MELBOURNE INSTITUTE
Applied Economic & Social Research

Working Paper Series

The elasticity of taxable income of low-income earners: bunching evidence from Spain

Ana Gamarra
María Arrazola
José Félix Sanz-Sanz

Working Paper No. 18/22
November 2022

THE UNIVERSITY OF MELBOURNE
MELBOURNE INSTITUTE
APPLIED ECONOMIC & SOCIAL RESEARCH
60 YEARS IMPACT

The elasticity of taxable income of low-income earners: bunching evidence from Spain*

Ana Gamarra
Melbourne Institute of Applied Economic and Social Research, University of Melbourne

María Arrazola
Facultad de CC. Jurídicas y Sociales, Universidad Rey Juan Carlos, Madrid

José Félix Sanz-Sanz
Facultad de Ciencias Económicas y Empresariales, Universidad Complutense de Madrid and ICAE

Melbourne Institute Working Paper No. 18/22
November 2022

* The Version of Record of this manuscript has been published and is available in Applied Economics Journal (18 Aug 2022), http://www.tandfonline.com/10.1080/00036846.2022.2102576

Melbourne Institute: Applied Economic & Social Research
The University of Melbourne
Victoria 3010 Australia
T +61 3 8344 2100
F +61 3 8344 2111
E melb-inst@unimelb.edu.au
W melbourneinstitute.unimelb.edu.au

Abstract

This paper estimates the elasticity of taxable income (ETI) for Spain. Using the bunching approach and administrative tax data from 2008 to 2017, we find evidence of bunching at the first tax kink (ETI=0.7) and missing mass around the second tax kink (ETI=0.4). Even though we detect heterogeneity in responses depending on taxpayers' personal and family circumstances, bunching and missing mass are mostly related to labour income. The main mechanism of response for bunching is associated with the use of certain deductions and allowances, while missing mass is driven by the phase-out region of a targeted deduction for labour income.

JEL classification: H26, H24, H31

Keywords: personal income tax, elasticity of taxable income, bunching, missing mass, deduction behaviour

I. Introduction

A central topic in public finance is the study of the elasticity of taxable income (ETI). Following Feldstein (1995, 1999), the analysis of the efficiency costs of taxation has put increasing emphasis on all the potential behavioural responses to income taxation apart from labour supply. In recent years, the literature has moved towards examining the precise nature of individuals' responses, taking advantage of the development of more robust econometric methods and the availability of administrative tax data (Saez et al. 2012). One strand of this literature uses a non-parametric method—called the bunching approach—to estimate the ETI. This approach was initially proposed by Saez (2010) and then modified by Chetty et al. (2011). This method exploits the clustering behaviour of taxpayers at (convex) kinks of non-linear tax systems. It is a visual technique that relies on identifying bunching in the distribution of taxable income and has the advantage of not being susceptible to endogeneity biases, a common problem suffered by alternative estimation methods (Bosch et al. 2020). The discrete jump of marginal tax rates at bracket cut-offs (i.e. kinks) introduces taxpayers' incentive to move from a point above the cut-off to a point just below it by reducing taxable income through legal or illegal channels (Kleven 2016). Therefore, looking for bunching around kink points provides evidence of behavioural responses to taxation, and more importantly, based on Saez's (2010) work, the ETI can be inferred from the amount of excess bunching.

In the last decade, more and more studies have used this method to estimate the ETI with a special focus on the behavioural responses of taxpayers placed in the upper part of the income distribution (see Saez et al. (2012) and Kleven (2016) for a survey of earlier literature and Arrazola and Hevia (2017) for a literature review of the ETI in Spain). This paper aims to fill this gap by answering the following questions: Do low-income taxpayers respond to the Personal Income Tax (PIT)? If they do, how? We rely on the bunching approach and annual cross-section data of income tax returns from the Spanish Tax Administration and the Spanish Institute for Fiscal Studies over the 2008–2017 period. We exploit the income tax reforms of 2012 and 2015. These tax reforms are the most recent ones for which microdata is available. The 2012 reform increased the marginal tax rates for all brackets and introduced two marginal rates at the top, which intensified the progressivity of the tax. The 2015 reform, among other tax changes, reduced all income tax rates and income thresholds (from seven to five) and modified a critical standard deduction for wage earners, the standard deduction for labour income (SDL). These exogenous modifications exacerbated the incentives for strategic behaviour of taxpayers. We complement our bunching analysis by running regressions to estimate the marginal effect of the potential channels used by low-income taxpayers to bunch on the probability of reporting a taxable income around the kink point. We focus on the first two tax brackets of the Spanish PIT. These brackets are of particular interest as they compromise more than half of all taxpayers of the tax. Moreover, the first kink is where tax liability starts and the change in the net-of-tax rate is the largest (26 percentage points).

In terms of the main findings, we find significant bunching at the first kink of $b = 8.9$; that is, the number of individuals around the kink is 890 times the number of individuals that would have been present in the absence of the kink. This bunching yields an implied elasticity of $e = 0.7$. We observe this bunching grows over time and varies across different types of taxpayers. Furthermore, we investigate the mechanisms underlying this bunching. We find that standard deductions, itemized deductions, and compensation for past negative taxable income allow much of the bunching detected at the first kink. Finally, we find a non-negligible missing mass around the second tax kink of $m = 0.42$, which yields an implied elasticity of $e = 0.26$. This missing mass is predominantly detected among wage earners only in the period 2015–2017. This hole in the taxable income distribution corresponds to a loss of wage earners of 42% compared to the average counterfactual distribution. We relate the evidence of missing mass to the SDL. Taxpayers have the incentive to remain on the deduction plateau just before starting the phase-out segment introduced in 2015. This creates the missing mass that we detect in the income distribution.

The remainder of the paper is organised as follows. Section 2 develops the empirical methodology that allows the estimation of the ETI using the bunching approach. Section 3 describes the institutional setting and data. Section 4 sets out the baseline results, while Section 5 presents the potential mechanisms of response. Section 6 briefly concludes.

II. Empirical methodology

The estimation procedure used in this study follows the bunching estimation technique of Saez (2010) and Chetty et al. (2011). This method relies on the idea that kink points in the budget set elicit behavioural responses and provide a source of identification to estimate the ETI (Kleven 2016).

Consider a linear tax system $T(z) = \tau_0 z$, where τ_0 is the marginal tax rate, preferences are convex and taxable income z is smoothly distributed among the population. Suppose that a tax reform introduces a small increase in the marginal tax rate from τ_0 to τ_1 at an income level z^*, such that $z < z^*$ is taxed at τ_0 and $z > z^*$ is now taxed at τ_1. This modification introduces an incentive to individuals with $z \in [z^*, z^* + dz^*]$ to reduce their income towards z^*. The income response of these individuals creates an excess mass around z^*. Saez (2010) relates the amount of excess mass to the compensated ETI (in the absence of income effects) as follows:

$$e(z^*) = \frac{\hat{b}}{z^* \cdot log\left(\frac{1-\tau_0}{1-\tau_1}\right)} \tag{1}$$

where z^* is the point where the marginal tax rate discretely jumps (i.e. the income threshold or tax kink) and it is expressed in units of bin width, $e(z^*)$ is the compensated ETI identified locally at z^* and $\left(\frac{1-\tau_0}{1-\tau_1}\right)$ is the net-of-tax ratio associated with z^*. Note that all these parameters are directly observable, except the bunching parameter $\hat{b}$. This parameter is defined as the excess mass around the kink point relative to the average density of the counterfactual distribution in a range $[z^L, z^H]$: $\hat{b} = \frac{\hat{B}}{\sum_{k=z^L}^{z^H} \hat{c}_k / N_k}$. This range is the area around the kink point affected either because of excess mass or missing mass, i.e. the excluded range.

The excess mass is estimated as the difference between the observed and counterfactual income distributions in the excluded range: $\hat{B} = \sum_{k=z^L}^{z^H} (c_k - \hat{c}_k)$. Following Kleven and Waseem (2013)[1], missing mass is estimated as $\widehat{M} = \sum_{k=z^L}^{z^H} (\hat{c}_k - c_k)$. The counterfactual distribution is the hypothetical income distribution in the absence of the kink. The identification assumption of this research design is that this distribution is a smooth function around the kink point (Kleven 2016). We construct the counterfactual distribution from the observed income distribution fitting a flexible polynomial and excluding observations in $[z^L, z^H]$:

$$c_j = \sum_{i=0}^{q} \beta_i (z_j)^i + \sum_{k=z^L}^{z^H} \gamma_k \cdot I(z_j = k) + \varepsilon_j \tag{2}$$

where c_j is the number of individuals in bin j, z_j is the level of income relative to the kink point in bin j, q is the order of the polynomial and ε_j is the error term. The counterfactual distribution is given by the predicted values from Eq. (2), omitting the dummies in the excluded range: $\hat{c}_j = \sum_{i=0}^{q} \hat{\beta}_i (z_j)^i$. Finally, to calculate the implied elasticity, we plug $\hat{b}$ into Eq. (1). Standard errors are calculated using a bootstrap procedure.

There are three critical methodological decisions for estimation. First, following Chetty et al. (2011), we group taxpayers into income bins of €500. Second, all fitted polynomials are of degree 7. Third, in line with previous studies, we detect the excluded range $[z^L, z^H]$ by visual inspection. Tables A1 and A2 in the online Appendix present robustness checks to show that none of these choices drive our main results.

III. Institutional setting and data

Spanish Personal Income Tax

The Spanish PIT is a dual income tax system with two tax bases. The general tax base includes labour, business, movable capital (derived from intellectual and industrial property, technical assistance, renting of movable property, businesses or mines, subletting and leasing image rights), immovable capital, capital gains (not derived from the transfer of assets) and imputed income. The savings tax base includes movable capital (derived from dividends, interest, income from insurance and capitalisation operations) and capital gains (derived from transmissions and reimbursements of assets). Both tax bases are taxed at progressive rates that jump up at certain thresholds, creating kinks in the tax schedule. For our analysis, we exploit the kinks in the general tax base for identification. It is also important to note that regional governments have legislative capacity over tax rates, income thresholds, deductions, and other elements defining the PIT. Therefore, the tax rate we work with is a combination of the tax rates set by central and regional governments[2]. In addition, the Spanish PIT is fully individualised; however, there are two exceptions for joint tax filing: married couples and unmarried cohabiting couples or single taxpayers with an underage child or a disabled person.

[1] It is important to note that Kleven and Waseem (2013) apply this definition to the estimation of notches. Unlike kinks, notches create bunching below the notch point and a hole above it. Notches are the result of discrete changes in the average tax rate and are detected in the tax liability distribution. This study is not a case of notches, as missing mass is detected in the taxable income distribution below the second kink point. However, we adjust the bunching-hole method of Kleven and Waseem (2013) to the estimation of missing mass.

[2] The regional governments of Navarre and the Basque Country have full legislative capacity over the PIT. For this reason, they are not included in this study.

Taxable income

To identify the mechanisms used by taxpayers to modify their taxable income, it is crucial to know the components of this income. Table 1 provides an overview of the computation of taxable income in the general tax base, divided into five stages. The first stage sums the *gross income* from each income source considered in the general base, i.e. labour, capital (immovable and movable), business, imputed income and capital gains. Second, from each income source the related deductible expenses required to earn that income are subtracted. The resulting income is what we call *net income*. Third, specific deductions related to each income source are subtracted from each net income, resulting in the *adjusted gross income*. We name these specific deductions standard deductions. The fourth stage adds the adjusted gross income from each income source and subtracts deductions that we call itemized deductions to obtain the *base income*. Table 1 details the eight itemized deductions in the tax system; most of them are related to private pension plans. Finally, *taxable income* from the general tax base results from subtracting the allowance for past negative taxable income from the base income. Taxable income is then taxed with the progressive tax schedule illustrated in Fig. 2. The result is further reduced by applying the tax schedule to the personal and family allowances. Unlike most tax systems where these allowances reduce gross income before applying the tax schedule, in the Spanish PIT these allowances take the form of 'non-genuine' allowances or tax credits, and are obtained in parallel to the computation of taxable income (Sanz-Sanz 2016). Importantly, the tax process continues, and further deductions and tax credits are applied until we yield the tax due. Finally, it is worth mentioning that during our period of study, the definition of the main components of taxable income did not change.

