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Behavioral Cross-Influence of a Shadow Tax Bracket: Evidence from Bunching where Income Tax Liabilities start

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Abstract

Work incentives channeled through the low-end of the income tax can be very hard to understand in a complex tax environment. Relying on the universe of French income tax returns from 2008 to 2014, this paper shows that tax filers who neglect a generalized tax credit misperceive an irrelevant Taxation Threshold (TT) as the effective Tax Collection Threshold (TCT) where income tax liabilities start. As a consequence, they perceive a shadow tax bracket characterized by a shadow marginal tax rate (MTR) below the TCT. Following a multiplication by 2.5 of this shadow MTR between 2011 and 2012, a significant amount of tax filers relocated from the effective TCT to the irrelevant TT. Using these dynamic earnings responses, I estimate a significantly positive *behavioral cross-influence* of the shadow tax bracket, a new sufficient statistic that arise in optimal income tax formulas with behavioral agents developed by Farhi and Gabaix (2020). Estimation of an income tax misperception model further highlights that tax filers take simultaneously into account the effective schedule and the shadow bracket instead of focusing exclusively on one of them, that misperceptions are heterogeneous and that online tax filers assign a larger probability to the effective tax schedule than filers in hard copy. A positive behavioral cross-influence confirms that misperceptions matter for the design of tax policies and warns against a potential underestimation of elasticities in standard empirical taxation.

JEL classification codes: D83, H24, H31, K34.

Keywords: Income tax misperception, behavioral cross-influence, bunching, Internet.

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1 Introduction

The low-end of income tax systems often gathers work incentives, such as the Earned Income Tax Credit (EITC) in the United States or the Employment Bonus (*Prime d'Activité*) in France. This is also where social benefits phase out, taxes phase in and where multiple discontinuities generated by tax deductions, tax exemptions and tax credits come into play.[1] Responsiveness to work incentives requires a deep understanding of the tax system. However, even with a perfect access to information, it may be very hard for tax filers to perceive these incentives in such complex fiscal environments (Abeler and Jäger, 2015), which involve challenging computations and a legal ability to assess entitlement to tax advantages. As evidenced by Chetty and Saez (2013), even teaching the tax code to potential EITC recipients is not straightforward. Beyond the shape of the tax schedule, the way financial incentives are implemented and framed may influence individual decisions (Saez, 2009). The design of fiscal policies requires to understand how perceptions of a tax system are forged and which features tax filers focus on.

In this paper, I estimate a significantly positive *behavioral cross-influence*, a new sufficient statistic that arise in optimal income tax formulas with behavioral agents, defined by Farhi and Gabaix (2020) as "the elasticity of the earnings of an agent at earnings z to the marginal retention rate at income $z^* \neq z$". Survey evidence of subjects using their average tax rate to form a mental representation of the income tax schedule in Rees-Jones and Taubinsky (2019) suggests a behavioral cross-influence of infra-marginal tax rates. Using French income tax returns, this paper shows direct evidence of earnings responses to the marginal tax rate at an irrelevant earnings level and provides, to my knowledge, the first estimate of a behavioral cross-influence.

The French income tax features a generalized non-refundable tax credit called the Tax Collection Minimum (*minimum de recouvrement*) such that tax filers only pay taxes that exceed this amount. The Tax Collection Threshold (TCT) where income tax liabilities start is therefore defined as the earnings level such that income taxes are equal to the Tax Collection Minimum.[2] A tax filer who neglects the Tax Collection Minimum will misperceive an irrelevant Taxation Threshold (TT) as the threshold where income tax liabilities start. As a consequence, she perceives a shadow tax bracket characterized by a shadow marginal tax rate (MTR) between the TT and the TCT. This ambiguity is maintained by the joint mention of both threshold on the same page of the Income Tax Guidebook (Figure 12). In practice, the Taxation Threshold has no economic nor legal consequences.

