ONLINE APPENDIX

"Wealth Tax Mobility and Tax Coordination"

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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.

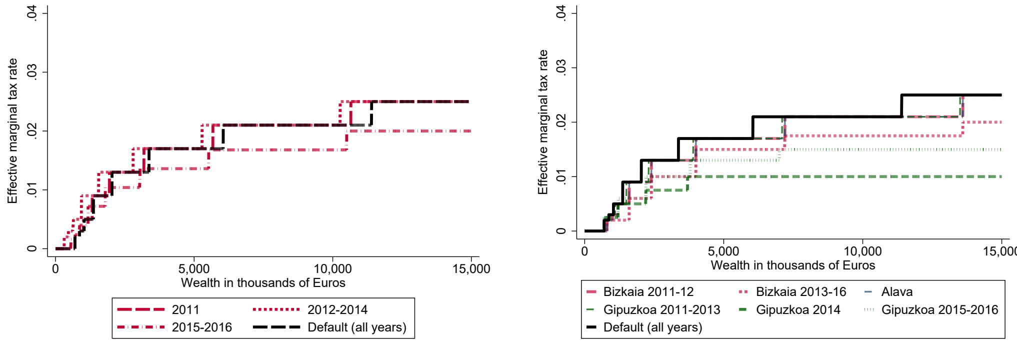
In 2001, the regions were ceded the right to change or include deductions in the wealth tax and the condition of keeping the same minimum bracket and minimum marginal tax rate as the national one was suppressed (Law 21/2001). Nonetheless, all regions kept the national schedule (0.2-2.5%) during the late 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

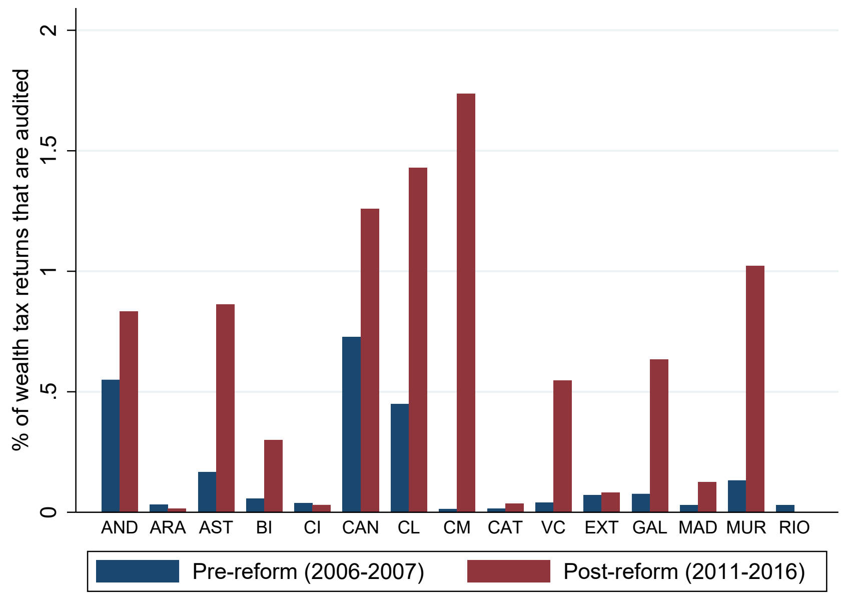
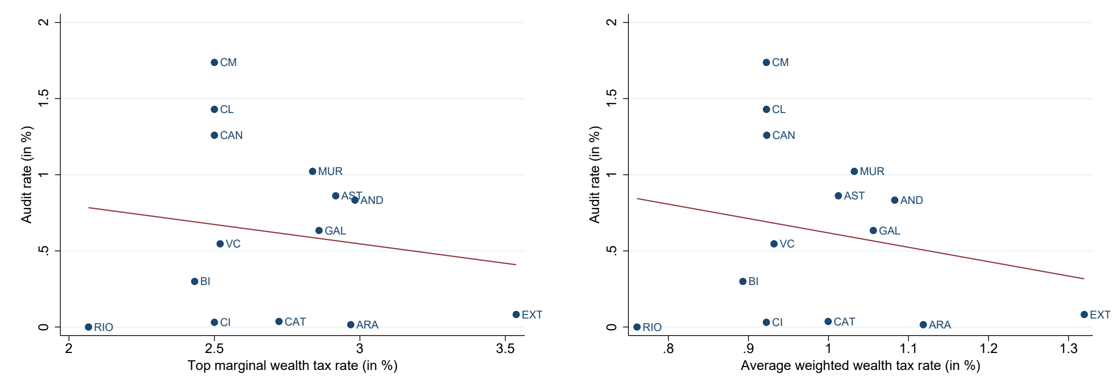


FIGURE A2: Wealth Tax Audit Rates, 2006-2016

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).



