

ONLINE APPENDIX

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The Elasticity of Taxable Income in Spain: 1999-2014

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A Tax Reforms: Further Details

A.1 Major Legislative Changes

The Law that regulates the Spanish personal income tax since 1999 was *Ley 40/1998 del IRPF*. This Law was replaced in 2003 by *Ley 46/2002 del IRPF*, and the latter replaced in 2007 by *Ley 35/2006 del IRPF*. The legislative package of urgent measures adopted to address the severe fiscal imbalances of Spain in 2011 (*RDL 20/2011 de medidas urgentes en materia presupuestaria, tributaria y financiera para la corrección del déficit público*) introduced extensive changes to the PIT, effective since the fiscal year 2012.

A.2 Other Tax Reforms

Besides the three major reforms of the PIT, there were several legislative changes over the period 1999-2014 that modified the set of deductions and tax credits. Among them, the most relevant change in terms of revenue was the introduction of the stimulus tax credit effective since mid-2008 and during 2009 (*RDL 2/2008 de medidas de impulso a la actividad económica*). This tax credit consists of €400 to taxpayers obtaining labor or business income under certain conditions. The estimated *ex ante* permanent revenue impact of the measure was very substantial (equivalent to 0.55 percent of GDP in 2008) in a period of large fiscal imbalances and thus was eliminated in 2010 (The Budget Law of 2010, *Ley 26/2009 de PGE de 2010*) with an estimated *ex ante* permanent revenue impact of 0.5 percent of GDP in 2010.

The introduction in November of 2007 (*Ley 35/2007*) of a tax credit associated to the born or adoption of a children is among the most prominent tax credits created in

this period. This tax credit consists of a €2,500 payment per taxpayer, it was in force until 2010 fiscal year and had an estimated *ex ante* revenue impact of 0.15 percent of GDP in 2008.

To mitigate the effects of inflation creating progressive taxation the legislator adjusted the tax brackets of the general tax base increasing them a 2 percent in the years 2000, 2005, 2006 and 2008. In the latter case, the price adjustment also affected personal and family tax credits and labor income deductions with an aggregate *ex ante* permanent impact equivalent to 0.1 percent of GDP in 2008 (The Budget Law of 2008, *Ley 51/2007 de PGE de 2008*).

In 2011, the central government introduced (The Budget Law of 2011, *Ley 39/2010 de PGE de 2011*) two additional brackets with higher marginal tax rates for top income earners: 44 percent for taxable income in the range between €120,000 and €175,000 and 45 percent for taxable income above that amount.

The flat tax rate applied to the savings tax rate was modified along the Great Recession in order to increase both its average effective taxation and its progressivity. In 2010 the baseline rate increased from 18 to 19 percent with a new bracket for taxable income above €6,000 taxed at 21 percent. The 2012 Reform introduced a surcharge of 2 percentage points in the first bracket of the savings tax base (i.e., tax rate of 21 percent) and additional 4 percentage points (i.e., tax rate of 25 percent) for income in the second bracket until reaching €24,000 when a new bracket was created with a tax rate of 27 percent.

A.2.1 Regional Tax Schedules

Regional governments started to slightly modify the marginal tax rates in 2007 (the first to do so was the Madrid Region) with very modest reductions across the full tax schedule. From 2008 to 2010 a reduced set of regions (Madrid, La Rioja, Murcia and Comunidad Valenciana) applied lower rates across the common four brackets with small differences with respect to the baseline schedule applied to the rest of regions. In 2011, six regions decided to create additional brackets increasing the marginal tax rates for top income earners. This trend towards higher differential taxation across regions was reinforced since 2012 when eight regions present significant differential with respect to the baseline tax rates. For instance, the Catalan government created in 2012 a top bracket that reached 56 percent (4 percentage points higher than the baseline central bracket and 7

pp higher than the pre-reform tax rate).²¹

Besides of changes in the tax rate structure, regional governments introduced since the 1990s several tax credits that either complement the ones included in the central level (e.g., investment in habitual housing) or create new ones (e.g., education and kindergarten expenditures). The total amount of these tax credits have progressively increased over time but it is still quantitatively tiny reaching an estimated impact of 0.03 percent of GDP in 2014 ([Dirección General de Tributos, 2019](#)). Finally, since 2010 several regional governments (Madrid, Cantabria and Castilla-La Mancha) have introduced enhancements in the tax credits associated to personal and family circumstances.

