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Wealth Tax Mobility and Tax Coordination

Abstract

We study the effects of decentralized wealth taxation on mobility and the effectiveness of tax coordination at mitigating tax competition. We exploit the reintroduction of the Spanish wealth tax, after which all regions except Madrid levied positive tax rates. We find the mobility responses to wealth taxes are within the range of prior estimates with respect to income taxes. However, wealth tax mobility responses generate losses to personal income tax revenues that are six times larger than the direct losses to wealth taxes. Madrid could achieve higher total regional revenues by agreeing to a harmonized positive tax rate.

JEL-Codes: E210, H240, H310, H730, J610, R230.

Keywords: wealth taxes, mobility, fiscal decentralization, fiscal federalism, tax coordination.

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Rising shares of capital income and the associated increases in wealth inequality observed in many countries have spurred new interest in wealth taxation (Scheuer and Slemrod, 2021; Smith et al., 2023; Saez and Zucman, 2022). Due to fears of wealth tax-induced mobility, policy proposals to coordinate tax rules across jurisdictions have been at the center of policy debates over the past decade, including some calls for a global wealth tax (Piketty, 2014). At the same time, failures to adopt wealth taxes at the global or national level have increased discussions about the viability of decentralized wealth taxation within federal systems.[1] Despite the importance of wealth taxes in recent debates, important questions remain understudied. How large are the mobility responses to wealth taxation? What are the effects of wealth tax-induced mobility on tax revenues, including other taxes that high-wealth individuals pay? How effective are various types of tax coordination?

We break new ground on these issues by focusing on Spain, which offers linked wealth and income tax administrative data and stark regional tax variation. Prior to 2008, Spain had a mostly uniform residence-based wealth tax, which was briefly suppressed. Regions started to exercise their autonomy to change wealth tax schedules after its reintroduction in 2011. Madrid plays a special role in this setting, as it is the sole region that has kept a zero effective tax rate on wealth. Thus, an individual with 3,000,000 Euro in taxable wealth can save up to approximately 9,400 Euro annually by moving to Madrid. We exploit this wealth tax reintroduction by assembling administrative wealth tax records for a longitudinal sample of individuals prior to the suppression of the wealth tax. We then link them to administrative personal income tax records before and after reintroduction. The linked individual personal income tax records contain information on fiscal residence, making it possible to follow the location of high-wealth individuals before and after reintroduction.

We provide three main results. First, we estimate wealth-tax induced mobility responses within Spain after the reintroduction of the wealth tax using a difference-in-differences design. The design compares individuals with taxable wealth above the filing threshold with those just below the threshold. After aggregating individual data to the region-year-wealth level, we document an approximately 7.5% increase in the wealthy population in Madrid by six years after reintroduction and a fall of 1.7% in the wealthy population of other regions. This implies an elasticity with respect to the net of-tax rate on wealth that is 7.96, which translates to an elasticity with respect to the net-of-tax capital income tax rate of 0.36.[2] To validate our design, we show that wealthy non-filers follow similar trends as wealthy filers

[1]See, California's bill AB-2289, New York's "Make Billionaires Pay" proposals, and Washington's HB-1406.

[2]The mobility elasticity with respect to the net of-tax rate on wealth estimated without covariates is 10.85, which translates to an elasticity with respect to the capital income tax of 0.49. The elasticities with or without covariates are not statistically different from each other and the estimates are economically similar.

prior to the reintroduction of the tax and migration effects do not predate tax changes.

We also exploit an individual location choice model and find that only differentials with Madrid—and not smaller tax differentials between other regions—matter for relocation choices. Two possible explanations are that either the zero tax rate in Madrid is particularly important or there is something special about Madrid. In the first case, there are reasons to believe it is not the zero rate itself that is most critical, but rather that fact that Madrid sets the *lowest* possible tax rate and that this rate is sufficiently different from the tax rates of the other regions. One possible theoretical argument for why a zero tax rate differs from a small positive tax rate is that in the latter case, individuals need to incur the fixed compliance costs of filing (Slemrod and Sorum, 1984). In the Spanish tax system, these fixed costs of filing still exist for only select taxpayers in Madrid, as only individuals with more than two million Euro of wealth are required to file a wealth tax declaration there. As a result, the zero tax rate does eliminates the fixed compliance costs for many. Further, due to the imperfect design of the wealth tax (e.g., the freedom to determining the reason for a move, self-reporting of moves and imperfect enforcement capacity) some of these fiscal residence changes may be fraudulent. Indeed, regional tax authorities confirmed that some of the changes of fiscal residence were found to be fraudulent. From a tax evasion standpoint, Madrid would provide the largest benefit of evading, as long as it remains as the region with the lowest wealth tax rate. And if the cost of evading were the same across regions, then Madrid would still be utilized. Finally, with respect to using the zero tax rate as a persuasive tool to lure taxpayers, the government of Madrid could still brand itself as the region with the "lowest-tax" and similarly publicize itself as the most attractive region of Spain for individuals and entrepreneurs given that most other regions set much higher rates.

With respect to whether Madrid could be special along other dimensions, we show to the best of our ability that high-wealth individuals are responding to wealth tax differentials rather than to unobservable time-varying characteristics. First, while data on secondary residences is limited, we show that Madrid is not an outlier in terms of the number of residences wealth taxpayers own there. Furthermore, the share of secondary residences owned by wealth taxpayers outside their home region is not any different to that of personal income tax filers. Second, we document that there is little heterogeneity in the responses by income or age, suggesting that the likelihood to move is not driven by their intention to work in Madrid, income tax nor inheritance differentials. We also document that self-employed wealthy individuals are not significantly more likely than non-self-employed wealthy individuals to move to Madrid after the reintroduction of the wealth tax. This result suggests that Madrid's zero tax rate does not seem to have induced more business relocations to that region either.[3] Finally, we document that the mobility effects are larger for taxpayers with higher levels of wealth, for whom tax differentials are larger and thus the incentives to move stronger. This increasing relationship between taxable wealth and the magnitude of the mobility responses helps fortify the case that high-wealth individuals are responding to wealth tax differentials.

For our second result, we use our causal mobility estimates to quantify interjurisdictional fiscal externalities. We find that all regions other than Madrid forego 5% of total wealth tax revenue due to mobility. An advantage of our data is the ability to link wealth and income tax records. Hence, we can also extend our estimates to study the fiscal externalities on other tax bases, in particular, the personal income tax. We find that Madrid gains 5% of its personal income tax revenue due to tax-induced mobility of wealth taxpayers, while the rest of regions forego 2.5%. The revenue from personal income taxation is six times larger than the revenue from wealth taxation for wealth taxpayers. Hence, the cross-base fiscal externalities are much larger in absolute terms than the direct effects.

Third, we combine the mobility and revenue analyses to study the effectiveness of tax coordination. A harmonized tax system forces many regions to change rates, while a minimum tax system only forces low-tax jurisdictions to change rates. Using our estimated mobility responses, we simulate the evolution of wealth and income tax revenues under counterfactual policies. We obtain two main results. First, we show that harmonization is only a revenue improvement for all regions if the harmonized rate is sufficiently close to the maximum decentralized rate. Second, we document that Madrid could achieve higher total—income plus wealth—revenues by agreeing to a positive harmonized tax rate, even one close to zero. This contrasts with the common justification—that by attracting high wealth taxpayers, the foregone wealth tax revenue will be lower than the additional personal income tax revenue—given for Madrid's zero tax rate on wealth. Our analyses thus suggest that Madrid is choosing a zero wealth tax rate for reasons other than maximizing its total revenues.

This paper contributes to three main strands of the literature. First, it relates to the literature studying the effects of taxation on the location decisions of individuals (Kleven et al., 2020) and businesses (e.g., Fajgelbaum et al., 2019; Giroud and Rauh, 2019; Suárez Serrato and Zidar, 2016). Prior research has mainly investigated mobility responses to the taxation of labor income, with only a few papers analyzing the effects of estate and capital gains taxes (Bakija and Slemrod, 2004; Agersnap and Zidar, 2021; Moretti and Wilson, 2022;

[3]These analyses are similar to Rubolino and Giommoni (2023), which shows that Italian taxpayers are willing to accept longer commute times in return for lower income tax rates and that tax-induced mobility responses are dampened among individuals facing higher mobility costs or frictions, such as married individuals, the elderly, and homeowners.

Conway and Rork, 2006). Papers estimating behavioral responses to wealth taxes (Durán-Cabré et al., 2019; Jakobsen et al., 2020; Londoño-Vélez and Ávila-Mahecha, 2021; Londoño-Vélez and Ávila-Mahecha, 2022; Ring, 2021; Seim, 2017; Zoutman, 2016) do not estimate mobility elasticities. Only one contemporaneous paper analyzes wealth tax-induced mobility by comparing two Swiss cantons with positive but different wealth tax rates (Brülhart et al., 2022). Our paper is thus the first to provide evidence on the role of large wealth tax differentials on residential choice among a complete set of regions within a country, as well as the first to study how the wealth tax mobility effects shape fiscal externalities on other tax bases and the effectiveness of coordination policies at mitigating those externalities. While the Swiss mobility elasticity is in the range of our estimates when calculated using their cross-canton panel estimate, it is estimated with respect to the marginal rather than the average rate, and thus likely larger. There are potentially three other differences between the Swiss and the Spanish setting. First, contrary to Spain, in Switzerland all cantons levy positive tax rates due to restrictions that prevent cantons to abolish the tax. Second, Switzerland is a smaller country than Spain. To the extent that mobility costs increase with the distance to the destination region, we should expect more mobility across regions the closer they are. Finally, Swiss cantons are smaller than Spanish regions and mobility elasticities increase as jurisdiction size decreases. This finding is consistent with Piketty and Saez (2013), who argue that the mobility elasticity should increase as jurisdictions become smaller.

The mobility responses to wealth taxes are within the range of previous estimates for income taxes. Given the limited evidence on wealth-tax mobility, this is a contribution because there is a priori no reason to believe that migration responses to wealth and income taxes are the same. On the one hand, a tax on the stock of wealth might be more salient than a tax on the flow of income—especially when withholding is only on income taxes. On the other hand, alternative evasion opportunities for wealth taxes might be more prominent than for income taxes, suggesting that migration due to wealth taxes can be smaller.

Second, the paper relates to the literature on the effects of taxation on tax evasion and avoidance (e.g., Slemrod and Yitzhaki, 2002; Slemrod, 2019). Recent evidence has emphasized the importance of tax havens as a vehicle to escape the taxation of individual financial assets and capital income (e.g., Alstadsæter et al., 2019; Casi et al., 2020; Johannesen et al., 2020; Londoño-Vélez and Ávila-Mahecha, 2021; Zucman, 2021), as well as corporate profits (e.g., Bilicka, 2019; Tørsløv et al., 2022). Our paper shows that in decentralized residence-based tax systems, individuals can effectively "move" the taxable location of their assets—even their "immobile" assets—by changing their fiscal residence from a non-zero to a zero-tax jurisdiction. This alternative form of individual-level tax avoidance or evasion differs from offshore tax evasion along two dimensions. First, individuals are able to avoid or evade the taxes on not only their financial, but also, their non-financial assets (e.g., land, real estate, unincorporated businesses), as the change of primary residence makes it possible to relocate *all* taxable wealth. Second, the change of fiscal residence might require less financial sophistication than offshoring financial assets into tax havens, so that who avoids or evades might be different across the two cases. For these reasons, one should not generalize results to the international setting, but instead apply them to taxation within federal systems.

Our estimated wealth tax-induced mobility responses may be driven by tax avoidance (real migration) or tax evasion (fraudulent changes in fiscal residence). However, the line between avoidance and evasion is blurry in this context, as it is with mobility in many fiscal federations. A real response could happen if a taxpayer buys/rents an apartment in Madrid and moves there to avoid the wealth tax. At the other extreme an individual may simply falsely misreport whether the region of Madrid is her primary residence without spending the majority of the year there. But for a taxpayer who splits time between two houses, truly altering the number of days spent in Madrid might be indistinguishable from simply falsely reporting the number of days. Assessing whether changes of fiscal residence are fraudulent or not is thus quite costly for the Spanish Tax Agency and the regional tax authorities, as this requires tracking the location of taxpayers in real time. As a consequence, we do not have the necessary information to quantify the relative importance of each channel either. Nonetheless, similar to Rubolino and Giommoni (2023), we provide suggestive evidence about the underlying motives and channels behind the moves through our heterogeneity analysis.

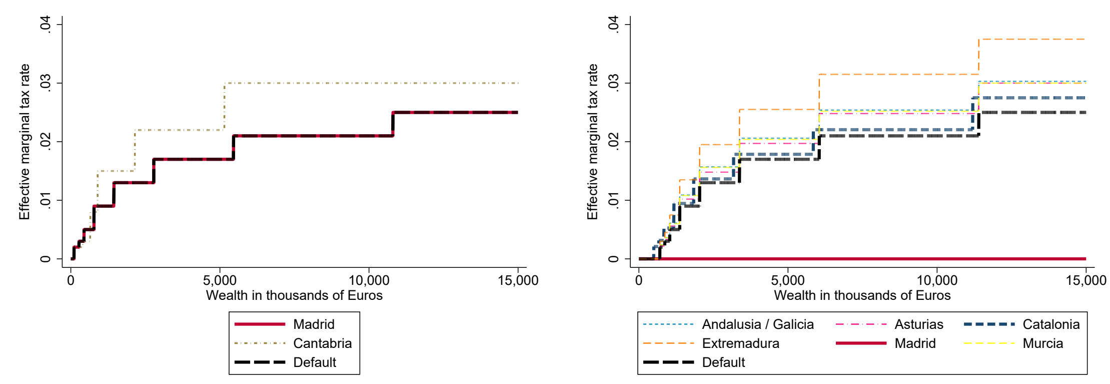
Finally, this paper is closely related to the literature on tax coordination (Keen, 1987; Keen, 1989; Kanbur and Keen, 1993; Devereux and Pearson, 1995; Agrawal, 2023; Hebous and Keen, 2023; Johannesen, 2022). Prior research often relies on models that focus on taxing goods or profits. Our revenue and tax coordination analyses imply that the theoretical framework for coordinating individual taxation might be different to the one for corporate or consumption taxation, because focusing on a single tax base can miss important effects, such as cross-base fiscal externalities. These fiscal externalities imposed on other tax bases are critical to determine whether or not Madrid's decisions are revenue maximizing or not.

1 Institutional Details

The Spanish wealth tax has been in place since 1978 (Law 50/1977) until the present, although it was briefly suppressed between 2008 and 2010. All regions are subject to this law except for Basque Country and Navarra, which due to their special status are autonomous to design most taxes, including the wealth tax.[4] The tax schedule is progressive and it applies to the sum of all individual wealth components net of debts.[5] Given the tax is on individual, and not joint wealth, joint assets are split among spouses.

Since 1997, the rights to modify the tax exemption amounts and the tax rates were ceded to the regions, under the condition of not setting rates below the national statutory minimum marginal tax rates and brackets (i.e, default schedule). In 2002, the regions were given the right to change or include deductions in the wealth tax and the condition of requiring a minimum bracket and marginal tax rates was suppressed. Despite this, all regions kept the national wealth tax schedule during the 1990's and early 2000's. In the mid-2000's, only a few small changes were implemented by some regions. Thus, it is only after its reintroduction in 2011 when significant differences in the wealth tax emerged.

Over the period 2002-2007, the filing threshold was 108,182.18 Euro (with filers amounting to 2.7% of the total adult population in 2007). Since 2011, the default threshold was increased and it is only levied if net taxable wealth is above 700,000 Euro (filers represent approximately 0.5% of the 2015 adult population).



(a) 2007

(b) 2014

FIGURE 1: Marginal Tax Rates across Regions

Notes: This figure depicts marginal tax rates and brackets across Spanish regions in 2007 (pre-reintroduction) and 2014 (post-reintroduction). We show the variation in 2014, as it is the year with the most common variation in tax rates in the post-reintroduction period. The figures have been constructed after digitizing the regional tax books (*Libros de tributación autónomica*) published by the Spanish Ministry of Finance. We also show the central (default) schedule that goes into effect if regions pass no legal modifications. Other years are similar to 2014, with minor differences.

The reintroduction of the wealth tax was authorized in September 2011 and initially came with uncertainty over when or if it would actually be implemented by regional governments. To have a different tax schedule than the national default, regions must actively pass a law, otherwise the national default schedule prevails. Immediately after the central government's

[4]Despite this, these regions levy wealth taxes at rates similar to the rest of Spain. See Appendix Figure A1.
[5]For further institutional details, including exempted assets and valuation, see Appendix A.1.

decision, the regional government of Madrid announced the suppression of the wealth tax and applied a 100% tax credit. This stands in contrast with regions such as Andalusia, Catalonia, and Extremadura who have raised the tax rates above the default schedule.[6] The first panel of Figure 1 shows the marginal tax rates under the mostly centralized wealth tax and the second panel shows the marginal tax rates in 2014, the year with the most common variation in tax rates. The tax savings of living in Madrid are sizeable.

For the purpose of this study, it is also important to know how fiscal residence is defined and to understand how taxpayers can change their fiscal residence by "moving" to another region. The fiscal residence is the property that constitutes the primary residence of the taxpayer and it is the same for all personal taxes, including the personal income tax. For a property to be a primary residence, the wealth taxpayer needs to have lived there continuously over at least three years. Nonetheless, the three-year general rule is quite vague, as "an exception applies in case of death of a family member, marriage, divorce, first job, job transfer or any other analogous circumstance" (Law 40/1998, Law 35/2006). Given the freedom granted via "analogous circumstances," this three-year rule is likely not binding for most taxpayers. Wealth taxpayers do not necessarily need to own a property ex-ante in Madrid to change the fiscal residence. They can change of fiscal residence by registering themselves in the properties of relatives, renting properties or buying a property in Madrid.

The wealth tax form is entirely self-reported. Taxpayers can directly change their fiscal residence on the tax form without having to provide any further evidence of when it became their primary residence. Only in the case of an audit a taxpayer needs to provide evidence about the reasons for her change of residence to satisfy the three year rule. Furthermore, the enforcement of the wealth tax is quite weak. Auditing falls to both the central and regional authorities. However, the incentives to audit are very low for central authorities, as all wealth tax revenue goes to the regional authority. Instead, regional authorities have more incentives to audit, but they do not have all the necessary information to do so, so that they need to request information to the central authorities.[7]

As the goal of our paper is to document the extent of wealth-tax induced mobility within

[6]There are several potential reasons why regions may chose high, low, or zero wealth taxes. Among others, the choice might be linked to the region's debt per capita level; the political affiliation of the party running the region; the population size in the region; the level of wealth inequality in the region; etc. Appendix Table A1 shows the results from regressing top marginal tax rates on these regional characteristics in 2014. None of these characteristics is significant including and excluding Madrid, but the sign of the correlations generally are in line with our intuition. These results suggest that there is no single force triggering the level of wealth tax rates chosen by regions.

[7]We digitize audit records for each region in Spain from 2005-2016 published by the General Inspection Department of the Spanish Ministry of Finance and document that wealth tax audit rates are relatively low, never surpassing 2% (Figure A2).

Spain, the reintroduction of the wealth tax should be considered in the context of other fiscal decentralization in Spain. The variation in other regional taxes could be a threat to identification if our wealth taxpayers would be responding to the regional differences in these other taxes and not to the reintroduction of the wealth tax in 2011. The central government also passed provisions allowing regions to set the tax brackets and tax rates on taxable labor income, which created incentives for high (labor) income individuals to move. Spain operates a dual personal income tax system, under which capital income is taxed at a common national schedule. Thus, for high-wealth individuals who obtain a substantial fraction of their income from the return to capital, decentralization of the labor income tax provided little additional incentive to move. As shown in Agrawal and Foremny (2019), the incentives to move due to the labor income tax are negligible for incomes below 90,000 Euro.[8] Figure A5 shows that approximately 75% of individuals that would be subject to the wealth tax have labor income below 90,000 Euro. We have repeated our baseline regression analysis dropping high labor income earners—the results are robust.

Inheritance taxes have also been decentralized since 1997, but regions did not exercise this right until the mid-2000s. In particular, Madrid adopted a tax credit of 99% on close relatives starting already in 2007, so that there is no additional incentive created by this tax starting in 2011 (Micó-Millán, 2023). Moreover, the place of residence for this tax is defined based on the location of the deceased over the last five years before death. Given this long duration of proof, and the fact that we focus on five years following reintroduction, we expect little of the mobility we identify to be a result of this tax.

2 Data

We combine two administrative data sets from the Spanish Institute of Fiscal Studies and the State Agency of Fiscal Administration. The first data set (*Panel de Declarantes del Impuesto sobre la Renta de las Personas Físicas 1999-2016*) consists of a 4% longitudinal sample of individual personal income tax returns, that contains all items reported on the annual personal income tax declaration. This includes the amount and source of income, personal characteristics (e.g., age and gender), and, critically, the fiscal residence of the tax filer. The micro-files are drawn from 15 of the 17 autonomous communities of Spain, in addition to the two autonomous cities, Ceuta and Melilla. We do not observe tax data for Basque Country and Navarra, as their fiscal regime works independently from the regions of the Common Fiscal Regime. Nonetheless, as we have seen in the previous section, both

[8] Figure A4 corroborates this statement by showing that the differences in marginal and average personal income tax rates are very small for labor incomes below 90,000.

regions levy a positive wealth tax with a very similar tax schedule to the rest of regions.