Table 1. Definitions of taxable income.

Gross income
(-) Deductions for income-related expenses
Net income
(-) Standard deductions or income-specific deductions
Adjusted gross income
(-) Itemized deduction for joint tax filing
(-) Itemized deduction for pension plans
(-) Itemized deduction for pension plans of the spouse
(-) Itemized deduction for pension plans to systems in favour of persons with disabilities
(-) Itemized deduction for contributions to protected assets of persons with disabilities
(-) Itemized deduction for maintenance paid and alimonies
(-) Itemized deduction for fees to political parties
(-) Itemized deduction for pension plans of athletes
Base income
(-) Allowance for past negative taxable income
Taxable income

The standard deduction for labour income

A critical standard deduction for our analysis is the SDL, also known as the general reduction for labour income. Adjusted gross labour income results from adding gross labour income minus deductible labour expenses minus the SDL. This deduction is applied to positive net labour income, conditional that the resulting income is not negative. The maximum annual amount of the SDL is €4,080 in 2008–2014, and €3,700 in 2015–2017, see Fig. 1. The 2015 tax reform modified this deduction substantially and turned it into a sizeable general tax deduction for low-wage earners. Two modifications are of particular interest for our analysis: the increment of the phase-out rate from 0.35 to 1.15625 and the introduction of an upper bound for net labour income at €14,450 and other rents at €6,500, see Fig. 1.

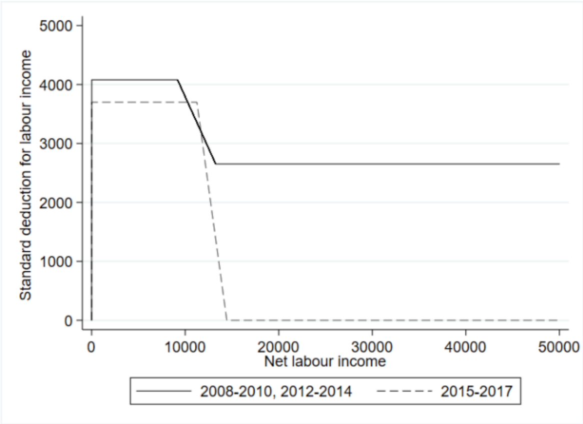


Figure 1. Standard Deduction for Labour Income.

Tax reforms

The Spanish PIT schedule has been subject to several changes over the 2008–2017 period. This study focuses on two core reforms of the PIT, the 2012 and 2015 tax reforms, carried out by the central government. Both were implemented in the context of the European Sovereign Debt Crisis. The 2012 tax reform increased the marginal tax rates for all brackets and introduced two marginal rates at the top, leaving the tax schedule for the general taxable income with seven tax brackets, see Fig. 2 (panel A). Fig. 2 captures only the first four tax brackets, as our analysis focuses on the first two kinks. The year 2015 was a year of reforms in the PIT, and for our analysis we exploit two major changes: the reduction of all income tax rates and income thresholds (from seven to five), see Fig. 2 (panel B), and the modification of the SDL, described above. The pre- and post-reform tax schedules are shown in Fig. 2 for three periods: 2008–2010, 2012–2014 and 2015–2017. Note that marginal tax rates and income thresholds remain constant within each period.

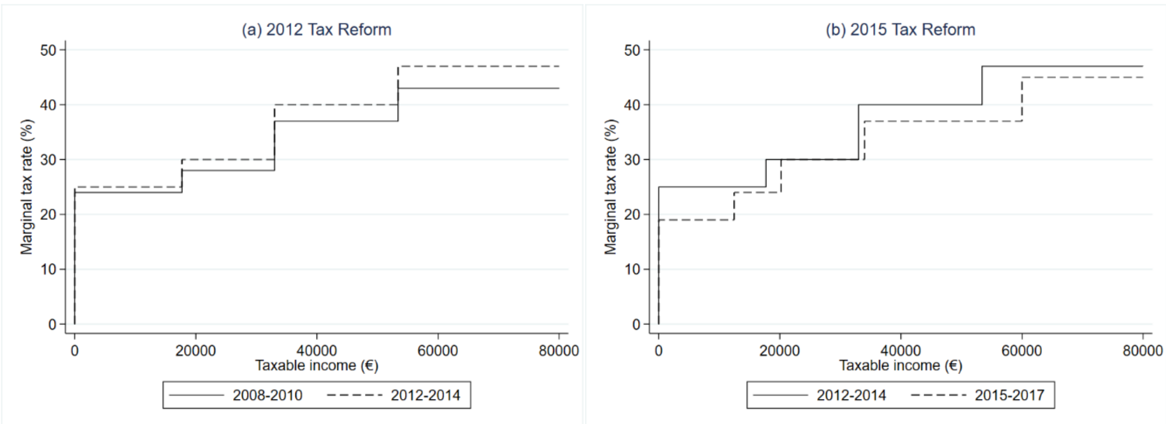


Figure 2. Tax Schedule 2008–2017.

Data

We use tax return microdata for the period 2008–2017, collected and prepared by the Spanish Tax Administration and the Institute for Fiscal Studies. It is an annual cross-section sample with sampling weights to reflect the distribution of income tax returns of the entire population, with an approximate number of 1.9 million annual observations that represent approximately 16 million taxpayers per year (see Table 2). An advantage of working with this type of data is that reported income represents the exact amount of taxable income the individual is due, and hence measurement error is minimal.

The data contain variables corresponding to all income sources, deductions and demographic information that we exploit in the study. All income concepts are directly observed in the tax return data.

Table 2 reports the mean and the standard deviation of each income concept in 2008–2010, 2012–2014 and 2015–2017. Over the whole period, the average amounts of gross income, net income, adjusted gross income, base income and taxable income are €23,739, €22,275, €19,630, €18,699 and €18,687, respectively.

We restrict the estimation sample as follows. First, we exclude individuals under 16 years old and above 65 to consider taxpayers of working age and non-pensioners. Second, we adjust all monetary variables for inflation. Third, because households with one breadwinner mostly choose joint filing, we consider the tax return the unit of analysis. Finally, we do not exclude taxpayers with negative taxable (or gross) income because our study focuses on bunching at the first income threshold.

Table 2. Summary Statistics.

	2008-2010		2012-2014		2015-2017	
	Mean	SD	Mean	SD	Mean	SD
Gross income	24,323	34,952	22,879	35,160	24,016	60,734
Net income	22,888	34,458	21,440	34,645	22,498	60,438
Adjusted gross income	20,220	34,458	18,796	34,699	19,873	60,622
Base income	19,185	34,001	17,884	34,280	19,029	60,371
Taxable income	19,173	33,997	17,871	34,278	19,015	60,370
Observations	4,821,725		5,544,727		6,931,141	
Population	48,928,564		47,504,277		47,677,398	

IV. Behavioural responses

This section provides evidence for excess mass at the first tax kink and missing mass around the second tax kink. Following Chetty et al. (2011), we calculate the difference between income and the respective tax kink each year. We then group individuals into €500 bins and quantify excess mass and missing mass by estimating a seventh-order polynomial to the observed income distribution using Eq. (2). The identification assumption underlying our estimates for excess mass and missing mass is that the income distribution would be smooth without the kink point.

First tax kink

We start our analysis by providing evidence for bunching at the first tax kink for the entire population. In Figure 3 we pool all years of data in three periods: 2008–2010 (panel A), 2012–2014 (panel B) and 2015–2017 (panel C). Note that marginal tax rates and income thresholds remain constant within each period. Each panel shows the observed taxable income distribution (blue line) around the first threshold (vertical line) as well as the estimated counterfactual distribution (red line). Figure 3 reveals a clear spike at the first kink point of the PIT in the three periods, although it is more pronounced in 2015–2017 compared to the other periods. Accordingly, the estimated excess mass is 6.61 (in 2008–2010), 8.85 (in 2012–2014) and 11.14 (in 2015–2017), and it is narrowly focused at the kink. When considering the change in the net-of-tax rate, this excess mass implies an ETI of 0.48 (in 2008–2010), 0.62 (in 2012–2014) and 1.06 (in 2015–2017). Many reasons could explain this sharp bunching. First, it is the largest and most salient kink in the budget set. Therefore it entails the largest distortions. Second, this point is precisely where taxable income starts to become positive. Third, because most PIT payers are at the bottom tail of the taxable income distribution, the first kink point has the largest share of taxpayers. Table A1 in the online Appendix presents several robustness checks to examine the sensitivity of our main result to three aspects of the estimation: the width of the excluded range (panel B), the order of the polynomial (panel C) and the choice of the bin width (panel D). Panel A shows the baseline result for the entire population for comparison. In general, the sensitivity analysis shows that the variation in the size of these parameters has a negligible impact on ETI estimates[3].

Annual graphs for 2008 to 2017 are reported in Figure B1 in the online Appendix. We observe that bunching follows a growing trend throughout the period, but it is more pronounced in 2015-2017. In non-reform years (2008 to 2010), bunching is between 6.43 and 6.69, and steadily increases to 8.56 following the 2012 tax reform. Bunching jumps considerably in 2015 to 10.93 and continues to increase to 11.58 in 2017. The elasticity follows a similar pattern; it grows from 0.47 in 2008 to 0.59 in 2012 and 1.10 in 2017. The persistent bunching at the first kink and its significant growth in years soon after the two reforms reflect a short-term adjustment to the reforms. This reaction speed points to low adjustment costs or inattention biases in bunching estimates and suggests that behavioural changes may be driven by compliance and real responses.

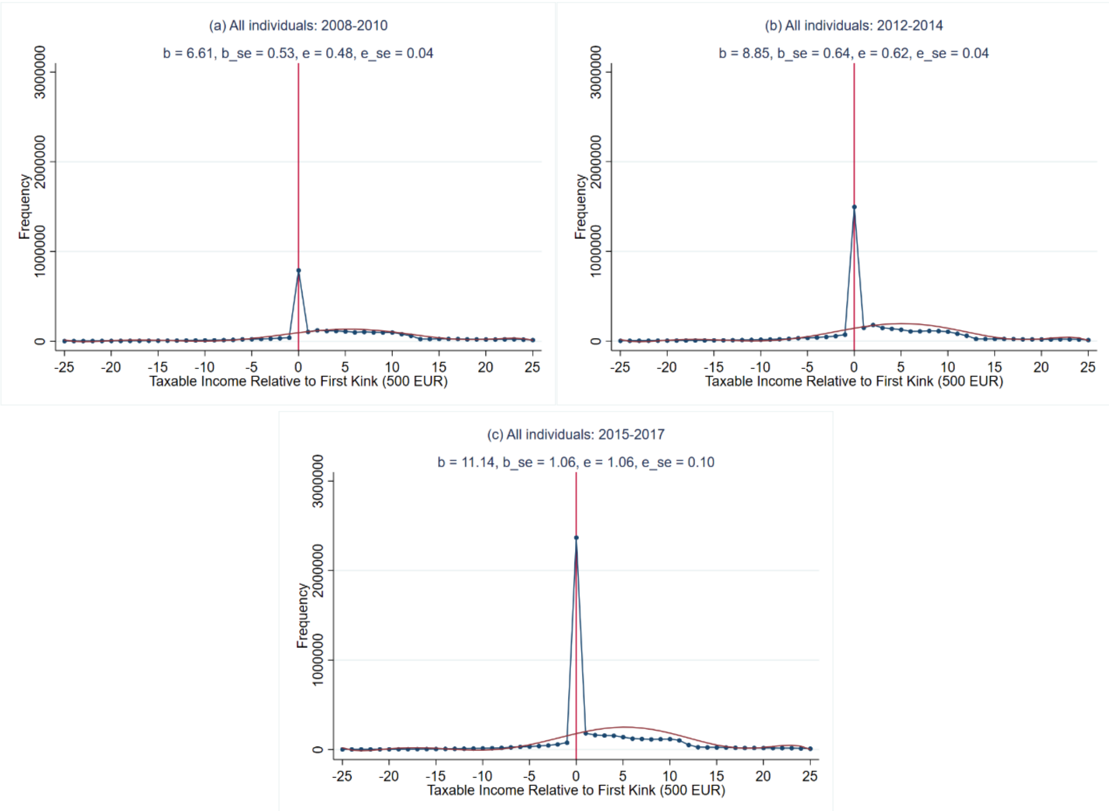


Figure 3. Excess Mass at the First Kink, All Individuals.