²¹Other regional governments also created additional tax brackets with higher marginal rates as Andalusia (top rate of 56 percent), Asturias (top rate of 55.5 percent) or Extremadura and Cantabria (top rates of 55 percent).

B Tax Calculator

In this appendix, we provide more details on the tax calculator used to calculate marginal tax rates and construct the instrumental variables. We also provide some evidence on the calculator’s performance to accurately compute the taxable income and tax liability for all taxpayers using detailed information from tax returns. The tax calculator is designed to be used with the administrative panel dataset of personal income tax (IRPF in Spanish) returns provided by the *Instituto de Estudios Fiscales* (IEF) for the period 1999-2014. The complete Stata codes are available from the authors upon request.

B.1 Definition of variables

Adjusted Gross Income

Let y_b denote the adjusted gross income (AGI) in tax base b , with $b = \{g, s\}$, where (g) denotes the general tax base and (s) the special/savings tax base. We omit taxpayer and time subscripts for notational simplicity. For each income source, the adjusted gross income (AGI) consists of gross income minus income-related expenditures (i.e., expenses needed to obtain income), as explained in Section 3.1. We consider six main components of income: we denote labor income with superscript L , business income with B , financial capital income with KF , real-estate capital income with KR , short-term capital gains with GS and long-term capital gains with GL .²² Note that long-term capital gains are defined as those obtained from the sale of assets held for more than two years for the period 1999-2000 and one year between 2001-2006. Between 2007 and 2012, no distinction was made between short and long-term capital gains, and the one-year threshold was reinstated in 2013.

In the formulas below, we differentiate between periods 1999-2006 and 2007-2014 because of the change in the definition of taxable income in the 2007 reform. Then, adjusted gross income for each period and tax base can be written as follows:

$$\begin{aligned} \text{Period 1999} - 2006 : \quad & y_g = y^L + y^B + y^{KR} + y^{KF} + y^{GS} \quad \text{and} \quad y_s = y^{GL} \\ \text{Period 2007} - 2014 : \quad & y_g = y^L + y^B + y^{KR} \quad \quad \quad \text{and} \quad y_s = y^{GL} + y^{GS} + y^{KF} \end{aligned}$$

²²We omit other income sources, called imputations and attributions, from the formulas below for simplicity, as they are distributed across the two tax bases but they represent small amounts for most taxpayers. However, we do incorporate them in the tax calculator to compute taxable income and tax liability.

Separately tracking each income source allows us to create a measure of adjusted gross income that is homogeneous over time for the period 1999-2014.

Taxable Income

We calculate taxable income z_b for each tax base $b = \{g, s\}$ by first subtracting from each AGI the remaining income-specific deductions in the tax code, denoted d^j for each income source j . We then aggregate the different income sources net of income-specific deductions and subtract the general deductions, denoted dg_b , and also the personal and family deductions, denoted f_b . The most relevant deductions in revenue terms are those related to labor income, the deductions originated by contributions to private pension plans or the ones related to past negative liabilities. Note that, for the general tax base in the period 2007-2014, the main components of the personal and family deduction, f_g , enter as a tax credit rather than a deduction, as we explain below. If taxable income in the general base is smaller than the personal and family deduction, the remnant of general and family deductions is applied as a deduction in the special tax base, both in periods 1999-2006 and 2007-2014. Then, we can express taxable income as follows:

$$\begin{aligned} \text{Period 1999-2006 : } \quad z_g &= \sum_j \{y^j - d^j\} - dg_g - f_g \quad \text{and} \quad z_s = y_s - dg_s - f_s \\ \text{Period 2007-2014 : } \quad z_g &= \sum_j \{y^j - d^j\} - dg_g \quad \text{and} \quad z_s = y_s - dg_s - f_s \end{aligned}$$

where $j = \{L, B, KR, KF, GS\}$ for period 1999-2006 and $j = \{L, B, KR, GS\}$ for 2007-2014.

Tax Liability and Tax Credits

Tax liability is calculated in two steps. In the first step, the income tax schedule of each tax base is applied to the taxable incomes defined above. Whenever tax liability is negative, the losses are carried out to the following year as tax credits (which can be used in the next 4 years). In period 2007-2014, the tax liability for the general base is calculated by applying the tax schedule to taxable income and separately to the personal and family exemption, and then subtracting the two resulting figures. For the vast majority of taxpayers, this implies that the personal exemption reduces tax liability at the lowest marginal rate (18 or 24 percent, depending on the year). Before 2007, when the exemption worked as a deduction, it reduced tax liability at each taxpayer's marginal tax rate. Therefore, this change in the definition of taxable income in the 2007

reform introduced more progressivity in the tax schedule.