Relying on the universe of French income tax returns from 2008 to 2014, I find evidence of significant bunching at both threshold, each year, among a set of tax filers who can easily and

[1] In 2017, there was over 160 income tax expenses in the US and over 240 in France. For the US: *An American Budget, Analytical Perspectives*, Budget of the US government, Fiscal year 2019, Table 13-1, p.156-160. For France: *Evaluation des voies et moyens, Tome II Dépenses Fiscales*, Annexe au Projet de Loi de Finances pour 2018, p.65-105.

[2] CGI, art. 1657-1bis.

precisely adjust their taxable income through reported intra-family transfers. More surprisingly, a multiplication by 2.5 of the shadow MTR between 2011 and 2012 triggered a significant relocation of tax filers from the effective TCT to the irrelevant TT. Evidence about these dynamic earnings responses are provided both at the aggregate level - reduction of the bunching mass at the TCT and rise in the bunching mass at the TT - and at the individual level, through a difference-in-difference estimation of transitions toward the irrelevant TT.

These empirical facts are interpreted within an income tax misperception model inspired by Farhi and Gabaix (2020). Rather than forcing optimizing tax filers to focus exclusively on either the effective tax schedule or the shadow tax bracket, I assume that they assign probabilities to each one of these two potential schedules. This *perceived* tax schedule is general enough to capture a wide range of misperception behaviors, including a way to cope with uncertainty about the tax schedule implemented by the government. A standard taxation model or a model with reference points cannot account for these empirical findings.

The income tax misperception model enables a separate identification of misperceptions and of responsiveness to perceived tax incentives, a clear description of the conditions under which the behavioral cross-influence is identified, and an evaluation of the heterogeneity of misperceptions. The elasticity with respect to perceived tax incentives is identified through the total bunching mass at both thresholds, the average misperception through the allocation of this mass between the two thresholds, controlling for differences in tax incentives at each of them, and the variance of misperceptions through the share of optimizing tax filers who relocate from the effective TCT to the irrelevant TT following a rise in the shadow MTR. These dynamic responses are the core empirical fact of this paper. Indeed, static evidence of bunching at both thresholds is not sufficient to determine whether tax filers take both tax schedules into account in their maximization program or if only a subset of filers completely ignores the effective tax schedule. The behavioral cross-influence is a sufficient statistic which can be expressed as a function of these structural parameters.

The shadow MTR has a significantly positive behavioral cross-influence on tax filers located at the effective threshold where tax liabilities start (TCT). This parameter is smaller but close to the structural elasticity, which implies that behavioral misperceptions should matter for the design and framing of tax schedules.

Beyond this behavioral cross-influence, estimation of earnings responses within the income tax misperception model tells much more about tax filers' mental representation of the tax schedule. First, rather than computing the income tax schedule themselves, the twin peaks bunching pattern is consistent with tax filers directly searching for the threshold where tax liabilities start and finding information about both thresholds in the Income Tax Guidebook (Figure 12) or using the official Income Tax Simulator made available by the government (Figure 11).

Second, tax filers assign an average probability of 75 % to the shadow tax bracket and of only 25 % to the effective tax schedule. These probabilities are heterogeneous but not extreme. Instead of a situation where some tax filers would focus exclusively on the effective tax schedule while the others would only consider the shadow tax bracket, all of them rather appear to take into account both potential schedules simultaneously, but they assign different probabilities to the effective tax schedule.

Third, in order to provide deeper intuitions about the nature of these tax misperception, I contrast these estimates depending on the way tax returns are filled out. Online tax filers assign on average a significantly larger probability to the effective tax schedule than filers in hard copy. Interestingly, both groups display the same structural elasticity. Responsiveness to perceived incentives and (mis)perception of incentives are two distinct structural parameters characterizing individual behaviors that the misperception model is able to disentangle.

Not all tax filers optimize with respect to the starting point of the income tax. Some may not pay attention at all, while others rationally attend to economically more meaningful features, such as a threshold for a simplified tax regime in Akcigit et al. (2018). In this framework without real economic frictions, I show that the estimator for the share of optimizers developed by Kleven and Waseem (2013) can be interpreted as global attention to the starting point of the income tax. The probabilities assigned to each threshold are estimated among a set of tax filers who pay attention to the low end of the income tax, such that they are independent from external features of the tax system. Each year, 20 to 25 % of tax filers in my sample appear to pay attention to this starting point which, according to the meta-analysis in Gabaix (2019), appears quite in line with income taxes representing around 9 % of total taxes on earnings for the marginal buncher at the TCT notch. This global attention is higher among online filers compared to filers in hard copy, though not significantly.