The second data set (*Panel de Declarantes del Impuesto sobre el Patrimonio, 2002-2007*) is a longitudinal sample of individual wealth tax returns, which contains detailed information about wealth taxpayers' assets and liabilities. These data are available for individuals included in the income tax panel who were subject to the wealth tax between 2002-2007. The legal definition of fiscal residence for wealth and income taxes is the same.

The income tax dataset is stratified by region, income level and main source of income, and it oversamples the top of the distribution. Given this stratification, the data are meant to be representative of the personal income tax distribution. Hence, the very wealthy taxpayers might thus be underrepresented in the estimation sample, resulting in a potential downward bias in the mobility elasticities. To overcome this, we reweight the data to be representative of the total population of both wealth taxpayers and personal income taxpayers across regions. For that, we assume that the sampling probability for wealth tax filers is constant within a region and a year. Our results are robust to not reweighting.

The main variable we use is the fiscal residence, which we directly observe in the annual personal income tax records before and after the reintroduction of the wealth tax. However, we need to estimate wealth for the years for which wealth tax records are not available (2008-2016) to both define treatment status in some of our specifications and to conduct the counterfactual revenue simulations. We do so by computing annual rates of return for each asset category as the ratio of the flow to the stock using national accounts. Using these returns, we then extrapolate individual wealth from 2008 onward using reported individual wealth in 2007 as an anchor. The extrapolation methodology we use relies on the assumption of constant rates of return by asset class. Rates of return may vary across taxpayers within asset class and also across regions (e.g., Bach et al., 2020; Fagereng et al., 2020, Smith et al., 2023). To test for the robustness of our extrapolation method, we first compare extrapolated average regional wealth to the actual reported average wealth published by the Spanish Tax Agency. Figure A6 shows that the extrapolation closely matches regional average wealth in both level and trend. We also compare extrapolated versus actual individual reported wealth levels using Catalonia's administrative wealth tax records after 2011.[9] Figure A7 shows that there exists a strong correlation between our extrapolated and the direct wealth measures in this region, especially around the 700,000 Euro threshold. Overall, this evidence supports the robustness of our wealth extrapolation method to define treatment status in some of our specifications and to carry the revenue analyses.[10]

[9]This is possible because the Catalan Tax Agency kindly granted us access to the universe of wealth tax records for Catalonia following the reintroduction of the wealth tax for this purpose.

[10]All details and robustness checks about the extrapolation method are described in Appendix A.2.

The microfiles do not allow to track international migration. To check that international mobility is not a concern, we requested from the Spanish Tax Agency the counts of wealth tax filers moving in and out of Spain during the pre and post-reform period. We received those counts for the population of wealth tax filers with gross wealth above 2,000,000 Euro and find that both net and gross migration flows from Spain to the rest of the world are negligible. Low international mobility is not surprising, as international residents are still subject to the wealth tax whenever their assets located in Spain are above the threshold.

Finally, our analysis also requires knowing the tax liabilities an individual pays in their region of residence and all possible counterfactual regions of residence. As there exists no publicly available wealth tax simulation model for Spain, we have constructed our own tax simulator.[11] This tax simulator and data and code are provided in Agrawal and Martínez-Toledano (2023); please see Appendix A.8.

3 Empirical Analysis

3.1 Treatment and Comparison Groups

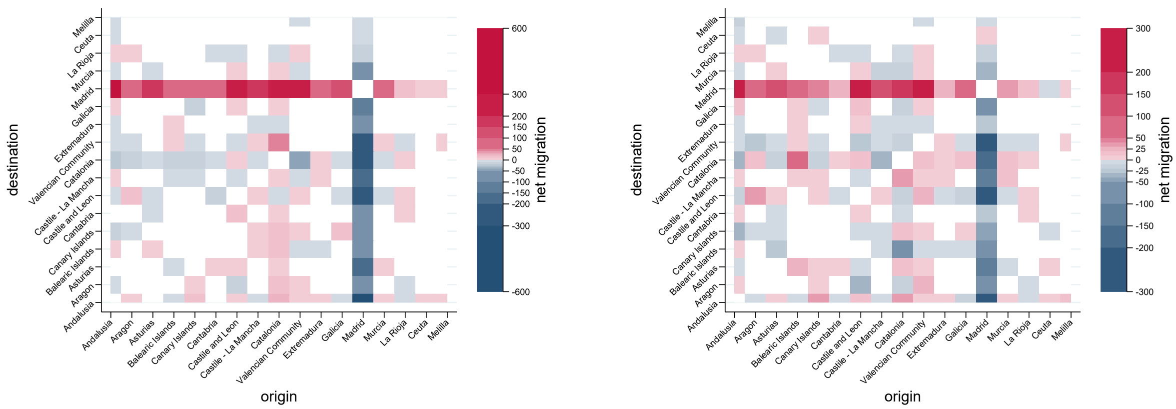
We start by defining the treatment and comparison groups that we will use in the subsequent analyses. In our baseline approach, we rely on the extrapolated data. The treatment group is individuals whose taxable wealth in 2010 is estimated to be above 700,000 Euro, the filing threshold. The advantage of this approach is that the treatment is based on the immediate year prior to reintroduction, but with the trade-off of using extrapolated wealth data. Nonetheless, the results are nearly identical if we use observed 2007 wealth to define treatment, as only 2.1% of individuals are classified differently.

We select our comparison group following the approach in Kleven et al. (2014), includes individuals who have taxable wealth below—but close to—the 700,000 Euro threshold in 2010. For our baseline specification, we focus on individuals with wealth between 600,000-700,000 Euro. Moving further down the wealth distribution allows us to have a larger comparison group, but comes at the risk of individuals being more different from the treatment group—many of whom have several million dollars of wealth. Alternatively, we use reported 2007 wealth to define the comparison group and results are nearly identical. One concern might be that individuals near the threshold might be partially treated in future years. However, such a concern is minor as tax rates in the first bracket are very low, meaning the tax savings across regions might be at most 334 Euro. We verify the results are robust to dropping individuals in the comparison group who cross the filing threshold in future years.

[11] All details about the tax simulator, including some robustness checks, are described in Appendix A.3.

3.2 Descriptive Evidence

As initial evidence, we construct heat maps showing the migration flows of our baseline treatment group between regions. Figure 2(a) shows the net migration patters of wealth tax filers to a given destination from a given origin region after the reform. To read the heat map, pick a destination row. If the cell is dark red, then net migration (in-flow from the "origin" region minus out-flow to the "origin" region) is stronger towards that "destination" region. If the cell is blue, the opposite is true. Figure 2(b) shows the change in net migration as the difference of annual net migration in the pre- and post-reform period. We construct this figure by calculating the annual average migration flows separately for the years prior to and after reintroduction. We then difference this data such that dark red cells see large increases in net migration following the reintroduction of the wealth tax, while blue pairs see net declines to that destination. Madrid is the strongest net recipient of wealth tax filers and its annual migration patterns increase dramatically relative to the period without a wealth tax. Almost every other region is losing high-wealth taxpayers to Madrid.[12]



(a) Post-Reform

(b) Post-reform minus Pre-reform

FIGURE 2: Net Flows Between All Region Pairs

Notes: This figure depicts net mobility patterns. Panel (a) shows the (annual average) net flow of wealth tax filers to a destination region following the reintroduction of the wealth tax (2011-2016). Panel (b) shows the change in the (annual average) net flow of wealth tax filers to a destination region in the five years following the reintroduction of the wealth tax (2011-2016) relative to the (annual average) net migration of wealth tax filers in the years prior to the reintroduction (2008-2010). Values in red indicate a net in-migration from the origin region while blue indicate a net out-migration to the origin region. Folding the graph along the 45 degree line yields the same values in absolute value, but with opposite signs.

[12]More descriptive evidence and summary statistics can be found on Appendix A.4.

3.3 Aggregate Analysis

3.3.1 Identification Strategy

To study the effect of Madrid's tax rate on mobility, we build tabulations from the micro files. We focus on the stock of taxpayers rather than wealth, as we directly observe the fiscal residence before and after the reintroduction of the wealth tax. In our preferred specification, we aggregate focusing on a balanced panel individuals that appear in the personal income tax data every year from 2008 to 2016. We also present trends for a longer balanced sample covering the period 2006-2016 to show that results are not affected by the onset of the 2008 financial crisis.[13] Balancing for fewer years makes the sample more representative.

We rely on a difference-in-differences event-study design where we compare the (log) share of individuals residing in Madrid between our treatment (i.e., individuals above the wealth tax filing threshold in 2010) and our comparison group (i.e., individuals just below the wealth tax filing threshold in 2010). The most relevant threat to identification would come from a shock that makes Madrid more attractive compared to other regions. The identifying assumption is that any unobservable shocks that influence the relative migration to Madrid are common to both the treatment and comparison group. This check that our treatment and comparison group consists of individuals with ex-ante similar observable characteristics such as age, gender, self-employed, and ownwership of a second home.

We estimate the following specification:

$$\ln n_{rit} = M_r \times D_i \times \left[\sum_{y=-5}^{-2} \theta_y \cdot \mathbf{1}(y = t-2011) + \sum_{y=0}^{5} \beta_y \cdot \mathbf{1}(y = t-2011) \right] + X_{rit}\alpha + \zeta_{ri} + \zeta_t + \nu_{rit}, \tag{1}$$

where r denotes the region, t the year, and $i = T, C$ the treatment and comparison groups defined in section 3.1, respectively. We define the population share as $n_{rit} = N_{rit}/\overline{N}_{it}$, where N_{rit} is the number of individuals in group i living in a given region r in year t, which is divided by the total population in Spain of that same group-year, $\overline{N}_{it}$.[14] Next, $\mathbf{1}(y = t - 2011)$ are indicators for each event year y, M_r is an indicator for the region of Madrid, and D_i is and indicator that equals one for the treatment group and zero otherwise. The added difference removes any common changes that affect both the treatment and the comparison group. Thus, θ_y corresponds to the relative evolution of the log share in the years prior to 2010, while β_y represents the evolution following the reform.

[13] We do not use an unbalanced sample as our primary specification because when taxpayers are added to the panel, they are meant to be representative of the region-income distribution and not of the region-wealth distribution. However, the results are robust in the unbalanced panel.

[14] In a balanced sample, using the share of individuals in a region is equivalent to using the population count.

Finally, ζ_{ri} and ζ_t are region-by-treatment and year fixed effects, respectively. In addition to the standard unit and time effects, in all specifications, the vector X_{rit} includes filer and Madrid indicators, filer-by-year fixed effects, filer-by-Madrid fixed effects, and critically for identification, Madrid-by-year fixed effects that absorb any region-specific shocks affecting both the treatment and comparison groups. In some robustness checks, the vector also contains controls such as region-filer-time varying characteristics on personal income tax rates and region-time-varying covariates.[15] The control variable for the the mean average tax rate on labor income is calculated by simulating tax rates using observed labor income.[16] We cluster the standard errors at the regional by treatment group level.

We also use a multinomial logit specification to obtain an elasticity of the stock:

$$\ln\left(\frac{n_{rit}}{n_{Rit}}\right) = \epsilon \cdot \ln\left(\frac{1-\tau_{rit}}{1-\tau_{Rit}}\right) + X_{rit}\alpha + \zeta_{ri} + \zeta_t + \nu_{rit}, \tag{2}$$

where $\frac{n_{rit}}{n_{Rit}}$ is the number of individuals belonging to group i in region r in year t normalized by the number in a given region R in Spain.[17] Similarly, $\frac{1-\tau_{rit}}{1-\tau_{Rit}}$ is the net-of-average-tax rate normalized relative to region R. As the effect of the tax rate in any one region r has a negligible effect on the stock in the normalized region R, the coefficient on the net-of-tax rate can be interpreted as an elasticity.[18] Because the net-of-tax rate is close to 1, the coefficient ϵ can be interpreted as a classical elasticity, or alternatively, as a semi-elasticity corresponding to a one percentage point change in the net-of-tax rate. All remaining variables and fixed effects are similarly defined as in (1).

Because we are using aggregate data, we need to take a stance on what the regional average tax rate is. To calculate the regional average tax rate (ATR), we simulate the ATR for every wealth tax filer in every region and year, using their time-varying wealth and our tax calculator. We then construct two regional measures of the aggregate ATR following Smith et al. (2019): an unweighted average and the wealth-weighted average across all individuals.

[15] These include economic factors (unemployment, GDP per capita, long term unemployment, R&D spending), demographics (fertility/mortality rates), amenities (heating/cooling degree days), and public spending on government services by various categories.

[16] Note that the Madrid by year fixed effects absorb any regional shocks that affect both the treatment and comparison group in Madrid relative to the other regions. Thus, in the absence of covariates, as the event study captures the relative effect, this model is isomorphic (i.e., yields identical point estimates) to the inclusion of region-year fixed effects.

[17] The multinomial logit specification is useful because the stocks of all regions add up to a constant. As a result, one might worry that there is some correlation between the population of region r and another region r' resulting from a population increase in r change altering the population elsewhere. The normalization by a given region allows us to model this. We select the largest region in Spain as the normalized region R, but we also show the results are robust to selecting any region other than Madrid.

[18] As in Akcigit et al. (2016), we assume that there are a sufficiently large number of regions, such that the tax rate of Madrid has a negligible impact on the number of wealthy in any *one* other region.

The unweighted average is simply the mean ATR for all individuals in the treatment (or comparison) group. The wealth-weighted ATR weights by the amount of 2010 wealth that each individual in the treatment (or comparison) group has. The use of a wealth-weighted average tax rate is preferred because individuals with higher wealth and hence, higher tax liabilities, respond more strongly to the tax, as we will show in the heterogeneity analysis.

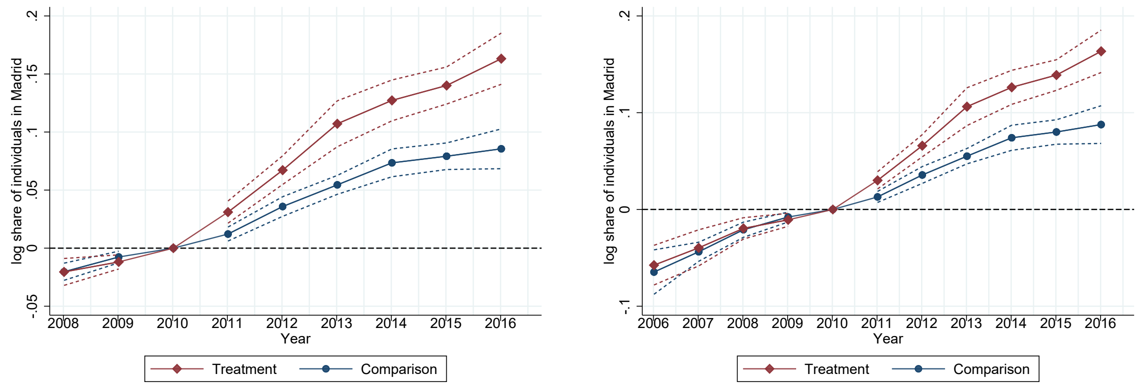
To address measurement error and possible endogeneity resulting from taxable wealth changing over time, we instrument for the net-of-tax differential. Following the difference-in-differences design, we instrument using the interaction of $M_r \times Post_t \times D_i$. This instrument captures the differential changes in Madrid for the treatment group relative to other regions and the comparison group. Alternatively, to capture the effects of tax differences across all regions we use the triple interaction with the full vector of region indicators, $\zeta_r \times Post_t \times D_i$.

3.3.2 Results

We first provide visual evidence of the effect of the wealth tax by estimating (1) and plotting the relative evolution of Madrid's population separately for the treatment and comparison groups. Figure 3 depicts the evolution of log population changes from a model that does not include any covariates. The left and right panels present results using the balanced 2008-2016 and 2005-2016 samples, respectively. The red-diamond line indicates that even prior to 2011, Madrid was becoming a more attractive place. However, the blue dotted line indicates Madrid was becoming similarly attractive for the comparison group. However, this trend rapidly accelerates starting in 2011 for the treatment group, but not for the comparison group. We can thus conclude that Madrid's zero tax rate accelerated the rate of growth of wealthy filers in the treatment group, with no noticeable change for the comparison group.

Calculating the triple interaction and plotting θ_y and β_y, the share of treated individuals located in Madrid steadily increases relative to the comparison group starting in 2011. By six years after the reform, Madrid's relative stock of treated individuals increases by approximately 7.5%. Given that Madrid represents only 22% of high-wealth individuals, this implies that the population of other regions only falls by less than 1.7%. Figure 4 reveals that the evolution of the stock is dynamic with relatively small effects in the first two years and larger effects afterward. Although migration flows may jump on impact, the stock is a slower moving variable. Moreover, the first two years of reintroduction were characterized by some uncertainty regarding the continuity of the tax, which hindered any type of tax re-optimization. Controlling for personal income tax rates does not change the results.

We find no significant differences in pre-trends consistent with the relative attractiveness of Madrid evolving similarly for both the treatment and comparison groups. The pre-reform coefficients being close to zero show that mobility effects follow tax changes and do not



(a) Short panel

(b) Long panel

FIGURE 3: Event Study of the (log) Population Share

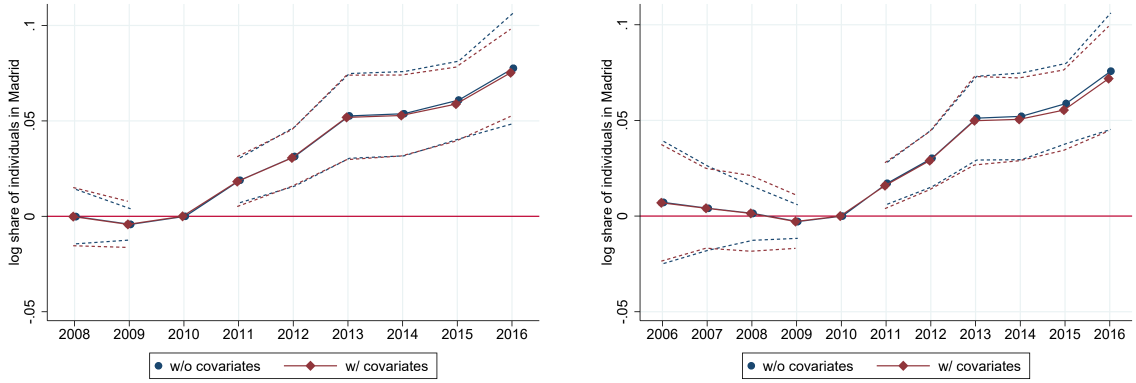
Notes: This figure shows the estimates of (1) where we plot separately the marginal effects for the treatment group of wealth tax filers and the comparison group of non-filers. In panel (a), individuals must appear in the data every year from 2008 to 2016. In panel (b), individuals must appear in the data every year between 2006 and 2016. The series in red shows results when n_{rit} is the regional share of the treatment group while the series in blue shows the results when n_{rit} is the regional share of the comparison group. The figure shows specifications that do not include any covariates. Standard errors are clustered at the region-group level and 95% confidence intervals are plotted.

predate them. This suggests that any unobservable factors making Madrid a relatively more attractive region for wealth tax filers similarly influenced individuals just below the filing threshold. The precise coefficient estimates of this design are given in Appendix Table A4.

We then estimate (2) in order to obtain the mobility elasticity of the stock. Panel I of Table 1 shows results when we instrument for the wealth weighted net-of-ATR with the triple interaction of Madrid by treatment group by an indicator for post-reform, while Panel II interacts each region dummy with treatment group by post.

Column (1) models are estimated by OLS. To address possible measurement error in the tax rate, in subsequent columns, we use the instruments discussed above. Column (2) does not include covariates. The elasticity is 10.85. Each subsequent column adds covariates. For example, column (3) controls for personal income tax rates. Focusing on the final column, including a full set of controls, the wealth tax elasticity with respect to the net-of-tax rate is 7.96. In words, a 1 percent increase (or, approximately, a one percentage point increase) in the net-of-tax rate raises the stock of wealth tax filers residing in a region by 7.96%. The average tax differential between Madrid and the other Spanish regions is just less than one percentage point, making the estimates consistent with the event studies shown previously. Finally, comparing Panels I and II, the elasticities are slightly larger when using an instrument specific to Madrid relative the instrument for each region. This suggests that the tax differentials with respect to Madrid have larger effects than elsewhere.