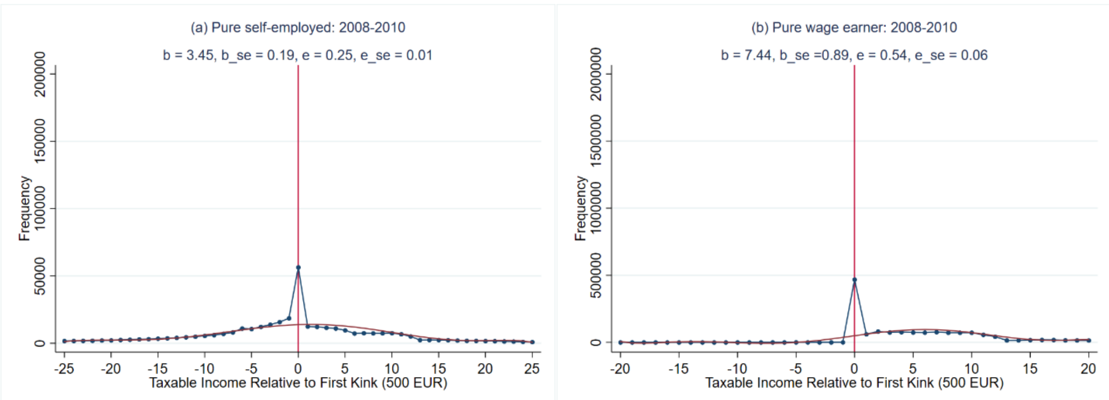
Heterogeneity in responses

We next examine heterogeneity in bunching by dividing the population into several groups. Figure 4 reports behavioural responses according to taxpayers' income source, by which we compare pure wage earners (defined as taxpayers whose only income source is labour) and pure self-employed (defined as taxpayers whose only income source is business). The estimated excess mass at the first kink is more than three times larger in pure wage earners than in pure self-employed: 7.44 versus 3.45 (in 2008–2010), 11.02 versus 3.27 (in 2012–2014) and 14.10 versus 3.12 (in 2015–2017). In contrast with the previous literature (Saez 2010;

[3] However, the choice of the bin width has an impact on excess mass. As noted in previous studies (Saez 2010, Bosch et al. 2020, Devereux et al. 2014, Adam et al. 2021), bunching is not a spike at the kink point, but rather a cluster around a kink. The presence of adjustment costs, psychological components, optimization frictions, imperfect forecast of income, and incomplete information about the exact kink location impede taxpayers to bunch exactly at the kink. When this happens, the choice of the bin width become relevant in the estimation of bunching.

Bastani and Selin 2014; Le Maire and Schjerning 2013), bunching at the first kink is higher among those with labour income. However, wage earners being more sensitive to taxation than the self-employed is a result that has also been obtained by recent studies, e.g. Bergolo et al. (2019) and Paetzold (2019). Self-employed individuals have greater opportunities to adjust their taxable income as they lack third-party reporting, but wage-earners may benefit more from several deductions related to labour income in the Spanish PIT, as we show in Section 5.

Table 3 presents estimates of the responses for other groups of the population[4]. There is significant heterogeneity in the responsiveness to the PIT among certain groups. This finding confirms that many factors other than income affect individuals' tax liability, such as taxpayers' circumstances. Panel A illustrates that bunching for taxpayers above age 40 is slightly larger than for those below that age (on average, 8.82 versus 8.48). This result can be explained by the fact that income is lower at the beginning of working life; hence, young taxpayers are generally more constrained from adjusting their taxable income (Arrazola et al. 2014; Sanz-Sanz et al. 2015; Bergolo et al. 2019). In terms of gender, we might expect more significant responses to the first kink for women than men considering that the former is more likely to be second or part-time earners, and hence they may have more flexibility in the choice of working hours and income decisions (Pillay 2020; Bosch et al. 2020; Paetzold 2019). Contrary to our expectation, panel B shows that the excess mass for men is larger relative to women (on average, 10.48 versus 7.33). The most plausible explanation is that what underlies men's responses is probably tax compliance decisions rather than labour supply decisions (Alinaghi et al. 2021). In Spain, the composition of the household plays a vital role in the determination of tax liability. In households with a single breadwinner, men are often the principal income earner. As illustrated in panel C, there are also differences across marital status: unmarried taxpayers are slightly more responsive than married couples (on average, 8.65 versus 8.40). This finding is in line with previous evidence for Spain, such as studies by Diaz-Caro and Onrubia (2018), Sanz-Sanz et al. (2015) and Arrazola et al. (2014). Panel D shows that joint filers are more responsive than single filers (on average, 9.38 versus 8.46). Joint filing has several benefits, such as the deduction for joint declaration (between €2,150 and €3,400) and the possibility of shifting deductions among couples. We next split the population depending on whether the taxpayer has a descendant or an ascendant. Panel E shows that taxpayers with no descendant are slightly more responsive than those with one or more descendants; the excess mass is on average 9.02 and 8.23, respectively. Panel F displays that taxpayers with ascendants are more sensitive to taxation than those with no ascendants (on average, 9.65 versus 8.87). Finally, we divide the sample into two groups depending on taxpayers' place of residence. Panel G shows that the excess mass is higher for taxpayers living in a wealthy region such as Andalusia, Madrid, Catalonia or Valence (on average, 10.05 versus 7.67). This geographic heterogeneity in bunching could be partly because of income distribution differences among regions.



[4] Graphs for these groups are available from the authors on request.

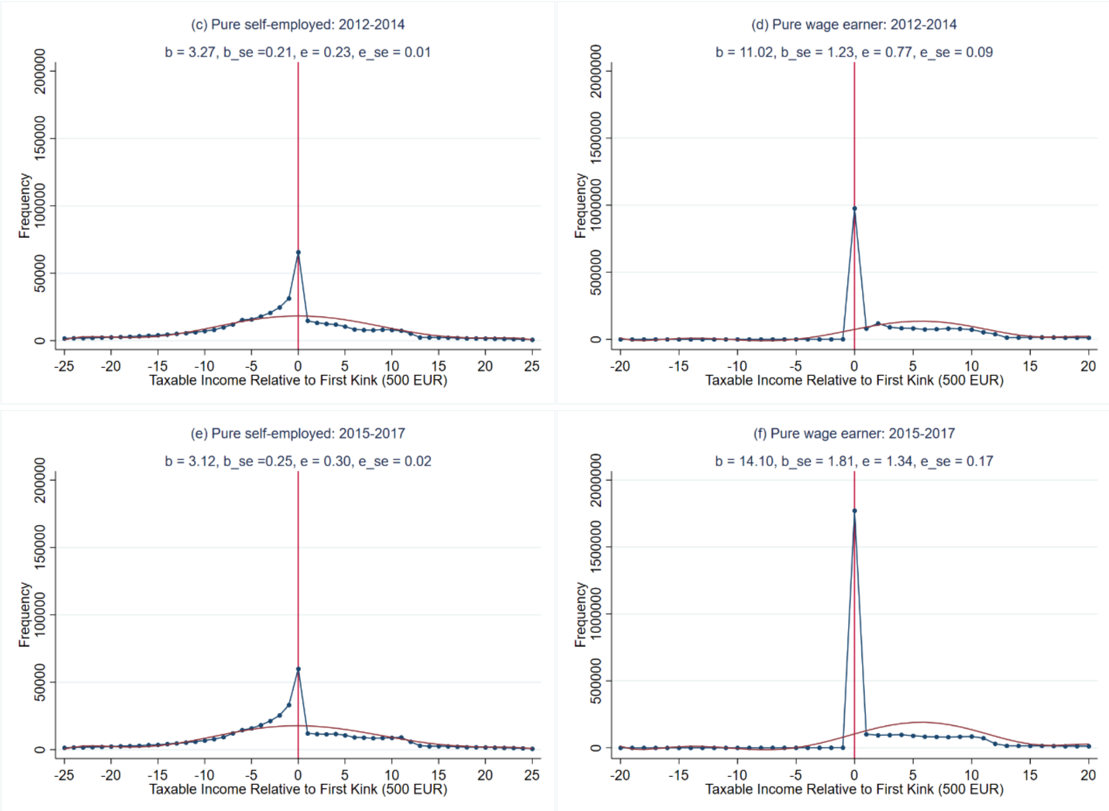


Figure 4. Excess Mass at the First Kink, Pure Self-employed *versus* Pure Wage Earners.

Table 3. Heterogeneity of Excess Mass.

	2008-2010				2012-2014				2015-2017			
	b	b (s.e.)	e	e (s.e.)	b	b (s.e.)	e	e (s.e.)	b	b (s.e.)	e	e (s.e.)
Panel A. Age												
≤ 40	6.17	0.58	0.45	0.04	8.72	0.70	0.61	0.05	10.57	1.13	1.00	0.11
> 40	6.89	0.56	0.50	0.04	8.53	0.75	0.59	0.05	11.04	0.90	1.05	0.09
Panel B. Gender												
Men	8.59	0.68	0.63	0.05	10.36	0.87	0.72	0.06	12.50	1.13	1.19	0.11
Women	4.90	0.44	0.36	0.03	7.33	0.61	0.51	0.04	9.76	0.87	0.93	0.08
Panel C. Marital Status												
Married	6.58	0.65	0.48	0.05	8.25	0.83	0.57	0.06	10.37	0.99	0.98	0.09
Unmarried	6.33	0.50	0.46	0.04	8.72	0.66	0.61	0.05	10.91	1.07	1.04	0.10
Panel D. Filing status												
Joint	8.57	1.61	0.62	0.12	9.51	2.17	0.66	0.15	10.05	2.22	0.95	0.21
Single	5.39	0.63	0.39	0.05	8.52	0.69	0.59	0.05	11.48	1.03	1.09	0.10
Panel E. Descendants												
>= 1	5.75	0.54	0.42	0.04	8.23	0.70	0.57	0.05	10.73	0.97	1.02	0.09
= 0	7.03	0.56	0.51	0.04	8.99	0.70	0.63	0.05	11.03	1.07	1.05	0.10
Panel F. Ascendants												
>= 1	6.08	0.55	0.44	0.04	10.40	0.93	0.72	0.06	12.48	1.16	1.18	0.11

= 0	6.62	0.54	0.48	0.04	8.85	0.68	0.62	0.05	11.13	1.02	1.06	0.10
Panel G. Region												
Rich	7.50	0.51	0.55	0.04	9.96	0.68	0.69	0.05	12.70	1.12	1.21	0.11
Poor	5.80	0.56	0.42	0.04	7.74	0.66	0.54	0.05	9.46	0.84	0.90	0.08

Second tax kink

In this section, we present evidence of missing mass around the second tax kink. Figure 5 shows the observed taxable income distribution (blue line) around the second threshold (vertical line) as well as the estimated counterfactual distribution (red line) for the entire population in 2015 (panel A), 2016 (panel B) and 2017 (panel C). In what follows, we will focus exclusively on the years 2015 to 2017 because no missing mass is detected in 2008–2014 (see Figure C1 in the online Appendix). The estimated missing mass is 0.90 in 2015, 0.63 in 2016 and 0.52 in 2017, translating into an implied elasticity of 0.57, 0.40 and 0.33, respectively. Table A2 in the online Appendix shows several robustness checks regarding the width of the excluded range, the order of the polynomial and the choice of the bin width. The evidence of missing mass is found across all these specifications, without exception, indicating that the main result is largely robust to varying these parameters[5].

