents among other irregularities. Immediately after the release of the audit, the mayor of Las Palmas (the second city in the Canary Islands) complained about the loss of transfer for his city due to the over-reporting of population in Sta. Cruz, which also generated an over-statement of transfers amounts. [3]

Theoretically, for a given level of enforcement, over-reporting will be larger the more generous are these transfers (i.e., the higher the amount of money linked to an additional resident). To our knowledge, there is no paper in the literature trying to estimate the effect of transfer generosity on population over-reporting to approximate the magnitude of the problem in real settings. The reason is probably that this magnitude would be very hard to estimate with a linear transfer scheme. Fortunately for our purposes, in Spain, per capita transfers to municipalities jump at population thresholds. Specifically, the grant per inhabitant changes discontinuously at 5000, 20000, and 50000 inhabitants for the entire local population. If transfers per capita increase discontinuously at population thresholds, incentives for municipalities to sort on the right of the threshold are very strong as one additional inhabitant brings additional grants for all existing inhabitants. Thus, municipalities face strong incentives to misreport population figures. In fact, there are many anecdotes in Spain of municipalities where the city council mentions the increase in transfers to justify an aggressive policy of trying to move population numbers over one of these thresholds.[4]

Policies which create jumps in the choice set of governments are commonly referred to as notches (Slemrod, 2010). We make use of these notches to estimate the effect of transfer generosity on population over-reporting. This paper is, to the best of our knowledge, the first to exploit notches in intergovernmental transfers to study the responses of local governments.

[3]The undue amount of transfers received by Sta. Cruz during a period of ten years was estimated to be on the order of 50 million Euro. The amount of transfers lost by Las Palmas was estimated by his mayor to be on the order of around 6 million Euro, and included not only the loss in national funds but also from other transfers allocated by the regional government.

[4]For example, in Manlleu (a town near Barcelona) a local newspaper informed that the city council discussed about the real gains of having jumped above 20 thousand inhabitants (see "The 20 thousand effect", in El 9nou, 20/10/2005).

Specifically, we use the methods developed in the taxation literature (Saez, 2010; Chetty et al., 2011; Kleven and Waseem, 2013) to quantify bunching that, in our case, corresponds to the excess density found above the notch-points. We also estimate the implied responses of population over-reporting to transfer generosity.

We find significant responses. We detect an excess mass of between 9 and 16% of municipalities above the relevant thresholds. The results also imply that there is a huge amount of heterogeneity in the responsiveness of municipalities to grants. For the most responsive municipalities, the elasticity of population over-reporting to grants is about 0.44 while the average response would be around 0.013. There is no evidence of bunching in the Census population figures which confirms manipulation (rather than real population responses) as the mechanism that generates bunching patterns. Finally, we find that the extent of over-reporting is higher during the period 1998-2006, but almost disappears after 2006, coinciding with an improvement of the enforcement of population numbers by the Spanish statistical office. A number of robustness checks indicate that the bunching patterns that we document are not likely to be explained by other institutional arrangements that also change discontinuously at population thresholds.

The paper which is closest to ours is Litschig (2012) which shows that grants allocated through a population based formula in Brazil are not effectively shielded from special-interests politics. The central government, in charge of the administration of relevant population information, inflated population numbers for politically aligned municipalities. As a consequence, aligned municipalities received on average more transfers than non-aligned municipalities. This proves that higher level governments may implement formulas which they can later on manipulate in their favor.[5]

The rest of the paper is organized as follows. In section 2 we describe the institutional background in detail. In section 3, we developed a stylized model of population over-reporting to guide the empirical findings. The empirical methods and data are described in section 4 while the results are presented and discussed in section 5. Section 6 concludes.

2. Institutional background

2.1. Local governments in Spain

The size of Spanish municipal governments is moderate, with municipal budgets representing around 15 per cent of total public spending in our period of study. Spanish municipal-

[5] It is interested to note that Brazilian transfers to local governments also exhibit notches, although in this case in the absolute value of transfers (the overall amount of transfers jumps at specific thresholds); this means that transfers per capita display a saw shape. The use of this type of scheme is probably related to the difficulties in monitoring local population numbers in Brazil; the design impedes any manipulation inside each bracket -since increasing population has no effect at all on the amount of transfers - but are huge close to the threshold.

ities have spending responsibilities similar to those in other countries (e.g., water supply, refuse collection and treatment, street cleaning, lighting and paving, parks and recreation, traffic control and public transportation, social services, etc.) with the only exception of education, that is a responsibility of regional governments. In terms of revenues, in 2012, inter-governmental grants represented 36 percent of local operating budgets. 69 percent of these transfers comes in the form of a formula-based block grant allocated by the central government (the *Participación Municipal en los Ingresos del Estado* - PIE). This grant - as all other financial aspects of Spanish local governments - is regulated in a law passed in 1988 by the central government (the Law 39/1988 *Reguladora de Haciendas Locales*) and which is of application to all the municipalities in the country. Although the variables and their exact weights have experienced (minor) changes over time, (weighted) population has determined the allocation of 75 per cent of its funds throughout the relevant years of our study.[6]

To account for supposedly differential spending needs, a weight of 1 is applied to the residents in municipalities smaller than 5 thousand inhabitants; this weight jumps to 1.17, 1.3 and 1.4 when the population of the municipalities jumps over the threshold of 5, 20 and 50 thousand inhabitants.[7] Note that this weight or multiplier is not applied exclusively to the population in excess of the threshold, but to the entire population of the municipality. The effect of the weighting scheme on per capita resources depends on the size of the pot of funds distributed each year which is determined by the evolution of national tax revenues. Panel a) of Figure 1 illustrates this with data from enacted budgets in 2005. In that year, the amount of per capita resources was expected to increase from 96 to 113, 125 and 135 euros for municipalities exceeding 5, 20, 50 thousand inhabitants. The absolute amount of resources implied is shown in Panel b) of Figure 1 which amounts to 85, 240 and 500 thousand euros per year, providing strong incentives to sort on the generous side of the threshold.

[Figure 1 about here]

The 1988 law that regulates local government finances also establishes spending responsibilities for each municipality size class. Besides the goods and services that all municipalities

[6]The other variables used in the formula are fiscal effort, the inverse of tax capacity, and the number of school units. There is a consensus among scholars that these elements do not work properly (see Solé-Ollé and Bosch (2005)). For instance, the fiscal capacity equalization element is very poorly designed and as a consequence it does not contribute at all to reduce differences in tax revenues.

[7]The law establishes a different funding scheme for municipalities with more than 75 thousand inhabitants. After 2001, instead from the above-mentioned formula grant, these municipalities obtain revenues from tax sharing of the main taxes, i.e. personal income tax, VAT, and excise taxes. It is not clear whether this had any effect on per capita resources at the 75 thousand threshold. Prior to 2001 there was not jump in this threshold, although there was an additional threshold in the formula grant, at 100 thousand, where a population weight equal to 2.8 was used. Unfortunately, the low number of municipalities around the 50, 75 and 100 threshold precludes any evaluation of these notches.

must provide, those exceeding 5 thousand inhabitants are also required to provide public parks, waste treatment, sports facilities and a library. When exceeding 20 thousand inhabitants, social services and fire protection must also be provided. Note that this is actually the rationale for the increase of per capita transfers at these thresholds. The application of this regulation is, however, not stringent as upper-level governments do not provide these services for the smallest municipalities. In practice, municipalities start to provide these services when citizens demand so, and this depends both on preferences and resources, which vary widely across municipalities.[8] Economies of scale are surely important too, so municipalities do not start to provide these additional services until they reach a minimum population size. Note, however, that this minimum population size is going to be different for each municipality and, certainly, needs not coincide with the thresholds established by the legislator. As a result of this, we do not observe that local public spending in the corresponding categories changes at the relevant thresholds. Instead, what we observe is spending per capita growing continuously, both before and after the threshold. We will come back over this issue at the end of the paper, providing quantitative evidence of it. For now, it is enough to keep in mind that we think it is quite reasonable to analyze the effect of the those thresholds as that of an exogenous increase in lump-sum revenues.[9]

Anecdotal evidence from the municipalities that have been engaged in population manipulation indicates that this is the only advantage considered in practice. Note also that in Spain there are not many other policies that jump at these thresholds (see Freier and Ade, 2011, for a discussion of this point). For instance, in contrast to other countries, the mayor's pay (Gagliarducci and Nannicini, 2013) or the fiscal oversight framework (Grembi and Troiano, 2014) does not depend directly on municipality size.[10] We are quite confident in making this statement, since the existing policy-discontinuities can be easily identified by analyzing the political and financial framework of local governments, which is a responsibility of the central government and is basically covered by a two national laws, the above mentioned which regulates municipal finances and a law which regulates the administrative and political workings of local governments (the Law 7/1985 *Reguladora de Bases de Régimen Local*). Besides the already mentioned increase in spending responsibilities, in these laws we find two other relevant policies switching at these thresholds: maximum tax rates for

[8]As we already mentioned, the equalization power of transfers to local governments is null, meaning there are huge revenue differences among municipalities.

[9]Alternatively, one might think that although higher layer governments don't provide these services, the local council is able to deny them too with the argument that they not compulsory until the threshold is reached. Then citizens welfare might improve after surpassing the threshold because they will be able to get the service from the council at not extra cost - since the service will come with the extra funding -. In this case the effect of the extra transfers would be similar to the one of an earmarked transfer (so, probably lower to the one of a lump sum transfers of the same amount, but still positive). In any case, as we have already argued, there is some evidence that suggest that these extra monies can be treated as a lump sum transfer.