Our baseline wealth tax mobility elasticity can be compared to the wealth tax mobility



(a) Short panel

(b) Long panel

FIGURE 4: Triple Difference of the (log) Population Share

Notes: This figure shows the coefficients on the triple interaction terms in (1). In panel (a), individuals must appear in the data every year from 2008 to 2016. In panel (b), individuals must appear in the data every year between 2006 and 2016. The series in red (diamonds) shows results without covariates while the series in blue (circles) shows the results including covariates. Standard errors are clustered at the region-group level and 95% confidence intervals are plotted.

estimated by Brülhart et al. (2022) between the Swiss cantons of Lucerne and Bern. Brülhart et al. (2022) obtain a 8.1 percentage point response after six years due to a 0.18 percentage point greater cut in the top marginal tax rate in Lucerne. This implies an elasticity of 45. However, the Lucerne wealth tax cut was particularly salient and perhaps coincided with other measures that made it more attractive to declare wealth there. Although the Lucerne tax cut response is viewed as exceptionally large relative to other cantonal tax reforms, we can assume that the composition of the taxable wealth response between these two cantons to be representative of other cantons. We can then estimate the overall cross-canton mobility elasticity for Switzerland by applying the share attributable to mobility estimated for Lucerne (24%) to the overall cross-canton taxable wealth elasticity (43), which implies a representative mobility elasticity of 10.3 for the whole of Switzerland. While this elasticity is in the range of our estimates, it is with respect to the marginal rather than the average rate, and thus likely larger than our estimates.

We also consider specifications that use the unweighted net-of-ATR across individuals rather than the wealth weighted rates. Because the wealth tax system is progressive and because wealth is skewed, the mean ATR across regions excluding Madrid (0.37%) is approximately one third of the wealth-weighted ATR (0.98%). Thus, as expected, the elasticities approximately triple in size.[19] Because the results are primarily driven by high-wealth taxpayers—as we show below—wealth-weighted average is preferred.

[19]As shown in Moretti and Wilson (2017), using an ATR at the 95th percentile versus the 99.9th percentile results in an elasticity that is almost twice as large in some specifications.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel I: Instrument with Madrid by Treatment by Post						
$\frac{1-\tau_{rit}}{1-\tau_{Rit}}$	5.562	10.854	10.471	9.267	9.139	7.812	7.966
	(2.745)	(0.571)	(0.957)	(1.080)	(1.080)	(1.149)	(1.247)
F-Stat		2366.4	1923.4	1654.1	1755.0	1215.4	1131.6
	Panel II: Instrument with Region by Treatment by Post						
$\frac{1-\tau_{rit}}{1-\tau_{Rit}}$	5.562	9.341	8.618	7.949	7.831	6.429	6.612
	(2.745)	(1.667)	(1.431)	(1.275)	(1.275)	(1.159)	(1.188)
F-Stat		100.8	1023.6	115.8	626.0	996.9	13383.9
J Statistic		0.378	0.613	0.689	0.686	0.686	0.398
OLS/IV	OLS	IV	IV	IV	IV	IV	IV

TABLE 1: Elasticity Estimates

Notes: This table estimates (2) using Andalusia as the region of normalization. Column (1) estimates the model using OLS, while columns (2)-(7) instrument for the net-of-tax rate. In Panel I, the instrument is $Madrid_r \times D_i \times Post_t$ while in Panel II, the instruments are $\zeta_r \times D_i \times Post$. Columns (1) and (2) do not include covariates. Each column then successively adds controls: (3) net-of-tax rate on personal income, (4) aggregate expenditures, (5) amenities, (6) economic controls, and (7) demographics. Standard errors are clustered at the region by treatment group level. Panel I includes only a single instrument, so we present only the F-statistic. In panel II, because we have an instrument for each region, we also present the p-value from the Hansen-J Statistic.

In Appendix A.5, we conduct additional robustness checks. First, we show the results are robust to alternative comparison groups: we rely on samples of individuals with lower wealth and we also identify individuals with a large amount of tax-exempt wealth, but who do not need to file the wealth tax and use them as comparison groups. Second, we show the results are also robust to various modeling choices such as reweighting the dataset to be representative of wealth tax filers and balancing the dataset to construct our tabulations.

3.3.3 The Wealth Tax Elasticity Converted into an Income Tax Elasticity

Wealth taxes are applied to the stock of wealth, while capital income taxes are applied to the flow generated by the stock. We convert our estimates to an equivalent capital income tax to allow for comparisons with the larger literature on income tax elasticities. Following Kopczuk (2019) and Brülhart et al. (2022), suppose that an individual with wealth W and a rate of return ρ in a given year can either be taxed next year on the accumulated stock $(1+\rho)\cdot W$ or on the return, $\rho \cdot W$. Then, a wealth tax rate τ will raise an equivalent amount of revenues as a capital income tax rate of T, where the relationship is given by:

$$T = \frac{(1+\rho)\cdot\tau}{\rho}. \quad (3)$$

We can thus convert our wealth tax elasticity, $\epsilon_{1-\tau}$, with respect to the wealth weighed

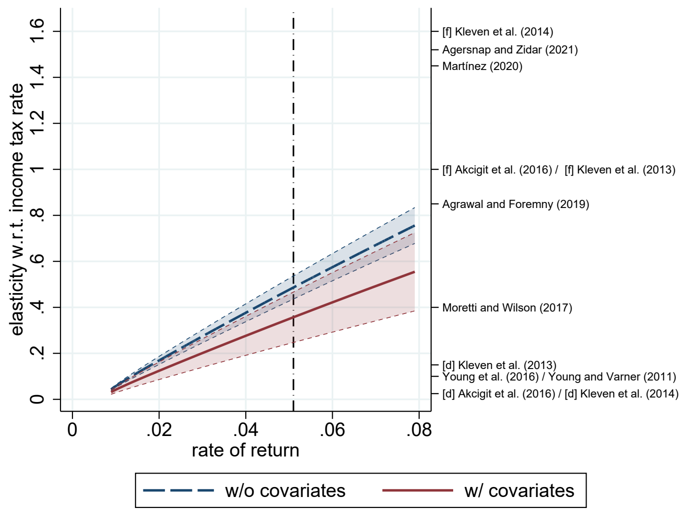


FIGURE 5: Mapping of Wealth to Capital Income Tax Elasticity

Notes: This figure translates the elasticity with respect to the net-of-tax rate on wealth to an elasticity with respect to the net-of-tax rate for capital income as a function of various rates of returns. To construct this, we use our empirical estimates from Table 1 Panel I Columns (2) and (7). We show results for the elasticities obtained from the regression with (red solid line) and without (blue dashed line) covariates. The vertical dash-dotted line depicts our baseline average annual rate (5%). This rate of return has been taken from the distribution of flow rates of return provided by Martínez-Toledano (2022) for Spain and it is the average rate of return for the top 1% wealth group in the post-reform period. When income-tax papers report separate elasticities for foreign and domestic individuals separately, we denote that with [f] and [d], respectively. When studies estimate short-run and long-run responses, we report the time horizon most comparable to ours.

net-of-tax rate, $1-\tau \approx 0.99$ using

$$\epsilon_{1-T} = \epsilon_{1-\tau} \cdot \frac{d\ln(1-\tau)}{d\ln(1-T)}, \tag{4}$$

where ϵ_{1-T} is the elasticity with respect to the capital income net-of-tax rate in (3).

Using the 5% average rate of return for the top 1% wealth group estimated by Martínez-Toledano (2022) for Spain, we obtain a capital income tax elasticity of approximately 0.36 with respect to the own-region wealth-weighted ATR.[20] The capital income tax elasticity with respect to the own-region wealth-weighted ATR without covariates is 0.49. Importantly, the elasticities with or without covariates are not statistically different from each other and the estimates are economically similar.

Figure 5 compares, when available, our estimates to estimates for the same time horizons of income tax studies.[21] Our estimated own-region elasticities are remarkably similar to

[20] When using the the mean unweighted ATR results from Table A6, this triples to 1.02.

[21] One exception is Young et al. (2016), who estimate a long-term response. The elasticity reported for Moretti and Wilson (2017) is a short-run elasticity; however, these authors also estimate that the effect of a permanent one percent increase in the net-of-tax rate between year t and $t+5$ would lead to a 6.0 percent increase in the stock of scientists by the end of year $t+10$. Under strong assumptions, Kleven et al. (2013) report long-run elasticities that are only slightly larger than those in the figure. Akcigit et al. (2016) show

the literature on the mobility of top income earners. These comparisons suggest that the potential added salience of annual wealth taxes relative to capital income taxes is not a major factor influencing mobility. Given the similarity of capital income and wealth responses, the subsequent analyses of cross-jurisdiction and cross-base fiscal externalities are likely to apply to both capital income and wealth taxation within federal systems.

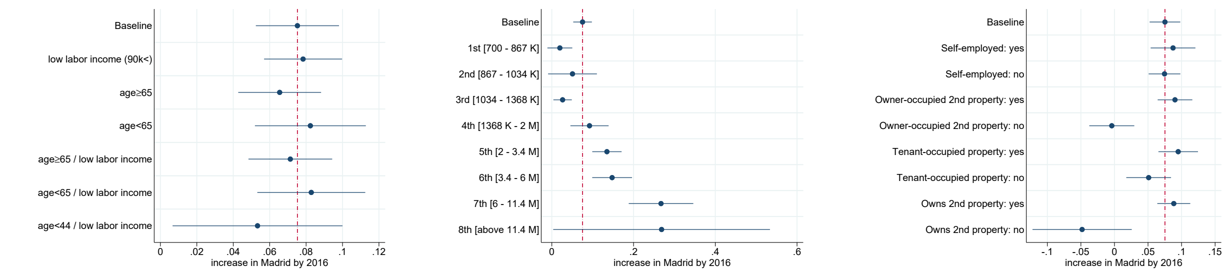
3.3.4 Heterogeneity

We study the heterogeneous effects of the wealth tax by separately tabulating the number of individuals by age, income, portfolio characteristics, and wealth. Figure 6 shows for the various sub-groups the coefficient on event year 2016 from (1). Select corresponding event studies are in the appendix. When conducting this exercise, we define the comparison group over the same sub-sample of individuals as the treatment group.

We first use the heterogeneity analysis in Figure 6(a) to rule out confounding effects such as income and inheritance tax reforms at the region by year level. There appears to be little heterogeneity in the responses by income or age. With regards to income, we drop individuals with labor earnings greater than 90,000 Euros, as Agrawal and Foremny (2019) show that regional differences in marginal income tax rates on earnings are quite small for incomes below this threshold. We find that the response of low earnings individuals—facing insignificant regional income tax differentials—is similar to the baseline, so that income tax differentials do not seem to confound our estimates. To rule out the effects of either the income or the inheritance tax, we also split the sample by age relative to retirement. We obtain similar effects for individuals above and below the retirement age, which again suggests that income and inheritance tax differentials across regions have a negligible effect. To jointly account for confounding effects coming from both inheritance and income tax variation, we split the sample by age relative to retirement and income, and for individuals below 44 (i.e., young) and income. None of these groups are statistically different.

Next, because the wealth tax is progressive, the incentives to relocate increase as taxable wealth increases. Individuals near the threshold face relatively small tax differentials and, as shown in Figure 6(b), see their population in Madrid increase by only less than 2%. Nonetheless, the effects almost monotonically increase as taxable wealth increases. Individuals in the top tax bracket—although smallest in their initial size, but facing the largest tax differentials—see their population in Madrid increase by over 20%. This increasing relationship between taxable wealth and the magnitude of the mobility responses helps fortify the case that high-wealth individuals are responding to wealth tax differentials rather than to

that domestic [foreign] inventors long-term mobility is slightly less [more] sensitive to tax rates.



(a) Age and Income

(b) Wealth Tax Bracket

(c) Self-employed and Owners of second properties

FIGURE 6: Heterogeneity: Increase in the Log Share of Each Sub-group

Notes: This figure shows for the various sub-groups the coefficient on event year 2016. The heterogeneity analysis is done for the short balanced panel (2008-2016) and it includes covariates. In panel (a), we split the sample by age and the amount of labor income. An individual is defined as having low labor income if he/she earns less than 90,000 Euros, the amount above which Agrawal and Foremny (2019) show that labor income tax differentials start to matter. In panel (b), we split the sample at each tax bracket threshold, which makes it possible us to conduct an heterogeneity analysis along the wealth distribution. In panel (c), we split the sample by self-employment status and by ownership of secondary residences. The baseline estimates for the full population are given by the red vertical lines. We cluster standard errors at the region by group level.

unobservable time-varying characteristics of Madrid.

3.3.5 Mechanisms

The estimated wealth tax-induced mobility responses may be driven by tax avoidance (real migration) or tax evasion (fraudulent changes in fiscal residence). Indeed, the loopholes in the law—in particular, the freedom to determining the reason for a move—coupled with self-reporting and imperfect enforcement capacity, as explained in Section 1, offer scope for both tax evasion and avoidance. The line between avoidance and evasion is, however, very blurry in this context. A real move would occur if a taxpayer buys an apartment in Madrid (or already owns second home there) and actually moves there to avoid the wealth tax. An example of evasion would occur if instead this same person would not move to Madrid, but instead pretend that she lives there. But, the line is blurry as as a real response [evasion] could occur by actually changing [falsely misreporting] the number of days spent in the primary/secondary residences across two regions.

Assessing whether changes of fiscal residence are fraudulent or not is quite costly for the Spanish Tax Agency and the regional tax authorities, as this requires tracking the location of taxpayers in real time and accessing information from other regions. The tax regional authorities likely cannot assess whether each single change of fiscal residence is fraudulent or not. As a consequence, we too do not have the necessary information to quantify the importance of each channel. We can, however, still provide some suggestive evidence about the underlying motives and channels behind the moves. In particular, we explore whether there exist heterogeneous effects in the mobility responses by self-employment status and by ownership of secondary residences. Figure 6(c) shows that self-employed wealthy individuals are not significantly more likely than non self-employed wealthy individuals to move to Madrid after the reintroduction of the wealth tax. This result reveals that Madrid's zero tax rate does not seem to have induced more business relocations to that region.

Instead, Figure 6(c) shows that owners of secondary residences are significantly more likely than non-owners to change their fiscal residence to Madrid after the reintroduction of the wealth tax. This result is driven by owners of owner-occupied secondary residences and not by owners of tenant-occupied properties. Our tax micro data unfortunately does not specify whether the secondary residence is located in Madrid or not. Hence, this result needs to be interpreted with care. If these properties were surely to be located in Madrid, this would imply that a tax induced change of fiscal residence to the region is more likely when a wealth taxpayer ex-ante owns a property in that region. Nonetheless, using aggregate tax statistics we document that wealth taxpayers do not appear to own a disproportionate share of secondary residences in Madrid and they do not own a disproportionately larger share of secondary residences outside of their home region relative to personal income taxpayers either (Appendix Section A.6). Hence, this evidence suggests that neither Madrid nor wealth taxpayers appear to be special with regards to ownership of secondary residences.

3.4 Individual Choice Model

The prior literature on taxation and mobility has employed two main identification strategies: either estimating the effect by aggregating the data or via individual choice models.

3.4.1 Identification Strategy

An individual location choice model allows us to control for individual-specific factors that may influence the probability of residing in a region. The definition of the treatment and comparison group and the balancing of the sample follows the aggregate analysis. Let individual i in year t choose among alternative regions r. The dependent variable d_{itr} is equal to one for the chosen region of residence and zero otherwise. We estimate:

$$d_{itr} = \beta \cdot M_r \times D_i \times Post_t + \gamma \cdot \zeta_r \mathbf{z}_{it} + \alpha \cdot X_{tr} + \omega_{it} + \iota_r + \varepsilon_{itr}. \tag{5}$$

The model, estimated as a linear probability model, includes interactions of alternative-region dummies ζ_r with characteristics of the taxpayer $\mathbf{z}_{it}$ (i.e., gender, age, age squared, gender by age, and labor income) in, which estimates a region-specific return and flexibly controls for differences in the wealth accumulation process across regions. Controls X_{tr} are the same as the ones used in the aggregate analysis at the alternative-year level. We also include case fixed effects ω_{it}, which force the identification to be based on within-variation across alternative regions for a specific taxpayer in a given year. M_r and D_i are defined as in the aggregate analysis and ι_r are alternative-region effects. Appendix A.5.2 discusses our methodological choices further and presents the baseline and robustness results in detail.

3.4.2 Results

The model indicates that the treatment group experiences a relative increase in the probability of residing in Madrid by 0.8 percentage points in the post-reform period. Given the baseline probability of residing in Madrid in the pre-reform period was 22.5%, this corresponds to approximately a 3.6% increase in the share of wealthy individuals in Madrid. To parallel the aggregate analysis, we can replace the post indicator by event indicators and report the cumulative effect in 2016. The treatment group experiences a relative increase in the probability of residing in Madrid of 1.3 percentage points, which yields an increase of approximately 5.8%, similar to the results of the aggregate analysis. Including individual controls, for which the aggregate model could not account, does not alter the results.[22]

To analyze whether small tax differentials between other regions matter, the $M_r \times Post$ indicator can be generalized by replacing the M_r indicator by region-specific indicators, ζ_r, omitting region $\hat{r}$. Estimation of this model returns a vector of coefficients β_r which capture the difference in the probability of choosing any region relative to a given omitted baseline region $\hat{r}$. Unlike the aggregate analysis, this specification makes it possible to estimate *pairwise* mobility by repeatedly selecting a different $\hat{r}$. Figure 7 shows the average post-reform effect. We find statistically insignificant results that are close to zero for almost every possible omitted region except Madrid. All regions see a decline in the probability of moving relative to Madrid (red diamonds), but no effect relative to any other region than the capital. Only pairs involving Madrid (at the bottom of the graph) as a destination see an increase in the probability of moving (blue circles). Hence, these analyses suggests that the tax rate of Madrid—and not smaller tax differentials between other regions—matters most for relocation choices.

Although it is not possible with the data and information available to provide a casual explanation for this result, there are two potential complementary explanations behind this finding. First, this result might be explained by the salience of the zero-tax relative to the other small inter-jurisdictional wealth tax differentials. In fact, there is plenty of anecdotal

[22] For a full discussion of results based on the individual choice model, see Appendix A.5.2. This Appendix furthermore presents results on heterogeneity as in the aggregated analysis.

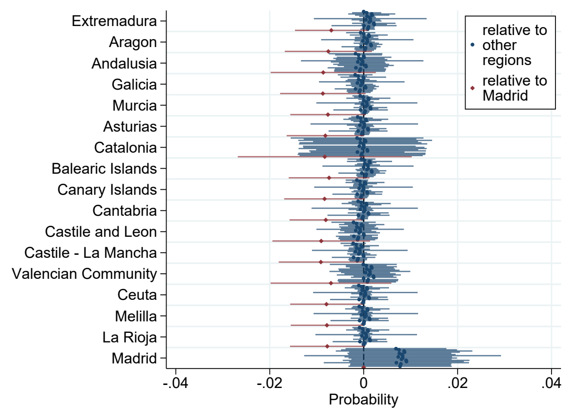


FIGURE 7: The Effect of Tax Differentials Between Region Pairs

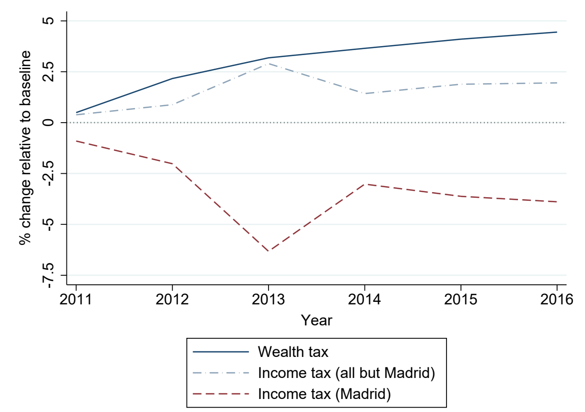
Notes: This figure depicts the effect of a modified version of equation (5) with by region by treatment by post interactions. We estimate this equation once for each region (17 times), omitting a different region as the base region each time. The resulting coefficients indicate the probability of choosing the region on the vertical axis as destination relative to each possible alternative (omitted region). Hence, each region pair appears twice. The coefficients for Madrid as the omitted region are plotted in red. Regions are ordered by their 2015 top-tax differential. Standard errors are clustered at the origin-bracket, alternative-bracket, and individual level and 95% confidence intervals are plotted in the figure.

evidence documenting that the very low tax has been used by the government of Madrid to publicize itself as the most attractive region of Spain for individuals and entrepreneurs. Furthermore, the Spanish press on both sides of the ideological spectrum has also constantly emphasized Madrid's zero wealth tax. Second, the loopholes in the wealth tax law—in particular, the freedom to determining the reason for a move—coupled with self-reporting and imperfect enforcement capacity, offer scope for tax evasion (fraudulent changes of fiscal residence) and avoidance (real migration). Hence, although we cannot quantify whether the changes of residence are fraudulent or not, there are reasons to believe that some of these changes may not be real. In fact, if the costs of evading are the same via all regions, Madrid would be the optimal evasion choice from the purely tax standpoint all else equal, as Madrid is the lowest wealth tax and, as a result, the region that affords the largest expected benefit of evasion. Conversations with regional authorities confirm that some of the changes of fiscal residence were found to be fraudulent.