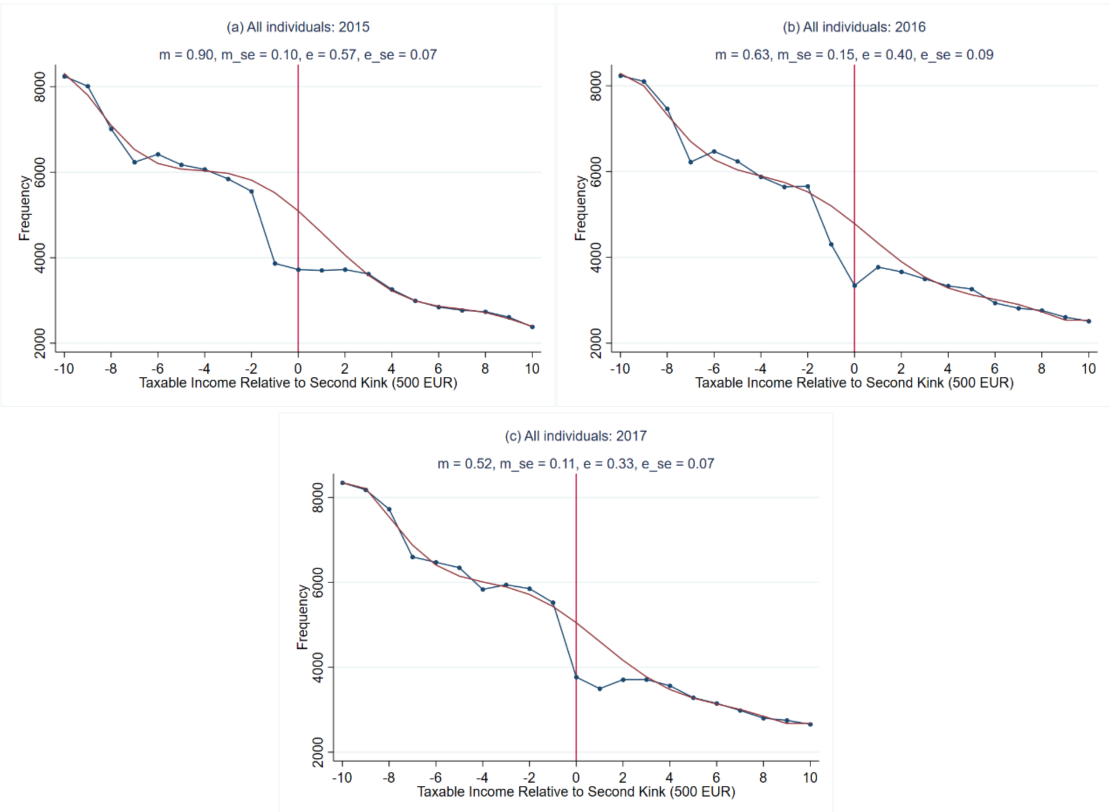


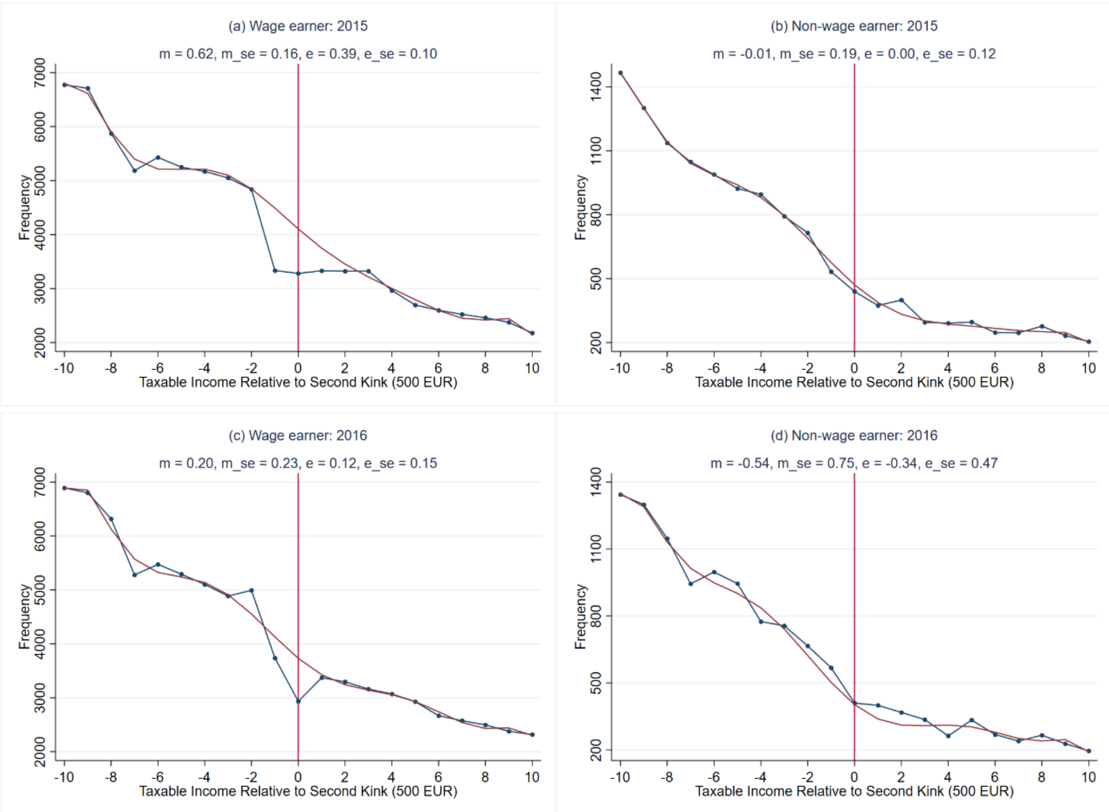
Figure 5. Missing Mass around the Second Kink, All Individuals.

Heterogeneity in responses

Figure 6 divides the taxpayer population into wage earners (defined as taxpayers with labour income) and non-wage earners (defined as taxpayers with no labour income). The difference between these two groups

[5] However, as noted above, in the presence of asymmetric missing mass, the choice of the bin width becomes relevant in the estimation of this parameter.

is noticeable: the wage earners distribution (left column) displays sharp missing mass around the second kink point while there is nothing in the distribution of non-wage earners (right column). The estimated missing mass on average over the entire period is 0.42 for wage earners and -0.29 for non-wage earners, which yields an implied elasticity of 0.26 and -0.18, respectively. Table 4 presents estimates of the responses for other groups of the population[6]. Heterogeneous responses by marital status (unmarried $m = 0.50$ versus married $m = 0.22$), number of descendants (with descendants $m = 0.17$ versus without descendants $m = 0.53$) and number of ascendants (with ascendants $m = 1.62$ versus without ascendants $m = 0.34$) identified at the first tax kink remain at the second. However, unlike the first kink, we observe significant differences by gender (men $m = 0.30$ versus women $m = 0.40$), by age (young $m = 0.50$ versus old $m = 0.23$), by filing status (joint filers m =-0.09 versus single filers $m = 0.56$) and by place of residence (rich $m = 0.24$ versus poor $m = 0.40$). These results can be explained by the fact that women, young individuals, single filers and taxpayers living in poor regions are more likely to have labour income as their primary (or only) income source. As a result, these groups are more affected by the phase-out region of the SDL.



[6] Graphs for these groups are available from the authors on request.

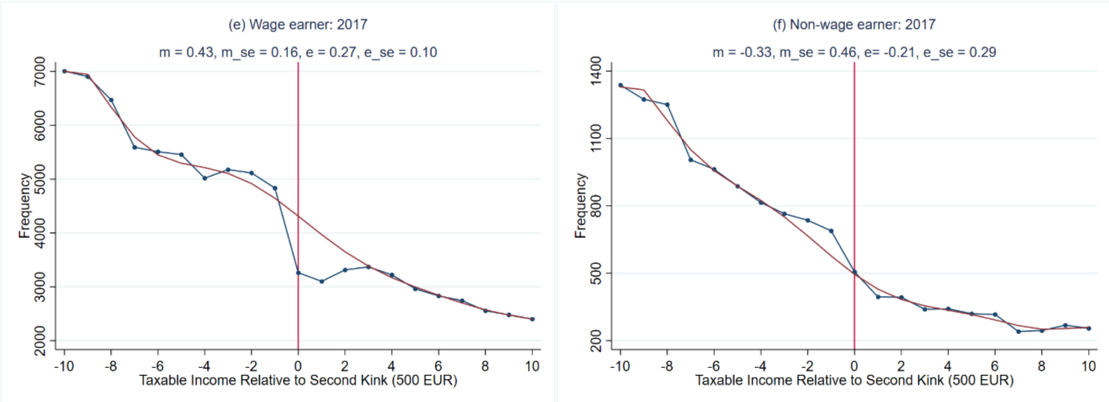


Figure 6. Missing Mass around the Second Kink, Wage Earners *versus* Non-wage Earners.

Table 4. Heterogeneity of Missing Mass.

	2015				2016				2017			
	m	m (s.e.)	e	e (s.e.)	m	m (s.e.)	e	e (s.e.)	m	m (s.e.)	e	e (s.e.)
Panel A. Age												
≤ 40	0.75	0.13	0.47	0.08	0.24	0.22	0.15	0.14	0.50	0.16	0.32	0.10
> 40	0.40	0.16	0.26	0.10	0.04	0.26	0.03	0.16	0.26	0.26	0.16	0.16
Panel B. Gender												
Men	0.45	0.18	0.29	0.12	-0.02	0.24	0.01	0.15	0.48	0.24	0.30	0.15
Women	0.69	0.11	0.44	0.07	0.33	0.29	0.21	0.18	0.17	0.25	0.11	0.16
Panel C. Marital Status												
Married	0.28	0.27	0.18	0.17	-0.10	0.46	0.06	0.29	0.49	0.31	0.31	0.20
Unmarried	0.92	0.08	0.58	0.05	0.43	0.20	0.27	0.12	0.15	0.24	0.10	0.15
Panel D. Filing status												
Joint	0.00	0.56	0.00	0.35	-0.45	0.76	0.28	0.48	0.19	0.58	0.12	0.37
Single	0.83	0.07	0.53	0.04	0.41	0.14	0.26	0.09	0.44	0.11	0.28	0.07
Panel E. Descendants												
>= 1	0.22	0.22	0.14	0.14	0.04	0.34	0.03	0.21	0.27	0.31	0.17	0.19
= 0	0.91	0.08	0.57	0.05	0.22	0.24	0.14	0.15	0.46	0.09	0.29	0.06
Panel F. Ascendants												
>= 1	1.56	0.82	0.98	0.52	1.54	0.77	0.97	0.49	1.77	0.80	1.11	0.50
= 0	0.55	0.14	0.35	0.09	0.13	0.23	0.08	0.15	0.34	0.17	0.21	0.11
Panel G. Region												
Rich	0.55	0.12	0.35	0.08	-0.09	0.40	0.05	0.25	0.26	0.25	0.17	0.16
Poor	0.55	0.18	0.34	0.11	0.24	0.19	0.15	0.12	0.41	0.14	0.26	0.09

V. Anatomy of behavioural responses

The previous section offered visual evidence and estimations of a sharp bunching at the first kink in the Spanish PIT and a non-negligible missing mass around the second kink. We also presented some evidence of heterogeneous responses, especially according to taxpayers' income source. In this section, we go one step further and examine the potential mechanisms behind these behavioural responses.