[10]This is not true anymore. A reform passed in January 2014 has introduced pay caps in municipal governments that differ across municipality sizes, as well as other changes regarding the personnel management

local taxes and council size. Regarding the first policy, during some years the rates in the property and local business taxes could be higher for those municipalities exceeding 5 and 20 thousand inhabitants. Some municipalities to the left of these thresholds did choose the maximum tax rate allowed by law, so jumping above the threshold would be the only way to increase taxes. Note however that this incentive disappeared after a modification of the law 2002, that kept the maximum tax rates but made them independent of population size. Moreover, it does not seem to us that this was a really compelling reason to try to inflate population: it would be rather difficult to sell this as a benefit for citizens and we have not been able to find any example of a local incumbent mentioning this possibility. Regarding council size, the number of councilor increase from 11 to 13, 17 and 21 when the 5, 10 and 20 thousand inhabitant thresholds are surpassed. However, a larger council is unlikely to explain the excess density patterns we document. We will show that there is no evidence of bunching around the 10 thousand threshold where council size increases while per capita grants do not. Moreover, as fragmentation might increase rather than decrease with council size, we would expect incumbent government to bunch to the left (rather than to the right) of the population thresholds in order to avoid an increase in the probability of governing in coalition or minority (see Fiva and Folke, 2014). And, as we will show below, the council size increases at the relevant thresholds are not large enough to produce a significant increase in fragmentation as measured by the probability of having a majority government.

2.2. Local population figures

In Spain, the Population Census has been carried out every tenth year (the last three in 1991, 2001 and 2011). In 1991, the census quantified the permanent population in each Spanish municipality by visiting all households in the country. A similar operation also took place in 1996 (which was called *Renovación padronal*) in order to reduce the excessive lag between the two consecutive censuses. The population levels that resulted from these large scale field projects run by the Spanish Statistical office (INE) were the only local official population figures at the time. These population figures also became the municipal registered population (*Padrón municipal*) for 1991 and 1996, respectively. This register was then updated yearly by the local authorities to account for births, deaths and migrations. The register provided a population count for non-census years that was used, for instance, to create electoral censuses. However, since population was used in the allocation of grants, the government was already concerned that municipalities could have incentives to inflate registered population. As a result, grants were only distributed according to official population counts. Specifically, the 1991 Census was used to distribute grants for the period 1991-1997 whereas grants in 1998 were distributed with the 1996 population count.

INE took the responsibility to coordinate and monitor the *Padrón* in 1996. Since 1998, there is an annual population count (referred to January the 1st) that is official and, therefore, used to allocate grants. The municipalities have to report monthly the changes in the *Padrón.* Then, the INE merges the *Padrón* of all municipalities with their own administrative records and communicate to each municipality the resulting official population, which can be understood as the level of reported population by the municipality net of any adjustment undertook by the INE. With these operations the INE is able, for example, to avoid a Spanish national from being registered in two different municipalities: once somebody moves to another cities and registers there, the INE will delete him automatically of the register of the city of origin. Similar automatic adjustments are made with regards to deaths and births, over which INE also obtains information on real time. The decision to base the allocation of grants on registered population number was due to the optimism in the workings of this automatic computerized monitoring system.[11] However, in practice, the monitoring by INE was far from perfect for a number of years. The INE has faced several challenges:

- Unreported migrations abroad: Irrespective of their legal status, immigrants had strong incentives to register. First, it is a necessary condition to access important public goods and services (including health care and education). Second, it can become a proof of residence in case of (extraordinary) regularization processes as the ones that took place in 1996, 2000, 2001 and 2005. However, when they return home or move to another country they do not communicate that they have abandoned the country (and the municipality) of residence. This means that immigrants are inflated in the register. The municipalities can claim that for them it is very costly to identify the immigrants that left the city, so there is no attempt to manipulate population numbers. Note, however, that the updating of the popualtion registry is established by law as a compulsory responsibility of all Spanish municipalities.

- Over-registration of visitors. This is the case of EU citizens and also of Spanish nationals that spend part of the year in the municipality (e.g., they own a vacation home). Clearly, if they spend most of the time in the municipality they should be considered residents and give right to the city council to claim additional transfers. However, municipalities tend to include them into the register without caring much about how much time they spend there. In fact, there is ample anecdotal evidence of municipalities putting effort and resources into marketing campaigns in order to convince these people to register. In some of the most blatant cases of population over-

[11] Note also that the previous system, based on Census data, although certainly less manipulable, was far from perfect. For instance, under the old system municipalities facing a high rate of population growth saw the levels of per capita transfers substantially reduced during the inter-census period. The failure in updating population numbers has also been documented to create huge inequities in other countries that use Census population to allocate transfers (see, e.g., Larcinese, Rizzo, and Testa, 2013, for the U.S.). So, moving to a continuous population measure seems a good idea, provided that enforcement problems are kept below a reasonable level.

reporting, the municipality registered people in the street as if it was simply running a survey. Of course, even if these people were correctly included in the register in the first time, they also tend to move out the country (e.g., they sell the property or rent it and stop visiting) without communicating this move to the local authorities.

- Incorrect inclusion in the register. For example, it might be that a resident is included many times with slightly different names and/or with different ID documents. This use to happen more in the case of immigrants and EU citizens. It might also be the case that the ID number of deceased people do not coincide with the one in the administrative register of the INE. In some of the cases this is due to administrative mistakes (this is what local councils always claim), while in others they reflect overt attempts to manipulate the register and, as such, they might entail legal responsibilities.

Some of these problems were already known since the implementation of the system in 1998, and others have been discovered as they manifested. Note, for instance, that the huge immigration boom experienced in Spain during those years was probably somewhat unexpected in 1998. Also, during these years there has been a huge boom in housing construction in coastal places that might exacerbate all the problems related to the monitoring of population in touristic areas. In any case, however, the INE has learned form theses developments and during the period has progressively improved enforcement, through the implementation of several data cleansing and auditing operations:

- The 2001 Census was the last field operation involving visits to all households. It produced a municipal population figure referred to November 2001. The Census operations revealed large discrepancies with the register and, between 2002 and 2004, municipalities were required to justify the discrepancies or make the due downsize adjustments. The ability of the Census to fully correct the problem was limited though. Our understanding is that, although the Census is the best approximation of the real resident population in the municipality, the INE can only used it as a starting bargaining point with the municipality, with the objective of forcing a downward adjustment of the register population. However, given the limited resources of the INE it might not be optimal to try to force a full adjustment. Note, for example, that the municipality might be able to bring proofs that some people is really residing in the municipality (e.g., utility bills) or might re-register again those people the year after the INE has cleaned the register.

- To deal with the problems in monitoring immigrants associated with under-reporting of out-migration and double registers, the INE introduced in 2006 the requirement that non-EU immigrants must renew their register every second year, being deleted from the register if they fail to do so. A similar mechanism has also been implemented by EU residents that, from March 2009, must also re-register every fifth year.

- In 2011 the last Census took place. It was a survey rather than a Census with only about 12% of the population being interviewed. One of its objectives was to increase the accuracy of the register . In fact, the probability of being surveyed was very high for individual types that were suspected to be over-represented in the register. Municipalities have been required to make the due downsize adjustments.

Two conclusions emerge from this discussion. First, some local councils found easiest to over-report the number of registered population. This was certainly easy in places with a lot of immigrants, either non-EU immigrants or EU citizens, and in places with a lot of vacation homes. Second, the ability of INE to monitor the municipal register seems to have increased over time. If the excess mass we observe at the right of the thresholds is explained by population manipulation, we should observe this phenomenon to be less intense in the last years of our sample. Of course, analyzing bunching in the 1991, 2001 and 2011 censuses provides another piece of evidence to disentangle between manipulation and truly population growth as the underlying mechanism at work.

3. Conceptual framework

3.1. A model of population over-reporting

To guide the interpretation of the empirical findings, this section first develops a very simple model of a local government that has to decide to what extent to over-state the real population of the municipality when reporting the population figures to the central government. The model is similar to a tax evasion model with endogenous probability of detection (Yitzhaki, 1987; Kleven et al., 2011)), although adapted to the particularities of the case under study. In the model, the local government decides on the amount of population to over-report taking into account the benefits from additional transfers and the costs derived from being caught inflating population numbers.[12] These costs are the product of the probability of being caught, which depends on the amount of over-reporting, and on the consequences of this event for the local incumbent.

The section is organized as follows. First, we will show how the local government selects the amount of population over-reporting in the case of a linear transfer schedule (i.e., a transfer allocated proportionally to population). Second, we will analyze how the amount of population over-reporting is affected by the presence of a notch in the transfer schedule. Third, we will add some realism in the model, introducing both heterogeneity of preferences and population shocks.

[12]Note that an increase in reported population does not drive up the costs of providing public services, since these people were already residents.

Linear transfer schedule:

Let's assume for the moment that the amount of transfers τ received by a local government is the product of the level of reported population r and per capita transfers α (i.e., $\tau = \alpha r$). Let's define $e = r - n$ as the level of over-reported population, where n is the number of residents in the municipality (which we assume exogenous) and r is reported population. The probability that population over-reporting is detected is denoted by $p(e)$. We parameterize p using the following Pareto distribution $p = 1 - e^{\gamma}$ where $-1 < \gamma < 0$.

The local government maximizes the following expected utility function:

$$u = (1 - p)\alpha(n + e) + p(\alpha n - \theta e) \tag{1}$$

which can be re-written as:

$$u = \alpha n + \alpha e - p(\alpha + \theta)e \tag{2}$$

where θ measures the cost per over-reported citizen if caught. The proportionality of this cost with respect to e means that the costs are going to be larger for big than for small deviations; huge over-reporting can hardly be attributed to mistakes. Among these costs accounted for by θ, we can cite: (i) a harm of the reputation of the local incumbent, since the detection of an over-reporting case might reveal the incumbent is not trustworthy; (ii) a reduction in the electoral prospects of the incumbent, due to the downgrading of the quality of local services and/or to the inability to fulfill the promises of improving them with the expected additional transfers[13]; (iii) the most serious cases (i.e., when courts are able to proof that cheating has occurred) might entail penalties for those involved (as, e.g., disqualification for public office, fines, even prison).