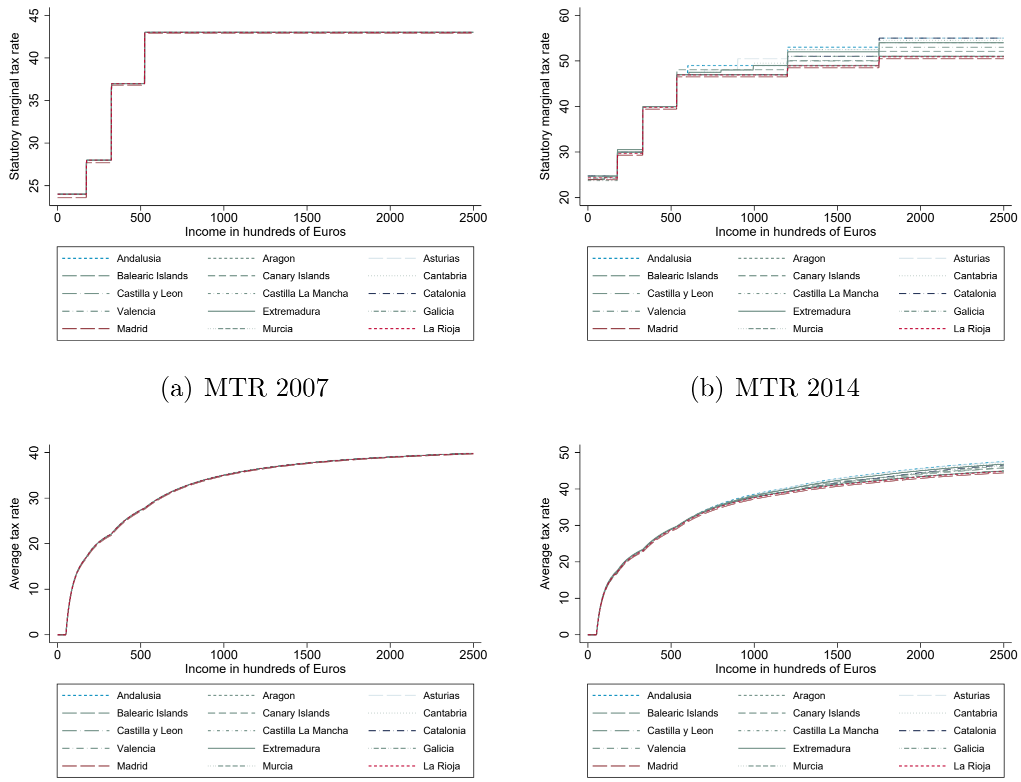
(a) Audit and Top Marginal Wealth Tax Rates (b) Audit and Average Wealth Tax Rates

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



(a) MTR 2007

(b) MTR 2014

(c) ATR 2007

(d) ATR 2014

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.

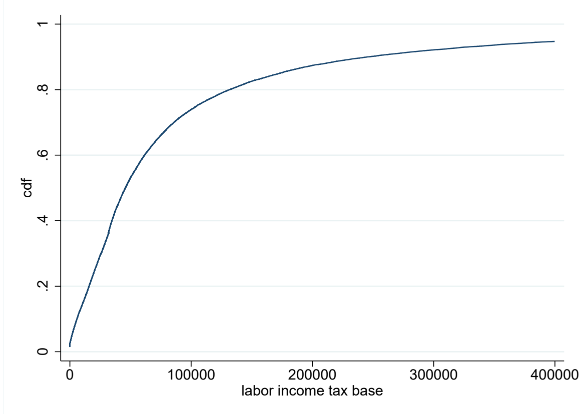


FIGURE A5: Cumulative Distribution of Wealth Tax Filers by Labor Income

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.

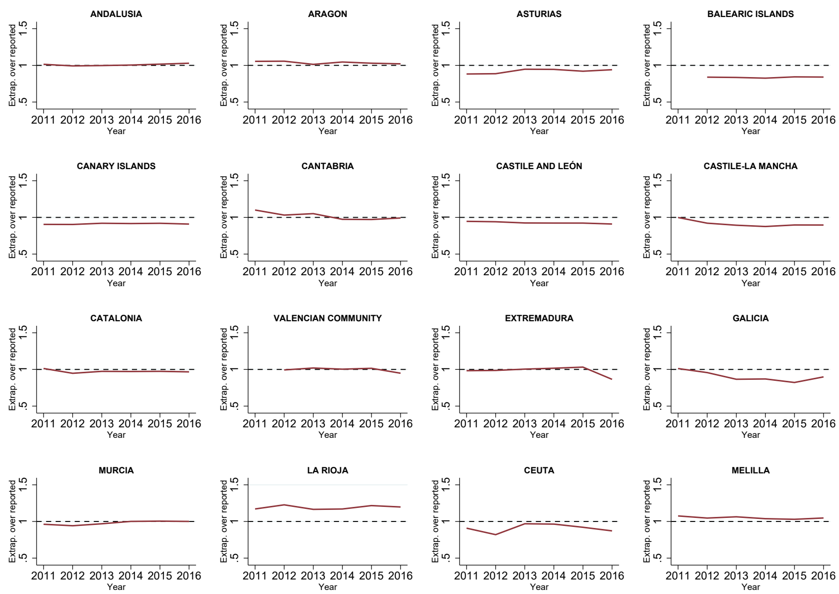


FIGURE A6: Average Taxable Wealth Across Spanish Regions, 2011-2016

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.