Excess Mass

Many factors interact to determine taxpayers' tax liability, such as income tax law provisions, statutory tax rates, and taxpayers' circumstances. In our case, three provisions in the PIT system considerably affect taxable income: standard deductions, itemized deductions, and the allowance for past negative taxable income. The leading hypothesis for this section is that Spanish taxpayers indeed use these three components of the PIT law to reduce their income and bunch at the first tax kink. Because tax law provisions interact with taxpayers' socio-economic characteristics, we detect heterogeneity in the use of these three components. We provide different avenues to test this heterogeneity. Our first test consists of replicating the bunching analysis using four concepts of income: net income (gross income minus deductible expenses), adjusted gross income (net income minus standard deductions), base income (adjusted gross income minus itemized deductions) and taxable income (base income minus the allowance for past negative taxable income). Comparing these four concepts of income can provide preliminary evidence of the components involved in the bunching response observed in Section 4.

We observe in Table 5 (panel A) that bunching grows throughout the components of taxable income. Accordingly, the estimated excess mass on average over the entire period for the whole population is 3.57 (net income), 7.11 (adjusted gross income), 8.80 (base income) and 8.87 (taxable income). The elasticity follows a similar pattern. Table 5 (panel B) shows no sign of bunching at the first kink in the net income distribution for pure wage earners; the estimated excess mass is on average -0.59. Before considering the standard and itemized deductions, there is no evidence of a behavioural response to the PIT.

In contrast, after considering standard deductions (i.e. using adjusted gross income), there is a clear bunching pattern around the first threshold. The excess mass using adjusted gross income is 6.81 (in 2008–2010), 10.82 (in 2012–2014) and 15.60 (in 2015–2017). Bunching gets even higher when we consider itemized deductions (i.e. using base income). There is almost no difference in bunching estimates for base income—7.43, 11.01 and 14.09—and taxable income—7.44, 11.02 and 14.10; bunching is equally high for both. This preliminary evidence does not allow us to claim that bunching at the first kink point is driven exclusively by standard deductions because taxable income is defined as a combination of many components. Nevertheless, it suggests that these deductions play a fundamental role in explaining the bunching behaviour of pure wage earners since there is no sign of bunching around the first kink without them. The importance of deductions as a mechanism behind taxpayers' responsiveness has also been analysed in Doerrenberg et al. (2017) for Germany and Almunia and López-Rodríguez (2019) for Spain. Table 5 (panel C) compares the bunching patterns for pure self-employed. Bunching at the first kink is small for net income and adjusted gross income; it is on average 1.09 and 1.13, respectively. That is, before considering itemized deductions, behavioural responses to the PIT are negligible. On the contrary, bunching grows after considering these deductions (i.e. using base income). Bunching estimates for base income are three times the estimates for adjusted gross income: 3.29 versus 0.63 (in 2008–2010), 3.11 versus 1.39 (in 2012–2014) and 2.94 versus 1.38 (in 2015–2017). The difference between the adjusted gross income distribution and the base income distribution suggests using itemized deductions as a mechanism to locate just at the kink or below it. This result coincides with Bergolo et al. (2019) and Paetzold (2019). Table 5 (panel B) shows as well that bunching in the taxable income distribution is slightly higher than in the base income distribution: 3.45 versus 3.29 (in 2008–2010), 3.27 versus 3.11 (in 2012–2014) and 3.12 versus 2.94 (in 2015–2017). That is, bunching increases slightly when we consider the allowance for past negative taxable income. This difference is only detected for pure self-employed and supports our hypothesis that some taxpayers use this tax provision strategically to adjust their taxable income. We refer to this allowance as income shifting because taxpayers can either (i) shift past income to the current tax year and reduce their current tax liability or (ii) shift current income to the next four years and reduce their future tax liability given that current taxable income is zero. The possibility of intertemporal income shifting among business earners coincides with Le Maire and Schjerning (2013) and Miller et al. (2019).

A 'non-negative' income rule in the Spanish PIT says that deductions and allowances cannot make the resulting income negative. To discard the possibility of a mechanical bunching derived from this rule, our second test consists of estimating bunching at 0€ taxable income, excluding taxpayers whose reported deductions (not those effectively applied) exceed their income. In doing so, we keep (i) taxpayers who consciously bunch at 0€ as their reported deductions coincide with their income and (ii) taxpayers who locate close to 0€ as a result of applying these deductions. Table A3 in the online Appendix shows that bunching estimates, as well as ETI estimates, are robust when excluding these taxpayers. Therefore, bunching in the Spanish PIT is not the result of a mechanical application of deductions and allowances.

Finally, Table 6 reports OLS regressions with a dummy for locating in the excluded range around the first tax kink on various dummy covariates[7]. The table shows results for the entire population, for pure self-employed and pure wage earners in 2008–2010, 2012–2014 and 2015–2017. The dummy covariates we consider are filing status, marital status, age, number of descendants, number of ascendants, gender and region. Standard errors are clustered on tax units. The following main findings emerge from the table. First, consistent with our hypothesis, standard deductions are positively correlated with locating near the first tax kink for pure wage earners. Second, pure self-employed who use itemized deductions or shift income have a higher probability of having an annual taxable income around the first kink point. The largest effect occurs in 2015–2017 for both groups. Third, family structure is also correlated with bunching behaviour. In general, unmarried taxpayers, joint filers, men, individuals with no descendants, individuals with ascendants and taxpayers living in rich regions are more likely to report incomes near the first kink. This last finding confirms the heterogeneous responses detected in Section 4.

In sum, these additional tests support the findings discussed in the previous section using the ETI. Deductions and income shifting are the result of a voluntary and strategic decision of taxpayers. Taxpayers use these options to adjust their reported income and reduce their tax liability by locating just at the first tax kink or around it. Therefore, they are part of the main channels to explain bunching responses at the first kink.

[7] A drawback in the data is that we have no information about the standard deductions from business income. Therefore, the dummy variable *Stand* represents only standard deductions from labour income.

Table 5. Mechanisms for Excess Mass.

	2008-2010				2012-2014				2015-2017			
	b	b (s.e.)	e	e (s.e.)	b	b (s.e.)	e	e (s.e.)	b	b (s.e.)	e	e (s.e.)
Panel A. All population												
Net income	5.04	1.29	0.37	0.09	3.31	0.70	0.23	0.05	2.37	1.04	0.23	0.10
Adjusted gross income	4.19	0.61	0.31	0.04	7.02	0.60	0.49	0.04	10.11	1.00	0.96	0.10
Base income	6.54	0.49	0.48	0.04	8.78	0.67	0.61	0.05	11.07	0.98	1.05	0.09
Taxable income	6.61	0.53	0.48	0.04	8.85	0.64	0.62	0.04	11.14	1.06	1.06	0.10
Panel B. Pure wage earners												
Net income	0.02	2.15	0.00	0.16	0.05	4.84	0.00	0.34	-1.83	1.00	-0.17	0.09
Adjusted gross income	6.81	1.35	0.50	0.10	10.82	1.50	0.75	0.10	15.60	2.54	1.48	0.24
Base income	7.43	0.80	0.54	0.06	11.01	1.18	0.77	0.08	14.09	1.98	1.34	0.19
Taxable income	7.44	0.89	0.54	0.06	11.02	1.23	0.77	0.09	14.10	1.81	1.34	0.17
Panel C. Pure self-employed												
Net income	0.64	0.22	0.05	0.02	1.35	0.25	0.09	0.02	1.30	0.27	0.12	0.03
Adjusted gross income	0.63	0.23	0.05	0.02	1.39	0.24	0.10	0.02	1.38	0.28	0.13	0.03
Base income	3.29	0.20	0.24	0.01	3.11	0.20	0.22	0.01	2.94	0.25	0.28	0.02
Taxable income	3.45	0.19	0.25	0.01	3.27	0.21	0.23	0.01	3.12	0.25	0.30	0.02

Missing mass

Many factors apart from income levels and taxpayers' circumstances determine the rate that applies to the last euro of a taxpayer's taxable income. Those factors are, for instance, the credits and deductions applied over specific income ranges, as the SDL. The SDL is a deduction for wage earners, and hence, it is wider in scope as it affects a large number of taxpayers in the Spanish PIT; i.e. wage earners represent 90% of our whole sample. The leading hypothesis for this section is that workers have a clear incentive to stay on the deduction plateau just before the application of the phase-out segment of the SDL, to benefit from the highest amount of the deduction. This incentive creates the missing mass that we detect in the income distribution. We believe that taxpayers do this by manipulating their reported income through real behavioural responses and evasion. We provide different avenues to test this hypothesis.

The phasing in and out of the SDL can make the statutory marginal rate differ from the effective marginal tax rate (EMTR). The EMTR is the type of tax rate that most directly affects the choices of individuals, and a modification of this rate can give strong incentives to taxpayers to reallocate their income. The SDL phase-out region starts at a net labour income level of €9,180 in 2008–2014 and €11,250 in 2015–2017. The sudden start of the phase-out creates a convex kink at these income levels (see Figure 1). For taxpayers with net labour income in this region, the EMTR is equivalent to the statutory rate plus the statutory rate multiplied by the phase-out rate (the rate at which the deduction phases out). Figure 7 shows a simulation of the EMTRs that taxpayers face on net labour income under the tax laws of 2008–2010 (panel A), 2012–2014 (panel B) and 2015–2017 (panel C). This figure illustrates that taxpayers with labour income in the phase-out region (in dashes) bore an EMTR of 32% in 2008–2010, 34% in 2012–2014 and 41–52% in 2015–2017. However, in a hypothetical scenario without the SDL, the statutory rates (in solid) would be 24% in 2008–2010, 25% in 2012–2014 and 19–24% in 2015–2017.

The 2015 tax reform increases the phase-out rate from 0.35 to 1.15625. Beginning in 2015 the deduction phases out at a rate of 22–28 cents for each euro of net labour income between €11,250 and €14,450. In other words, if a taxpayer in the phase-out region earns an additional euro of net labour income, his or her deduction would shrink by 22–28 cents. This modification makes this region undesirable for wage earners who respond by not locating themselves there. Indeed, this region coincides with the location of the missing mass.

In addition, the SDL phase-out region is equivalent to an increase in the marginal tax rate at €9,180 in 2008-2010, €9,180 in 2012-2014, €11,250 and €14,450 in 2015-2017 (see Figure 7). At these thresholds the marginal tax rate jumps discretely from 24 to 32% in 2008-2010, from 25 to 34% in 2012-2014, and from 19 to 41% and from 41 to 52% in 2015-2017. A discrete increase in the marginal tax rate induces a change in taxable income based on the bunching approach. Therefore, the SDL phase-out region produces a sensitivity that we exploit for the estimation of the ETI. This elasticity is 0.08 in 2008-2010, 0.13 in 2012-2014 and 0.14-0.28 in 2015-2017. This means that for each 1% increase of the SDL phase-out region, income decreases by 8% in 2008-2010, 13% in 2012-2014 and 14-28% in 2015-2017. In 2015-2017, the sensitivity of wage earners to the SDL phase-out region is higher than in previous years. This higher sensitivity supports our hypothesis that in 2015-2017 wage earners have more incentives to avoid this region, either because of its perverse effect on the magnitude of the EMTRs or to benefit from the highest amount of the SDL.

Table 6. Determinants of Excess Mass.