This paper contributes to a growing literature in behavioral public finance, presented by McCaffery and Slemrod (2006); DellaVigna (2009); Congdon et al. (2011); Chetty (2015); Bernheim and Taubinsky (2018); Farhi and Gabaix (2020). Behavioral agents may respond differently to policies than standard economic agents. In order to design tax reforms, the social planner should therefore anticipate these behavioral deviations.

Psychological biases appear important for the design of income taxes (Gerritsen, 2016; Rees-Jones and Taubinsky, 2019; Farhi and Gabaix, 2020).[3] A standard agent knows the whole tax schedule and reacts only to incentives impacting her own earnings. In contrast, a behavioral agent may neglect or simplify some relevant features of income tax systems and focus on other irrelevant features. Abeler and Jäger (2015) find that subjects placed in a complex fiscal environment are much less responsive to tax incentives. Faced with non-linear incentives, they tend to extrapolate the tax schedule from their own earnings level using their average tax rate (Liebman

[3]Another major strand of the empirical literature in behavioral public finance highlights the non-negligible consequences of behavioral biases for indirect taxation: Gruber and Kőszegi (2004); Chetty et al. (2009); Goldin and Homonoff (2013); Taubinsky and Rees-Jones (2018); Allcott et al. (2019).

and Zeckhauser, 2004; Ito, 2014; Rees-Jones and Taubinsky, 2019). Following a non-distortive loss of the Child Tax Credit, Feldman et al. (2016) observe that households adjust their labor supply as if this lump-sum change were raising their marginal tax rate. Here also, agents happen to miss a feature of the tax system (Tax Collection Minimum) and consequently focus on an irrelevant Taxation Threshold, giving rise to a bunching mass there that cannot be rationalized by any standard model.

These investigations are more broadly related to the way people form mental representations of tax systems (Stantcheva, 2020). The diffusion of information clearly matters for taxpayers to respond to fiscal incentives (Chetty et al., 2013) and assistance may not be enough (Chetty and Saez, 2013). Behavioral agents are not insensitive to the empirical design and framing of tax policies (Rees-Jones and Taubinsky, 2018). The influence of the Income Tax Guidebook on French tax filers confirms the importance of framing effects, but also the strong consequences of an ambiguous communication. Martinez et al. (2019) similarly observe that IRS documentation may have misguided U.S. tax filers into thinking that 2008 Economic Stimulus payments were linked to filing dates.

From a methodological perspective, this paper contributes to a literature using bunching techniques to uncover behavioral biases. Visually, the twin-peaked bunching pattern immediately reveals misperceptions and helps narrowing down the process through which tax filers form their mental representation of the tax schedule. Rees-Jones (2017) uses bunching masses to show evidence of loss aversion from tax filers with a positive balance due on tax day. Bunching highlights knowledge of specific tax regimes in Akcigit et al. (2018) and appears as a proxy for a higher responsiveness to tax incentives in Chetty et al. (2013). See Kleven (2016) for a review of papers relating bunching to behavioral biases.

In order to identify tax misperceptions, I extend the bunching framework to consecutive discontinuities in the budget set. This approach is related to the estimation of adjustment frictions developed by Gelber et al. (2020), except that discontinuities can be notches and influence each other. Another methodological improvement is the exploitation of relocations between discontinuities over time to recover the distribution of a structural behavioral parameter of interest.

Finally, this paper contributes to a small literature on electronic tax filing. Electronic automation of tax collection can make taxpayers more passive (Finkelstein, 2009) or in contrast improve program participation (Kopczuk and Pop-Eleches, 2007) and search for relevant information (Hoopes et al., 2015). At the starting point of the French income tax, the second effect would prevail.