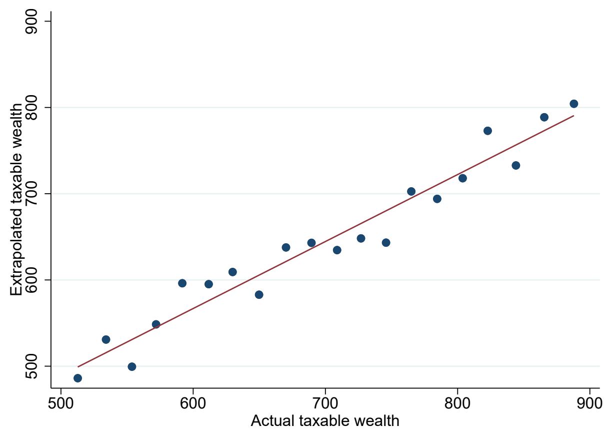


FIGURE A7: Extrapolated vs. Actual Taxable Wealth, 2011-2016 (Using Catalan Wealth Tax Records)

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.

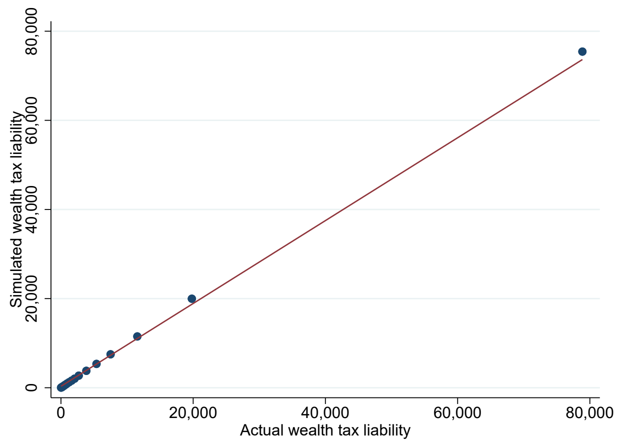


FIGURE A8: Simulated vs. Direct wealth tax liabilities, 2007

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

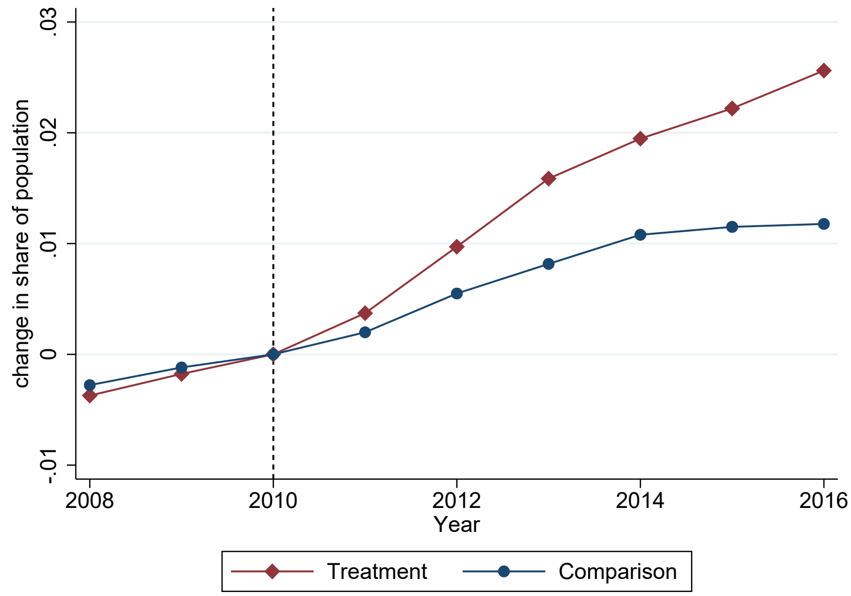


FIGURE A9: Madrid's Zero Tax Rate Facilitates Tax-induced Mobility

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;