	All individuals			Pure self-employed			Pure wage earners		
	2008-2010	2012-2014	2015-2017	2008-2010	2012-2014	2015-2017	2008-2010	2012-2014	2015-2017
Constant	0.33***	0.36***	0.37***	-0.00**	0.00**	0.01***	-0.02	0.17**	0.05*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.04)	(0.08)	(0.03)
Item	-0.07***	-0.07***	-0.11***	0.09***	0.11***	0.13***	-0.03***	-0.07***	-0.11***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Stand	-0.10***	-0.08***	0.06***				0.25***	0.14*	0.42***
	(0.00)	(0.00)	(0.00)				(0.04)	(0.08)	(0.03)
Shift	-0.26***	-0.27***	-0.33***	0.03***	0.04***	0.05***	0.12**	-0.01	0.09***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.05)	(0.07)	(0.03)
Joint	0.37***	0.43***	0.48***	0.18***	0.17***	0.16***	0.38***	0.50***	0.56***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Married	-0.07***	-0.09***	-0.11***	0.02***	0.01***	0.00	-0.05***	-0.09***	-0.11***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Descendants	-0.09***	-0.07***	-0.07***	-0.03***	-0.02***	-0.01***	-0.10***	-0.08***	-0.08***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ascendants	-0.06***	-0.00	0.01**	-0.01*	-0.00	0.01	-0.04***	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Men	-0.00*	0.01***	0.01***	0.01***	0.01***	0.00	0.03***	0.03***	0.04***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Region	0.01***	0.01***	0.00***	-0.01***	-0.00***	-0.01***	0.00***	0.00	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	2,105,320	3,169,565	3,728,426	312,749	393,921	389,114	1,141,725	1,758,124	2,272,452
R-squared	0.10	0.11	0.10	0.17	0.18	0.17	0.09	0.11	0.09
F statistic	6,806	12,491	15,322	1,705	1,522	1,685	7,185	15,103	15,365

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

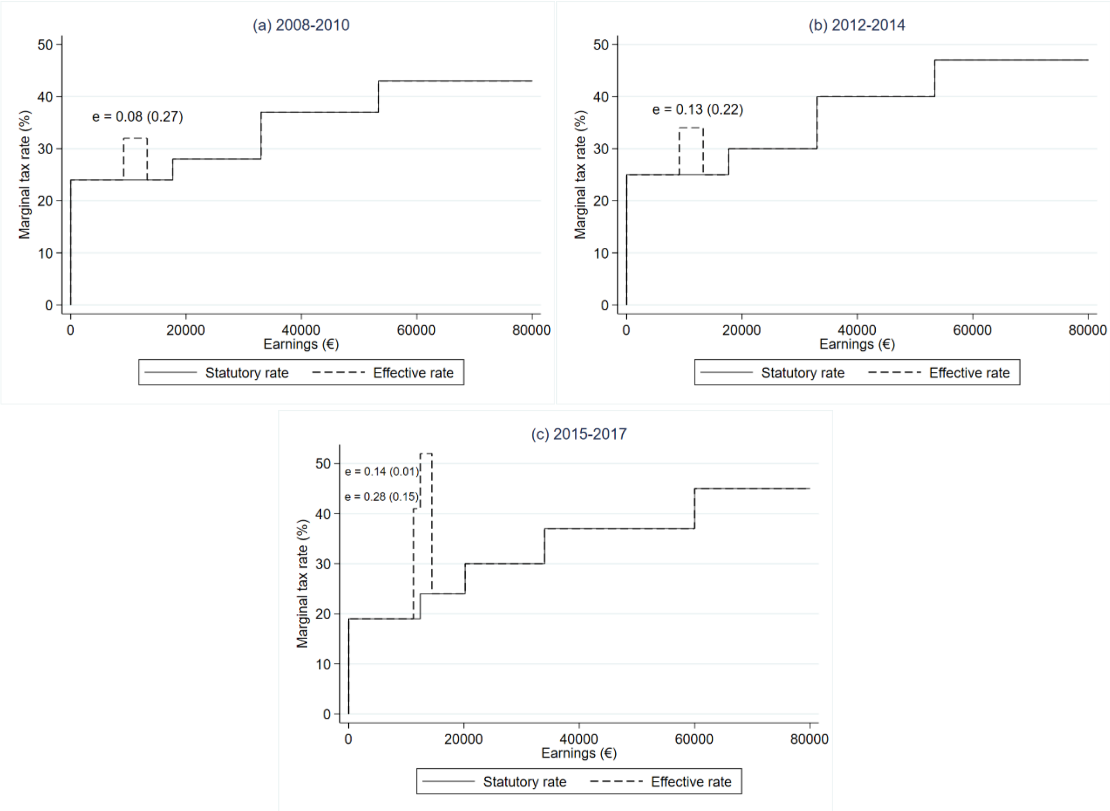


Figure 7. Statutory and Effective Marginal Tax Rates.

Finally, we replicate the bunching analysis of Section 4 using two different income concepts: net labour income before SDL—i.e. gross labour income minus deductible expenses—and net labour income after SDL—i.e. gross labour income minus deductible expenses minus SDL. Figure 8 shows a clear hole between €5,500 and €12,500 in both distributions, especially in the net labour income distribution before SDL (left column). This evidence suggests that the missing mass is the result of a strategic decision; wage earners have the incentive to report taxable income at a certain threshold. They can do this, for instance, in collusion with their employers, under-reporting or modifying their working hours. To reinforce this idea, Table 7 reports the results of OLS regressions with a dummy for reporting an income above €5,500 conditional on being a wage earner in 2008–2010, 2012–2014 and 2015–2017. The dummy covariates we consider are filing status, marital status, age, number of descendants, number of ascendants, gender and region. Consistent with our hypothesis, wage earners who use the SDL in 2015-2017 are less likely to locate above €5,500, which is precisely where the missing mass begins. In other words, Table 7 shows that wage earners in 2015-2017 have the disincentive of being above €5,500. This result is not observed in previous years.

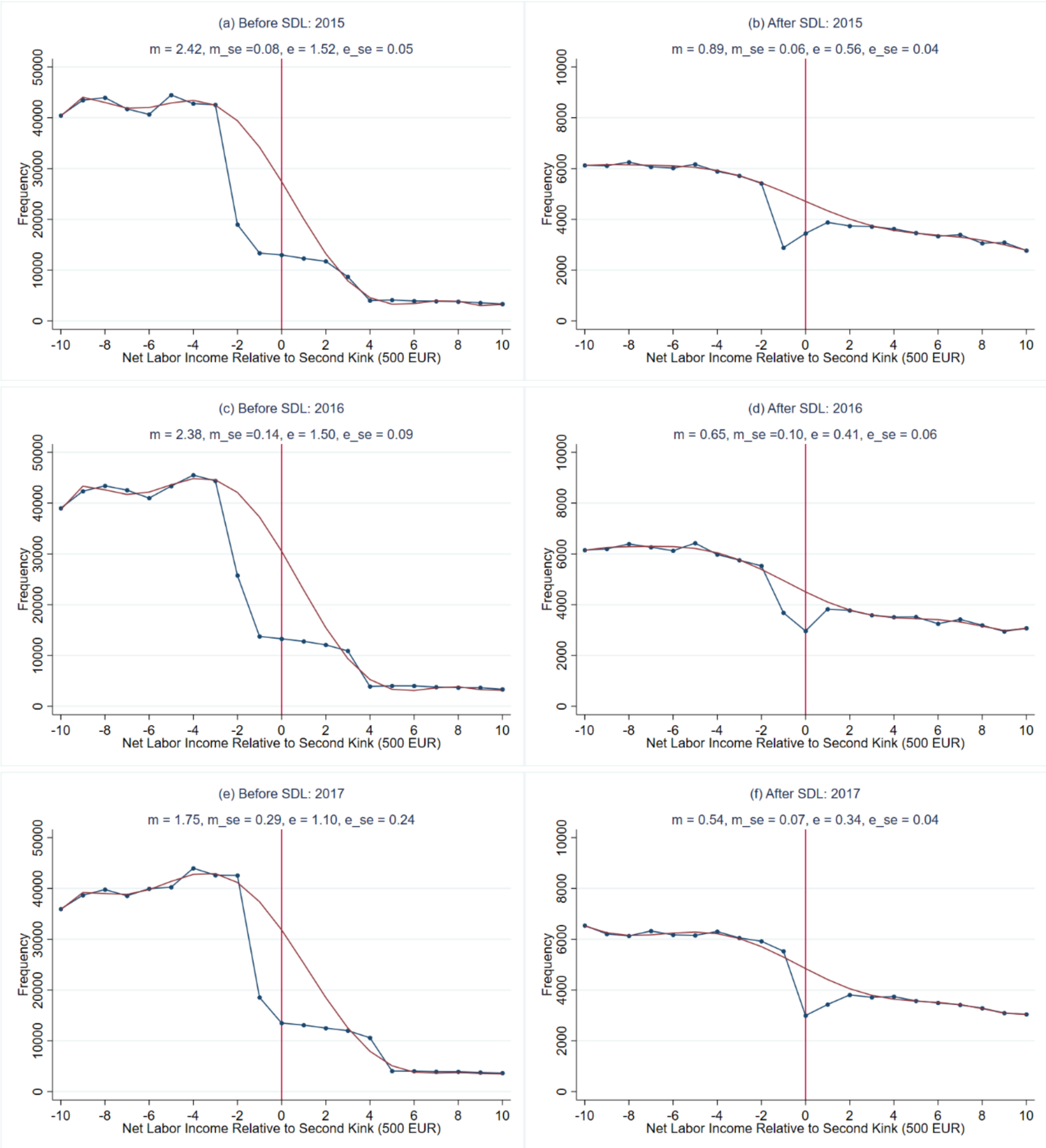


Figure 8. Mechanisms for Missing Mass.

Table 7. Determinants of Missing Mass.

	2008-2010	2012-2014	2015-2017
Constant	0.33***	0.25***	0.92***
	(0.02)	(0.02)	(0.00)
SDL	0.41***	0.45***	-0.62***
	(0.02)	(0.02)	(0.00)
Joint	-0.07***	-0.06***	-0.05***
	(0.00)	(0.00)	(0.00)
Married	0.03***	0.05***	0.03***
	(0.00)	(0.00)	(0.00)
Age > 40	-0.01***	-0.04***	-0.01***
	(0.00)	(0.00)	(0.00)
Descendants	0.05***	0.06***	0.05***
	(0.00)	(0.00)	(0.00)

Ascendants	0.08***	0.10***	0.05***
	(0.00)	(0.01)	(0.00)
Men	0.11***	0.08***	0.02***
	(0.00)	(0.00)	(0.00)
Region	0.02***	0.02***	-0.00***
	(0.00)	(0.00)	(0.00)
Observations	4,014,461	4,494,748	5,785,695
R-squared	0.03	0.02	0.48
F statistic	2992	1791	78282

*** p<0.01, ** p<0.05, * p<0.1

VI. Conclusions

This study used the bunching approach to estimate the ETI from administrative personal income data for the Spanish taxpayer population from 2008 to 2017. This paper exploited two major reforms introduced during this period that had different effects on the tax schedule: a tax increase in 2012, a tax cut and a deduction modification in 2015. These exogenous variations created room for strategic behaviour of taxpayers. Results were obtained based on observed responses in the first two tax brackets of the income tax schedule and for various taxpayer classifications. In addition, to complement bunching analysis, we ran regressions to estimate the marginal effect of the potential mechanisms on the probability of reporting a taxable income around the kink.

We found substantial bunching at the first kink of $b = 8.9$, with an implied elasticity of 0.7 for the entire period. Further differences in personal and family characteristics were examined, strongly supporting the hypothesis that the ETI varies across different types of taxpayers. The 2012 and 2015 tax reforms allowed investigation of the dynamics of bunching. Bunching grows over the period considered, especially in years soon after the reforms. Investigating the potential mechanisms that drive bunching responses, we found that three components of taxable income play an important role: standard deductions, itemized deductions and the allowance for past negative taxable income. Bunching analysis and a number of regressions supported the hypothesis that these components are the major response mechanisms at the first kink. In addition, we detected substantial missing mass around the second kink point only in the period 2015–2017 and predominately among wage earners. For the entire population missing mass is $m = 0.7$, and the implied elasticity is $e = 0.4$. Further exploration of the potential mechanisms behind missing mass confirmed that the SDL could discourage wage earners from reporting income in the SDL phase-out region. This creates the hole we observe in the taxable income distribution around the second tax kink.

Acknowledgements

The authors thank the Instituto de Estudios Fiscales (IEF) for providing access to the administrative tax data. We have benefited from the seminar participants of the 75th Annual Congress of the International Institute of Public Finance (Glasgow, August 2019) and the 2019 European Job Market.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the Fundación de las Cajas de Ahorros (FUNCAS).

ORCID

Ana Gamarra ID: http://orcid.org/0000-0002-5585-1027

María Arrazola ID: http://orcid.org/0000-0002-4407-9510
José Félix Sanz-San ID: http://orcid.org/0000-0002-5633-8807

References

Adam, S., Browne, J., Phillips, D. & Roantree, B. (2021). Frictions and taxpayer responses: evidence from bunching at personal tax thresholds. *Int Tax Public Finance 28,* 612–653.