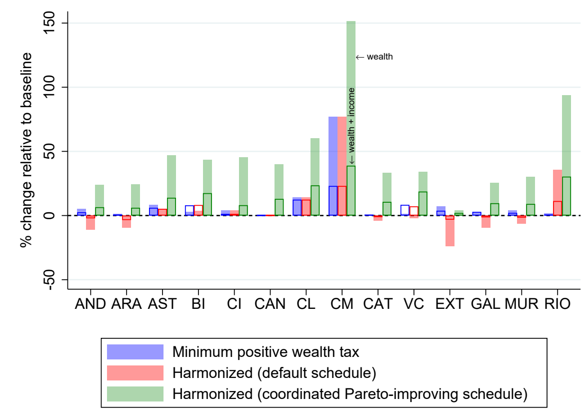
4 Revenue Analysis

We study the revenue implications of wealth tax-induced mobility, as well as the effect of various types of tax coordination policies (harmonization and minimum tax rates) on regional tax revenues. We focus on both the direct effect of mobility on wealth tax revenues and, new to the literature, the cross-base effect on personal income tax revenues. Understanding cross-base revenue effects is key to understanding tax coordination, as the direct revenue effects might be different from the total revenue effects, particularly when the cross-base effects concern one of the most important tax instruments. In Spain, the personal income tax accounts for approximately 90% of total regional direct tax revenues in 2015, while the rest of regional taxes (e.g., wealth tax, inheritance tax) are approximately equal in size.

We conduct the revenue analysis by means of counterfactual simulations. To do so, we first identify the number of tax-induced movers to Madrid based on the annual coefficients estimated from (1). We then reassign the estimated number of tax-induced movers back to their home region. As the total number of movers observed in the data is greater than the causally estimated number of estimated tax-induced movers, we apportion across regions the increase in Madrid's population by using the annual shares of net migration that each region contributes to Madrid relative to the pre-reform period. We then draw taxpayers randomly from the set of movers involving Madrid.[23]



(a) Non Tax-induced vs. Tax-induced Mobility



(b) Alternative Scenarios

FIGURE 8: Revenue Simulations, 2011-2016

Notes: Panel (a) depicts, for all regions excluding Madrid, the percent change in wealth tax (solid blue line) and personal income tax revenue (dashed-dotted blue line) from shutting down tax-induced mobility relative to the baseline with tax-induced mobility. The figure also shows, for the region of Madrid, the percent change of income (dashed red line) tax revenue between the same counterfactual and baseline scenarios. The change is the average difference in revenue between the decentralized scenario absent tax-induced mobility to Madrid relative to the baseline decentralized scenario with tax-induced mobility to Madrid over the period 2011-2016. We convert this difference into a percent by dividing by the baseline revenue. Panel (b) depicts the percentage change of wealth plus income tax revenue (or only wealth) absent tax-induced mobility to Madrid relative to the baseline decentralized scenario with tax-induced mobility to Madrid over the period 2011-2016 under three different counterfactual scenarios: a scenario with a binding minimum wealth tax rate at the default schedule, a harmonized scenario where all regions adopt the default wealth tax schedule, and a harmonized scenario that is revenue-improving for all regions relative to the baseline. Unfilled bars capture the effect of income plus wealth tax revenues, while filled bars capture the effect of only wealth tax revenue. The regions of Ceuta and Melilla are excluded from the figure as they are very small.

We proceed by first using our mobility estimates to simulate the revenue effects of closing down tax-induced mobility. In the presence of tax differentials, such a reduction in mobility

[23]Our counterfactual simulations are based on a partial equilibrium analysis. Appendix A.7 explains in detail the assumptions we rely on and why we believe our partial equilibrium analysis is valid.

could possibly be achieved by perfect enforcement or by implementing large regional exit taxes. Figure 8(a) shows the percent change of wealth tax revenue (solid blue line) on all regions—other than Madrid—from eliminating tax-induced mobility to Madrid relative to the observed baseline with tax-induced mobility. Spain foregoes approximately 5% of total wealth tax revenue in 2016 due to tax-induced mobility. The revenue losses rise over time, consistent with the number of movers to Madrid increasing between 2011-2016.[24] Further, Madrid levies a positive personal labor income tax and collects revenues from the centralized capital income tax, so that income tax revenues are transferred from the rest of Spain to Madrid. Figure 8(a) also shows that in 2016, Madrid foregoes nearly 5% of income tax revenue from closing down mobility (dashed red line), while the rest of regions would gain approximately 2.5% (dashed-dotted blue line).

The fiscal externalities from tax-induced mobility are quite heterogeneous across regions (Figure A21). Whereas Castile-La Mancha, Castile and León, and Asturias lose on average more than 10% of their wealth tax revenue due to tax-induced mobility, Catalonia and Cantabria lose less than 1% of revenue. The two Castiles are within a short distance of Madrid, suggesting that proximity may be important at lowering the cost of tax avoidance. Furthermore, the correlation between foregone wealth and income tax revenue is higher in regions with low tax-induced mobility, meaning that many of the movers in the regions with the largest wealth tax revenue effects are *rentiers* with little taxable income. Even though the *percent* change in revenue is not very different—and sometimes smaller—between wealth and total taxes, the cross-base fiscal externality on the personal income tax is much more important in absolute terms, as regional personal income tax revenues in regions other than Madrid are approximately 6 times larger than wealth tax revenues. Hence, quantifying cross-base fiscal externalities is key to assessing the total revenue effects of tax-induced mobility.

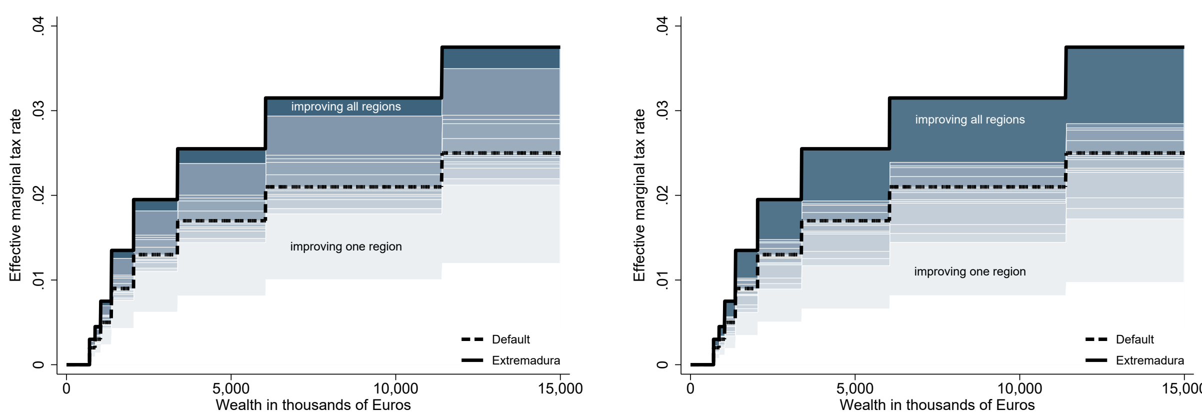
We then study how tax coordination might shape tax revenues. We compare the baseline wealth and personal income tax revenues to the simulated revenues under different scenarios which eliminate or mitigate tax-induced mobility: a scenario with a minimum tax rate, a harmonized scenario in which we apply the default (centralized) wealth tax schedule, and finally, a scenario in which we gradually increase the harmonized tax schedule until we find a harmonized tax system that makes all regions better-off in terms of tax revenues.

Figure 8(b) depicts the percent change of wealth and personal income tax revenues (un-

[24]Taxpayers might respond by accumulating or reporting more (less) wealth when moving to the zero-tax (positive-tax) region. Although we cannot estimate these responses directly, we adjust our simulations for taxable wealth responses using the taxable wealth elasticities found in the literature. Our results are very similar either when accounting for new evasion strategies (that do not accumulate over time) or real savings reductions (that are cumulative). Appendix A.7 explains how we carry out these alternative counterfactual simulations and presents the results accounting for taxable wealth responses (Figure A22).

filled bars) and the percent change of wealth tax revenues (filled bars) for the three counterfactual scenarios over the period 2011-2016. We confirm the result of the theoretical literature that setting a minimum positive tax rate is Pareto improving with respect to revenues (Kanbur and Keen, 1993). However, harmonizing the wealth tax schedule by applying the national default schedule is not revenue-improving for all regions: those with higher wealth tax schedules than the default (i.e., Andalusia, Catalonia, Extremadura, Galicia, Murcia) realize losses due to the mechanical effect of lowering rates. Only if harmonization is to a rate that is very close (e.g. 40% higher than the default in 2014) to the maximum decentralized rate (e.g., Extremadura's rate is 50% higher than the 2014 default), will every region gain wealth tax revenue (Figure 9(a)).

Cross-base effects are also important when evaluating the revenue implications of tax coordination. After accounting for personal income tax revenues, the harmonized rate that benefits all regions is significantly lower (only 29% higher than the default schedule) than when not accounting for them (Figure 9(b)). This means that if voting rules required unanimity, then harmonization could be implemented at a lower tax rate when accounting for other revenue sources affected by mobility than when simply focusing on the wealth tax.[25]



(a) Improving wealth tax revenue

(b) Improving wealth and income tax revenue

FIGURE 9: Coordinated Revenue-Improving Wealth Tax Schedules, 2014

Notes: This figure compares the coordinated wealth tax schedules that are revenue-improving for different sets of regions in 2014. Each shaded area represents an increase of at least one region which would benefit from the higher schedule. Panel (a) shows the wealth tax schedule for 2014 that improves wealth tax revenues relative to the baseline and panel (b) the one that improves wealth and income tax revenues. The figure also highlights the schedule applied by Extremadura—the highest in this year—and the default schedule.

But, harmonization under an unanimity rule seems unlikely because it will lack support

[25] We also identify the tax rate for which harmonization would never be desirable because all regions other than Madrid would lose revenue. If harmonization is to a rate well below the minimum positive decentralized rate (e.g. 52% [61%] lower for wealth [wealth and personal income] tax revenue than the default in 2014), then every region will lose revenues (Figure 9).

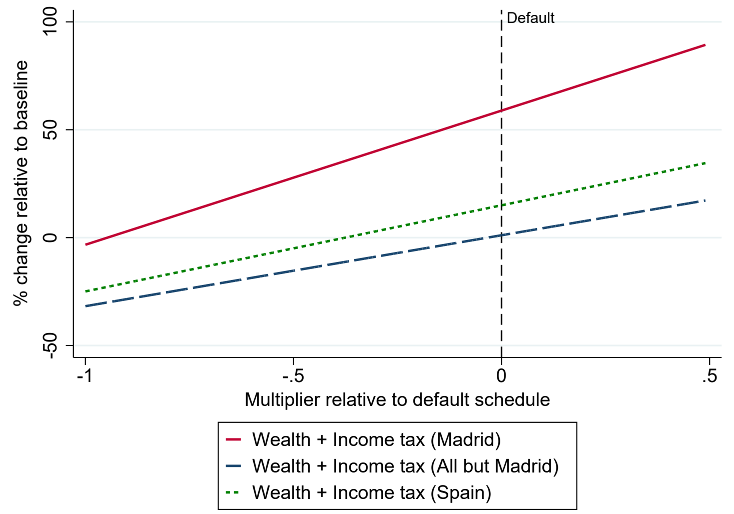


FIGURE 10: Harmonization Simulations, 2011-2016

Notes: This figure depicts the average percent change in both wealth and income tax revenue relative to the baseline at different harmonized schedules over 2011-2016. The results are presented separately for Madrid, the average of all regions (excluding Madrid) and Spain as a whole.

from both high- and low-tax regions. In particular, zero-tax regions may object, as they clearly set tax rates in a way that is likely not revenue-maximizing and thus increasing their revenue may be immaterial. Figure 10 shows that because its wealth tax base is so large, Madrid could indeed achieve higher total income plus wealth tax revenues by agreeing to a positive harmonized tax rate that is sufficiently close to zero (multiplier near -1). Hence, our analysis reveals that Madrid is thus choosing the zero wealth tax and resisting proposals to harmonize for reasons other than maximizing *total* revenues from all fiscal instruments.

When considering the other regions and excluding Madrid, Figure 10 shows that harmonizing at the default schedule (multiplier 0) would generate similar overall revenues to the decentralized baseline, suggesting that regions would be indifferent between harmonization or decentralization. However, if Madrid is also taken into consideration even a much lower harmonized rate than the default is enough to achieve higher total revenues relative to the baseline due to the large amount of wealth in Madrid. This suggests that revenue maximization is not the motive underlying tax coordination policies.

5 Conclusion

This paper exploits unique tax variation resulting from the reintroduction of the Spanish wealth tax to estimate mobility responses and to study the resulting consequences for tax revenues. Under a residence-based tax system, internal low-tax jurisdictions, such as Madrid, allow the wealthy to reduce their tax liabilities and obtain higher after-tax rates of return without having to offshore wealth. We show that the domestic mobility elasticities are comparable to mobility responses for income taxes, thus revealing that the direct wealth tax revenue effects should not be any different to those of income taxes. Nonetheless, our analysis reveals that cross-base fiscal externalities—those coming from income taxes—can be much more important than the direct fiscal externalities from wealth taxation. This illustrates the importance of accounting for those effects; omitting ignores important efficiency concerns.

Our results provide important insights for current debates over decentralized wealth and capital income taxation in federal systems around the world. While we exploit the variation created by the Spanish system, many of the features which might initially appear unique to our setting are common to fiscal federations. First, Spanish regions are economically integrated and an individual's residence for tax purposes can change either because of real migration or a fraudulent declaration of one's primary residence. For instance, such a residency rule is no different to the one in the U.S., where an individual can misreport the number of days spent at a vacation home in a zero-tax state, making it possible to evade taxes on worldwide capital income. Second, wealth taxes are similar to residence-based capital income taxes that are set sub-nationally in many federal systems. Finally, like many other state-level capital taxes, the presence of very low tax jurisdictions—similar to Florida or Texas in the U.S.—is critical for mobility. In particular, taxation of capital income follows the residence principle, so individuals can "move" the location of all assets subject to income taxes to these states by changing the primary state of residence. Thus, our results shed light on how federal interventions could make decentralized capital income taxes more tenable.

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ONLINE APPENDIX

"Wealth Tax Mobility and Tax Coordination"

by David R. Agrawal, Dirk Foremny, and Clara Martínez-Toledano

A Appendix

A.1 A Summary of Taxation in Spain

A.1.1 The Wealth Tax

The Spanish wealth tax was adopted in 1978 (Law 50/1977) aimed at complementing the personal income tax (Law 44/1977), but with an extraordinary character. As it is common for wealth taxes, it has been since then a progressive annual tax on the sum of all individual wealth components net of debts. The wealth tax was centrally administered and all regions were required to implement this tax, excluding Basque Country and Navarre, which have never been part of the Common Fiscal Regime (*Régimen Fiscal Común*) and manage their taxes independently.

With the new 1991 law (still in place at present), the wealth tax ceased to have the initial transitory and extraordinary characteristics, asset valuation rules were improved, filing become strictly individual and many changes were introduced to the former wealth tax system (Law 19/1991). Collectibles and consumer durables (excluding mainly vehicles, boats, planes, jewelry and antiques) started to be exempted, as well as pension and property rights in the individual's ownership. The first important reform after the new 1991 law was the introduction of the exemption on some business assets and company shares (except from shares in property investment companies) in 1993 (Law 22/1993, RD 2481/1994).

Since 1996 the rights to modify the minimum exempted and the tax rates were ceded to the regions under the condition of keeping the same minimum bracket and marginal tax rate as the national one (Law 14/1996). The first important reform of the wealth tax of the 2000s was the introduction of an exemption in primary residence of 25,000,000 pesetas or 150,253.03 Euro in 2000 (Royal Decree Law 3/2000). For a property to be qualified as the primary residence, the wealth taxpayer needs to have lived continuously there (spending at least 183 days a year) over at least three years or in case not, the taxpayer could benefit from the exemption in case of death, marriage, divorce, first job, job transfer or any other analogous circumstance (Law 40/1998, Law 35/2006). Wealth taxpayers are obliged to report their primary residence and any other urban property using the highest of the following three values: the assessed value, the purchasing value or any other administrative value (e.g., value reported in estate taxes). According to the Spanish Tax Agency of Fiscal Administration, most wealth taxpayers report assessed values, as this is the value the Tax Agency also has.

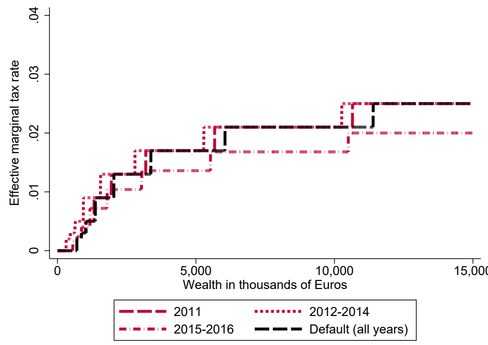
In 2001, the regions were ceded the right to change or include deductions in the wealth tax and the condition of keeping the same minimum bracket and minimum marginal tax rate as the national one was suppressed (Law 21/2001). Nonetheless, all regions kept the national schedule (0.2-2.5%) during the late 1990's and beginning of the 2000's (a few regions changed the minimum exemption and only Cantabria changed the tax schedule in 2006).

In 2008, the wealth tax was suppressed (Law 4/2008) and reintroduced with a temporary character with the aim of reducing the public deficit for years 2011 and 2012 (Royal Decree Law 13/2011). Even though the central government had approved its reintroduction, regional governments had the legislative power to implement it or not and regional differences in the wealth tax schedule became significant. For instance, Madrid decided to keep the suppression of the wealth tax after 2011, contrary to regions such as Catalonia and Extremadura who have raised the top marginal tax rates (up to 2.75% and 3.75%, respectively) above the national tax rate (2.5%).[26] With the reintroduction some of the main features of the wealth tax system were modified. The exemption on primary residence was raised up to 300,000 Euro, all individuals under personal obligation having gross wealth over 2,000,000 Euro were obliged to file and the new minimum exemption was raised up to 700,000 Euro. With Law 16/2012 the wealth tax was extended until 2013 and with Laws 22/2013, 36/2014, 48/2015, 6/2018 and RD-Law 3/2016, the wealth tax was extended for an indefinite number of years, so that it is still currently in place. Note that after reintroduction, the regions of Basque Country and Navarre kept having a wealth tax similar to the default schedule proposed by the central government (Figure A1).

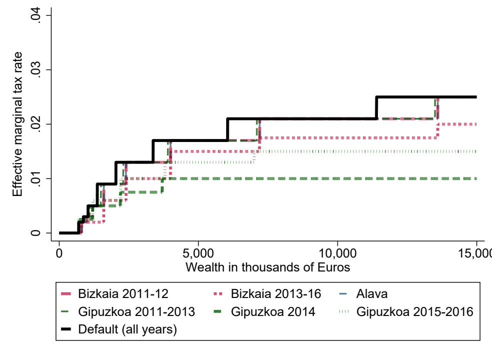
Both, residents (under personal obligation) and non-residents (under real obligation), are required to file if they have a positive net taxable base. The wealth tax is residence-based and non-residents only have to file the assets held in Spanish territory. Individuals are resident in Spain for tax purposes if they spend more than 183 days in Spain during a calendar year or if they have Spain as their main base or centre for activities or economic interests. It is presumed, unless proven otherwise, that a taxpayer's habitual place of residence is Spain when, on the basis of the foregoing criteria, the spouse (not legally separated) and underage dependent children permanently reside in Spain.

Wealth tax filers are required to annually report end-of-year taxable financial assets at market value (e.g. cash, bank deposits, stocks, bonds, financial assets held abroad, etc.), taxable non-financial assets (e.g. real estate, land, consumer durables, non-corporate business

[26] Some regions have also set different minimum exempted thresholds to the default over time. Our wealth tax calculator accounts for these differences. We further verify that our empirical analyses are robust to these differences by re-estimating our baseline regression models excluding one region at a time.



(a) Navarra



(b) Basque Country

FIGURE A1: Marginal Tax Rates in *Foral* Regions

Notes: This figure depicts marginal tax rates and brackets across Navarra and Basque Country, the only two regions which are not part of the common fiscal regime and hence, for which we lack data. The default schedule applied to the rest of regions, as in Figure 1, is shown for reference. If not indicated differently, schedules were valid between 2011-2016. The schedules of the Basque Country vary across provinces as indicated in Panel (b).

assets, non-financial assets held abroad), and taxable debt (e.g. mortgages, inter-personal debts). They are also obliged to report non-taxable business assets and stocks and the full value of their primary residence. Note that both taxable and non-taxable business assets need to be reported at book value. Taxable wealth does not necessarily equal wealth at market value for someone that has a substantial share of housing or land. The reason is that most taxpayers report these assets at cadastral value, which is well below market value.

While income is largely covered by third-party reporting in Spain, there is no third-party reporting of wealth. Hence, enforcement capacity in the case of wealth taxes is still limited. Audits can be made by central or regional tax authorities. The central government may carry wealth tax audits whenever the reported information in the personal income tax form does not match with what is reported in the wealth tax form. The central government also shares information with regional authorities for auditing purposes. However, verifying the primary address comes with substantial difficulty to both tax authorities. They tend to make the audits based on utility bills, bank transaction information and other expenses. The incentives to audit are higher for regional than central authorities as all wealth tax revenue goes to the regional authority. Self-reporting coupled with imperfect enforcement capacity offers scope for tax evasion and avoidance.