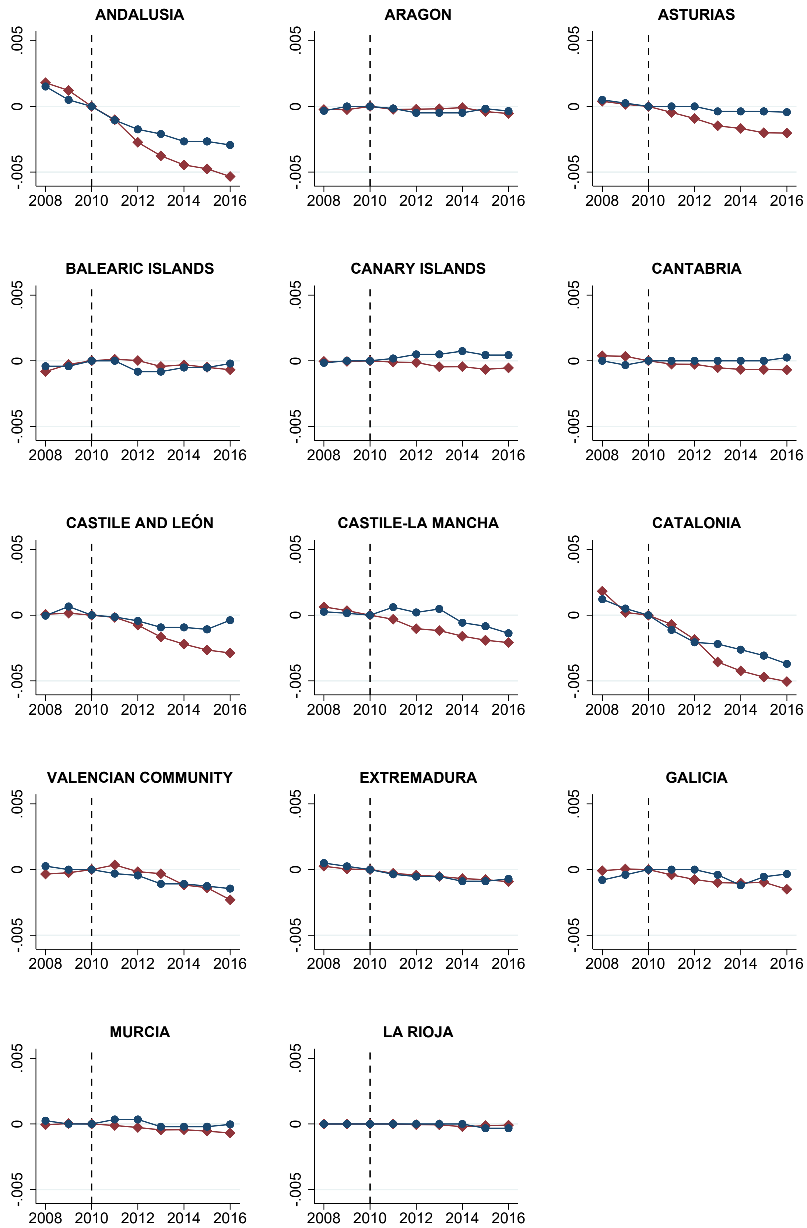


FIGURE A10: Tax-Induced Mobility from each Region

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.

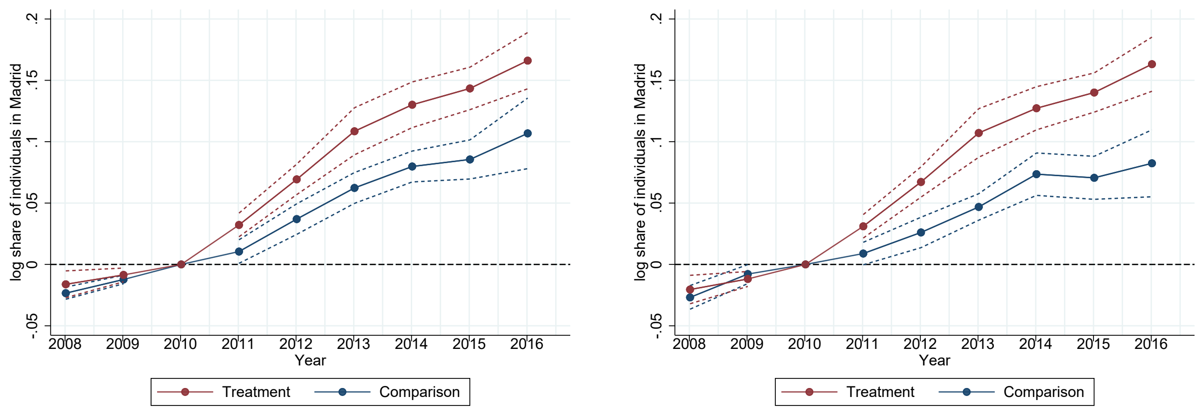
of the wealth tax if they filed wealth taxes under the centralized regime in 2007 and had taxable wealth of more than 700,000 Euro already in 2007. The comparison group is then the individuals just below this threshold when relying on 2007 taxable wealth data. Note that differences to our baseline setting 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.