In the second step to calculate tax liability, we subtract all tax credits, denoted by TC . Some tax credits are refundable, denoted TC_R , in the sense that their application can make tax liability negative. Some examples are the maternity-related tax credits and the €400 stimulus given to all taxpayers in years 2008 and 2009. Some other tax credits are non-refundable, denoted TC_N , for example the mortgage interest deduction that was in place until 2013. Then, tax liability in each period can be expressed as follows:

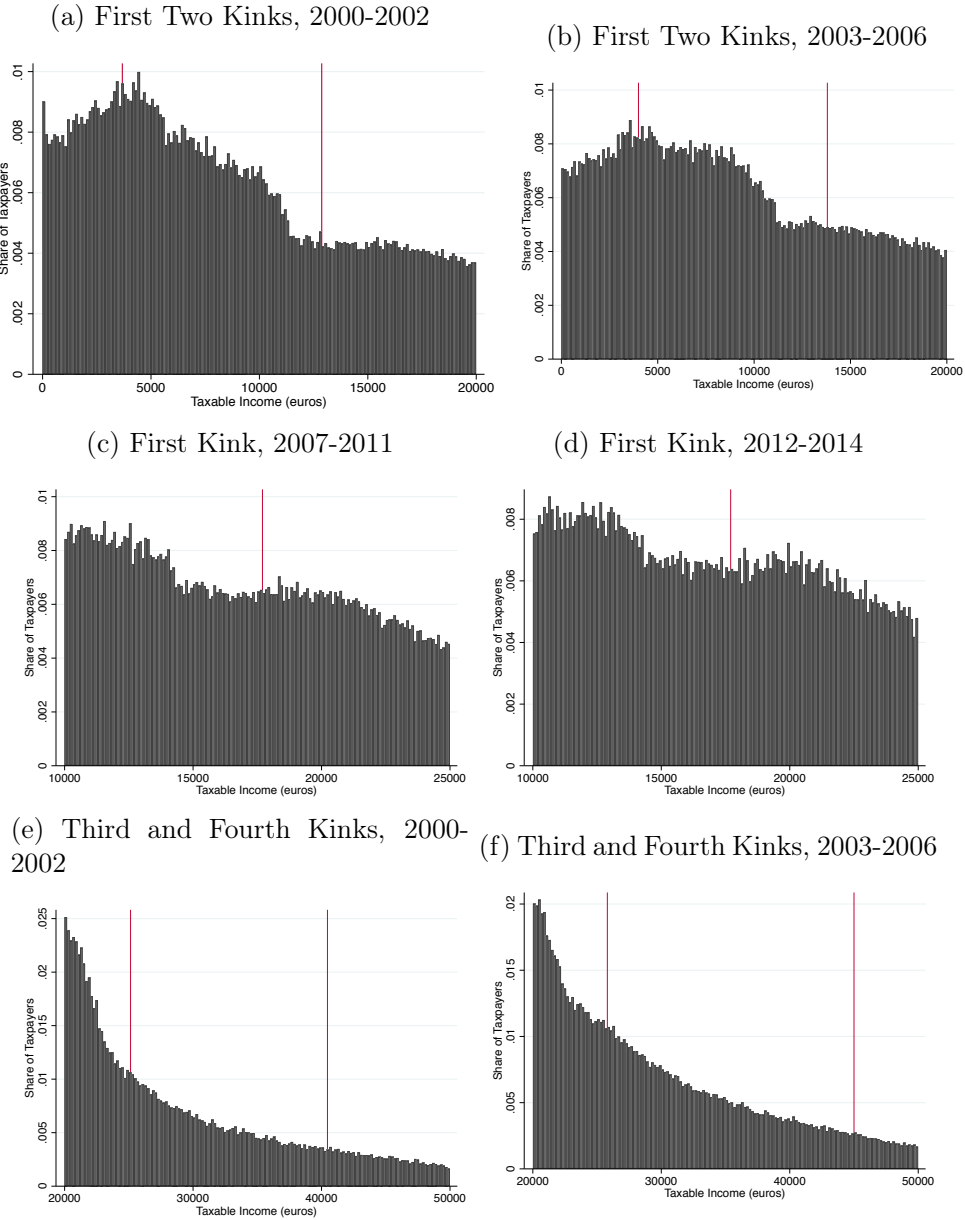
$$\text{Period 1999} - 2006 : \quad T(z) = \max[0, T_g(z_g) + T_s(z_s) - TC_N] - TC_R$$

$$\text{Period 2007} - 2014 : \quad T(z) = \max[0, T_g(z_g) - T_g(f_g) + T_s(z_s) - TC_N] - TC_R$$

The calculation of marginal tax rates and the construction of the predicted-tax-rate instruments are described in Sections 3.3 and 4.2.