Non-compliance, including fraudulent moves and misreporting of wealth can be penalized according to Spanish fiscal legislation *Ley General Tributaria (LGT)*. The penalty is proportional to the amount evaded and the rate varies between 50 and 150% depending on both the amount evaded and if there was hiding. Only if this amount exceeds 120,000 Euros this is considered to be a crime (Article 305 *Código Penal*). In this case, penalties are a larger multiple of the amount evaded, which has to be determined by a judge.

A.1.2 Audit Rates

To better understand enforcement of the wealth tax and monitoring of wealth taxpayers, we digitize tabulations on wealth audit records for each region in Spain from 2006-2016 published by the General Inspection Department of the Spanish Ministry of Finance. An audit can be conducted due to detect the misreporting of fiscal residence or any other misreporting activity. These statistics are thus an upper-bound of the audit rate of the fiscal residence.

Figure A2 shows the average annual audit rates by region before and after the reintroduction of the wealth tax. The audit rate is the number of audited returns divided by the total number of wealth tax returns filed. Prior to reintroduction, despite the regions administering and receiving wealth tax revenue, there was little regional variation in audit rates and they were less than 0.1% for most regions. However, after reintroduction, audit rates slightly increased in most regions but not uniformly, ranging from almost none in Aragon to over 1.5% in Castile-La Mancha. Given these data are for all audits, the audits of fiscal residence are even lower. Taken together, this evidence supports the idea of costly monitoring of wealth taxpayers and weak enforcement of the wealth tax. But, the increase may be consistent with added post-reform suspicions that wealth taxpayers may misreport their residences.

We also show that there is no statistically significant correlation between audit rates and wealth tax rates. Figure A3 shows this for top marginal tax rates and wealth-weighted average tax rates. High-tax regions appear no more likely than low-tax regions to audit.

A.1.3 Other Taxes

The reintroduction of the wealth tax should be considered in the context of fiscal decentralization in Spain. The central government also passed provisions allowing regions to set the tax brackets and tax rates on their half of the personal income tax on *labor*, which created incentives for high (labor) income individuals to move. Spain operates a dual income tax system, under which capital income is taxed at a common schedule. Agrawal and Foremny (2019) show that the incentives to move due to the labor income tax in Spain are negligible for incomes below 90,000 Euro in our period of study. Figure A4 corroborates this statement by showing that the differences in marginal and average personal income tax rates are very small for labor incomes below 90,000 before and after the reintroduction of the wealth tax. Furthermore, Figure A5 also shows that approximately 75% of individuals that would be subject to the wealth tax have labor income below 90,000 Euro. Thus, for high-wealth individuals who obtain a substantial fraction of their income from the return to

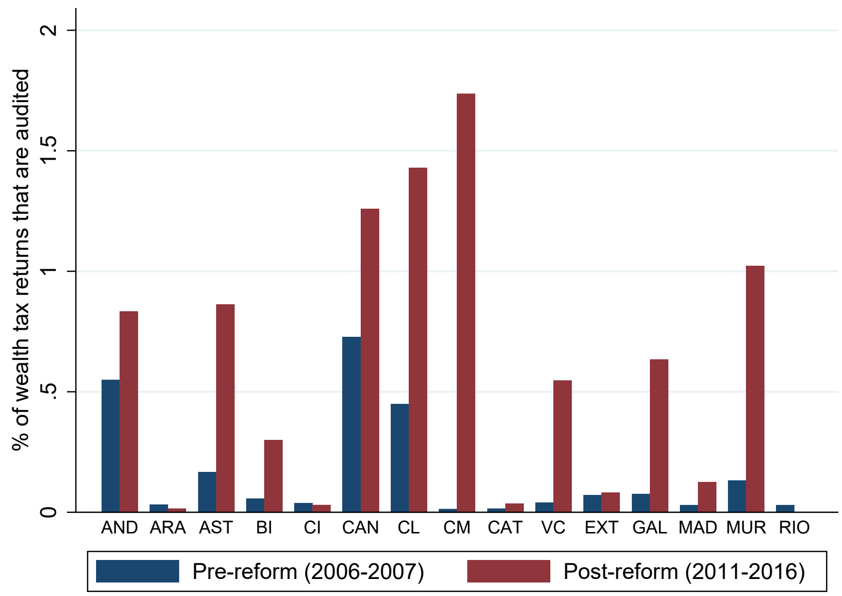
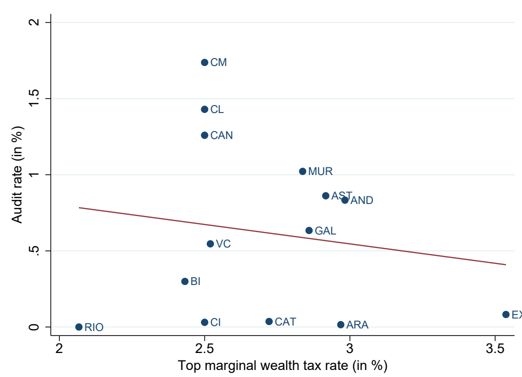
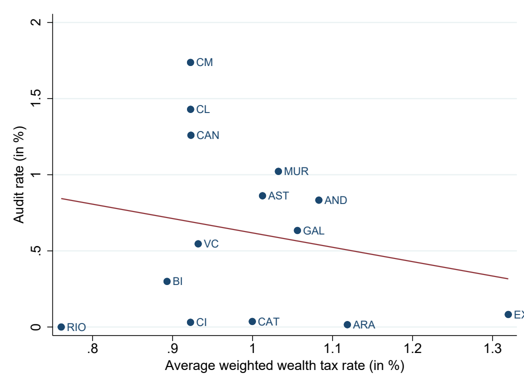


FIGURE A2: Wealth Tax Audit Rates, 2006-2016

Notes: This figure depicts percent of wealth tax returns that are audited before and after the reintroduction of the wealth tax. To calculate audit rates, we have digitized statistics on wealth tax audit records for all regions in Spain over the period 2006-2016 published by the General Inspection Department within the Spanish Ministry of Finance. Madrid does not have a zero audit rate in the post-reform period, because they might be auditing returns prior to reintroduction or auditing wealth tax returns which provide information to auditors about capital income tax revenue (recall that individuals with wealth above 2 million Euro are required to file a wealth tax return in Madrid post-reintroduction, despite having a zero wealth tax liability).



(a) Audit and Top Marginal Wealth Tax Rates



(b) Audit and Average Wealth Tax Rates

FIGURE A3: Audit Rates and Wealth Taxes across Regions, 2011-2016

Notes: These figures depict the relationship between audit rates and wealth tax rates across regions. Panel (a) presents the correlation between region-specific audit rates on the region-specific top marginal wealth tax rates. Panel (b) presents the correlation between region-specific audit rates on the region-specific wealth-weighted average tax rates. Both the dependent and independent variables are based on 2011-2016 averages. The line of best fit uses a regression model that weights by regional population.

capital, decentralized labor income tax provided little additional incentive to move.

Wealth transfer taxes are also decentralized to the regions. Spain operates an inheritance

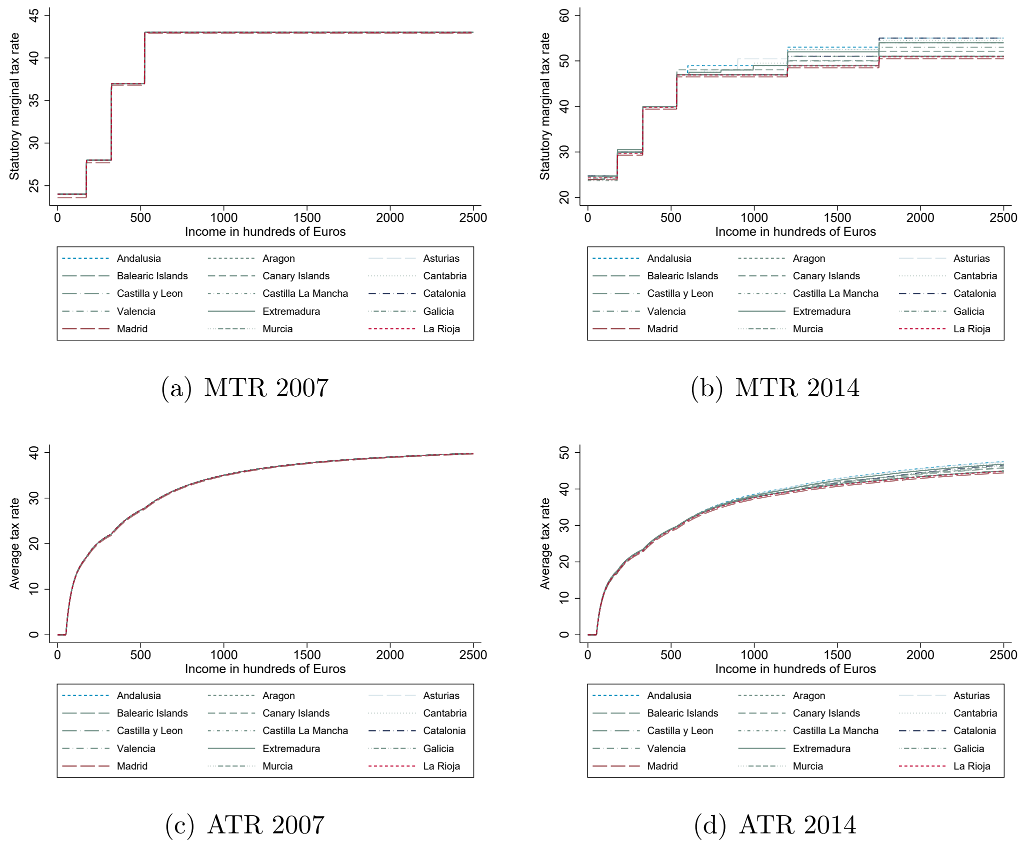


FIGURE A4: Personal Income Tax Rates across Regions

Notes: This figure documents differences in personal income tax rates across the distribution of taxable labor income before and after the reintroduction of the wealth tax (capital income is taxed at uniform rates across all regions). Taxable labor income (x-axis) is shown in units of hundreds of Euros. Similar to Figure 1 for the wealth tax, we depict statutory marginal tax rates for 2007 in panel a) and for 2014 in panel b). Note that the Spanish system operates individual-specific tax credits, such that low incomes remain untaxed. To account for this, panels c) and d) show average tax rates for single households. All four figures depict the tax schedules for all regions under the Common Fiscal Regime (that is, the regions of Basque Country and Navarra are excluded).

tax (not an estate tax). Inheritance taxes have been decentralized to the regions since 1997, but regions did not exercise this right until the mid-2000s. In particular, Madrid operates a tax credit of 99% on close relatives since 2007, so that there is no additional incentive to relocate to Madrid created by this tax starting in 2011 (Micó-Millán, 2023). Moreover, the place of residence for this tax is defined based on the location of the deceased over the last *five* years before death. Given this long duration of proof, and the fact that we focus on five years following reintroduction, we expect little of this new mobility to be a result of these taxes. Spain has no other personal taxes at the regional level.

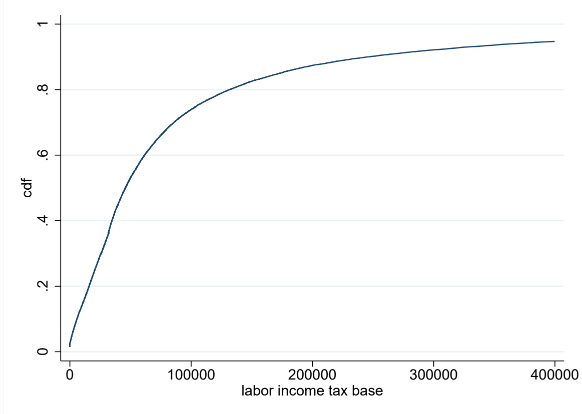


FIGURE A5: Cumulative Distribution of Wealth Tax Filers by Labor Income

Notes: This figure shows the cumulative distribution of taxable labor income for our baseline treatment group (i.e., wealthy individuals with taxable wealth above 700,000 Euro in 2010). This figure is constructed by using the linked personal income and wealth tax data and shows the distribution in 2010. The x-axis depicts the labor income tax base in Euro.

A.1.4 Determinants of Tax Policy

There are several potential reasons why regions may chose high, low, or zero wealth taxes. Among others, the choice might be linked to the region's debt per capita level (i.e., more indebted regions might be more prone to raise additional revenues through wealth taxation); the political affiliation of the party running the region (i.e., left-wing parties tend to be more prone to progressive wealth taxation); the population size in the region (i.e., larger regions tend to have a less elastic tax base and hence might be more prone to higher taxes); the level of wealth inequality in the region (i.e, voters in regions with higher wealth concentration levels might push for lower wealth taxes). To understand the choice of tax rates is related or not to these specific characteristics, we regress top marginal tax rates on these regional characteristics in 2014, one of the years with the largest tax variation across regions. Table A1 shows that none of these characteristics is significant including and excluding Madrid, but the direction of the correlations generally go in line with our intuition. These results suggest that there is no clear force triggering the level of wealth tax chosen by regions. However, this is obviously based on a small number of observations.

A.2 Wealth Extrapolation Method

A.2.1 Methodology

We estimate wealth in the years for which wealth tax records are not available by combining national accounts, wealth and personal income tax returns. Following Martínez-Toledano (2022), we map each personal income category from national accounts to a personal wealth

	(1) all regions	(2) w/o Madrid
Debt p.c.	0.560	-0.286
	(0.949)	(0.292)
Left-wing	0.383	0.036
	(0.614)	(0.358)
GDP p.c.	-0.163	0.138
	(0.337)	(0.093)
Top 1% wealth share	-0.074	-0.029
	(0.058)	(0.035)
Constant	4.710	2.221
	(2.721)	(0.540)
# obs	17	16

Notes: This table shows results of a regression of top marginal tax rates on regional characteristics. Robust standard errors are in parentheses.

TABLE A1: Correlations with top MTR

category in non-financial and financial accounts. For non-financial accounts we rely on the reconstruction done by Artola Blanco et al. (2021) and for financial accounts on the Bank of Spain balance sheets. We can map urban real estate, business assets, life insurance, deposits, debt assets, shares and debts. Then, we compute the annual rate of return for each asset category as the ratio of the flow to the stock. Using these returns, we then extrapolate individual wealth from 2008 onward using reported individual wealth in 2007 as an anchor.

Asset categories for which the aggregate rate of return is not available in national accounts (e.g., jewelry, antiques, rural real estate, industrial and intellectual property rights) are extrapolated forward using the annual growth rate of the average reported values from official aggregate wealth tax records published by the Spanish Tax Agency over the period 2011-2016. For some assets (e.g., taxable business assets, liabilities), we also use this last procedure, as it better matches the evolution of total reported wealth by region. We refine the extrapolation by adjusting reported urban real estate to account for the exemption on main residence, which was raised in 2011.

A.2.2 Robustness Checks

To test for the robustness of our extrapolation method, we first compare extrapolated average regional wealth to the actual reported average wealth published by the Spanish Tax Agency. Figure A6 shows that the extrapolation closely matches regional average wealth in both level and trend. We also compare extrapolated versus actual individual reported wealth levels using Catalonia's administrative wealth tax records after 2011. Figure A7 shows that there exists a strong correlation between our extrapolated and the direct wealth measures in this region around the 700,000 Euro threshold. Overall, this evidence supports the robustness of our wealth extrapolation method to define treatment status in some of our specifications and to carry out the revenue analysis.

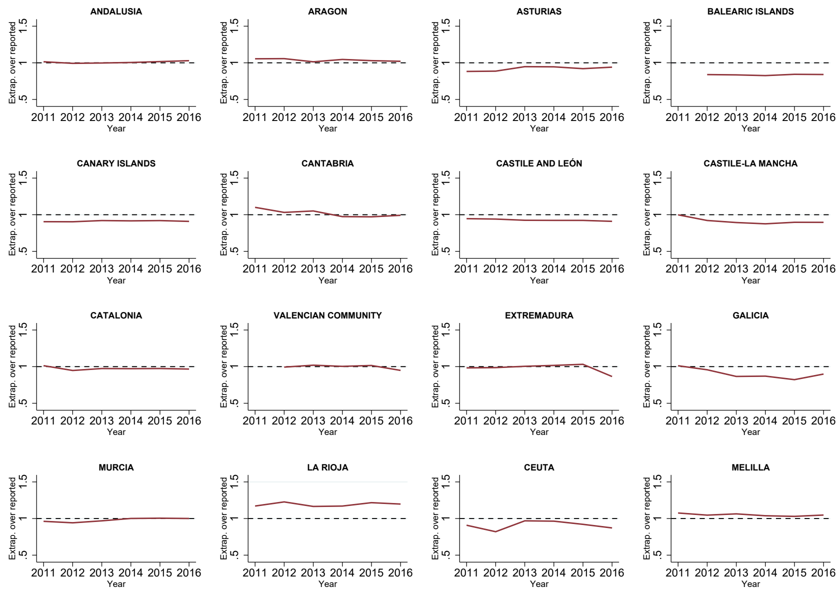


FIGURE A6: Average Taxable Wealth Across Spanish Regions, 2011-2016

Notes: This figure compares extrapolated versus actual reported average wealth across Spanish regions over the period 2011-2016. Reported average wealth figures across regions have been calculated after digitizing the official wealth tax statistics published by the Spanish Tax Agency. Note that the region of Madrid is missing, as it has a 0% wealth tax rate over the whole period 2011-2016.

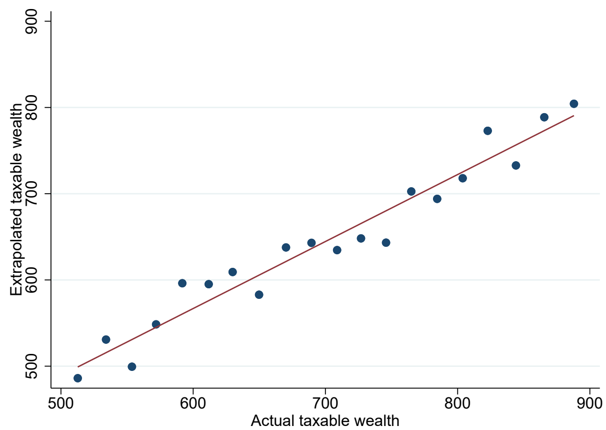


FIGURE A7: Extrapolated vs. Actual Taxable Wealth, 2011-2016 (Using Catalan Wealth Tax Records)

Notes: This figure compares extrapolated versus actual individual reported wealth levels around the 700,000 Euro threshold for Catalonia's wealth taxpayers pooling years 2011-2016. The Catalan wealth tax records have been kindly shared by the Catalan Tax Agency. The comparison is made for the subsample of Catalan wealth taxpayers we are able to match across the two data sources (approximately 40% of our sample).

A.3 Wealth Tax Calculator

We build a wealth tax calculator to compute marginal and average tax rates for all individuals in the seventeen Spanish regions from 2005-2007 and 2011-2016, as the wealth tax was suppressed between 2008 and 2010. The tax calculator takes into account regional variation in marginal tax rates, tax bracket thresholds and the basic deductions included in the input data table. Information about marginal tax rates, deductions and tax brackets are taken from the annual *Manual Práctico de Renta y Patrimonio* published by the Spanish Ministry of Finance. We use the tax calculator to simulate for each individual the average tax rate in her region of residence and hypothetical tax rates if she lived in any other region. The tax simulator thus provides all counterfactual levels of the wealth tax burden across regions of Spain under both a decentralized and centralized wealth tax system.

A.3.1 Structure of Input Data

The tax calculator consists of a STATA program file (spatax.ado) which runs over a data-set which contains the input variables needed. The command is

```
spatax taxbase, y() pers_handicap() tb_general() tb_capital() tb_cgains()
   tl_cg() tl_rg() div_nont() sample_type() taxl_wt_lim() taxl_wt()
   tl_saving() id_houshold() out(),
```

where the variables are defined as in Table A2. These input variables allow us to construct an average and marginal tax rate for each person for all years and regions in the data set. The option `out` specifies the prefix which will be added to each variable (see output data). Tax rates and bracket thresholds are not inputs in the data set because they are coded directly into the program which feeds in wealth, income and characteristics for each individual.

Variable	Definition
y	Year identifier (2005-2007, 2011-2016)
pers_handicap	Handicap status: 0 - not handicapped, 1 - handicapped up to 33%, 2 - between 33%-66%, 3 - above 66%
tb_general	PIT labor income tax base
tb_capital	PIT capital income tax base
tb_cgains	Positive capital gains from the selling of assets purchased more than one year in advance (part of the capital income tax base)
tl_cg()	PIT liabilities to central government
tl_rg()	PIT liabilities to regional government
div_nont()	non-taxable dividends in the personal income tax
sample_type()	Type of personal income tax filing: 1 - individual 2 - joint
taxl_wt_lim()	Wealth tax liability cap (60% of the personal income tax base + div_nont + tb_cgains)
taxl_wt()	Wealth tax liability before applying the wealth-income tax liability cap
tl_saving()	Capital income tax liability
id_houshold()	Household identifier

TABLE A2: Input Variables Tax Calculator

A.3.2 Output Data

The output variables are given by a set of marginal and average tax rates. These variables are labeled *mtr_ out-prefix_ region* & *atr_ out-prefix_ region* where region is the official region identifier according to the National Institute of Statistics and the prefix is added as specified by the out() option.