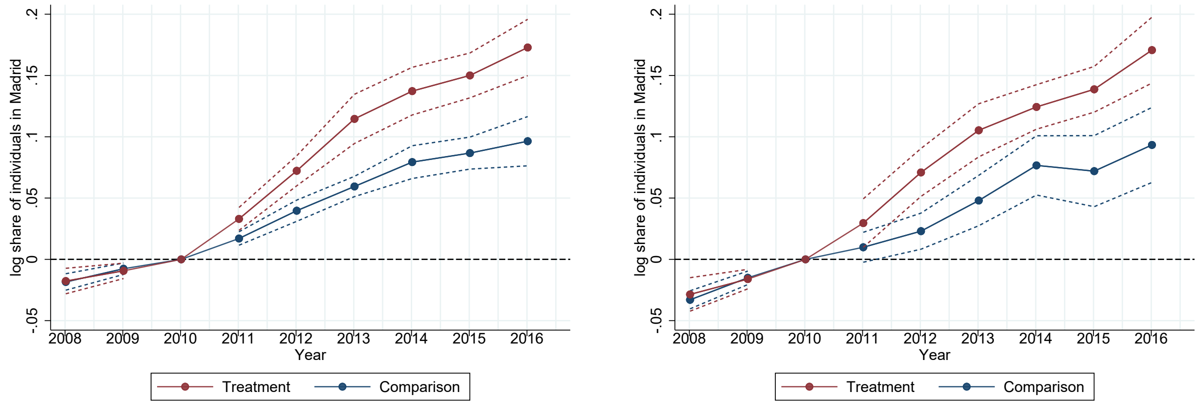
(a) Groups based on 2007 wealth

(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

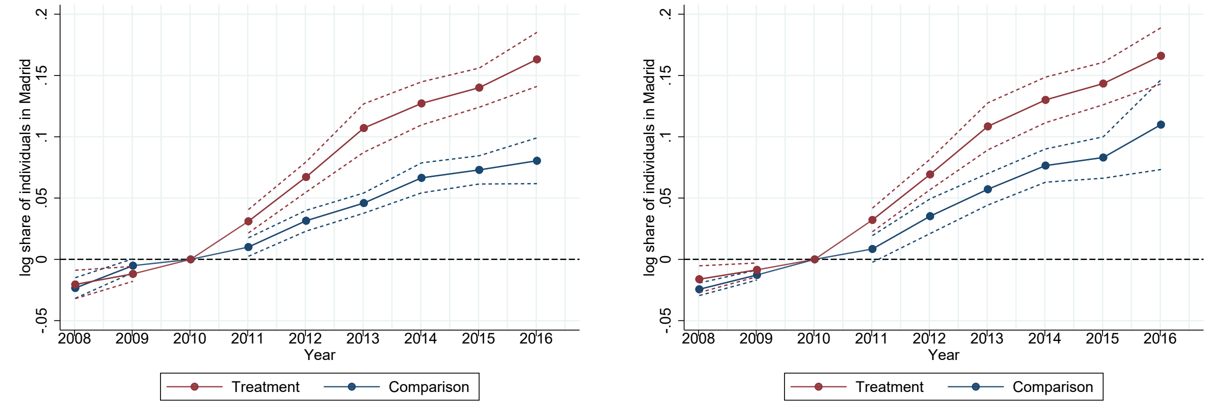
FIGURE A12: Robustness: Sample Construction

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.

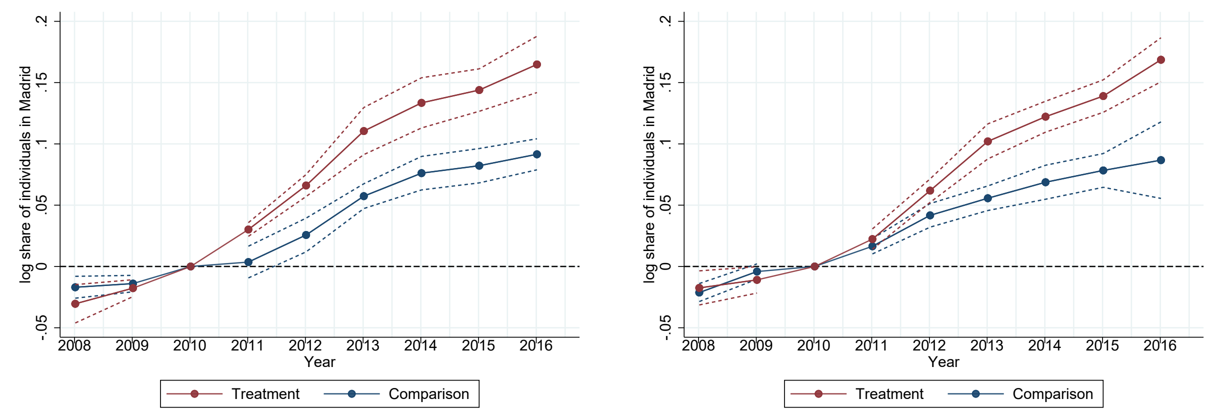
Figure A15 (Panel b) summarizes the results of the prior robustness checks by presenting the cumulative effect of the reintroduction of the wealth tax on mobility by plotting the 2016 coefficient from the triple difference event study. In addition, Panel (a) presents additional robustness checks by documenting 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.