The first order condition of the maximization of (2) is:

$$e^{*} = \left(\frac{\theta}{\alpha + \theta} \frac{1}{\gamma + 1} \right)^{1/\gamma} \tag{3}$$

Given that $-1 < \gamma < 0$, it can readily be seen that over-reporting increases with per capita grants (α), decreases with the cost of cheating if caught (θ) and increases if the probability

[13]The detection of over-reporting does not usually entail the obligation of returning the transfers unduly received. However, if voters have loss aversion (see, e.g., Alesina and Pasarelli, 2014) the reduction in the provision of public services (when transfers return to the previous level) might cause more harm than the increase in utility obtained during the years of buoyancy. Also, the local incumbent might have spent the extra resources in types of spending that is difficult to adjust (e.g., hiring) or that generate additional costs (e.g., infrastructure maintenance), meaning that the loss of transfers will fall on other spending categories perhaps more valuable to voters.

of being caught is low (γ is small in absolute value). Our object of interest is the effect of the generosity of transfers on the level of over-reporting as it measures the leakage of transfer funds due to the difficulties in avoiding cheating by local governments. Specifically, the elasticity of over-reported population with respect to grants is:

$$\epsilon_{e,\alpha} = \frac{-1}{\gamma} \frac{\alpha}{\alpha + \theta} \tag{4}$$

while the elasticity of reported population ($r = n + e$) with respect to grants amounts to:

$$\epsilon_{r,\alpha} = \frac{-1}{\gamma} \frac{\alpha}{\alpha + \theta} \frac{e}{e + n} \tag{5}$$

Given a linear transfer scheme, this parameter would be hard to estimate empirically. Fortunately for us, the existence of notches in the transfers to local governments in Spain will allow us to quantify it.

Notched transfer schedule:

Let's consider now what happens when the transfer schedule has a notch. The notched schedule can be written as:

$$\tau = [\alpha + \beta d(r > \hat{r})]r \tag{6}$$

Where $d(r > \hat{r})$ is a dummy variable equal to one if reported population is larger than the threshold $\hat{r}$ and α and β are positive parameters. According to this expression, per capita transfers are equal to α if $r \leq \hat{r}$ and to $\alpha + \beta$ if $r > \hat{r}$. At the threshold, increasing reported population by one inhabitant makes the amount of transfers jump by $\beta\hat{r}$. This creates very powerful incentives to over-report. The utility of a municipality with a notched transfer scheme is:

$$u = (1 - p)[\alpha + \beta d(r > \hat{r})](n + e) + p[(\alpha + \beta d(r > \hat{r}))n - \theta e] \tag{7}$$

Figure 2 illustrates the expected utility level with a notched transfer scheme which displays a discontinuity at $\hat{r}$. The increase in utility at the notch is $(1 - \hat{p})\beta\hat{r}$. That is, the increase in grants, $\beta\hat{r}$, times the probability of not being detected, $1 - \hat{p}$, where $\hat{e} \equiv \hat{r} - n$ and $\hat{p} \equiv p(\hat{e})$. In the example shown in the figure, the municipality is close enough to $\hat{r}$ and the expected utility at the threshold, $u(\hat{r})$, is higher than at its interior equilibrium, $u(r^*)$. As it delivers higher utility, this municipality will report $\hat{r}$.

[Figure 2 about here]

[Figure 3 about here]

Panel a) in Figure 3 shows all three possible cases. The dotted line depicts the case of a municipality that is too far from the threshold. Here, $u(r^*) > u(\hat{r})$ and the municipality will report its interior equilibrium level, r^*. The dashed line corresponds to the case already illustrated in Figure 2 in which the municipality is better off reporting $\hat{r}$. Finally, the solid line defines the municipality that is indifferent between reporting r^* and $\hat{r}$. For this marginal municipality, that we denote by $\tilde{r}$, it verifies that the utility achieved at its interior optimum equals utility at the notch, i.e. $u(r^*) = u(\hat{r})$ which implies:

$$\alpha n + \alpha e^* - p^*(\alpha + \theta)e^* = \alpha n + \alpha \hat{e} - \hat{p}(\alpha + \theta)\hat{e} + (1 - \hat{p})\beta\hat{r} \tag{8}$$

The utility that a municipality can achieve at the notch $\hat{r}$ can be decomposed in two parts as shown in Figure 2. The first three terms in the right-hand side of equation (8) reflect the utility at $\hat{r}$ absent the extra funds while the last term captures the utility jump at the threshold, $(1 - \hat{p})\beta\hat{r}$. Note that the αn terms drop out of equation (8) which yields $(\alpha e^* - p^*(\alpha + \theta)e^*) = (\alpha\hat{e} - \hat{p}(\alpha + \theta)\hat{e}) + ((1 - \hat{p})\beta\hat{r})$. The left hand side of this equation is a constant term as e^* and p^* do not vary across municipalities. It turns out that the right-hand side increases with population (n). For $e > e^*$, $(\alpha e - p(\alpha + \theta)e)$ diminishes with e. Hence, $(\alpha\hat{e} - \hat{p}(\alpha + \theta)\hat{e})$ increases with n as $\hat{e} = \hat{r} - n$. The second term, $(1 - \hat{p})\beta\hat{r}$, also increases with n because of a lower probability of being caught when reporting $\hat{r}$. Hence, there is a unique $\tilde{n} = \tilde{r} - e^*$ for which (8) holds. This has the effect of modifying the reported population density function as shown in panel b of Figure 3. All municipalities with r^* between $\tilde{r}$ and $\hat{r}$ will report $\hat{r}$, creating an excess mass at exactly this point which corresponds to the density hole between $\tilde{r}$ and $\hat{r}$.

The location of the marginal buncher identifies the reported population change induced by the notch, i.e. $\hat{r} - \tilde{r}$. A measure of the change in grants faced by the marginal buncher will enable us to identify the responsiveness of reported population to grants. When moving from $\tilde{r}$ to $\hat{r}$, grants increase by $\alpha(\hat{r} - \tilde{r}) + \beta\hat{r}$. Relative to the increase in reported population, this grant increase is $\alpha + \beta\hat{r}/(\hat{r} - \tilde{r})$. Since just below $\tilde{r}$ grants increase by α, grants per reported inhabitant increase by $\beta\hat{r}/(\hat{r} - \tilde{r})$ between $\tilde{r}$ and $\hat{r}$. Hence, the elasticity of reported population to grants can be estimated as follows:

$$\epsilon_{r,\alpha} = \frac{dr/r}{d\alpha/\alpha} \simeq \frac{\frac{\hat{r}-\tilde{r}}{\tilde{r}}}{\frac{\hat{r}\beta}{\hat{r}-\tilde{r}}\frac{1}{\alpha}} = \frac{(\hat{r} - \tilde{r})^2}{\hat{r}\tilde{r}}\frac{\alpha}{\beta} \tag{9}$$

Heterogeneity and population shocks

The stylized model used above can be made more realistic by relaxing some assumptions. First, we allow γ_i to be heterogenous to reflect that some municipalities might have more possibilities to cheat than others. To analyze how bunching might look like in this scenario we resort to simulations. The results are presented in panel b) of Figure 4. Compared with the baseline case with no heterogeneity - which is shown in Panel a) - we can see that now the range that goes from $\tilde{r}$ to $\hat{r}$ is not completely empty. Indeed, close to $\tilde{r}$ there are many municipalities for which deviating from its optimum is now too costly; the proportion of these municipalities decreases steadily as one approaches the notch threshold. Second, real population (n) might be affected by shocks and these shocks would make reported population difficult to control. Panel c) shows the density function if we consider both heterogeneous γ_i's and exogenous shocks in population simultaneously. Bunching becomes fuzzy in this scenario which is what we expect to find in the empirical densities that we will analyze below.

[Figure 4 about here]

4. Identification and data

4.1. Identification method

First, we plot the actual distribution of the data using appropriate bins and check for a discontinuity at the threshold. We apply the test developed by McCrary (2008). We consider a significant discontinuity as evidence of bunging behavior. However, the existence of a density discontinuity at the notch does not enable us to quantify neither the amount of bunching, nor the response of reported population to grants. To quantify these, we will use the procedures developed by Kleven and Waseem (2013) and Chetty et al. (2011) whose workings are summarized in Figure 5 .

[Figure 5 about here]

Bunching at notch-points can be identified by calculating the difference between the *actual* distribution and an estimated *counterfactual* distribution. Choosing r_L and r_U defines the excluded range (the area suspected to be affected by bunching). We then estimate a counterfactual distribution fitting a polynomial of order q to the actual distribution of population bin counts c_j where we dummify the bins in the excluded range:

$$c_j = \underbrace{\sum_{i=0}^{q} \beta_i (r_j)^i}_{polynominal} + \underbrace{\sum_{i=r_L}^{r_U} \gamma_i \mathbf{1}[r_j = i]}_{dummies} + \varepsilon_j \tag{10}$$

The (estimated) counterfactual distribution is built with the polynomial coefficient estimates obtained in (10), namely, $\widetilde{c_j} = \underbrace{\sum_{i=0}^{q} \widetilde{\beta_i}(r_j)^i}$.

The city size distribution has been widely studied within the urban economics literature. Although there is some controversy as to which parametric distributions fits the data better, see e.g. (Gabaix, 1999) and (Eeckhout, 2004), the city size distribution is smooth and can be well approximated by a low order polynomial. In our baseline specification we choose a second order polynomial (i.e. q=2) although we test the robustness of the results to higher order polynomial specifications.

In practice, it might not always be obvious how to choose the excluded range, that is r_U and r_L. The excess mass should be relatively concentrated to the right of the notch point and, following Kleven and Waseem (2013) , we choose the upper limit r_U by visual inspection. Then, we choose r_L by equating the excess mass above the notch (B) with the missing mass below the notch (A). Finally, we compute standard errors with a non-parametric bootstrap as in Chetty et al. (2011).