The rest of the paper is organized as follows. Section 2 presents the quasi-experimental framework. Section 3 discusses identification within a model of tax misperception. Section 4 develops the estimation strategy. Section 5 displays the main results. Finally, Section 6 concludes.

2 Quasi-Experimental Framework

This section presents the quasi-experimental framework used to elicit income tax misperceptions. First, I provide some elements on the low-end of the French income tax. Second, I present the administrative data and the population of interest. Finally, I show descriptive evidence of bunching at an irrelevant income threshold that is consistent with tax misperceptions.

2.1 Institutional Background

2.1.1 The Low-end of the French Income Tax

The income tax is the second source of revenue for the French state, accounting for a quarter of its budget.[4] First part of Table 1 provides an overview of the main tax brackets and associated marginal tax rates between 2008 and 2014. In 2008, the progressive income tax is made of four brackets with marginal tax rates increasing from 0% to 40%. In 2012, a fifth bracket is created and in 2014, the first tax bracket is suppressed. The taxable income of a single tax filer is defined as the sum of reported gross earnings[5] net of deductible expenses and tax rebates. Income taxes are computed applying the progressive tax schedule to the net taxable income and subtracting non-refundable and refundable tax credits.

Each person living, working or having her major economic interests in France has to report her taxable income, regardless of her income level.[6] Even those who expect to be exempted should report their earnings since the income tax return is a proof of eligibility for social and tax advantages.[7] Hence, becoming taxable does not involve any further filing cost. Before the introduction of an income tax withholding system in 2019, over the study period (2008 to 2014), tax filers used to report their earnings for the previous year. The income tax schedule used to be voted at the end of the earnings year, which prevented real earnings responses, since taxpayers did not know the tax schedule yet when making their labor supply decisions.

Income reporting is quite an easy process that makes the income tax very salient. In the most general case, they fill out a 2042 form with their personal information, the structure of their tax household, their detailed earnings and tax credits. From these elements, the tax administration computes the total amount of taxes due for the year and notifies tax households Before the introduction of a tax withholding system, most taxpayers (excluding self-employed earners, some

[4] Table I.2.c, Projet de loi de finances pour 2021, Assemblée Nationale, September 2020.

[5] Reported gross earnings is the sum of wages, pensions, income from securities, capital gains, revenue from land, agricultural, industrial and commercial or non-commercial profits net of previous deficits. Deductible expenses include intra-family transfers, pension plan contributions, social security contributions, special deductions for elderly or disabled persons. Other types of earnings are totally exempted (family benefits, saving account interests,...) or partially exempted (wages of apprentices, students' income from short contracts,...) from income taxes. Employees' social contributions are not taxable. Nearly everyone benefit from a deduction of 10% for itemized professional expenses.

[6] The only exceptions are diplomats, members of the International Committee of the Red Cross (CICR) and, before 2014, people whose earnings were below the guaranteed minimum or low-income retired households.

[7] Employment bonus, property/housing/television tax exemptions or tax reliefs,...

Table 1: Low end of the French income tax

	2008	2009	2010/11[a]	2012[b]	2013	2014[c]
Bracket MTR	*Lower bound of tax brackets*					
5.5[c]	5,852	5,875	5,963	5,963	6,011	-
14	11,673	11,720	11,896	11,896	11,991	9,690
30	25,926	26,030	26,420	26,420	26,631	26,764
40/41[a]	69,505	69,783	70,830	70,830	71,397	71,764
45[b]	-	-	-	150,000	151,200	151,956
Parameters	*"Décote" and tax collection minimum*					
S	862	866	878	960	1016	1135
r	0.5	0.5	0.5	0.5	0.5	1
T_0	61	61	61	61	61	61
Thresholds	*Starting point of the income tax*					
TT (z_k)	11,088	11,136	11,300	11,791	12,067	13,744
TCT (z_n)	11,729	11,776	11,946	12,141	12,353	13,958