Appendix Figures

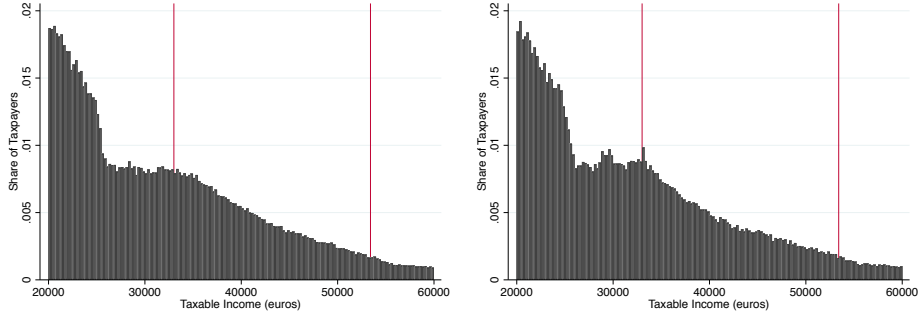
Figure A.1: Bunching Evidence at Kinks



Notes: these figures show the taxable income distribution (in nominal euros) around several kinks at low and middle income levels created by the Spanish personal income tax schedule over the period 2000-2014. A kink is defined as the taxable income threshold where taxpayers face a change in their marginal tax rate. The distributions pool yearly data for different periods of time when the tax schedule is identical across these fiscal years. To compute the share of taxpayers in each bin of taxable income, we elevate each observation included in the sample using the sampling weight reported in the data. The bins of taxable income are €200 wide. The graphs show that there is no significant bunching at any of the kinks in the taxable income distribution over the period 2000-2014.

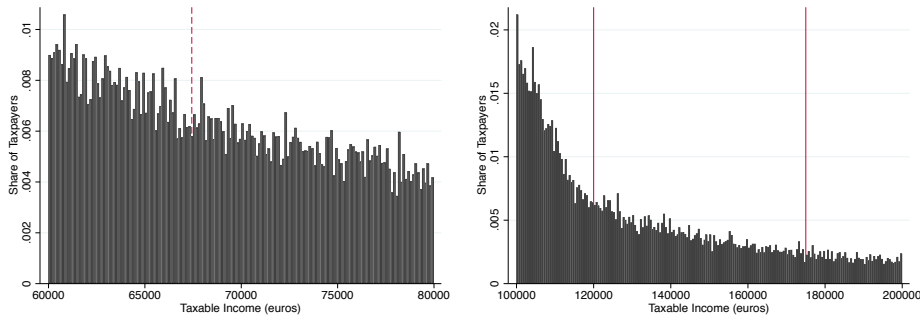
Figure A.2: Bunching Evidence at Kinks

(a) Second and Third Kinks, 2007-2011 (b) Second and Third Kinks, 2012-2014

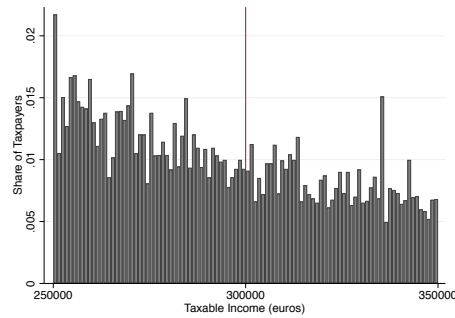


(c) Fifth Kink, 2000-2002

(d) Fourth and Fifth Kinks, 2011-2014



(e) Sixth Kink, 2011-2014



Notes: these figures show the taxable income distribution (in nominal euros) around several kinks at middle and high income levels created by the Spanish personal income tax schedule over the period 2000-2014. A kink is defined as the taxable income threshold where taxpayers face a change in their marginal tax rate. The distributions pool yearly data for different periods of time when the tax schedule is identical across these fiscal years. To compute the share of taxpayers in each bin of taxable income, we elevate each observation included in the sample using the sampling weight reported in the data. The bins of taxable income are €200 wide, except for panel (e) where the bin width is €500 and panel (f) where it is €1,000. The graphs show that there is no significant bunching at any of the kinks in the taxable income distribution over the period 2000-2014.