As show in the theoretical section, a measure of the density hole along with the change in grants induced by the notched schedule can be used to compute the elasticity of reported population to grants. In the stylized model developed above, there was a marginal buncher whose location determined the size of the density hole (and bunching). In reality, municipalities will be heterogenous with respect to the elasticity of reported population to grants. An example was provided in panel b of Figure 4 where municipalities differed in their possibilities to cheat. We propose two different measures of the elasticity of reported population to grants. Our first method uses the lower bound of reported population r_L that corresponds to the point where the density hole disappears. This identifies the elasticity of reported population to grants that corresponds to the most elastic municipalities:

$$\epsilon_{r_L,\alpha} = \frac{(\hat{r} - r_L)^2}{\hat{r} r_L} \frac{\alpha}{\beta} \tag{11}$$

The second method captures an average response of reported population to grants. In the density hole area, that is, between r_L and $\hat{r}$, we know the estimated counterfactual $(\widetilde{c_j})$ and the observed count (c_j) in each bin. Hence, we can compute the proportion of municipalities that respond in each bin. For each bin, we also know the reported population response, that is, $\hat{r} - r_j$. Hence, the average elasticity amounts to:

$$\epsilon_{r,\alpha} = \sum_{j=r_L}^{\hat{r}} \tilde{w_j} \frac{(\widetilde{c_j} - c_j)}{\widetilde{c_j}} \frac{(\hat{r} - r_j)^2}{\hat{r} r_j} \frac{\alpha}{\beta} \tag{12}$$

where $\tilde{w}_j = \frac{\widetilde{c_j}}{\sum_{j=r_L}^{\hat{r}} \widetilde{c_j}}$

4.2. Data

We use official population data from municipal registers (the *Padrón municipal*) for the years 1998-2011. The data refers to 1st of January and it is the very same data that determines the allocation of PIE. Note that this concept does not correspond exactly with the one of 'reported population' used in the theoretical section as we are not able to measure 'reported population'. Clearly, this is information at the disposal of the INE, since it corresponds to the population number remitted by municipalities, but it does not disclose it to preserve confidentiality on the monitoring procedures employed. Our official population numbers are reported population plus/less any adjustment that the INE has successfully imposed on municipalities. So, in practice, we are looking at distortions in the distribution of corrected population; in terms of the theoretical model this concept would be $r - p(e)e$. Note, however, that the qualitative prediction on this variable is exactly the same than for r unless monitoring is completely effective. Of course, after an increase in enforcement, the amount of bunching of both official and reported populations will decrease.

Most of the analysis focuses on municipalities within +/- 40% of the relevant population thresholds. Table 1 indicates the number of observations per year around the 5 and 20 thousand inhabitants. We are not using the 50 thousand threshold because of the limited number of municipalities in the neighborhood of the threshold. We also consider the 10 thousand threshold as we will use it to conduct an important placebo test. To graph the data, we use 1% bins. This results in 50 inhabitants-groups per bin at 5000, 100 inhabitants-groups per bin at 10000, and 200 inhabitants-groups per bin at 20000. Since we include the range of +/- 40%, we have 40 bins to the left and another 40 bins to the right of each threshold.

Table 1: # of observations around thresholds

threshold	# observations per year
5000	735-790
10000	469-524
200000	324-348
500000	104-138

5. Results

5.1. Baseline model - Bunching at 5000 and 20000

As a first step, we run the McCrary (2008) test around the relevant thresholds since detecting a significant discontinuity in the density function is a necessary condition for the existence of notching behavior. The top panel of Table 2 presents the results for all the thresholds included in the study.

Table 2: Baseline results

threshold	5000	10000 (Placebo)	20000
discontinuity	✔	✘	✔
McCrary	0.683	0.188	0.766
s.e. (McCrary)	0.123	0.123	0.205
notching	✔	✘	✘
mass (b)	2.646	0.205	0.613
s.e. (b)	0.684	0.340	0.650
range [r_L r_U]	[3700 5800]	[9600 10200]	[19600 21200]
# municipalities (B)	352	16	29
B as % of counterfactual (left)	9.9	3.1	16.1
B as % of counterfactual (right)	19.6	13.7	5.8
$\epsilon_{r_L,\alpha}$	.408		.002
$\epsilon_{r,\alpha}$	.013		.000

The McCrary (2008) test results reported indicate that the density is higher at the generous side of the threshold in those thresholds in which per capita grants increase (columns 1 and 3). These differences are highly statistically significant at both the 5000 and 20000 thresholds (t-values of 5.55 and 3.74 respectively). In order to quantify bunching and to compute the responses of population over-reporting to transfer generosity, we turn to the empirical methodology presented in section 4.1. Figures 6 and 8 plot the actual distributions of the data using appropriate bins for the 5000 and 20000 thresholds.

[Figures 6 and 8 about here]

Consistent with the results of the McCrary (2008) test, the data shows an excess density to the right of the relevant thresholds. We set r_U to be 5800 and 21200 (by visual inspection), the results being largely insensitive to the exact values chosen as shown in Appendix A. Then, we estimate equation 10 for different candidate values r_L. We choose r_L as to minimize the difference between the density hole to the left of the threshold (M) and the excess mass to the right of the threshold (B) as illustrated in Figure 5 . The results are presented in the bottom panel of Table 2. The third row identifies the excluded range, that is, the range in which the density function is affected by bunching behavior. Row 4 shows the excess mass (B) to the right of the threshold. There are 352 municipalities to the right of the 5000 threshold that should be to the left of it, while this figure is 29 for the 20000 threshold. This amounts to 9.9 and 16.1 of the counterfactual density in the area where a density hole is observed, that is, the area comprised between r_L and $\bar{r}$. Following Kleven and Waseem (2013) we report a relative measure of excess mass (b) which is the excess mass (B) over the average density in the density hole area. Its bootstrapped standard error is also reported below and indicates that the bunching is statistically significant at the 5000 threshold but not at the 20000. This is unsurprising given the limited sample size at this larger threshold. The last two rows in Table 2 show the results of the two measures of the elasticity of population over-reporting with respect to grants. Focusing on the 5000 threshold, the results indicate that, for the most responsive municipalities, a 1 percent increase in grants would increase population over-reporting by 0.44 percent, i.e. (i.e. $\epsilon_{r_L,\alpha} = 0.44$). If we focus on the average response ($\epsilon_{r,\alpha}$), the estimated elasticity is 0.013. This indicates that there is a huge amount of heterogeneity in terms of the responsiveness of municipalities to grants.

5.2. Real population responses?

Our model is focused on one type of response to the incentives created by transfer schedule: the one based on reporting population numbers which are larger than the number of real residents in the municipality. We have already argued that there is ample anecdotal evidence that this has been the main margin of adjustment in the Spanish case. However, it could also be that municipalities would respond by, for instance, enacting more expansionary zoning policies.[14]

Fortunately for our purposes, we also have information of the resident population of each municipality, as contained in the Censuses of Population conducted in 1991, 2001, and 2011. Note that, if the results we observed are driven by real population responses, Census population counts should also show bunching patterns around the relevant thresholds. The relevant McCrary (2008) tests are reported in Table 3.

[14]Note that in Spain this is a responsibility fully in the hands of local governments. There is ample evidence that preferences of voters and politicians determine the size of developable land and other zoning instruments (see, e.g. Solé-Ollé and Viladecans-Marsal, 2012, 2013).

Table 3: McCrary (2008)-test using census data.

	1991	2001	2011	2001-2011
discontinuity	✘	✘	✘	✘
McCrary 5000	-0.242	0.126	0.037	0.093
s.e. (McCrary)	0.335	0.372	0.478	0.299
discontinuity	✘	✘	✘	✘
McCrary 10000	-0.437	0.168	0.338	0.250
s.e. (McCrary)	0.718	0.477	0.579	0.385
discontinuity	✘	✘	✘	✘
McCrary 20000	0.096	0.552	1.107	0.717
s.e. (McCrary)	0.605	0.662	0.912	0.543

The results of Table 3 suggest that, using Census population counts, the density functions around the relevant thresholds are continuous. As we do not find the discontinuities which we documented for the register data, we can rule out real responses of population growth. Note that in none of the years when the census was conducted the test shows a significant discontinuity. This hold also true when we pool the two years of the census (2001 and 2011) which coincide with our sample period of the register data.

5.3. Bunching with varying levels of enforcement

As explained in section 2, monitoring on the part of INE has become more effective over time. To analyze if bunching is less acute with better monitoring, we split our sample into two different sub-periods (1998-2005 and 2006-2011). Figure 9 shows bunching patterns at the 5000 and 20000 thresholds for these two sub-periods.

[Figure 9 about here]

The data suggests that, indeed, bunching patterns are stronger for the sub-period in which monitoring from the central government was less effective. Table 4 shows the results reported in Table 2 by splitting the sample in these two sub-periods. The results confirm that, indeed, weaker institutions give local governments more room to manipulate their population figures. Interestingly, notching at the 20000 threshold becomes statistically significant if we focus on the sub-period in which enforcement was lower.

Table 4: Bunching with varying levels of enforcement

threshold	5000		20000	
period	1998-2005	2006-2011	1998-2005	2006-2011
discontinuity	✔	✔	✔	✔
McCrary	.8100007	.4027683	.763938	.6653435
s.e. (McCrary)	.1630917	.1674763	.2361313	.3472806
notching	✔	✘	✔	✘
mass (b)	2.126971	.5464977	.7711616	n.a.
s.e. (b)	.5429153	.332819	.3627177	n.a.
# municipalities (B)	160	29	20	n.a.
B as % of counterfactual (left)	9.5	7.4	15.2	n.a.
B as % of counterfactual (right)	27.6	32.1	19.9	n.a.
range [r_L r_U]	[4000 5450]	[4600 5100]	[19200 20200]	[19200 20100]

5.4. Other policies jumping at the thresholds?

In section 2 we explained that there are two other institutional arrangements that change at the 5000 and 20000 thresholds: Council size and spending responsabilities. We address them in turn.

Council size increases at the 5000 and 20000 thresholds but, luckily for our purposes, also change at the 10000 threshold. Quantifying bunching at the 10000 threshold is, thus, an indirect way of testing if council size could be explaining the bunching patterns that we observe. Figure 7 shows the population density while the second column in Table 2 reports the bunching estimates for the 10000 threshold. Overall, all the results indicate that there is no discontinuity in the population density around the 10000 threshold.

[Figure 7 about here]

Another indirect test to rule out that differences in council size are explaining bunching patters is to show that, in fact, the changes in council size at the relevant thresholds are actually marginal changes. In Figure 10 we plot the share of local councils which operate under majority for each bin around the 5000 threshold in our main analysis. The data does not show a significant change in the percentage of councils with a majority government. This reflects that fragmentation does not increase significantly at these applanation thresholds. All in all, the evidence suggests that council size does not play a role in explaining bunching patterns.

[Figure 10 about here]

As for expenditure needs, we have explained that they increase with population size. Focusing on the 5000 thresholds, municipalities surpassing this threshold are required to provide public parks, waste treatment, sports facilities and a library. We have computed per capita spending in these items. Figure 11 shows that this variable, in fact, evolves smoothly at the 5000 threshold. This supports the arguments advanced in section 2 pointing that, de facto, spending responsibilities do not really change at the 5000 inhabitants.