Alinaghi, N., Creedy, J. & Gemmell, (2021). Elasticities of taxable income and adjustment costs: bunching evidence from New Zealand. *Oxford Economic Papers*, 1-26.

Almunia, M. & López-Rodríguez, D. (2019). The elasticity of taxable income in Spain: 1999-2014. *SERIEs, 10,* 281-320.

Arrazola, M. & Hevia, J. (2017). La elasticidad de la renta declarada: concepto, relevancia y resultados para España. *Papeles de Economía Española, 154,* 144-159.

Arrazola, M., Hevia, J., Sanz-Sanz, J.F. & Romero, D. (2014). *Personal Income Tax and the elasticity of Reported Income to Marginal Tax Rates: An Empirical Analysis Applied to Spain*. Working Paper 3593, Victoria University of Wellington, Chair in Public Finance.

Bastani, S. & Selin, H. (2014). Bunching and non-bunching at kink points of the Swedish tax schedule. *Journal of Public Economics, 109,* 36-49.

Bergolo, M., Burdin, G., De Rosa, M., Giaccobasso, M. & Leites, M. (2019). *Tax bunching at the Kink in the Presence of Low Capacity of Enforcement: Evidence From Uruguay*. IZA Discussion Papers, 12286, Institute of Labor Economics (IZA), Bonn.

Bosch, N., Dekker, V. & Strohmaier, K. (2020). A Data-Driven Procedure to Determine the Excluded range-An Application for the Netherlands. *International Tax Public Finance, 27,* 951-979.

Chetty, R., Friedman, J., Olsen, T. & Pistaferri, L. (2011). Adjustment Costs, Firm Responses, and Micro versus Macro Labor Supply Elasticities: Evidence from Danish Tax Record. *Quarterly Journal of Economics, 126*, 749-804.

Devereux, M. P., Liu, L., & Loretz, S. (2014). The elasticity of corporate taxable income: New evidence from UK tax records. *American Economic Journal: Economic Policy, 6,* 19–53.

Diaz-Caro, C. & Onrubia, J. (2018). How do taxable income responses to marginal tax rates differ by sex, marital status and age? Evidence from Spanish dual income tax. Econ Open-Access Open-Assess J12(2018–67), 1–24

Doerrenberg, P., Peichl, A. & Siegloch, S. (2017). The elasticity of taxable income in the presence of deduction possibilities, *Journal of Public Economic, 151*, 41-55.

Feldstein, M. (1995). The Effect of Marginal Tax Rates on Taxable Income: A Panel Study of the 1986 Tax Reform Act. *Journal of Political Economy, 103*, 551-572.

Feldstein, M. (1999). Tax Avoidance and the Deadweight Loss of the Income Tax. *Review of Economics and Statistics, 81*, 674-680.

Kleven, H.J. & Waseem, M. (2013). Using Notches to Undercover Optimisation Frictions and Structural Elasticities: Theory and Evidence from Pakistan. *Quarterly Journal of Economics, 128,* 669-723.

Kleven, H.J (2016). Bunching. *Annual Review of Economics, 8,* 435-464.

Le Maire, D. & Schjerning, B. (2013). Tax bunching, income shifting and self-employment. *Journal of Public Economics, 107*, 1-18.

Miller, H., Pope, T. & Smith, K. (2019). *Intertemporal income shifting and the taxation of owner-managed businesses.* IFS Working Paper WP19/25.

Paetzold, J. (2019). How do taxpayers respond to a large kink? Evidence on income and deduction behavior from Austria. *International Tax Public Finance, 26,* 167–197.

Pillay, N. (2020). *Taxpayer responsiveness to taxation: Evidence from bunching at kink points of the South African income tax schedule*. WIDER Working Paper, World Institute for Development Economic Research (UNU-WIDER).

Saez, E. (2010). Do taxpayers Bunch at Kink Points? *American Economic Journal: Economic Policy, 2,* 180-212.

Saez, E., Slemrod, J. & Giertz, S. H. (2012). The Elasticity of Taxable Income with Respect to Marginal Tax Rates: A critical review. *Journal of Economic Literature, 50*, 3-50.
Sanz-Sanz, J. F., Arrazola, M., Rueda-López, N. & Romero-Jordán, D. (2015). Reported gross income and marginal tax rates: estimation of the behavioural reactions of Spanish taxpayers. *Applied Economics, 47,* 466-484.
Sanz-Sanz, J.F. (2016). The Laffer curve in schedular multi-rate income taxes with non-genuine allowances: An application to Spain. *Economic Modelling*, 55, 42-56.

Appendix A

Table A1. Sensitivity Analysis, Excess Mass.

Period	Excluded range	Polynomial order	Bin width	b	b (s.e.)	e	e (s.e.)
Panel A. Baseline							
2008-2010	[-2, 2]	7	500	6.612	0.534	0.482	0.040
2012-2014	[-2, 2]	7	500	8.854	0.644	0.616	0.047
2015-2017	[-2, 2]	7	500	11.138	1.056	1.057	0.096
Panel B. Varying excluded range							
2008-2010	[-1, 1]	7	500	6.780	0.498	0.494	0.036
2012-2014	[-1, 1]	7	500	8.559	0.771	0.595	0.054
2015-2017	[-1, 1]	7	500	11.533	1.079	1.095	0.102
2008-2010	[-3, 3]	7	500	6.184	0.495	0.451	0.036
2012-2014	[-3, 3]	7	500	8.578	0.715	0.596	0.050
2015-2017	[-3, 3]	7	500	10.644	0.935	1.010	0.089
Panel C. Varying polynomial order							
2008-2010	[-2, 2]	6	500	6.413	0.947	0.467	0.069
2012-2014	[-2, 2]	6	500	8.597	1.314	0.598	0.091
2015-2017	[-2, 2]	6	500	10.809	1.984	1.026	0.188
2008-2010	[-2, 2]	8	500	7.095	0.724	0.517	0.053
2012-2014	[-2, 2]	8	500	9.092	0.903	0.632	0.063
2015-2017	[-2, 2]	8	500	11.404	1.394	1.082	0.132
Panel D. Varying bin width							
2008-2010	[-20, 20]	7	50	66.695	1.748	0.486	0.013
2012-2014	[-20, 20]	7	50	83.530	3.178	0.581	0.022
2015-2017	[-20, 20]	7	50	113.612	3.245	1.078	0.031
2008-2010	[-10, 10]	7	100	33.988	1.186	0.495	0.017
2012-2014	[-10, 10]	7	100	42.546	1.847	0.592	0.026
2015-2017	[-10, 10]	7	100	56.698	2.362	1.076	0.045
2015-2017	[-4, 4]	7	250	13.464	0.744	0.491	0.027
2015-2017	[-4, 4]	7	250	17.802	1.037	0.619	0.036
2015-2017	[-4, 4]	7	250	22.527	1.418	1.069	0.067
2015-2017	[-1, 1]	7	1000	3.194	0.343	0.466	0.050
2015-2017	[-1, 1]	7	1000	4.383	0.436	0.609	0.061
2015-2017	[-1, 1]	7	1000	5.457	0.660	1.036	0.125

Notes: Note that varying the bin width but fixing the excluded range automatically changes the width of the bunching window, so to (approximately) fix the width of the bunching window when changing the bin width, we also change the number of excluded bins.

Table A2. Sensitivity Analysis, Missing Mass.

Period	Excluded range	Polynomial order	Bin width	m	m (s.e.)	e	e (s.e.)
Panel A. Baseline							
2015	[-2, 2]	7	500	0.898	0.104	0.566	0.066
2016	[-2, 2]	7	500	0.631	0.149	0.398	0.093
2017	[-2, 2]	7	500	0.524	0.114	0.330	0.067
Panel B. Varying excluded range							
2015	[-1, 1]	7	500	0.656	0.059	0.413	0.037
2016	[-1, 1]	7	500	0.583	0.079	0.368	0.050
2017	[-1, 1]	7	500	0.387	0.070	0.244	0.044
2015	[-3, 3]	7	500	1.201	0.193	0.757	0.122
2016	[-3, 3]	7	500	1.078	0.283	0.679	0.178
2017	[-3, 3]	7	500	0.586	0.239	0.369	0.150
Panel C. Varying polynomial order							
2015	[-2, 2]	6	500	0.896	0.125	0.565	0.079
2016	[-2, 2]	6	500	0.628	0.187	0.396	0.118
2017	[-2, 2]	6	500	0.521	0.147	0.328	0.092
2015	[-2, 2]	8	500	0.550	0.145	0.346	0.092
2016	[-2, 2]	8	500	0.122	0.245	0.077	0.154
2017	[-2, 2]	8	500	0.354	0.168	0.223	0.106
Panel D. Varying bin width							
2015	[-20, 20]	7	50	7.604	0.625	0.479	0.039
2016	[-20, 20]	7	50	5.923	0.669	0.373	0.042
2017	[-20, 20]	7	50	4.735	0.661	0.298	0.042
2015	[-10, 10]	7	100	3.815	0.350	0.479	0.044
2016	[-10, 10]	7	100	2.942	0.365	0.369	0.046
2017	[-10, 10]	7	100	2.309	0.388	0.290	0.049
2015	[-4, 4]	7	250	1.580	0.190	0.496	0.060
2016	[-4, 4]	7	250	1.221	0.270	0.383	0.085
2017	[-4, 4]	7	250	0.934	0.208	0.293	0.065
2015	[-1, 1]	7	1000	0.422	0.000	0.552	0.000
2016	[-1, 1]	7	1000	0.282	0.000	0.369	0.000
2017	[-1, 1]	7	1000	0.353	0.000	0.462	0.000

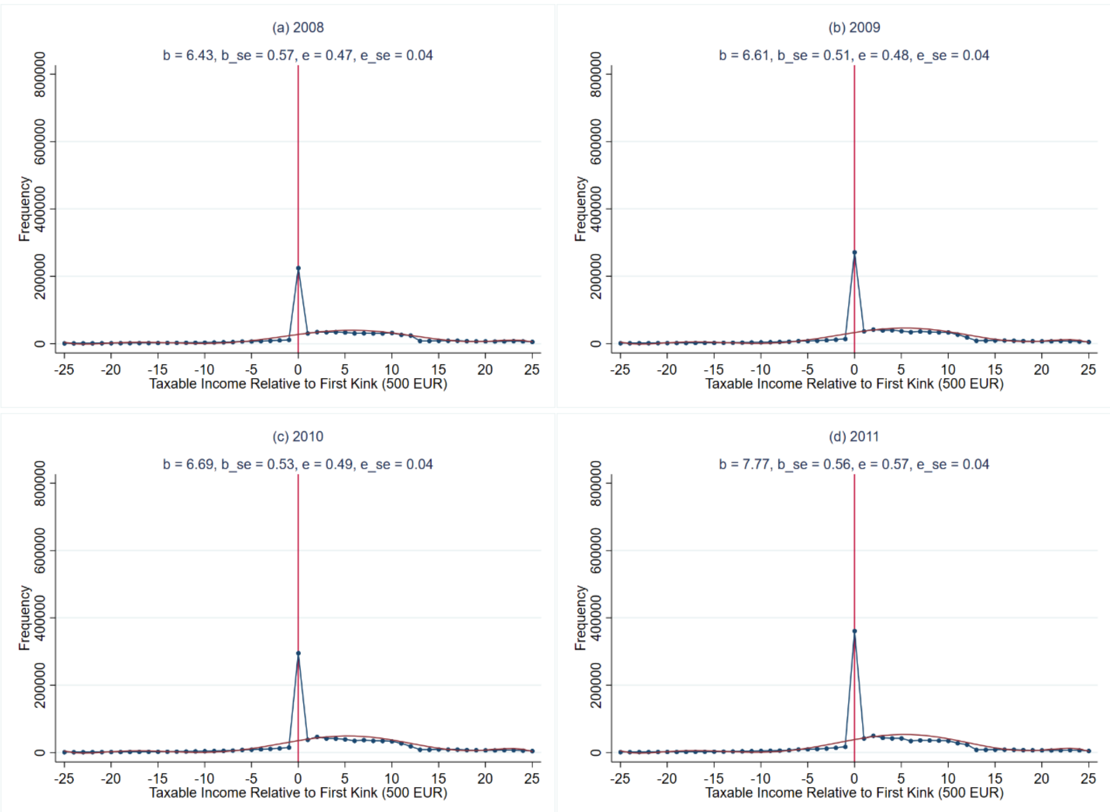
Notes: Note that varying the bin width but fixing the excluded range automatically changes the width of the bunching window, so to (approximately) fix the width of the bunching window when changing the bin width, we also change the number of excluded bins.