A.3.3 Robustness Checks

To test the robustness of our simulator, we compare the simulated and direct wealth tax liabilities for the years in which direct individual wealth information is available. Figure A8 shows that in 2007, the last year for which direct wealth tax information is available, the simulated wealth tax liabilities consistently match the direct wealth tax liabilities available in the administrative tax return data. We also use the Catalan wealth tax micro files and compare the direct Catalan wealth tax liabilities with the simulated wealth tax liabilities over the 2011-2016 period. We regress the simulated wealth tax liabilities on the direct wealth tax liabilities pooling all years 2011-2016 and find a ver strong correlation between the two. Overall, this evidence supports not only the robustness of the tax simulator, but also that of the extrapolation method.

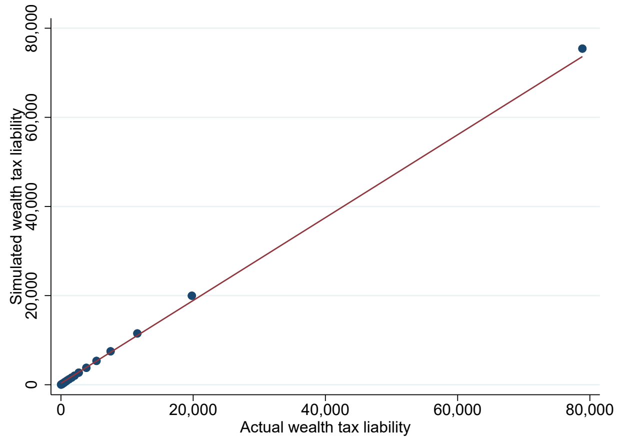


FIGURE A8: Simulated vs. Direct wealth tax liabilities, 2007

Notes: This figure compares simulated versus actual wealth tax liabilities for all wealth taxpayers in 2007, the last year for which we have direct information on wealth. Results are presented in Euro.

A.4 Descriptive Evidence

The key result of our paper can be seen in the raw tabulations (Figure A9). We separately plot the change in the share of our treatment group—taxable wealth greater than 700,000 Euro—who reside in Madrid (red diamonds) and the analogous series for our comparison group, that is, those individuals whose taxable wealth in 2010 lies between 600,000 and 700,000 Euro (blue circles). Initially, approximately 22% of wealth tax filers reside in Madrid. Following reintroduction, the share of wealth tax filers reporting Madrid as their fiscal residence increases by about 1.5 percentage points more than the comparison group. Relative to the event studies in the text, this figure is made without using any regression analysis. To construct it, we simply calculate the share of individuals within each group that declare Madrid as their residence in each year, normalizing this share to zero in the year before the reform for both series.

Figure A10 makes an analogous graph for the share of Spain's population in the treatment or comparison group of each other region. As can be seen, some regions see an outflight of residents that is larger than other regions.

Table A3 shows the summary statistics in 2010 for the baseline treatment group (individuals with taxable wealth greater than 700,000 Euro in 2010) and for the baseline comparison group (individuals with taxable wealth just below the threshold in 2010). Individuals above the threshold, obviously have higher wealth and capital income than the comparison group. They also have slightly higher labor income and are slightly older, but do not differ by gender, secondary residences, or self-employment status. Of course, our empirical design does not require the level of wealth to be similar in both groups or in all regions, but rather that

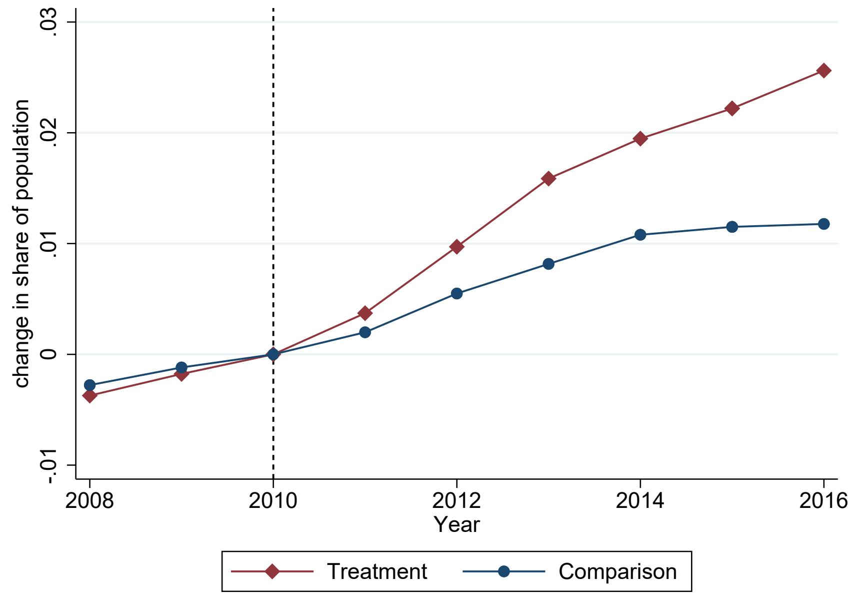


FIGURE A9: Madrid's Zero Tax Rate Facilitates Tax-induced Mobility

Notes: This figure shows the share of wealth tax filers (red diamonds) and individuals below the filing threshold (blue circles) who reside in Madrid. Wealth tax filers are defined as individuals with taxable wealth greater than 700,000 Euro in 2010, while the comparison group are individuals with taxable wealth between 600,000 and 700,000 Euro. We follow a re-weighted balanced sample of filers and non-filers over time, normalizing each series to zero in 2010.

the treatment and comparison group trend similarly. Obviously the comparison group we have selected is most similar along the income and wealth dimensions, as moving further down the wealth distribution makes the treatment and comparison group even less similar in their levels. Selecting individuals just below the threshold follows Kleven et al., 2014.

A.5 Empirical Analysis: Robustness Checks

A.5.1 Aggregate Analysis

This section presents additional results and robustness checks for the aggregate analysis. First, Table A4 presents the point estimates that correspond to the results present in Figure 4. In Panel I, we present a simple design that uses $D_i \times M_r \times Post$ rather than the dynamic design in the main text. Thus, these coefficients represent the average effect in the post-reform period. As migration is a flow and is expected to increase the stock over time, Panel II presents the cumulative six year effect (the coefficient on the appropriate event indicator for 2016). Consistent with the figure in the main text, Madrid's relative population of wealthy individuals increased by 7.5% by six years after the reform.

Next, we show the robustness of our results to various treatment/comparison definitions and model specifications. We present the event studies for a selection of robustness checks;

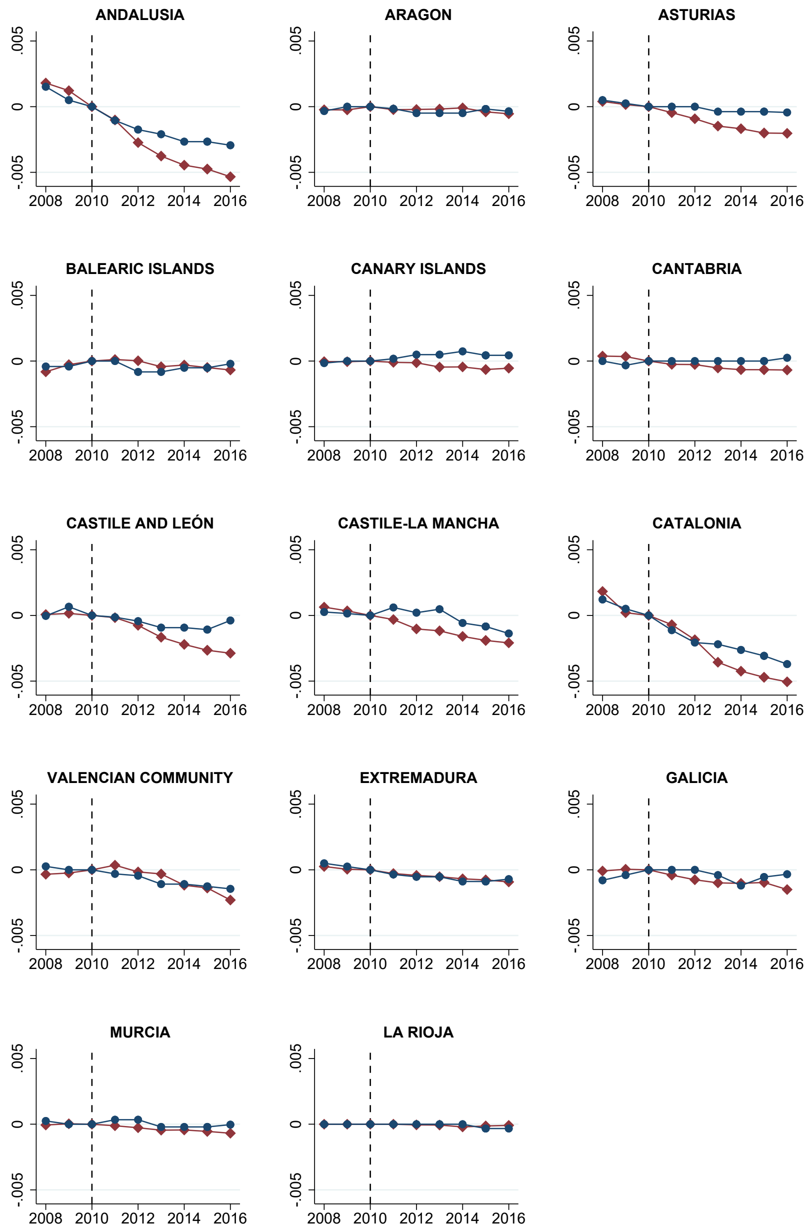


FIGURE A10: Tax-Induced Mobility from each Region

This figure shows the share of wealth tax filers (red diamonds) and individuals below the filing threshold (blue circles) who reside in each given region. Wealth tax filers are defined as individuals with taxable wealth greater than 700,000 Euro in 2010, while the comparison group are individuals with taxable wealth between 600,000 and 700,000 Euro. We follow a re-weighted balanced sample of filers and non-filers over time, normalizing each series to zero in 2010.

due to space constraints additional robustness checks are summarized numerically rather than presenting the event studies graphs. In Panel (a) of Figure A11, we rely on the 2007 taxable wealth records, i.e. these estimates do not rely on extrapolated data to define the treatment and comparison groups. We classify an individual as treated by the reintroduction

Variables	Mean	sd	Min	Max
Panel A: Treated filers in 2010				
Taxable wealth	2,355.06	5,971.67	700.01	313,633.81
Labor income	62.24	270.50	0.00	14,006.16
Capital income	72.49	245.11	-3,193.13	22,162.30
Business income	30.72	190.55	-1,125.26	21,560.03
Debt	179.51	1,364.70	0.00	203,162.04
Age	64.78	12.05	11.00	106.00
Female	0.44	0.50	0.00	1.00
Self-employed	0.30	0.46	0.00	1.00
2nd property	0.91	0.29	0.00	1.00
Panel B: Comparison Group				
Taxable wealth	648.75	28.92	600.00	699.99
Labor income	44.09	135.55	0.00	4,152.69
Capital income	28.13	73.43	-132.13	3,504.88
Business income	24.25	113.88	-165.92	2,838.78
Debt	76.65	222.22	0.00	4,453.49
Age	62.82	11.75	8.00	102.00
Female	0.45	0.50	0.00	1.00
Self-employed	0.31	0.46	0.00	1.00
2nd property	0.90	0.30	0.00	1.00

TABLE A3: Summary Statistics, 2010

Notes: This table presents summary statistics of the 2010 characteristics for our preferred treatment group (i.e., individuals with taxable wealth above 700,000 Euro in 2010) and comparison sample (i.e., individuals with 600,000-700,000 Euro of taxable wealth in 2010). Note that all figures are calculated using weights to match the total number of wealth tax filers in every region in 2010. All monetary values are in thousands of Euro.

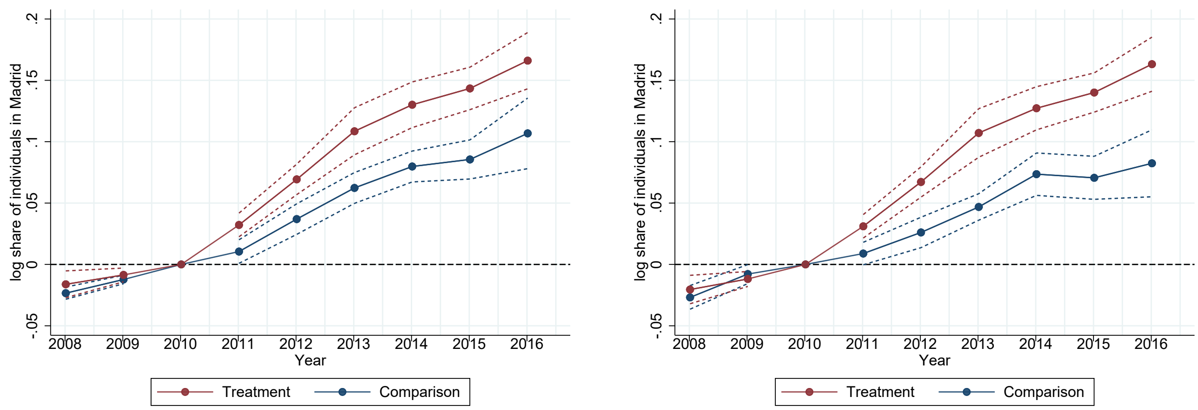
of the wealth tax if they filed wealth taxes under the centralized regime in 2007 and had taxable wealth of more than 700,000 Euro already in 2007. The comparison group is then the individuals just below this threshold when relying on 2007 taxable wealth data. Note that differences to our baseline setting a minor, as using the administrative wealth tax data to determine who has more than 700,000 Euros in 2007 only classifies 2.1% of individuals differently than using extrapolated 2010 wealth. Second, a concern with our design is that some individuals in our comparison group may cross the filing threshold over time, thus being partially treated. In general, we believe this is not a concern as wealth in the lower brackets generates little tax liabilities. Individuals in the lowest wealth tax bracket pay at most 334 Euro in taxes per year, making the incentives to move negligible. However, Panel (b) of Figure A11 shows the results when dropping any individuals in the comparison group whose extrapolated wealth grows above the 700,000 filing threshold throughout our sample.

Figure A12 shows the results are robust to not reweighting (Panel a) to not balancing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel I: Average Post-Reform Effect						
$M_r \times D_i \times Post_t$	0.051	0.042	0.051	0.051	0.051	0.051	0.050
	(0.011)	(0.009)	(0.011)	(0.010)	(0.010)	(0.010)	(0.009)
	Panel II: Cumulative Effect						
$M_r \times D_i \times Year_{2016}$	0.078	0.070	0.075	0.074	0.074	0.075	0.075
	(0.014)	(0.009)	(0.015)	(0.012)	(0.011)	(0.011)	(0.011)
OLS or WLS	OLS	WLS	OLS	OLS	OLS	OLS	OLS

TABLE A4: The Average and Cumulative Effect on Madrid

Notes: This table shows the estimates of a variant of (1). In Panel I, the event indicators are replaced by a simple post dummy, which is interacted with a treatment group indicator. In panel II, we use the full set event dummies interacted with an indicator for the treatment group. Panel I thus presents the average post-reform effect while in Panel II presents the cumulative effect six years after the reform by reporting the final event study coefficient. All columns except for column (2) use OLS while column (2) weights the regression by region population. Columns (1) and (2) do not include covariates. Each column then successively adds controls: (3) net-of-tax rate on personal income, (4) aggregate expenditures, (5) amenities, (6) economic controls, and (7) demographics. Standard errors are clustered at the region by treatment group level.



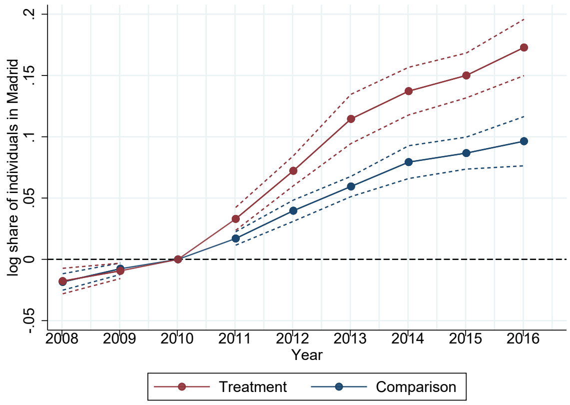
(a) Groups based on 2007 wealth

(b) Exclude individuals growing into treatment

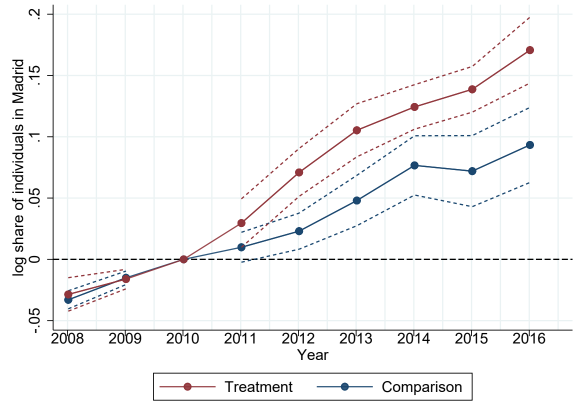
FIGURE A11: Robustness: Treatment/Comparison Definition

Notes: This figure replicates the baseline analysis using two alternative definitions of the treatment an comparison group. Panel (a) defines treatment and comparison status based on 2007 wealth (as opposed to 2010 wealth in the main text). Panel (b) uses the baseline treatment/comparison group defined using 2010 wealth, but drops all individuals if their extrapolated taxable wealth is ever above 700,000 Euro in the post reform period. The series in red shows results when n_{rit} is the regional share of the treatment group while the series in blue shows the results when n_{rit} is the regional share of the comparison group. The figure shows specifications that do not include any covariates. Standard errors are clustered at the region-group level and 95% confidence intervals are plotted.

(Panel b) the sample. As discussed in the text, the personal income tax dataset is not representative of wealth tax filers at the region level. Thus, we reweighted the data to match regional statistics. The first panel shows that the results are robust to not using this reweighting approach. Second, in our main specification, we balance the sample over the period of study. This is necessary because individuals are not added to the panel randomly. However, balancing the sample comes at a cost of making the sample older. Again, the results are robust to this exercise.



(a) Unweighted sample



(b) Unbalanced sample

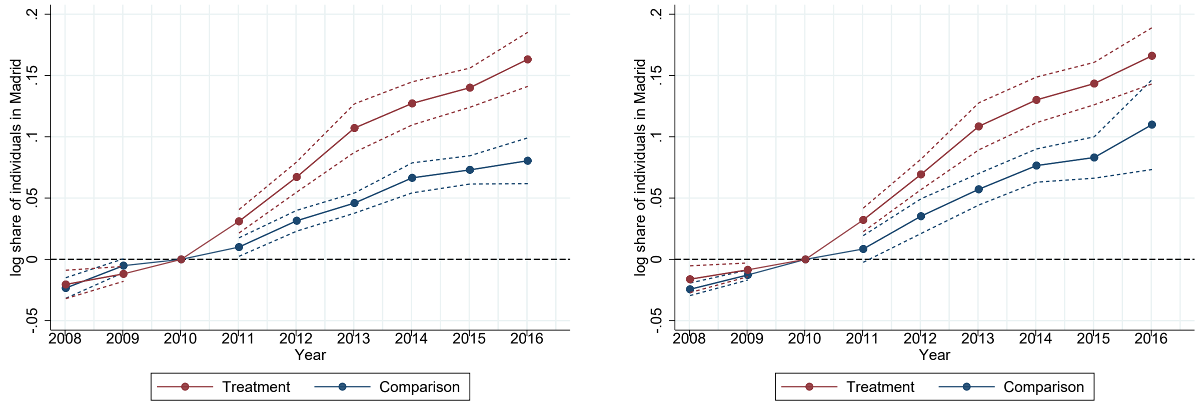
FIGURE A12: Robustness: Sample Construction

Notes: This figure replicates the baseline analysis using two alternative approaches to aggregating the data. Panel (a) uses the balanced sample, but does not apply our weights to aggregate. Panel (b) uses weights but does not require the individual to be in the panel for the entire time period of analysis. The series in red shows results when n_{rit} is the regional share of the treatment group while the series in blue shows the results when n_{rit} is the regional share of the comparison group. The figure shows specifications that do not include any covariates. Standard errors are clustered at the region-group level and 95% confidence intervals are plotted.

In Figure A13 we show the results are robust to defining the comparison group using total wealth (instead of taxable wealth). In other words, when defining the comparison group, we include tax exempt assets to define the amount of wealth. This exercise is useful because it allows us to compare high taxable wealth individuals with similarly high wealth individuals that do not file the wealth tax because their wealth portfolio is tilted toward tax-exempt assets.