[Figure 11 about here]

6. Conclusion

In this paper we analyze notches generated by a transfer system to local governments. We find significant evidence that the incentives generated by the grant schedule create manipulated population figures. Municipalities, which are in charge of the administration of local registers of residence, systematically inflate numbers of inhabitants such that they are eligible for higher per capita transfers. Our results are robust to a battery of robustness checks, and most importantly, do not show up if we use census data instead of population numbers from the registers.

References

Alesina, Alberto. and F Pasarelli. 2014. "Loss aversion in politics." mimeo.

Bird, Richard M. and Michael Smart. 2002. "Intergovernmental Fiscal Transfers: International Lessons for Developing Countries." *World Development* 30 (6):899–912.

Boex, J. and J. Martinez-Vazquez. 2007. "Designing intergovernmental equalization transfers with imperfect data: concepts, practices, and lessons." In *Fiscal equalization: challenges in the design of intergovernmental transfers*, edited by J. Martinez-Vázquez and Bob Searle. Springer.

Bordignon, Massimo, Paolo Manasse, and Guido Tabellini. 2001. "Optimal Regional Redistribution under Asymmetric Information." *American Economic Review* 91 (3):709–723.

Chetty, Raj, John N. Friedman, Tore Olsen, and Luigi Pistaferri. 2011. "Adjustment Costs, Firm Responses, and Micro vs. Macro Labor Supply Elasticities: Evidence from Danish Tax Records." *The Quarterly Journal of Economics* 126 (2):749–804.

Dixit, Avinash and John Londregan. 1995. "Redistributive Politics and Economic Efficiency." *The American Political Science Review* 89 (4):pp. 856–866.

Eeckhout, Jan. 2004. "Gibrat's Law for (All) Cities." *American Economic Review* 94 (5):1429–1451.

Fiva, Jon H. and Olle Folke. 2014. "Mechanical and Psychological Effects of Electoral Reform." *British Journal of Political Science* (fortcoming).

Foremny, Dirk. 2014. "Sub-national deficits in European countries: The impact of fiscal rules and tax autonomy." *European Journal of Political Economy* 34 (0):86 – 110.

Freier, R. and F. Ade. 2011. "When can we trust population thresholds in Regression Discontinuity Designs?" Discussion papers 1136, DIW Berlin.

Gabaix, Xavier. 1999. "Zipf's Law For Cities: An Explanation." *The Quarterly Journal of Economics* 114 (3):739–767.

Gagliarducci, Stefano and Tommaso Nannicini. 2013. "Do better paid politicians perform better? Disentangling incentives from selection." *Journal of the European Economic Association* 11 (2):369–398. URL http://dx.doi.org/10.1111/jeea.12002.

Grembi, V. and U. Troiano. 2014. "Policy Responses to Fiscal Restraints: A Difference-in-Discontinuities Design." mimeo, Bocconi University.

Huber, Bernd and Marco Runkel. 2006. "Optimal Design of Intergovernmental Grants Under Asymmetric Information." *International Tax and Public Finance* 13 (1):25–41.

Kleven, Henrik J. and Mazhar Waseem. 2013. "Using Notches to Uncover Optimization Frictions and Structural Elasticities: Theory and Evidence from Pakistan." *The Quarterly Journal of Economics* 128 (2):669–723.

Kleven, Henrik Jacobsen, Martin B. Knudsen, Claus Thustrup Kreiner, Søren Pedersen, and Emmanuel Saez. 2011. "Unwilling or Unable to Cheat? Evidence From a Tax Audit Experiment in Denmark." *Econometrica* 79 (3):651–692. URL http://dx.doi.org/10.3982/ECTA9113.

Larcinese, V., L. Rizzo, and C. Testa. 2013. "Changing needs, sticky budget: evidence from the geographic distribution of US Federal Grants." *National Tax Journal* 66 (2):311–342.

Litschig, Stephan. 2012. "Are rules-based government programs shielded from special-interest politics? Evidence from revenue-sharing transfers in Brazil." *Journal of Public Economics* 96 (1144):1047–1060.

McCrary, Justin. 2008. "Manipulation of the running variable in the regression discontinuity design: A density test." *Journal of Econometrics* 142 (2):698–714.

Oates, Wallace E. 1972. *Fiscal federalism*. New York: Harcourt Brace Jovanovich.

———. 1999. "An Essay on Fiscal Federalism." *Journal of Economic Literature* 37 (3):1120–1149.

Persson, Torsten and Guido Tabellini. 2002. *Political Economics: Explaining Economic Policy*. MIT Press Books. The MIT Press.

Saez, Emmanuel. 2010. "Do Taxpayers Bunch at Kink Points?" *American Economic Journal: Economic Policy* 2 (3):180–212.

Slemrod, Joel. 2010. "Buenas Notches: Lines and Notches in Tax System Design." *University of Michigan Workin Paper* .

Solé-Ollé, Albert and Núria Bosch. 2005. "On the Relationship between Authority Size and the Costs of Providing Local Services: Lessons for the Design of Intergovernmental Transfers in Spain." *Public Finance Review* 33 (3):343–384. URL http://pfr.sagepub.com/content/33/3/343.abstract.

Solé-Ollé, Albert and Elisabet Viladecans-Marsal. 2012. "Lobbying, political competition, and local land supply: Recent evidence from Spain." *Journal of Public Economics* 96 (1-2):10 –19.

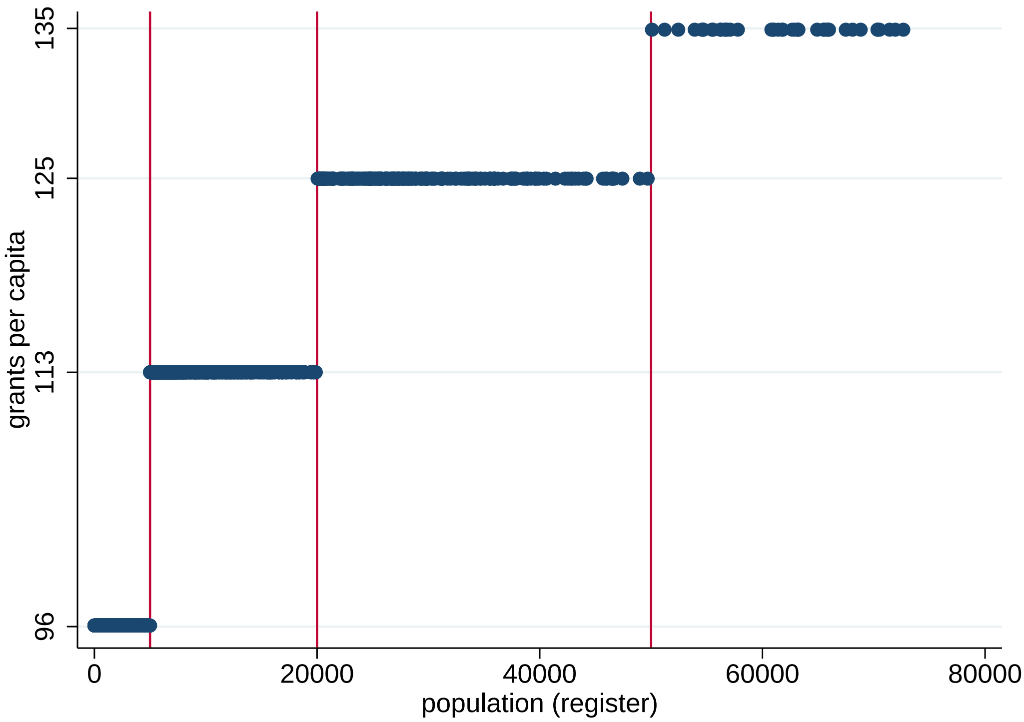
———. 2013. "Do political parties matter for local land use policies?" *Journal of Urban Economics* 78 (C):42–56.

Wildasin, David E. 1986. *Urban Public Finance*. Routledge.

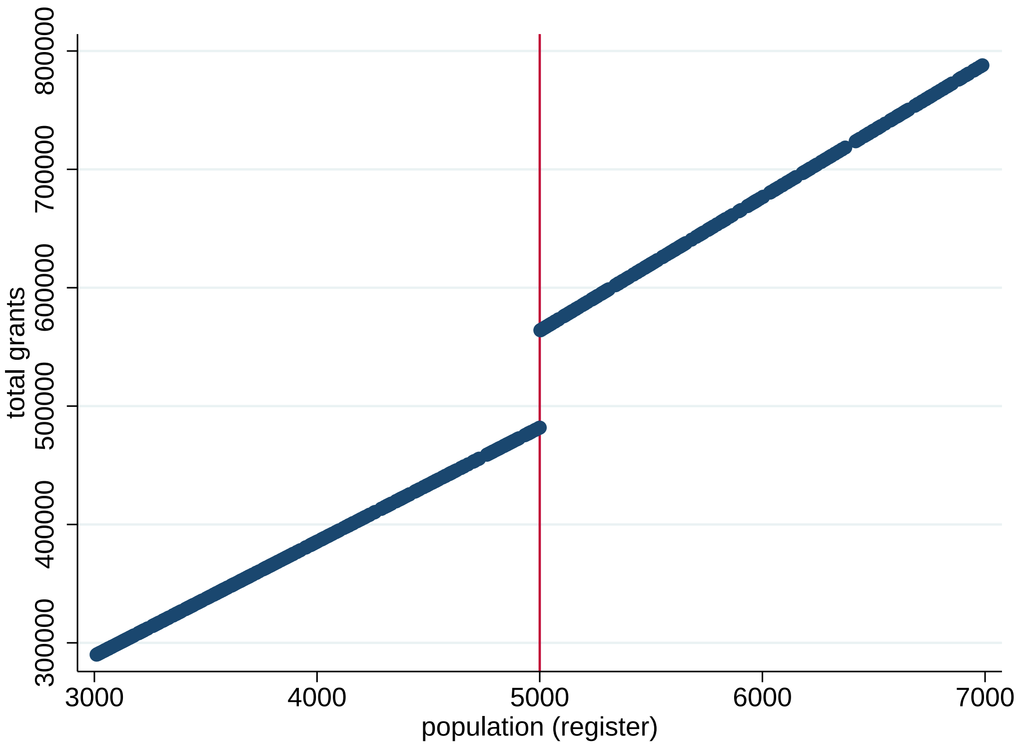
Yitzhaki, Shlomo. 1987. "On the Excess Burden of Tax Evasion." *Public Finance Review* 15 (2):123–137. URL http://pfr.sagepub.com/content/15/2/123.abstract.