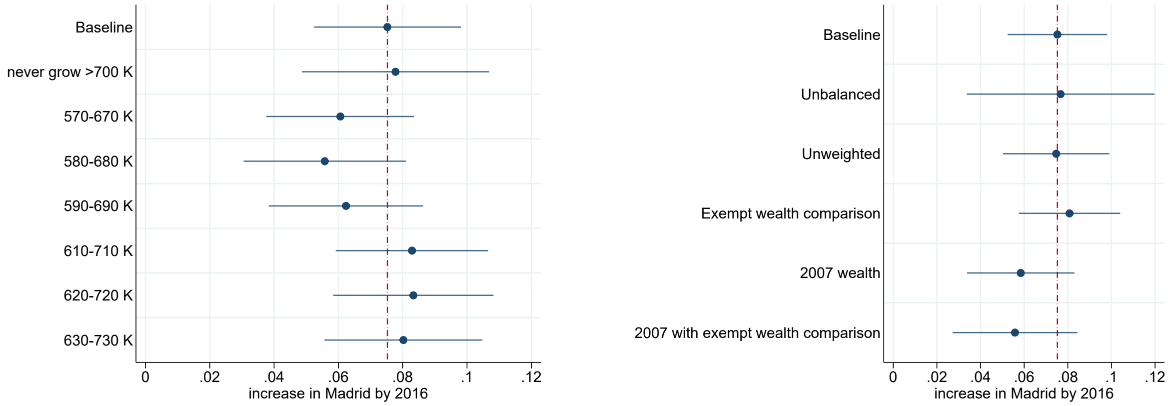


(a) 65 and older, low labor income (b) 64 and younger, low labor income

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

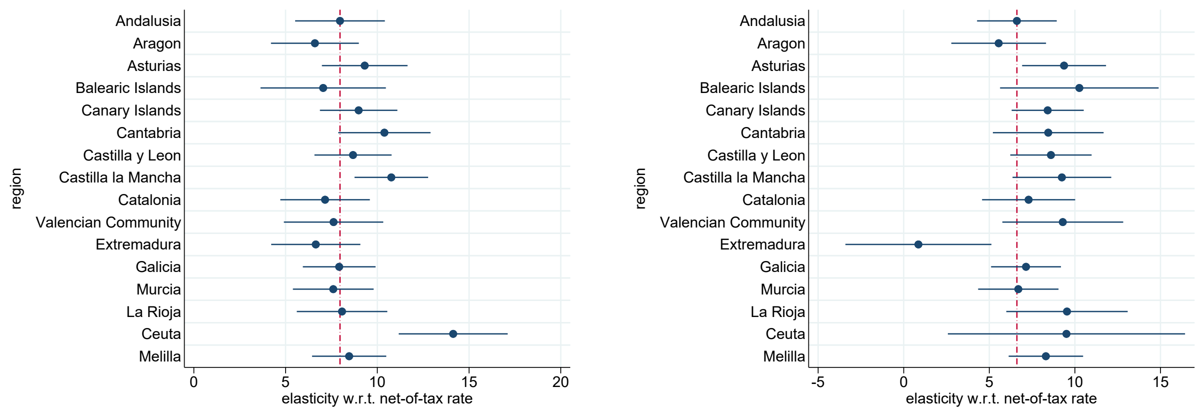
TABLE A6: Stacked Research Design with All Dyad Pairs

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]