Finally, Figure A14 shows the event studies for various subsamples over which we conduct a heterogeneity analysis. In this figure, we show the results for individuals that have a low amount of labor income. Panel (a) and (b) differ as they split the sample by age. When conducting this analysis the restrictions applied to the treatment group also apply to the comparison group. The results indicate that our results are not driven by individuals that have a high amount of labor income (and thus regional taxes on labor income are not confounding our estimates). Additionally, age is not critical, suggesting that any differences in inheritance taxation across regions are negligible.

Figure A15 (Panel b) summarizes the results of the prior robustness checks by presenting the cumulative effect of the reintroduction of the wealth tax on mobility by plotting the 2016 coefficient from the triple difference event study. In addition, Panel (a) presents additional robustness checks by documenting the sensitivity of the results to the range of taxable wealth used to construct the comparison group. There is no significant statistical difference between those effects and the baseline.

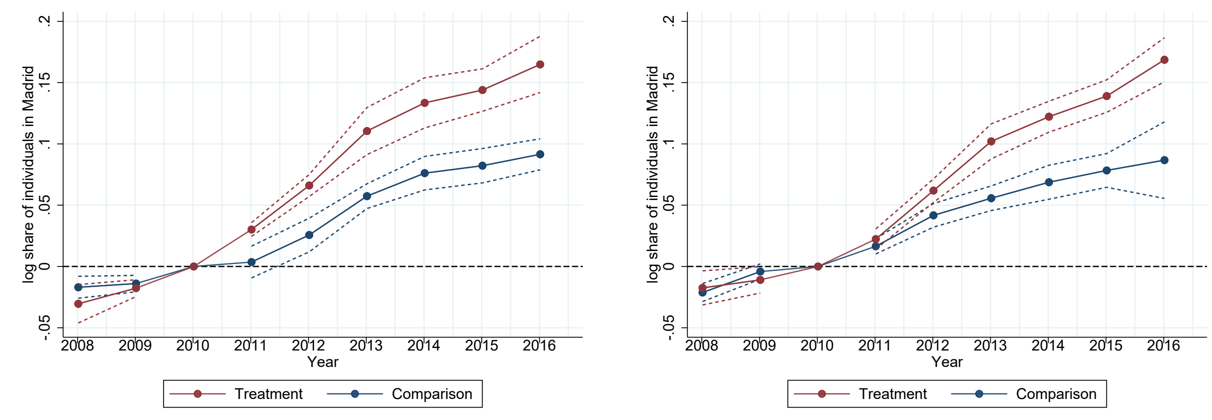


(a) Groups based on 2010 wealth (non-taxable)

(b) Groups based on 2007 wealth (non-taxable)

FIGURE A13: Robustness: Alternative Comparison Group Including Non-taxable Wealth

Notes: This figure replicates the baseline analysis using two alternative comparison groups. In particular, the comparison group based on non-filers that would be subject to the wealth tax if all assets (including ones exempt from taxation) were to be taken into account when calculating taxable wealth. Panel (a) uses 2010 wealth, while panel (b) uses 2007 wealth. The series in red shows results when n_{rit} is the regional share of the treatment group while the series in blue shows the results when n_{rit} is the regional share of the comparison group. The figure shows specifications that do not include any covariates. Standard errors are clustered at the region-group level and 95% confidence intervals are plotted.



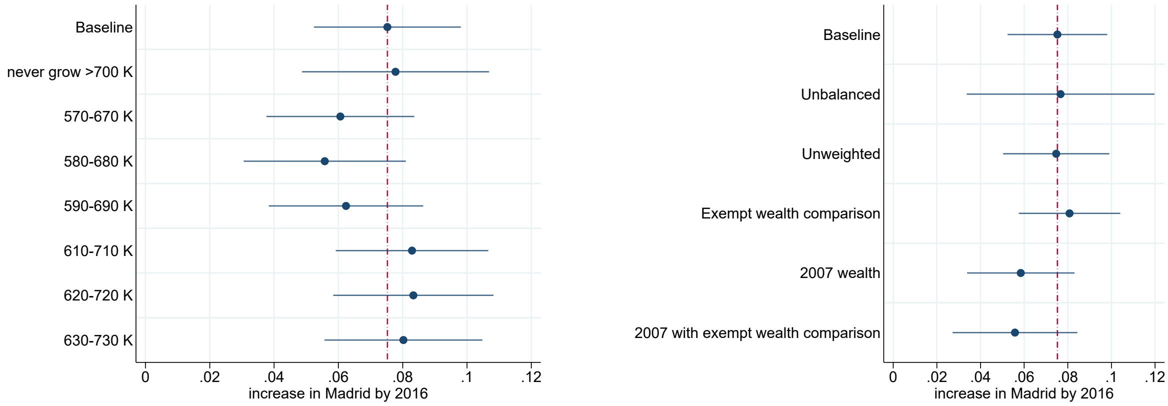
(a) 65 and older, low labor income

(b) 64 and younger, low labor income

FIGURE A14: Robustness: Age and Labor Income

Notes: This figure shows the event study for some sub-groups studied in our baseline heterogeneity analysis. When defining both the treatment and comparison group, we only include individuals that have low labor income (below 90,000 Euro). Panel (a) focus on individuals who are 65 or older while (b) focuses on individuals younger than 65. The series in red shows results when n_{rit} is the regional share of the treatment group while the series in blue (circles) shows the results when n_{rit} is the regional share of the comparison group. The figure shows specifications that do not include any covariates. Standard errors are clustered at the region-group level and 95% confidence intervals are plotted.

When aggregating taxes to the region-year level, researchers must make assumptions on which average tax rate to use. Some studies use the top marginal tax rate as a proxy for the average tax rate or use the average tax rate at a given percentile of the income/wealth distribution to simulate the tax rate. Given we identify larger effects for higher wealth



(a) Thresholds Used to Construct Comparison

(b) Model Assumptions

FIGURE A15: Summary of Robustness Checks

Notes: This figures shows the robustness of the cumulative percent change estimated in Figure 4. Panel (a) shows the robustness to shifting the comparison group thresholds up or down the taxable wealth distribution. Panel (b) shows the robustness to using an unbalanced sample, not weighting the number of filers, using wealth inclusive of exempt wealth to construct the comparison group, using 2007 wealth to construct the treatment/comparison group, and using 2007 wealth to construct the comparison group based on wealth inclusive of exempt wealth.

households, we use a wealth weighted average tax rate. In Table A5 we show the results are robust to using a raw average across all taxpayers. As expected, given the percent change in the stock of taxpayers is the same, using a raw mean lowers the average tax rate and thus raises the elasticity. This is consistent with Moretti and Wilson (2017), where using an ATR at the 95th percentile of income versus the 99.9th percentile results in an elasticity that is almost twice as large in some specifications.

	Panel I: Instrument with Madrid by Treatment by Post						
$\ln(1-\tau_{itj})$	13.720	29.482	28.572	25.093	24.730	21.088	21.610
	(7.649)	(1.588)	(2.633)	(2.872)	(2.864)	(2.986)	(3.287)
F-Stat		2014.2	1296.2	1114.6	1191.3	803.3	620.2
	Panel II: Instrument with Region by Treatment by Post						
$\ln(1-\tau_{itj})$	13.720	23.335	21.498	19.925	19.809	16.337	16.849
	(7.649)	(5.564)	(4.960)	(4.033)	(3.880)	(3.343)	(3.345)
F-Stat		63.8	195.7	102.6	520.0	1025.2	26250.2
J Statistic		0.496	0.614	0.688	0.676	0.676	0.507
OLS/IV	OLS	IV	IV	IV	IV	IV	IV

TABLE A5: Elasticity with Respect to the Raw Mean of the Net-of-tax Rate

Notes: This table estimates (2) using Andalusia as the region of normalization. The only difference relative to Table 1 in the main text, is that these models do not weight by wealth when constructing the average tax rate. As a result, the (log) net-of-tax rate is the rate net of the raw mean of average tax rates across individuals. Columns (1) and (2) do not include covariates. Each column then successively adds controls: (3) net-of-tax rate on personal income, (4) aggregate expenditures, (5) amenities, (6) economic controls, and (7) demographics. Standard errors are clustered at the region by treatment group level. Panel I includes only a single instrument, so we present only the F-statistic. In panel II, because we have an instrument for each region, we also present the p-value from the Hansen-J Statistic. All other Table notes from Table 1 apply.

As noted in the main text, when estimating the elasticity of the stock of individuals, we normalize relative to the region of Andalusia. The estimates may be slightly sensitive to choice of the region to which we normalize. As a result, we conduct an alternative specification where we normalize relative to each region in the dataset. We then stack each of these normalized datasets over each other and add dyad by treatment fixed effects to the estimating equation. We then estimate the model using all dyad pair combinations and instrument using Madrid by treatment by post fixed effects (Panel I) and dyad by treatment by post fixed effects (Panel II). Table A6 shows the results. While this design averages over all of the stacked datasets, calculating appropriate standard errors is challenging. For this reason, we believe the point estimates of this design are more important than the significance.

	Panel I: Instrument with Madrid by Treatment by Post						
$\ln(1-\tau_{itj})$	6.800	12.058	11.161	9.974	9.843	8.548	8.762
	(0.616)	(0.856)	(0.871)	(0.740)	(0.707)	(0.665)	(0.640)
F-Stat		835.9	914.7	959.8	967.5	945.4	900.2
	Panel II: Instrument by Region Dyad by Treatment by Post						
$\ln(1-\tau_{itj})$	6.800	11.907	10.773	10.046	9.900	8.271	8.535
	(0.616)	(0.541)	(0.521)	(0.458)	(0.441)	(0.416)	(0.407)
F-Stat		18.7	51.0	56.1	200.2	429.0	805.9
J Statistic		0.518	0.640	0.283	0.228	0.228	0.022
OLS/IV	OLS	IV	IV	IV	IV	IV	IV

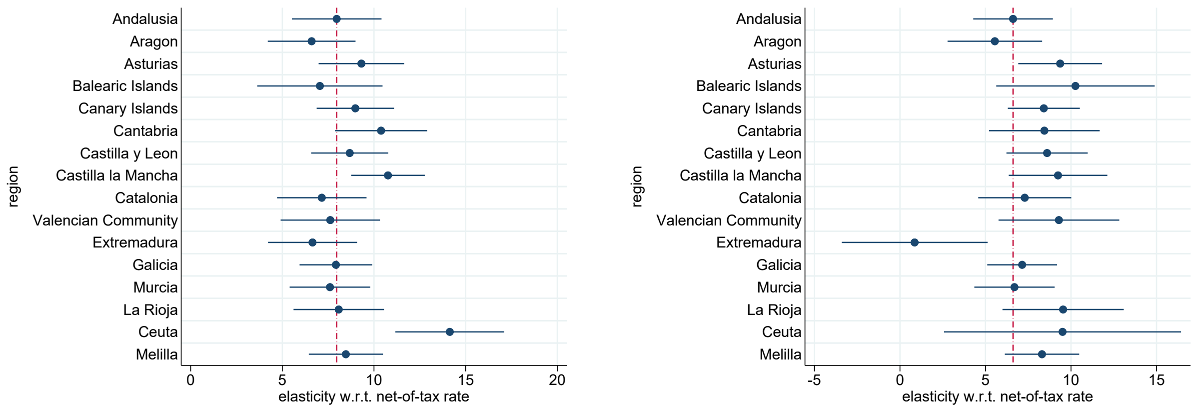
TABLE A6: Stacked Research Design with All Dyad Pairs

Notes: This table estimates a stacked variant of (2) where we normalizing relative to each possible region r and then stack each of these sets over each other. In other words, we construct all possible region pairs (dyads) and and pool them in a single regression. Region by treatment group fixed effects are replaced by dyad by treatment group fixed effects. Columns (1) and (2) do not include covariates. Each column then successively adds controls: (3) net-of-tax rate on personal income, (4) aggregate expenditures, (5) amenities, (6) economic controls, and (7) demographics. Standard errors are clustered at the dyad by treatment group level. Panel I includes only a single instrument, so we present only the F-statistic. In panel II, because we have an instrument for each dyad, we also present the p-value from the Hansen-J Statistic. All other Table notes from Table 1 apply.

We further address the sensitivity to the region of normalization (the pivot region) by altering the region of normalization and reestimating (2) separately for each different normalization. In our baseline specifications, we choose the largest region (Andalusia) as the region of normalization. Figure A16 shows that this choice is innocuous. Only in a couple of cases (generally when the baseline region is relatively small) estimates differ slightly in magnitude. This provides evidence supporting the assumption that removing one region does not alter the probabilities of choosing other regions.

Finally, figure A17 shows the heterogeneous effects analogous to those presented in the main text of the paper. In the main text, we reported the percent change in the regional populations. In this figure, we report the elasticity by each group.[27]

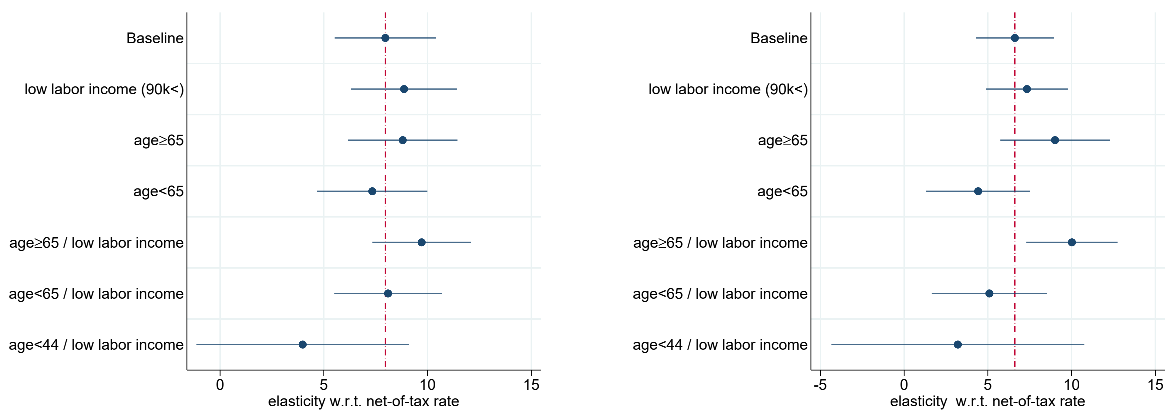
[27] We omit a figure for the results by wealth because tax differentials change over the wealth distribution,



(a) Madrid by Treatment by Post Instrument (b) Region by Treatment by Post Instrument

FIGURE A16: Robustness to Region of Normalization

Notes: This figures shows robustness of the elasticity estimates in Table 1 Column (7) to the choice of the pivot region (the region of normalization R). The baseline table normalizes relative to the region of Andalusia. Panel (a) are the estimates corresponding to Panel I in the table, while Panel (b) are the estimates corresponding to Pane II of the table. Standard errors are clustered at the region by treatment group level.



(a) Madrid by Treatment by Post Instrument (b) Region by Treatment by Post Instrument

FIGURE A17: Heterogeneous Effects

Notes: Analogous to Figure 6, this figure shows heterogeneous effects. The only difference is that this figure presents the heterogeneity in the elasticity estimated from (2) rather than the percent changes in the stock. In panel (a), we instrument using Madrid by treatment by post. In panel (b), we instrument with region by treatment by post. The baseline estimates for the full population are given by the red vertical lines. We cluster standard errors at the region by group level.

A.5.2 Individual Choice Model

The individual choice model is presented in (5) in the main text. In this appendix, we first include additional details outlining our methodological choices and then present additional results.

making it difficult to interpret changes in the elasticity.

In order to make the individual choice model comparable to the aggregate analysis, we balance our data over the same time period (2008-2016) as in the aggregate analysis. Again, we show that results are robust to an unbalanced sample. Further, we follow the same definition of the treatment and comparison group in the aggregate analysis and include individuals with taxable wealth larger than 700,000 Euro in 2010 as treated, and those below that threshold but above 600,000 Euro as comparison units. Our ability to include a comparison group in the multinomial choice framework allows us to compare the change in the probability of moving to Madrid for wealth tax filers relative to similar untreated units, adding a flavor of a difference-in-differences design to the analysis.

In some specifications, we replace the $Post_t$ indicator in (5) with year dummies, which yields event-study estimates and makes it possible to analyze the cumulative effect at the end of our period, as in the aggregate model.

We use a linear probability model.[28] This is based on our desire to include many binary covariates for which logit models are ill-suited. Although the predicted probability of any one region is not bounded, the case fixed effects included in (5) force the probabilities over all regions to sum up to one for each individual in a given year. Thus, an increase in the probability of one region must decrease the probability of choosing other regions.[29] We cluster standard errors at the origin-bracket, alternative-bracket and individual level following Akcigit et al. (2016) and Moretti and Wilson (2017), who cluster at the origin/destination-ability level. In our setting, tax brackets form analogous partitions to ability.

Next, we document additional results from the individual choice model that are not presented in the main text. Table A7 documents the baseline results from equation (5). Panel I shows the average effect, and panel II the cumulative effect obtained from an event study approach. Columns (a-e) show the results using various fixed effects and controls, including individual-specific factors that are interacted by alternative region indicators and simulated income tax controls. The inclusion of controls does not have a substantial impact. Replacing the region level controls with alternative region-by-year fixed effects in column (e) leaves results unchanged. Columns (f-h) demonstrate the robustness of our estimates. First, column (f) shows that dropping high income taxpayers with labor income above 90,000 Euro facing potentially significant income tax differentials does not matter, thus providing

[28] The specification of (5) is the linear equivalent to an alternative-specific conditional logit.

[29] The fact that the linear probability is not bounded between 0 and 1 is not a problem given we care about the partial effect of taxes on the dependent variable, and not the fitted probability per se. The advantage of a nonlinear framework is the ability to relax the independence of irrelevant alternative (IIA) assumption, i.e., the relative probability of an individual choosing between two options is independent of any additional alternatives in the choice set. Given most mobility is driven by Madrid, the odds of choosing Madrid over Catalonia, for example, are unlikely to differ when the alternatives include or exclude different regions. The aggregate analysis presented some evidence in favor of this.

	Baseline					Labor<90 K	Comp. < 700k	Unbalanced
	Panel I: Average Effect							
	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)	(1g)	(1h)
$M_r \times D_i \times Post_t$	0.009	0.008	0.008	0.008	0.008	0.009	0.010	0.009
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)
	Panel II: Cumulative Effect (2016)							
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)	(2g)	
$M_r \times D_i \times Year_{2016}$	0.015	0.014	0.014	0.013	0.015	0.013	0.017	0.012
	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)	(0.007)
# obs	4608819	4608819	4608819	4608819	4608819	3239469	4381461	6429332
balanced sample	yes	yes	yes	yes	yes	yes	yes	no
comparison group	yes	yes	yes	yes	yes	yes	yes, restricted	yes
PIT differential (ATR)	no	yes	yes	yes	yes	yes	yes	yes
regional controls	no	no	yes	yes	no	yes	yes	yes
individual controls	no	no	no	yes	yes	yes	yes	yes
fixed effects	$\omega_{it}, \iota_r, year$	$\omega_{it}, \iota_r, year$	$\omega_{it}, \iota_r, year$	$\omega_{it}, \iota_r, year$	$\omega_{it}, \iota_r \times year$	$\omega_{it}, \iota_r, year$	$\omega_{it}, \iota_r, year$	$\omega_{it}, \iota_r, year$

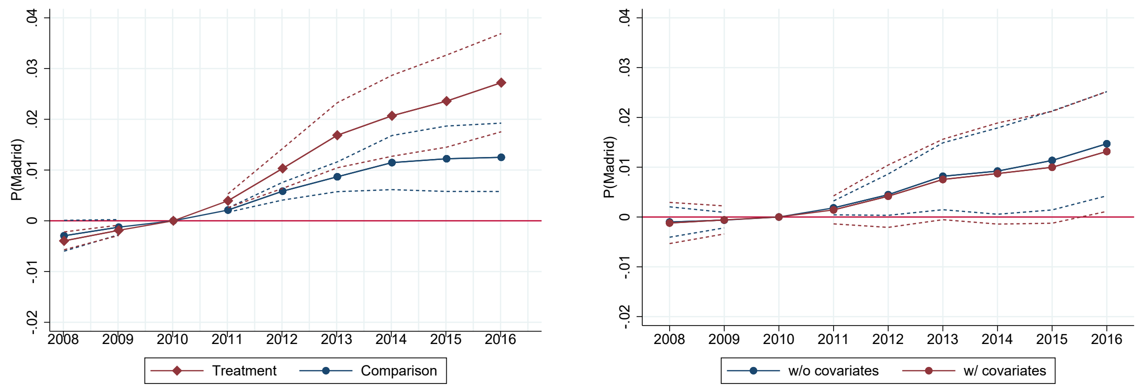
TABLE A7: Individual Choice Model

Notes: This table presents the results from the individual choice model given by (5) for the our baseline treatment group relative to the comparison group. Panel I represents the results from the model presented in the text, while Panel II replaces the *Post* indicator with event dummies and reports the coefficient on the interaction with the final event dummy. All models include a full set of case, time, and alternative-region fixed effects and other controls as indicated in the table. Individual controls include age, age squared, gender, gender by age, and labor income, each of which is interacted with an indicator for each alternative region, thus allowing for a separate coefficient for each alternative. Model (e) includes alternative-region by year fixed effects. Model (f) excludes individuals with labor income above 90 K. The restricted comparison group in model (g) refers to the sample which never reaches wealth >700,000 during the treatment period as in the aggregated analysis. Model (h) uses an unbalanced sample. Standard errors are clustered three-ways at the origin-tax-bracket, alternative-tax-bracket, and individual level.

additional evidence that results are not driven by changes in personal income taxes. Second, analogous to the aggregate analysis, column (g) changes the comparison group by eliminating individuals which in the post-period reached a level of wealth above 700,000 Euro. The results are only slightly larger. Column (h) of Table A7 shows the estimates of the model using an unbalanced sample of individuals. The results for the unbalanced (h) and balanced (d) sample are nearly identical, which suggests that non-random attrition, perhaps due to non-filing or out-of-country migration, does not threaten our results. All the results presented in this table further verify the identifying assumptions of the aggregated analysis.