Appendix Tables

Table A.1: Tax Calculator Accuracy Rates

Year	General Tax Base		Special or Savings Tax Base	
	Taxable Income	Tax Liability	Taxable Income	Tax Liability
1999	99.0%	98.2%	99.9%	99.8%
2000	99.5%	98.9%	100.0%	100.0%
2001	99.3%	98.6%	100.0%	100.0%
2002	99.3%	98.4%	100.0%	100.0%
2003	97.8%	98.3%	100.0%	100.0%
2004	98.7%	98.5%	100.0%	100.0%
2005	98.0%	98.6%	100.0%	100.0%
2006	97.8%	98.7%	100.0%	100.0%
2007	100.0%	99.0%	100.0%	100.0%
2008	100.0%	98.9%	99.5%	99.6%
2009	100.0%	98.9%	100.0%	100.0%
2010	100.0%	98.8%	100.0%	100.0%
2011	100.0%	98.8%	100.0%	100.0%
2012	100.0%	98.7%	100.0%	99.5%
2013	100.0%	98.6%	100.0%	99.6%
2014	100.0%	97.7%	100.0%	99.5%

Notes: this table reports the percentage of cases in which taxable income and tax liability calculated with our tax calculator is within two percent of the actual values recorded in the administrative panel dataset of tax returns. As can be seen in the table, the accuracy rates are a bit higher for taxable income compared to tax liability, and also for the period 2007-2014 compared to 1999-2006. In any case, all accuracy rates are very high, with the lowest value at 97.7 percent.

Table A.2: ETI Estimates including Lagged Splines

	Gruber-Saez		Kleven-Schultz		Weber	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(1 - \tau)$	0.408*** (0.015)	0.409*** (0.015)	0.627*** (0.019)	0.627*** (0.019)	0.644*** (0.036)	0.628*** (0.036)
$\Delta \ln(v)$			0.041*** (0.001)	0.041*** (0.001)		
Observations	3,440,136	3,440,136	3,133,430	3,133,430	2,983,196	2,983,196
Diff-in-Sargan p-value	0.00	0.00	0.00	0.00	0.23	0.20
Base-Year Splines	Lag Cubic	Lag Log	Lag Cubic	Lag Log	Lag Cubic	Lag Log
Weights	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: this table reports the elasticity of taxable income (ETI) for the period 1999-2014 including lagged splines in order to capture potential heterogeneous trends in income across groups of taxpayers during the sample period. Columns 1-2 report the estimates of the ETI applying the Gruber-Saez estimation method under two alternatives: lagged cubic splines (column 1) and lagged log splines (column 2). Columns 3-4 report the estimates of the ETI using the method from Kleven and Schultz (2014) under two alternatives: lagged cubic splines (column 3) and lagged log splines (column 4). Columns 5-6 report the estimates of the ETI using the method from Weber (2014) under two alternatives: lagged cubic splines (column 5) and lagged log splines (column 6). Standard errors clustered by taxpayer are reported in parentheses. All specifications include regional and year fixed-effects as well as controls for age, age squared, gender and indicators for joint filing, children, ascendants and the type of taxpayer according to her main source of income (employee, self-employed, saver or taxpayers with other main source of income such as capital gains). Observations in all regressions are weighted by log base-year taxable income. Significance levels: *** = 1%, ** = 5%, and * = 10%.