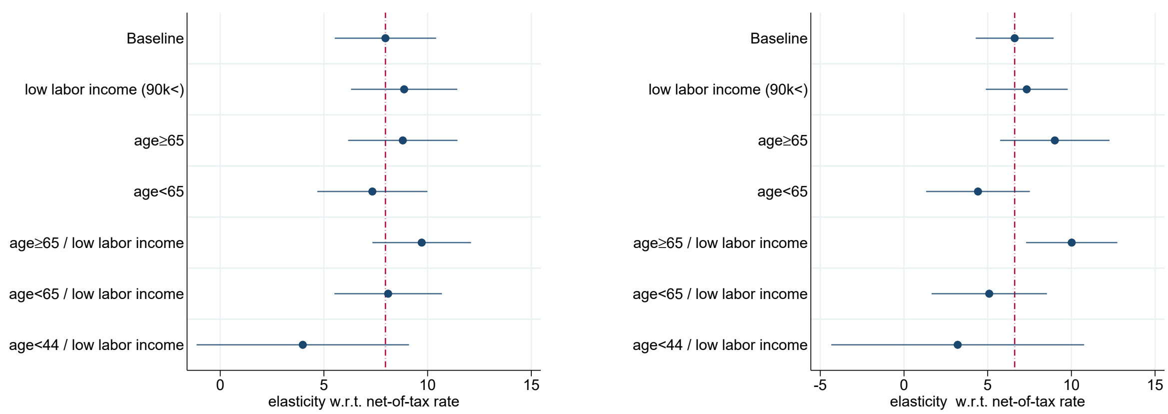
[27] We omit a figure for the results by wealth because tax differentials change over the wealth distribution,



(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	$\omega_{it}, \iota_r, year$	$\omega_{it}, \iota_r, year$	$\omega_{it}, \iota_r, year$	$\omega_{it}, \iota_r, year$	$\omega_{it}, \iota_r \times year$	$\omega_{it}, \iota_r, year$	$\omega_{it}, \iota_r, year$	$\omega_{it}, \iota_r, year$

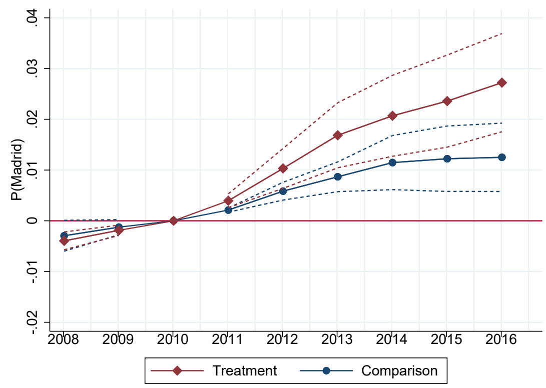
TABLE A7: Individual Choice Model

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.

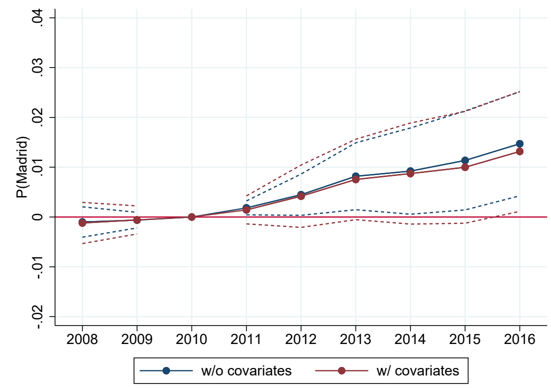
additional evidence that results are not driven by changes in personal income taxes. Second, analogous to the aggregate analysis, column (g) changes the comparison group by eliminating individuals which in the post-period reached a level of wealth above 700,000 Euro. The results are only slightly larger. 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