To interpret the magnitudes of these results note that a coefficient of 0.013 indicates that the treatment group experienced an 1.3 percentage point increase in the probability of residing in Madrid (relative to the comparison group). To compare this to the aggregate analysis, we can benchmark this change using the pre-reform baseline probability of choosing Madrid (22.5%). Thus, the probability of choosing Madrid increased by 5.8%. This is slightly smaller than the 7.5% increase detected in the aggregate analysis, although the confidence intervals of the estimates overlap. The individual choice model likely yields a slightly smaller effect due to its ability to control for individual specific factors that may influence the probability of moving to Madrid.

To relate these results to the analysis based on aggregated data, the full set of event coefficients is shown in Figure A18. The event study based on individual data demonstrates a clear trend break, as in the aggregate analysis.



(a) Treatment and Comparison

(b) Triple Difference

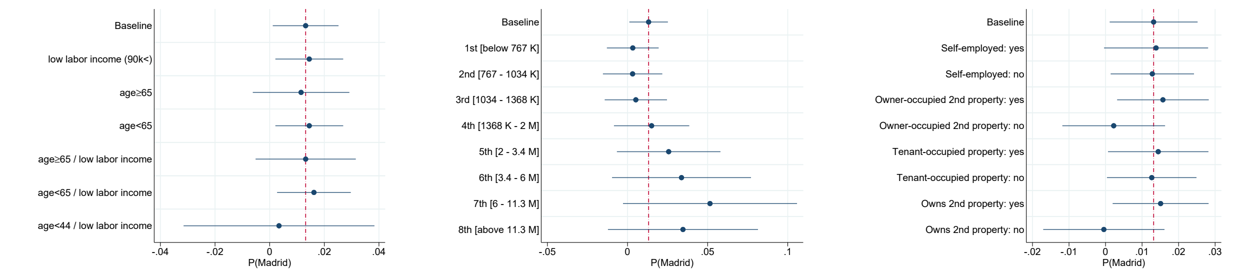
FIGURE A18: Choice Event Study

Notes: These figures show results from the extended version of (5) with event time dummies replacing the post indicator. Panel (a) shows the difference in the probability of declaring Madrid as fiscal residence for the treatment and comparison group relative to Madrid and the base year. Panel (b) shows the triple difference estimate of the probability of declaring Madrid as fiscal residence for the baseline model and a model including a full set of controls. Table A7 shows the cumulative effect for 2016 in panel II of models (2a) without controls and (2d) with controls. Standard errors are clustered at the origin-bracket, alternative-bracket, and individual level. Dashed lines indicate 95% confidence intervals. The model uses the 2006-2016 balanced sample, as we need lagged information for the construction of the cluster variable.

As in the aggregate analysis, we document in Figures A19 that the effects are not heterogeneous across taxpayer characteristics, with the exception of the level of wealth and secondary properties. Again, the effects are larger for taxpayers with higher levels of wealth, for whom tax differentials are larger and thus the incentives to move stronger.

A.6 Mechanisms: Secondary Residences

This section studies the ownership of secondary residences across Spanish regions among taxpayers. First, in Figure 20(a), we compare the share of secondary residences owned by wealth taxpayers in their home region (blue bar), Madrid (red bar), the average in other regions (dark green bar) and the region where they have the highest share of secondary residences (light green bar). We highlight two important results. First, most secondary residences are owned in the home region of the taxpayer. Second, wealth taxpayers do not appear to own a disproportionate share of secondary residences in Madrid, as the share in Madrid is very low. In particular, there are very few regions whose share in Madrid is larger than the maximum share in any other region. The shares for wealth taxpayers have been calculated based on the information about the ownership of secondary residences shared with



(a) Characteristics

(b) Wealth Tax Bracket

(c) Self-employed and Owners of second properties

FIGURE A19: Heterogeneous Effects

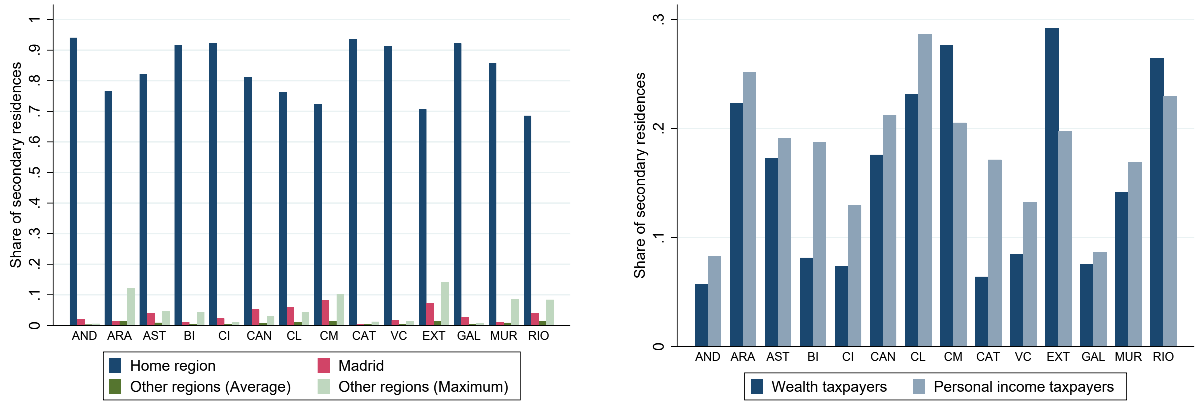
Notes: This figure shows for the various sub-groups the coefficient on event year 2016. The heterogeneity analysis is done including a full set of covariates, i.e. the estimations follows column (2d) of Table A7. In panel (a), we split the sample by age and the amount of labor income. An individual is defined as having low labor income if he/she earns less than 90,000 Euros, the amount above which Agrawal and Foremny, 2019 show that labor income tax differentials start to matter. In panel (b), we split the sample at each tax bracket threshold, which makes it possible us to conduct an heterogeneity analysis along the wealth distribution. In panel (c), we split the sample by self-employment status and by ownership of secondary residences. The baseline estimates for the full population are given by the red vertical lines. We cluster standard errors at the origin-bracket, alternative-bracket and individual level.

us by the Spanish Tax Agency for the year of 2016. Unfortunately, we were unable to obtain additional data.

Second, we compare in Figure 20(b) the share of secondary residences owned by wealth taxpayers (dark blue bar) and personal income taxpayers (light blue bar) outside of their home region. This evidence reveals that wealth taxpayers do not seem to own a disproportionately larger share of secondary residences outside of their home region relative to personal income taxpayers. If anything, personal income taxpayers in most regions appear to have a larger share of secondary residences outside their home region than wealth taxpayers. The shares for personal income taxpayers have been calculated based on the annual publication of the ownership of secondary residences published by the Spanish Tax Agency in its *Estadística sobre Declarantes del IRPF (2019)*.

A.7 Methodology for Revenue Analysis

This section describes the methodology used to analyze how tax-induced mobility responses affect wealth and income tax revenues by means of counterfactual simulations. We then use the counterfactual simulations to make comparisons with respect to the baseline scenario, that is, the observed (realized) revenues. To construct the counterfactuals, we simulate the evolution of wealth and income tax revenue absent tax-induced mobility. Consistent with our empirical analysis, tax-induced migration is defined as mobility to Madrid, as the small tax differentials between other regions have no noticeable effect on the stock of wealthy taxpayers. To identify the number of tax-induced movers, we use the annual coefficients of



(a) Wealth Taxpayers

(b) Wealth vs. Personal Income Taxpayers

FIGURE A20: Ownership of Secondary Residences across Spanish Regions

Notes: These figures depict the ownership of secondary residences across Spanish regions among taxpayers. Panel (a) shows the share of secondary residences owned by wealth taxpayers in their region of fiscal residence (blue bar), Madrid (red bar), the average in other regions (dark green bar) and the region where they have the maximum share of secondary residences (light green bar). Panel (b) compares the share of secondary residences owned by wealth taxpayers (dark blue bar) and personal income taxpayers (light blue bar) outside of their home region. The shares for wealth taxpayers have been calculated based on the information about the ownership of secondary residences shared with us by the Spanish Tax Agency for 2016. The shares for personal income taxpayers have been calculated based on the annual publication about the ownership of secondary residences published by the Spanish Tax Agency in its *Estadística sobre Declarantes del IRPF (2019)*.

the relative change in the stock of movers to Madrid from (1).

We apportion the change in Madrid's stock back to each of the other origin regions of Spain using the annual shares of net migration that each region contributes to Madrid relative to the pre-reform period. By making the apportionment factors based off the change in net-migration relative to 2010, these factors are consistent with the econometric specification. As we do not know who moved for tax or non-tax reasons, we draw taxpayers (i.e., individuals with taxable wealth above 700,000€) randomly from the set of movers involving Madrid. Given that tax-induced effects involves both movement to Madrid and inducing some people who would move from Madrid to stay, whenever the selected number of movers in each region does not add up to the total net migration share, we draw taxpayers randomly from the set of stayers in Madrid over the 2011-2016 period. We assign them to each region so as to match each region's net migration share to Madrid. Because the distribution of taxpayers in Madrid is more skewed than in the rest of regions, we censor the wealth drawing so as to never pick approximately the richest 1% of stayers. This also helps deal with the fact that we have a stratified sample, rather than the full universe of taxpayers.[30]

As the personal income and wealth tax panel is meant to be representative of the personal

[30]For movers from Castile and León to Madrid, we also censor the personal income tax liability for the largest top 1%, as some of the movers in this region are ultra rich individuals and they would not receive so much weight if we had the full universe of taxpayers.

income tax distribution, we need to reweight the dataset so that it is also representative of the wealth tax distribution. First, we reweight the sample of wealth taxpayers to match regional totals over the period 2006-2007. We then extrapolate these weights forward by applying region-specific adult-age population growth rates using the Annual Population Series (*Cifras de Población*) published by the Spanish Statistics Institute. Finally, we reweight the subsample of personal income taxpayers that do not file wealth taxes so that after reweighting, the full panel matches the total number of personal income taxpayers in each region and year. In the counterfactual revenue simulations, we fix the regional distribution of wealth tax filers to its pre-reform level and only allow the weights to change over time through the change in the total number of wealth tax filers. This is a partial equilibrium analysis.

We simulate four different scenarios eliminating any tax-induced mobility:

1. Decentralization without tax-induced mobility: We keep the baseline wealth and income tax schedule in each region unchanged but close down tax-induced mobility. This is the only scenario for which we also simulate the personal income tax. We do so by keeping fixed the baseline personal income tax liability for both capital and labor income (i.e., we assume there are no differences in the personal labor income tax schedule between Madrid and the rest of regions), so that the only thing that changes is the region of residence. Figure A21 shows region-specific revenue changes in response to closing down tax-induced mobility.

2. A binding positive minimum wealth tax: We keep the baseline wealth tax schedule in each region unchanged except for the zero-tax regions (i.e., Balearic Islands and Valencian Community in 2011, Madrid between 2011-2016). For these regions, we assign the default schedule, which is the lowest positive schedule observed. This scenario could arise if the central government only allowed regions to deviate upward from the default schedule.

3. Harmonization with default schedule: We apply the default (centralized) wealth tax schedule to each region, including Madrid. As all regions levy the same tax rate, this closes down tax-induced mobility as discussed above.

4. Harmonization with a Pareto-improving schedule: We find the coordinated harmonized wealth tax schedule over the period 2011-2016 such that all regions are better-off (according to tax revenue) after harmonization. To do this, we scale the marginal tax rate in each bracket upward by 1% increments (relative to the default schedule). We then conduct a search, which iterates until we find a wealth tax schedule that generates a Pareto improvement in terms of tax revenue for all regions. In each year, we never let the harmonized tax rate rise above the maximum regional tax rate in that year.

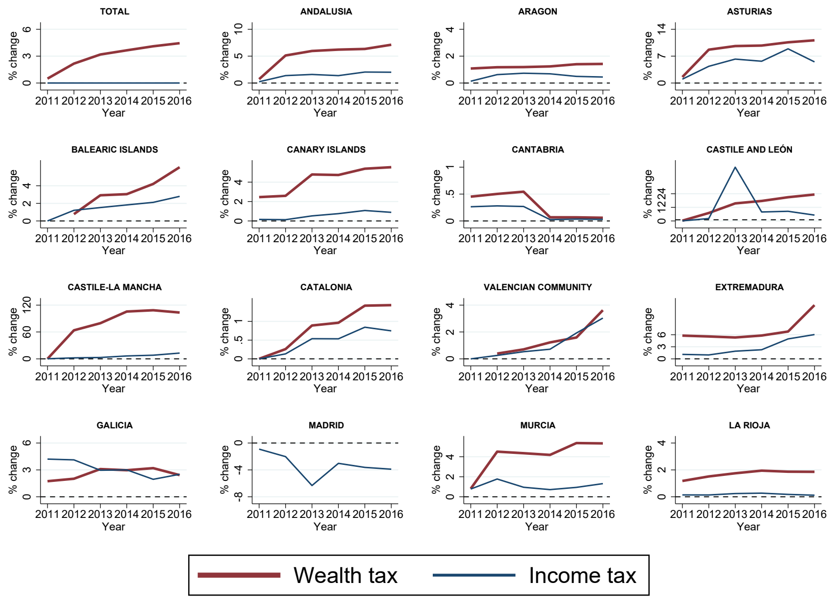


FIGURE A21: Wealth and Income Tax Revenue Across Spanish Regions, 2011-2016

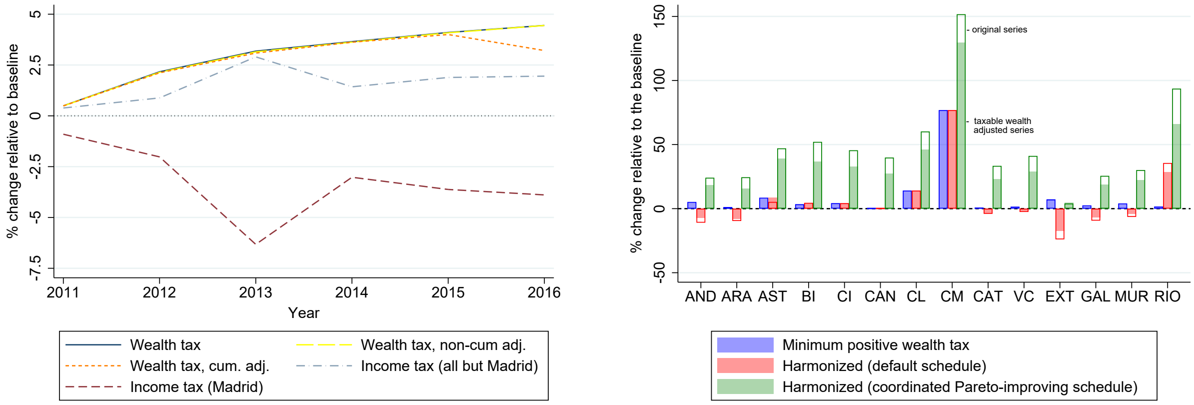
Notes: This figure depicts the percent change of wealth and income tax revenue under the decentralized scenario absent tax-induced mobility to Madrid relative to the baseline decentralized scenario with tax-induced mobility to Madrid across Spanish regions over the period 2011-2016. Note that we exclude the regions of Ceuta and Melilla from the figure, as they count on a very small sample of wealth taxpayers and thus have a very low share of movers.

A.7.1 Accounting for Taxable Wealth Responses

We rerun our revenue simulations accounting for taxable wealth responses. We do so by using the following formula to adjust taxable wealth:

$$\hat{W_{i,t}} = W_{i,t} \cdot [1 + \frac{\epsilon}{100} \cdot [(1 - mtr_{i(r),t}) - 1)] \cdot 100, \tag{A1}$$

where $W_{i,t}$ stands for taxable wealth for taxpayer i at period t before applying the minimum exempted, ϵ is the taxable wealth elasticity, and $mtr_{i(r),t}$ is the marginal tax rate at period t for individual i based on the tax schedule of the counterfactual region of residence r. We use 6.5 as taxable wealth elasticity, which corresponds to the average of the elasticities estimated by Jakobsen et al. (2020). We perform two types of adjustments. In the first adjustment, we do not cumulate the taxable wealth responses, that is, we only adjust taxable wealth every year taking into account the year-specific taxable wealth response, but not the responses from previous years. In the second adjustment, we do cumulate the taxable wealth responses, that is, we adjust taxable wealth every year taking into account both year-specific taxable wealth response, and the already adjusted taxable wealth from previous years. Figure A22 shows that both types of adjustments provide similar results to the ones obtained without accounting for taxable wealth responses.



(a) Non Tax-induced vs. Tax-induced Mobility

(b) Alternative Scenarios

FIGURE A22: Wealth Tax Revenue Simulations, 2011-2016

Notes: Panel (a) depicts, for all regions excluding Madrid, the percent change in wealth tax (solid blue line) from shutting down tax-induced mobility relative to the baseline with tax-induced mobility. Using taxable wealth elasticities from the literature as described in Appendix A.7, the dashed yellow and orange lines represent the percent change of wealth tax revenue after accounting for non-cumulative and cumulative taxable wealth responses other than migration, respectively. The change is the average difference in revenue between the decentralized scenario absent tax-induced mobility to Madrid relative to the baseline decentralized scenario with tax-induced mobility to Madrid over the period 2011-2016. We convert this difference into a percent by dividing by the baseline revenue. Panel (b) depicts the percentage change of wealth tax revenue absent tax-induced mobility to Madrid relative to the baseline decentralized scenario with tax-induced mobility to Madrid over the period 2011-2016 under three different counterfactual scenarios. The three different counterfactual scenarios are: a decentralized scenario with a minimum wealth tax rate at the default schedule, a harmonized scenario where all regions adopt the default wealth tax schedule and a harmonized scenario that is revenue-improving for all regions relative to the baseline. Filled bars capture the effect of accounting for non-cumulative taxable wealth responses. The regions of Ceuta and Melilla are excluded from the figure as they are very small.

A.7.2 Assumptions behind the Partial Equilibrium Analysis

Our counterfactual simulations are based on a partial equilibrium analysis and thus we rely on several assumptions to carry them out. First, as we only focus on tax-induced mobility to Madrid, we assume that there are no other interjurisdictional fiscal externalities between other high-tax jurisdictions. This assumption is justified as we document in Figure 7 that nearly all tax-induced mobility is driven by the salient zero-tax region of Madrid. Second, as discussed above, a region's share of tax-induced movers to Madrid is assumed to be proportional to the change in the number of movers to Madrid by region. To the extent that most of the mobility changes are due to wealth tax differences within Spain, this assumption is also justified. Third, international mobility could alter the revenue effects. However, as discussed in Section 2 of the main draft, international flows of wealth tax filers are negligible both in the pre and post-reform period. Fourth, our analysis abstracts from economic spillovers (i.e., capital reallocation, talent/innovation due to labor market reallocation) due to the presence of top wealth holders. Reallocating mobile capital facing a world rate of return is not likely, except for investments in real estate. Labor reallocation is also expected to be minimal, as most wealth tax filers moving to Madrid are non-working age rentiers (see Figure A3). Fifth, our cross-base revenue effects are only based on the personal income tax (labor and capital) and thus exclude other regional taxes. Given that the personal income tax raises 90% of direct tax revenue, we expect our cross-base revenue effects on the personal income tax to be very close to the effects taking all regional taxes into account. For all these reasons, the fiscal externalities based on our partial equilibrium analysis should be close to the ones of a general equilibrium analysis.

Finally, although tax harmonization will entirely eliminate mobility caused by tax differentials, a minimum tax rate may not because tax differentials still exist. To study minimum taxes, we assume that a minimum rate at the default schedule does not result in tax-induced migration to the region setting the minimum tax rate. Nonetheless, we could be overestimating the revenue effects if new tax evasion strategies arise in the presence of minimum tax rates. We believe that this assumption is also reasonable, as the differences in top marginal rates and the default schedule are relatively small and thus not very salient. The minimum tax rate simulation also assumes no strategic responses by high-tax jurisdictions, which would alter the revenue effects in high-tax jurisdictions.

A.8 Data Appendix

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