Table A.3: ETI Estimates in the Balanced Panel

	Gruber-Saez		Kleven-Schultz		Weber	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(1 - \tau)$	0.382*** (0.020)	0.399*** (0.020)	0.601*** (0.032)	0.622*** (0.032)	0.447*** (0.047)	0.445*** (0.047)
$\Delta \ln(v)$			0.051*** (0.003)	0.052*** (0.003)		
Observations	1,181,998	1,181,998	1,068,836	1,068,836	1,000,069	1,000,069
Diff-in-Sargan p-value	0.00	0.00	0.00	0.00	0.36	0.36
Base-Year Splines	Cubic	Log	Cubic	Log	Lag Cubic	Lag Log
Weights	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: this table reports the elasticity of taxable income (ETI) for the period 1999-2014 using the balanced panel of taxpayers included in the sample. Columns 1-2 report the estimates of the ETI applying the Gruber-Saez estimation method under two alternatives: cubic splines (column 1) and log splines (column 2). Columns 3-4 report the estimates of the ETI using the method from Kleven and Schultz (2014) under two alternatives: cubic splines (column 3) and log splines (column 4). Columns 5-6 report the estimates of the ETI using the method from Weber (2014) under two alternatives: lagged cubic splines (column 5) and lagged log splines (column 6). Standard errors clustered by taxpayer are reported in parentheses. All specifications include regional and year fixed-effects as well as controls for age, age squared, gender and indicators for joint filing, children, ascendants and the type of taxpayer according to her main source of income (employee, self-employed, saver or taxpayers with other main source of income such as capital gains). Observations in all regressions are weighted by log base-year taxable income. Significance levels: *** = 1%, ** = 5%, and * = 10%.

Table A.4: ETI Estimates including Pensioners

	Gruber-Saez		Kleven-Schultz		Weber	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(1 - \tau)$	0.429*** (0.013)	0.419*** (0.013)	0.586*** (0.017)	0.584*** (0.017)	0.625*** (0.033)	0.612*** (0.032)
$\Delta \ln(v)$			0.037*** (0.001)	0.038*** (0.001)		
Observations	4,516,638	4,516,638	3,980,947	3,980,947	3,404,067	3,404,067
Diff-in-Sargan p-value	0.00	0.00	0.00	0.00	0.78	0.79
Base-Year Splines	Cubic	Log	Cubic	Log	Lag Cubic	Lag Log
Weights	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: this table reports the elasticity of taxable income (ETI) for the period 1999-2014 considering pensioner taxpayers included in the sample. Columns 1-2 report the estimates of the ETI applying the Gruber-Saez estimation method under two alternatives: cubic splines (column 1) and log splines (column 2). Columns 3-4 report the estimates of the ETI using the method from Kleven and Schultz (2014) under two alternatives: cubic splines (column 3) and log splines (column 4). Columns 5-6 report the estimates of the ETI using the method from Weber (2014) under two alternatives: lagged cubic splines (column 5) and lagged log splines (column 6). Standard errors clustered by taxpayer are reported in parentheses. All specifications include regional and year fixed-effects as well as controls for age, age squared, gender and indicators for joint filing, children, ascendants and the type of taxpayer according to her main source of income (employee, self-employed, saver or taxpayers with other main source of income such as capital gains). Observations in all regressions are weighted by log base-year taxable income. Significance levels: *** = 1%, ** = 5%, and * = 10%.

Table A.5: ETI Estimates excluding Regional Movers

	Gruber-Saez		Kleven-Schultz		Weber	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(1 - \tau)$	0.353*** (0.014)	0.340*** (0.014)	0.547*** (0.018)	0.541*** (0.018)	0.634*** (0.036)	0.617*** (0.036)
$\Delta \ln(v)$			0.043*** (0.001)	0.043*** (0.001)		
Observations	3,956,894	3,956,894	3,490,996	3,490,996	2,946,864	2,946,864
Diff-in-Sargan p-value	0.00	0.00	0.00	0.00	0.28	0.27
Base-Year Splines	Cubic	Log	Cubic	Log	Lag Cubic	Lag Log
Weights	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: this table reports the elasticity of taxable income (ETI) for the period 1999-2014 excluding taxpayers that changed their regional fiscal residence in any year included in the sample period. Columns 1-2 report the estimates of the ETI applying the Gruber-Saez estimation method under two alternatives: cubic splines (column 1) and log splines (column 2). Columns 3-4 report the estimates of the ETI using the method from Kleven and Schultz (2014) under two alternatives: cubic splines (column 3) and log splines (column 4). Columns 5-6 report the estimates of the ETI using the method from Weber (2014) under two alternatives: lagged cubic splines (column 5) and lagged log splines (column 6). Standard errors clustered by taxpayer are reported in parentheses. All specifications include regional and year fixed-effects as well as controls for age, age squared, gender and indicators for joint filing, children, ascendants and the type of taxpayer according to her main source of income (employee, self-employed, saver or taxpayers with other main source of income such as capital gains). Observations in all regressions are weighted by log base-year taxable income. Significance levels: *** = 1%, ** = 5%, and * = 10%.