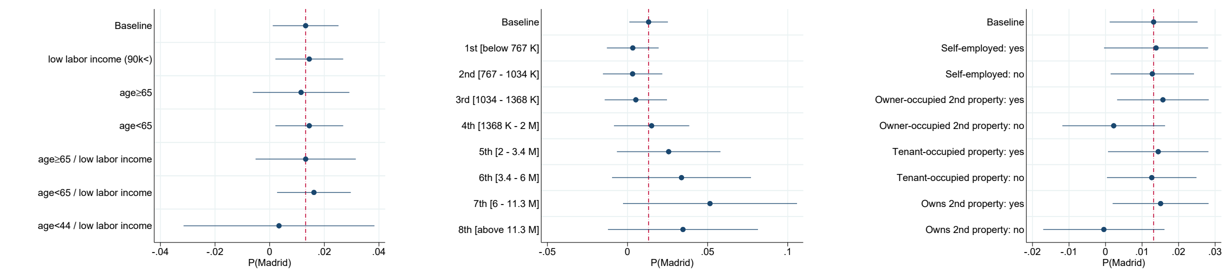
FIGURE A18: Choice Event Study

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

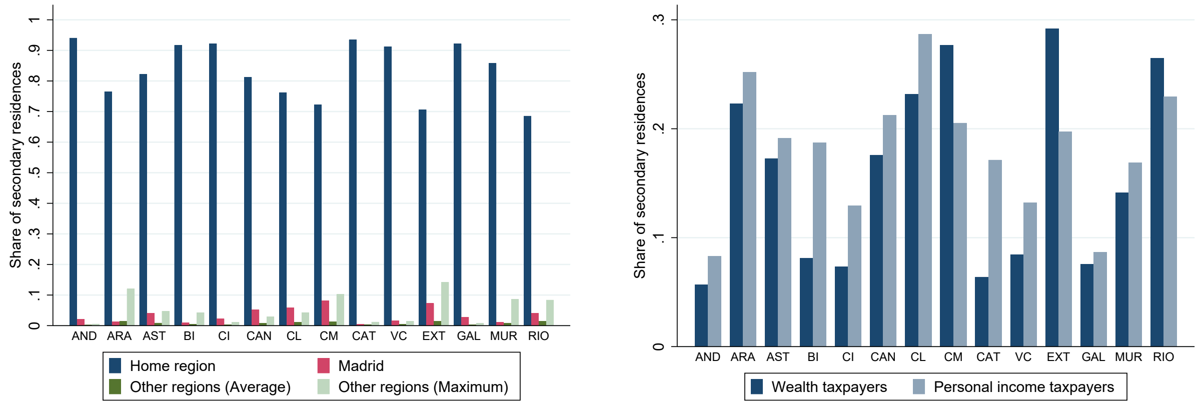
Notes: This figure shows for the various sub-groups the coefficient on event year 2016. The heterogeneity analysis is done including a full set of covariates, i.e. the estimations follows column (2d) of Table A7. In panel (a), we split the sample by age and the amount of labor income. An individual is 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.

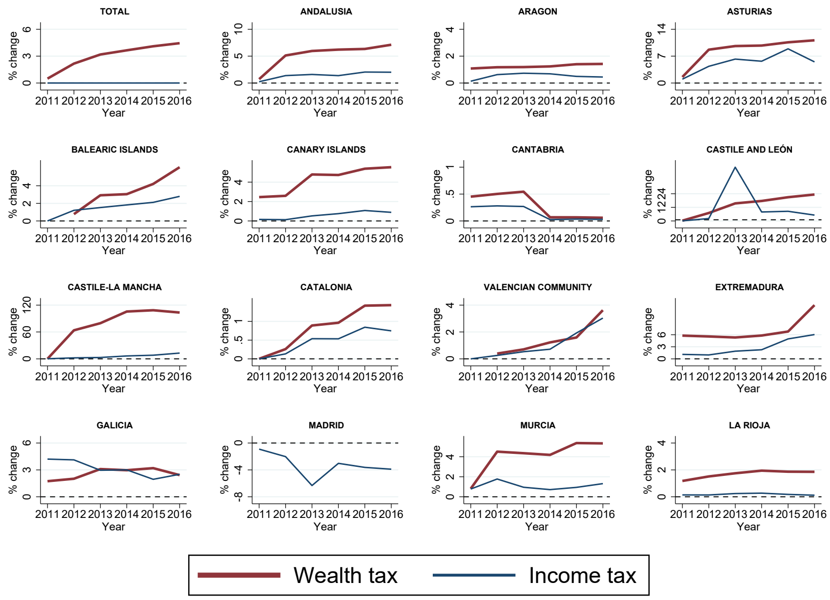


FIGURE A21: Wealth and Income Tax Revenue Across Spanish Regions, 2011-2016

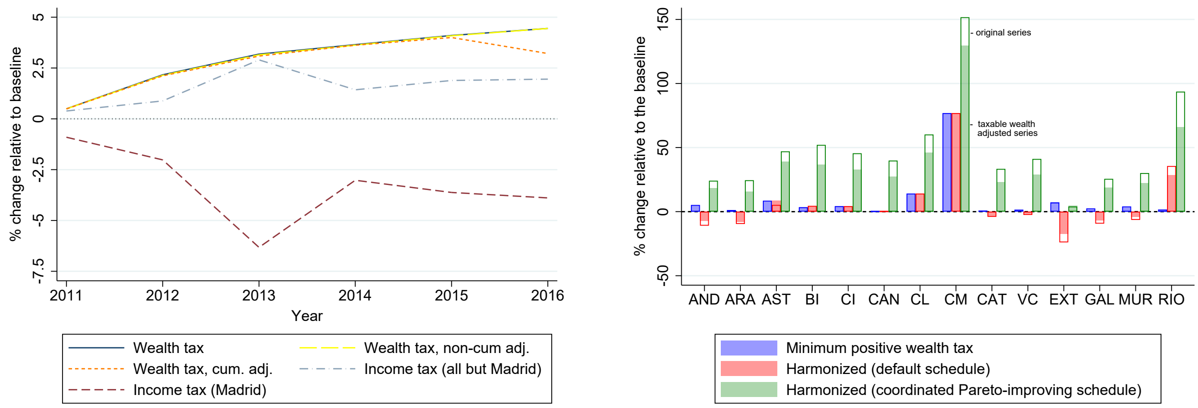
Notes: This figure depicts the percent change of wealth and income tax revenue under the decentralized scenario absent tax-induced mobility to Madrid relative to the baseline decentralized scenario with tax-induced mobility to Madrid across Spanish regions over the period 2011-2016. Note that we exclude 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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