Graphs and tables

Figure 1: Distributed grants in 2005



(a) grants per capita



(b) grants in absolute values

Notes: 75% of PIE allocated according to population figures inhabitant. Data for 2005

Figure 2: Utility with a notched transfer scheme

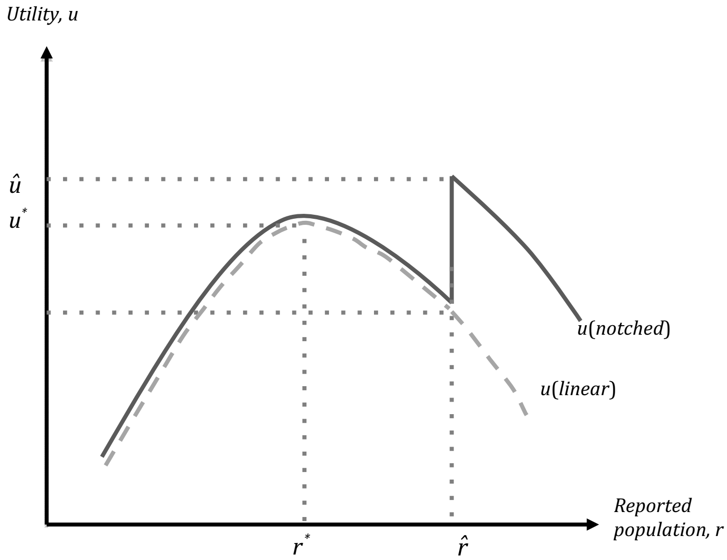
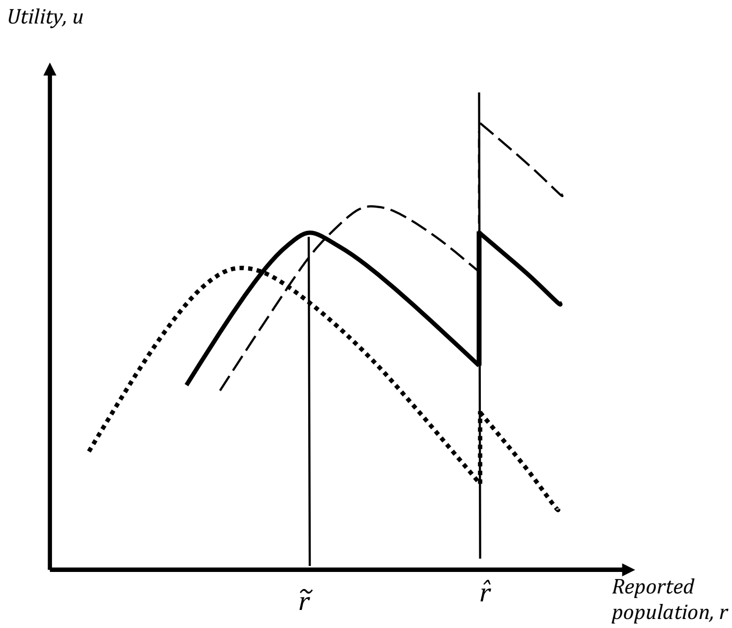
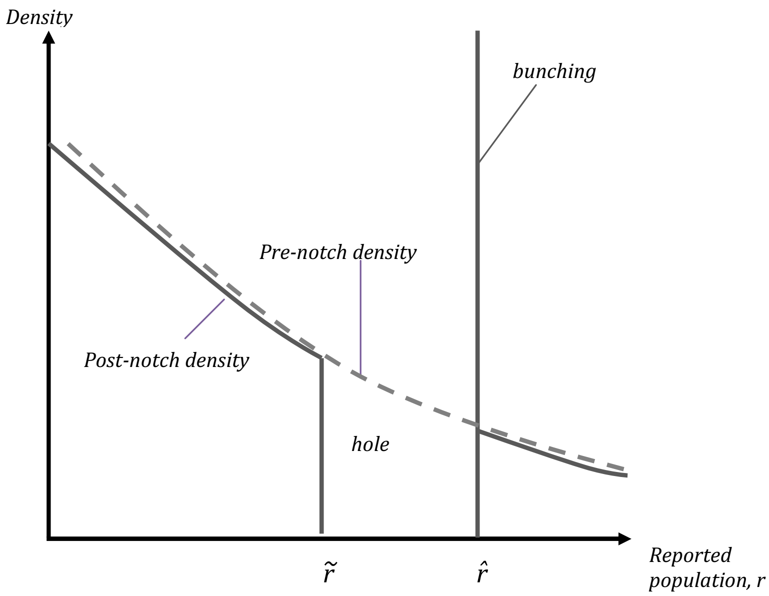


Figure 3: Effect of a notched transfer scheme on reported population density

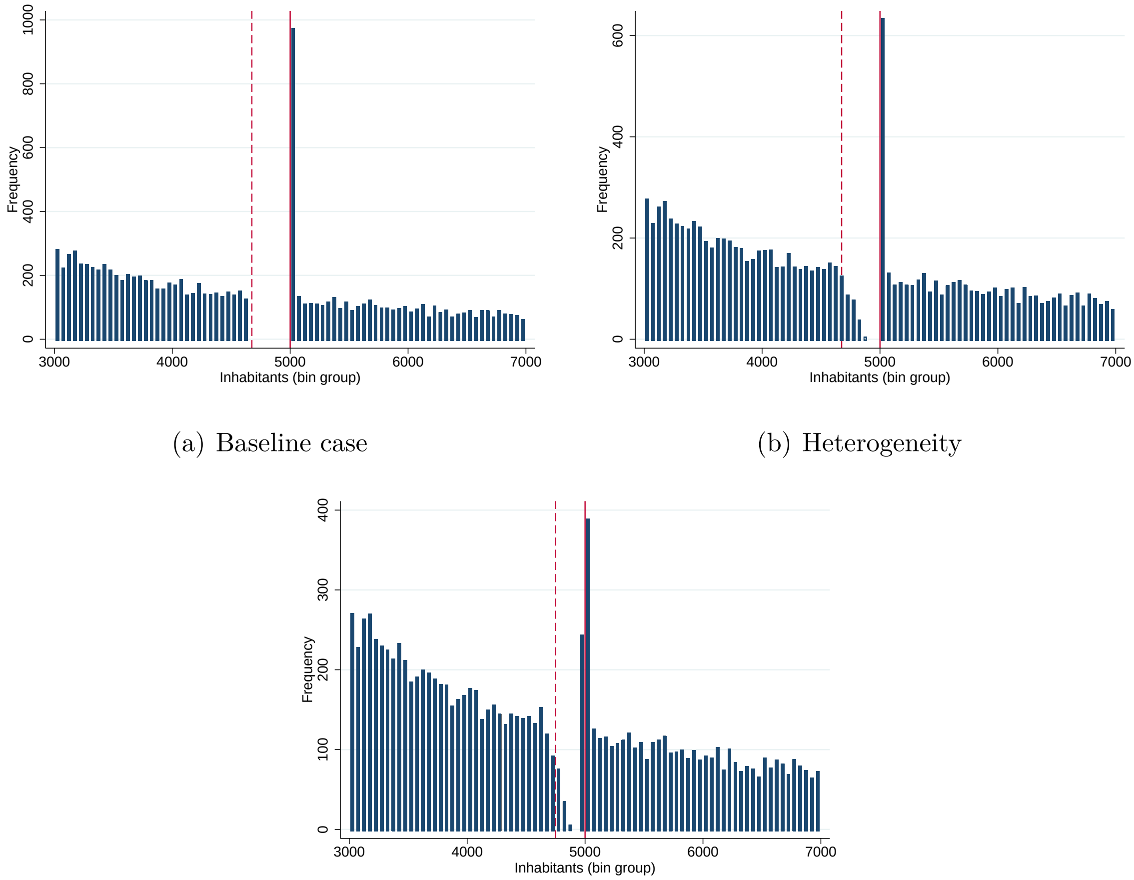


(a) Utility



(b) Density function

Figure 4: Bunching in the presence of heterogeneity and shocks



(a) Baseline case

(b) Heterogeneity

(c) Shocks and Heterogeneity

Notes: Simulation based on 100k draws. n drawn from a log-normal distribution with mean and standard deviation equal to 6.458 and 1.840. α, β, θ equal to 100, 16, 400. In panel a, γ is -0.1 while $\gamma_i \sim U(-0.2, -0.1)$ in panels b and c. In panel c, the shock is drawn from a lognormal distribution with mean and standard deviation equal to 0 and 0.003. Logged reported population is then $ln(r) \cdot shock$.