Table A3. Robustness checks, Excess Mass.

Period	Excluded range	Polynomial order	Bin width	b	b (s.e.)	e	e (s.e.)
Panel A. Baseline							

2008-2010	[-2, 2]	7	500	6.612	0.534	0.482	0.039
2012-2014	[-2, 2]	7	500	8.854	0.644	0.616	0.045
2015-2017	[-2, 2]	7	500	11.138	1.056	1.057	0.100
Panel B. Excluding net income < reported standard deductions							
2008-2010	[-2, 2]	7	500	6.703	0.618	0.488	0.045
2012-2014	[-2, 2]	7	500	8.993	0.744	0.625	0.052
2015-2017	[-2, 2]	7	500	11.375	1.170	1.080	0.111
Panel C. Excluding adjusted gross income < reported itemized deductions							
2008-2010	[-2, 2]	7	500	4.702	0.440	0.343	0.032
2012-2014	[-2, 2]	7	500	7.562	0.593	0.526	0.041
2015-2017	[-2, 2]	7	500	10.298	0.850	0.977	0.081
Panel D. Excluding base income < reported allowance for past negative taxable income							
2008-2010	[-2, 2]	7	500	6.612	0.499	0.482	0.036
2012-2014	[-2, 2]	7	500	8.854	0.695	0.616	0.048
2015-2017	[-2, 2]	7	500	11.138	1.033	1.057	0.098
Panel E. Excluding net labour income < reported SDL							
2008-2010	[-2, 2]	7	500	6.645	0.520	0.484	0.038
2012-2014	[-2, 2]	7	500	8.923	0.695	0.620	0.048
2015-2017	[-2, 2]	7	500	11.201	0.990	1.063	0.094

Appendix B



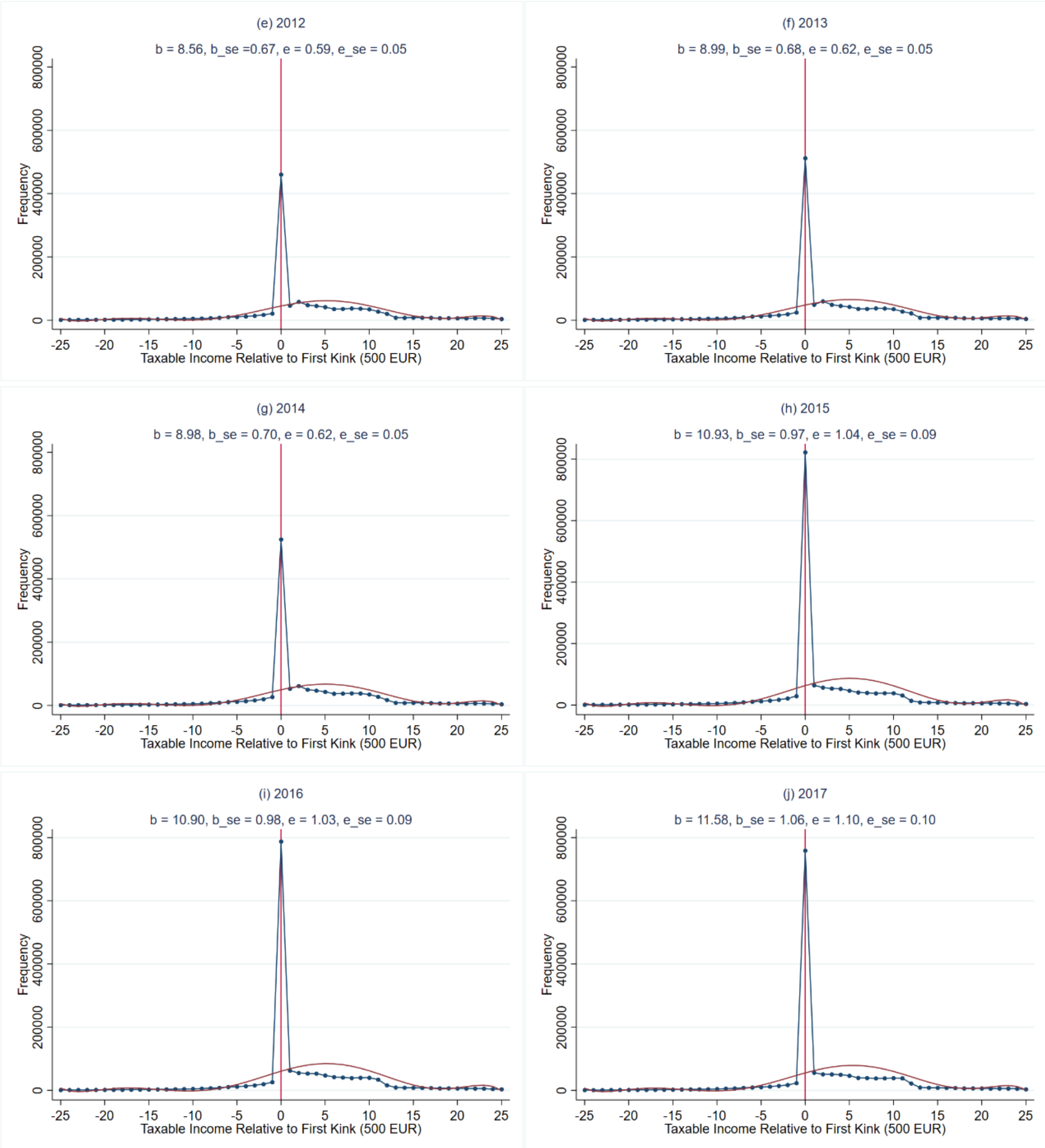
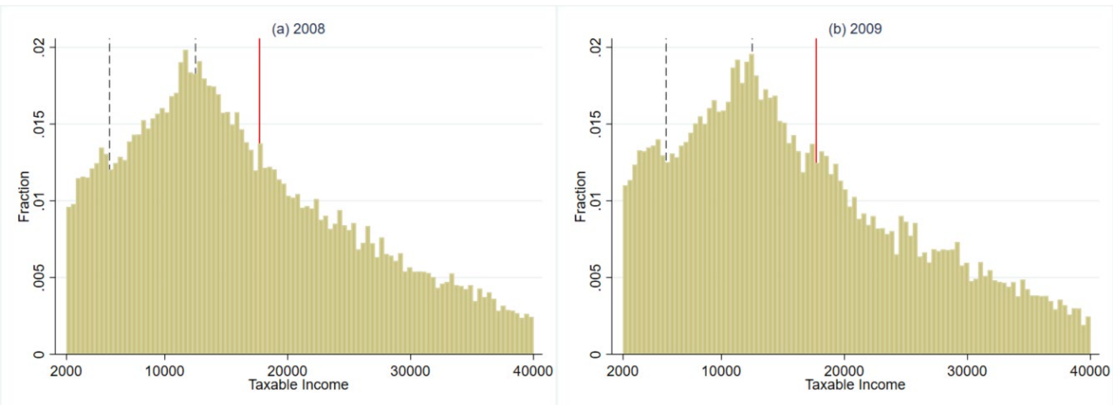


Figure B1. Dynamics of Bunching, First Kink.

Appendix C



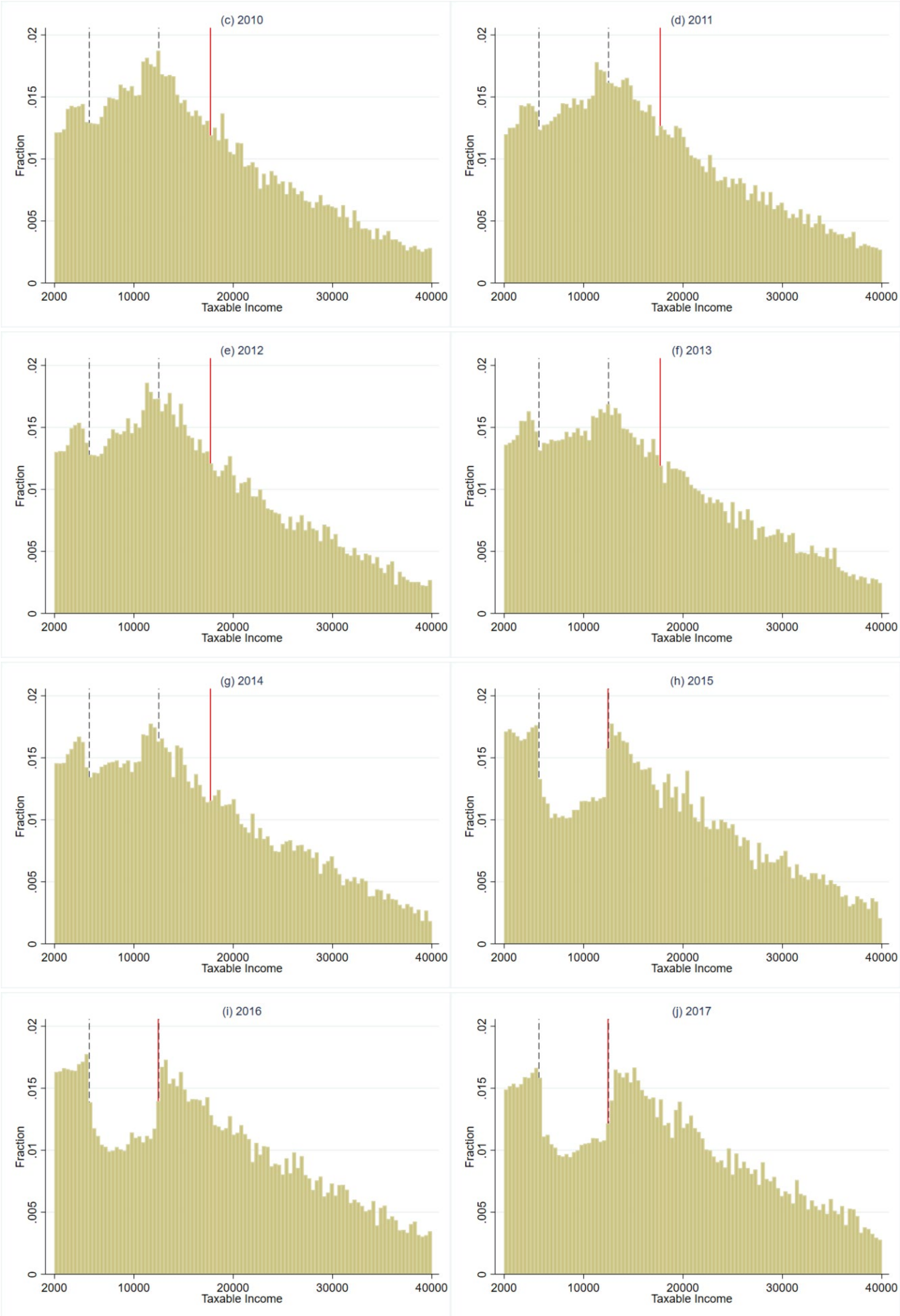


Figure C1. Dynamics of Missing Mass, Second Kink.

THE UNIVERSITY OF MELBOURNE

MELBOURNE INSTITUTE
APPLIED ECONOMIC & SOCIAL RESEARCH

60 YEARS IMPACT