Figure 5: Illustration of the procedure used to identify bunching

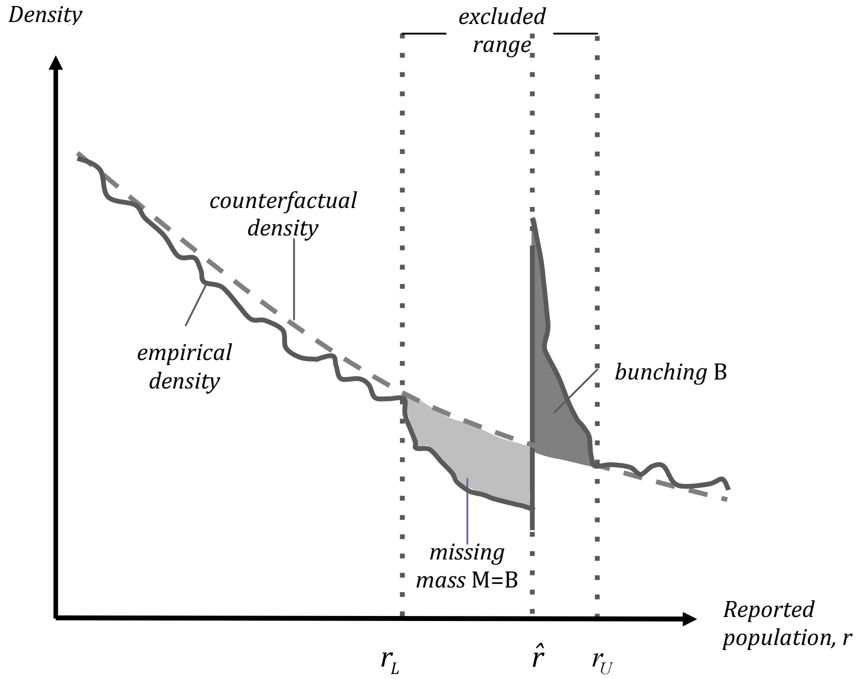
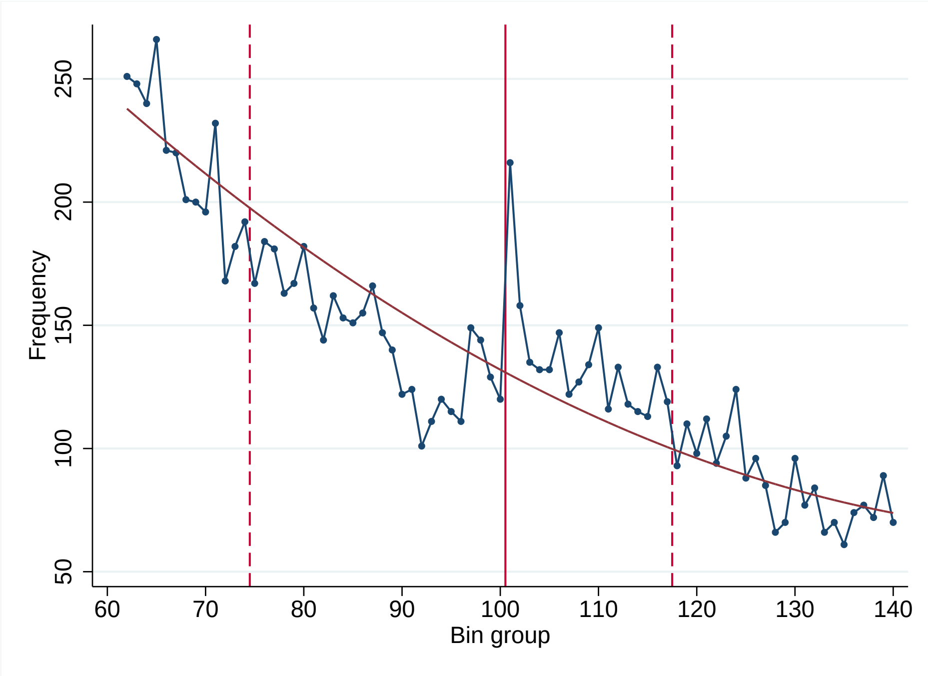
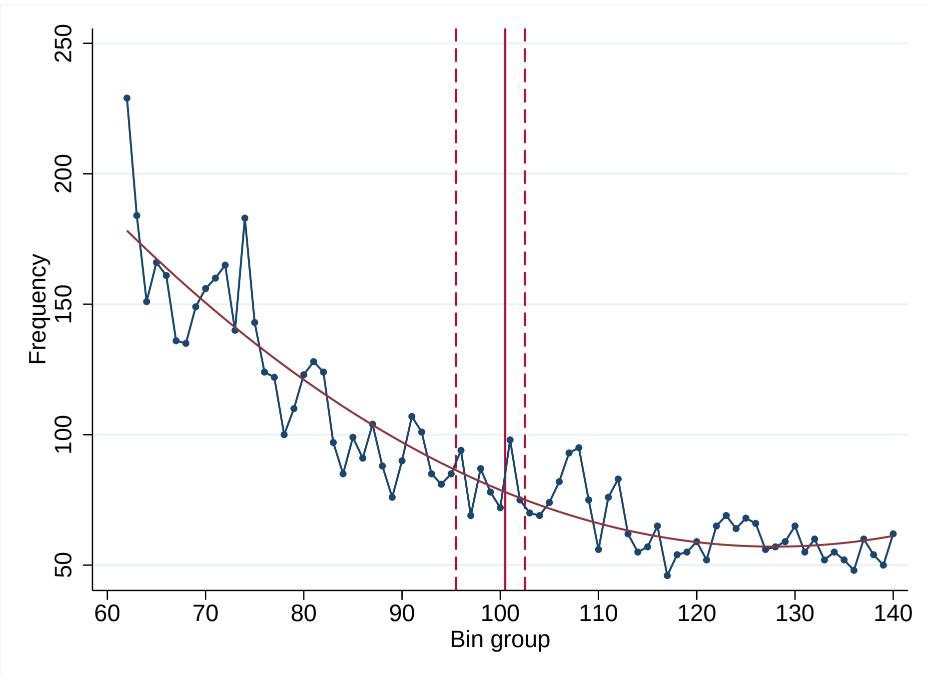


Figure 6: Baseline graph: 5000-threshold



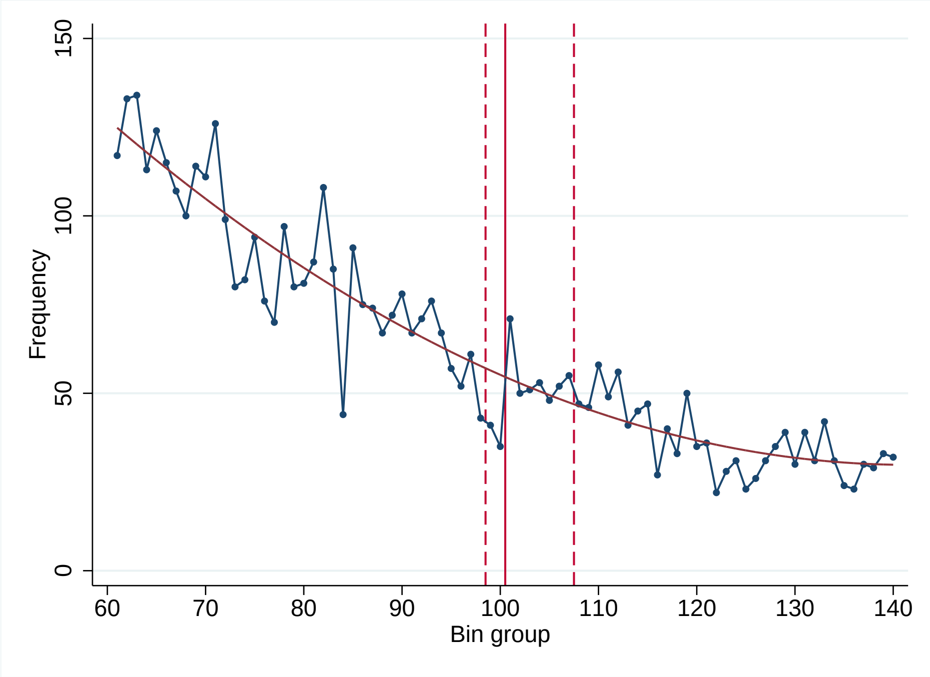
Notes: notching around 5000 inhabitants. Bins of 50 inhabitant size. Pooled for 1998-2011.

Figure 7: Baseline graph: 10000-threshold



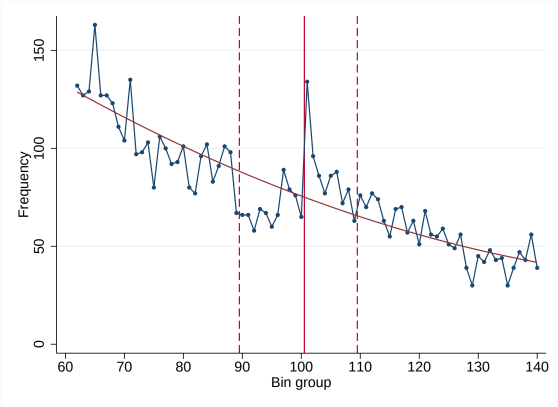
Notes: notching around 10000 inhabitants. Bins of 100 inhabitant size. Pooled for 1998-2011.

Figure 8: Baseline graph: 20000-threshold

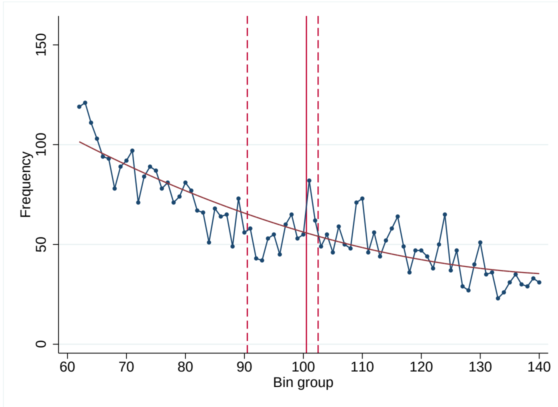


Notes: notching around 20000 inhabitants. Bins of 200 inhabitant size. Pooled for 1998-2011.

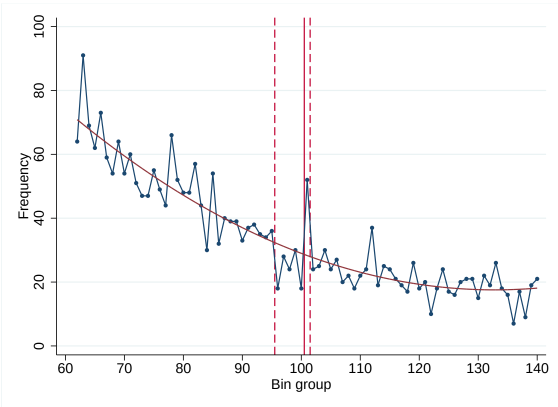
Figure 9: Bunching with varying levels of enforcement



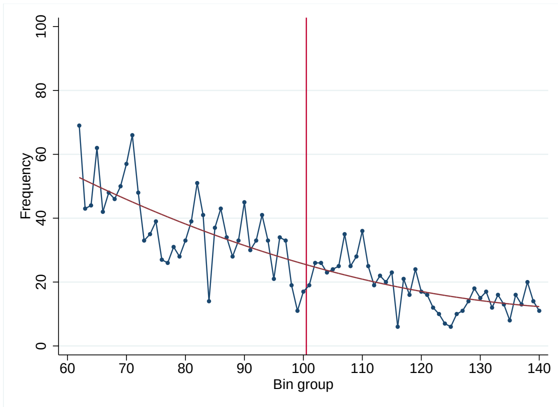
(a) 1998-2005 - 5000 inhabitants



(b) 2006-2011 - 5000 inhabitants



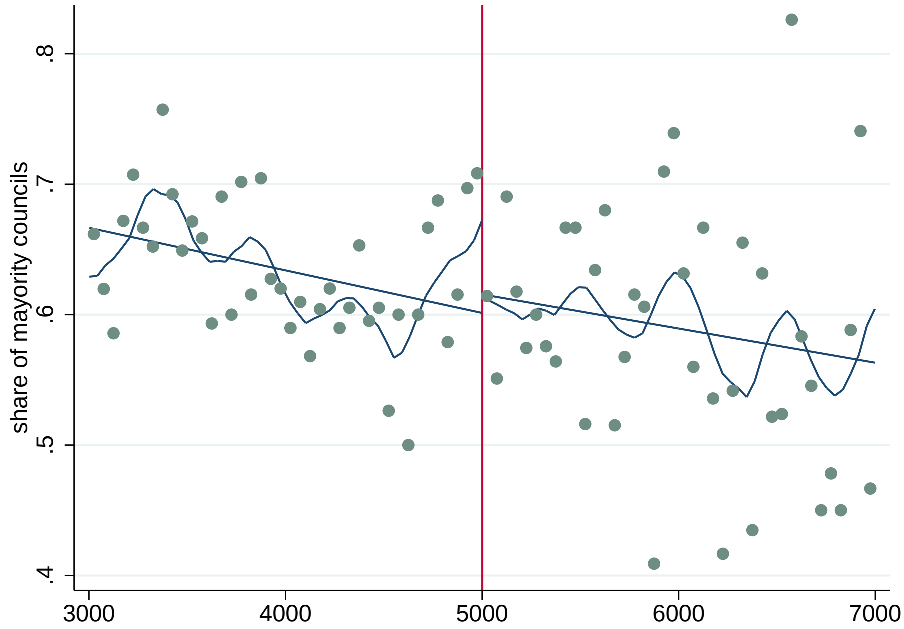
(c) 1998-2005 - 20000 inhabitants



(d) 2006-2011 - 20000 inhabitants

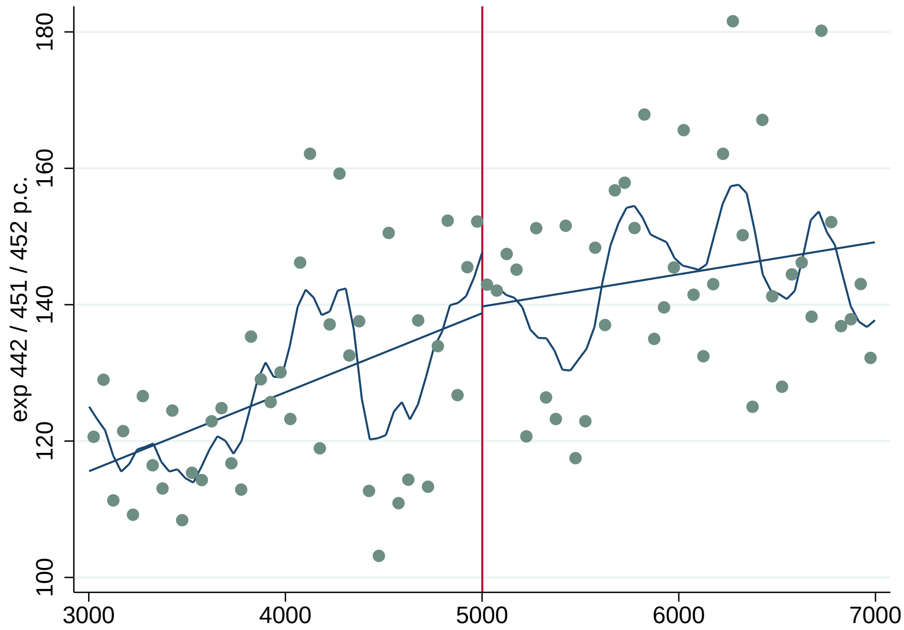
Notes: notching around 5000 (panel a and b) and 20000 (panel c and d) inhabitants. The size of each bin is 10% of the threshold (i.e. 50 or 200 inhabitants). Pooled for 1998-2005 (panel a and c) and 2006-2011 (panel b and d).

Figure 10: Council fragmentation at the 5000 threshold



Notes: share of councils operating with majority. The figure is supplemented by local polynomials and a linear fit.

Figure 11: Change in expenditure responsabilities at the 5000 threshold



Notes: expenditures per capita which become mandatory at the 5000 inhabitants threshold. The figure is supplemented by local polynomials and a linear fit.

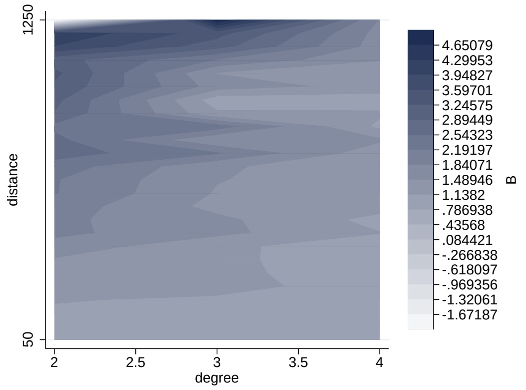
A. Alternative assumptions of notching parameters

We performed several robustness checks to validate our results against alternative parameters one could assume to calculate the excess mass at the notch. First, we allowed for variation of the upper bound p_U of the notching region, and second the degree of the polynomial p. In this section we present results when we repeated the estimation of the baseline case for various combinations of the two.

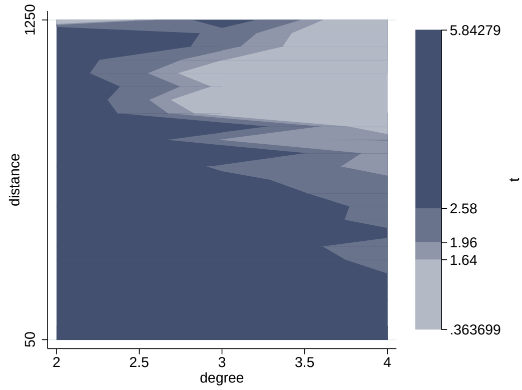
[Figure 12 about here]

The figures presented here show that our baseline result are robust to variation of the parameters mentioned above. While the magnitude of notching naturally varies with the assumption of p_U, the qualitative pattern remains the same across all alternative estimations. While we find significant evidence for manipulation at the 5000 thresholds, the results for the 20000 and 10000 threshold do not differ much from the baseline analysis. Most importantly, the 5000 threshold remains statistically significant at the 1% level for almost all specifications (dark-blue shaded area) and we would fail to achieve significance at the 10% level only by estimating at least a third-order polynomial and allowing for and upper bound of more than 1000 inhabitants. However, this is explained by non realistic estimations of the counterfactual applying those parametrization.

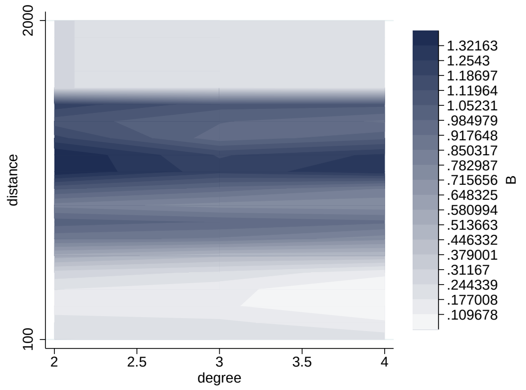
Figure 12: Alternative parameters



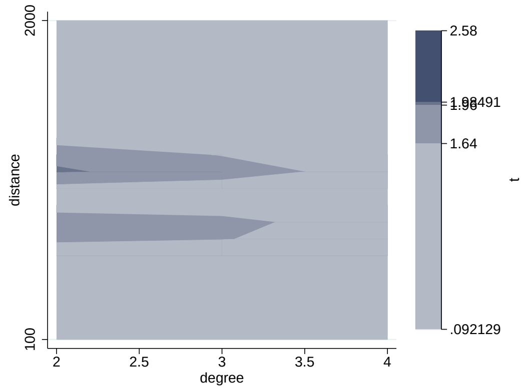
(a) 5000 - bunching



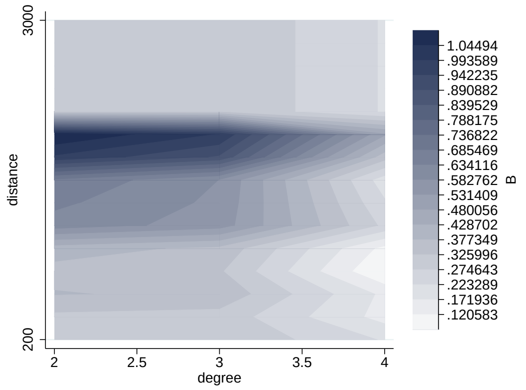
(b) 5000 - significance



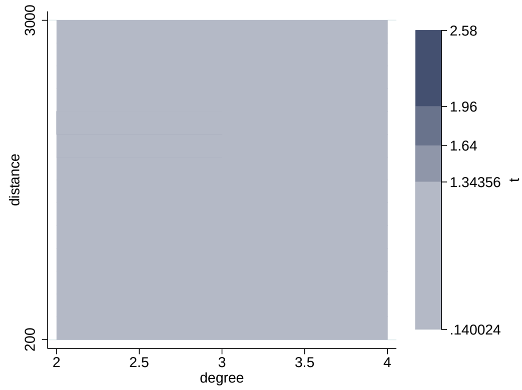
(c) 10000 - bunching



(d) 1000 - significance



(e) 20000 - bunching



(f) 20000 - significance

Notes: Distance represents the chosen starting range on the vertical axis. The horizontal axis shows variation over the polynomial used to estimate the counterfactual. Amount of notching B at 5000 inhabitants. Bins of 50 inhabitant size. Pooled for 1998-2011. Notching around 5000 (panel a and b), 10000 (panel c and d), and 20000 (panel e and f) inhabitants. The size of each bin is 10% of the threshold.