Note: This table displays the parameters required to compute the taxable income level where income tax liabilities start as well as the resulting TT and TCT for a single taxpayer. Columns refer to the year of earnings. a: Tax parameters remain unchanged in 2010 and 2011 and the last bracket marginal tax rate is raised from 40 to 41% from 2010 on. b: In 2012, a 45% tax bracket is created. c: In 2014, the first tax bracket is suppressed and a different parameter S is used for couples. Art. 197 CGI.

capital owners and people claiming tax credits) already benefited from third-party reporting: filling-out the 2042 tax form mostly consisted in checking that the pre-filled information was correct. Moreover, as discussed in the last section of this paper, tax filers have access to a free government-provided income tax simulator on the Internet. As a consequence, taxpayers feel the burden of taxes they pay each year. In an historical perspective, Poncet and Weidenfeld (2019) relate this earnings reporting process to a ritual used to build the French citizenship around tax compliance. In contrast to price-included taxes, such as the value-added tax or social contributions, payment of the French income tax is made very salient.

If administrative reporting procedures are rather simple, the low end of the income tax schedule involves complex mechanisms. Bierbrauer et al. (2020) argue that the threshold where tax liabilities start meets political objectives, considering that each year since 2000 at least, half of tax households are excluded from the French income tax. Instead of providing an explicit threshold of taxable income z^* above which income tax liabilities start, the government defines this threshold implicitly. Let's denote by $t(z)$ the piecewise linear income tax rate defined in Table 1. Tax liabilities start high above the lower bound of the first tax bracket due to two generalized tax reductions: the "décote" and the tax collection minimum. The former is characterized by two parameters, S and r, such that taxpayers are exempted from taxes if $t(z) \leq rS/(1+r)$, their marginal tax rate is multiplied by $1+r$ if $rS/(1+r) < t(z) \leq S$ and they pay $t(z)$ otherwise. Hence, this mechanism raises the point of entry in the income tax as well as the marginal tax rate just above.[8] The latter is the consequence of the government not collecting income taxes below a tax collection minimum $T_0 = 61$€. Finally, the effective income tax schedule $T(z)$ is given by:

$$T(z) = \begin{cases} 0 & \text{if} \quad t(z) \leq \frac{rS+T_0}{1+r} \\ (1+r)t(z) - rS & \text{if} \quad \frac{rS+T_0}{1+r} < t(z) \leq S \\ t(z) & \text{if} \quad t(z) > S \end{cases} \tag{1}$$

The threshold z_n where income tax liabilities start is implicitly defined as the solution of $t(z_n) = \frac{rS+T_0}{1+r}$. Table 1 displays the value of S, r and T_0 from 2008 to 2014, as well as the resulting Tax Collection Threshold (TCT) z_n for single tax filers. For them, this threshold is always in the second tax bracket: the two tax reductions make the first tax bracket void.

2.1.2 (Mis)perceived income tax schedule

Faced with such complexity, taxpayers may as well directly search for the threshold z_n. For this purpose, they can access different sources of information. In France, there is a very little use of tax preparers, but the government provides a free access to an online tax simulator and to the Income Tax Guidebook, which details the way income tax returns should be filed.[9] Figure 11 in Appendix B is a simulation of the 2015 tax schedule for 2014 earnings. The taxpayer has to fill out a virtual tax return. She ends up with a detailed computation of her income taxes and gets informed about her taxable income, how much she has to pay, her average tax rate and the statutory marginal tax rate of her tax bracket.[10]

Figure 12 in Appendix B displays the presentation of the starting point of income taxes according to the Income Tax Guidebook. The upper-right paragraph "Exemption limits" generates a major ambiguity between two potential thresholds. On the one hand, it is mentioned that *"You are not taxable (your taxes are equal to 0) when your net taxable income is below the limits indicated in Table 6"*, which defines a(n irrelevant) Taxation Threshold. On the other hand, *"Your income tax is less than 61€ and you do not have to pay income taxes if your net taxable income is below limits indicated in Table 7."* defines the (effective) Tax Collection Threshold. The Taxation Threshold has no economic nor legal consequences, but is made as salient as the Tax Collection Threshold by the Income Tax Guidebook.

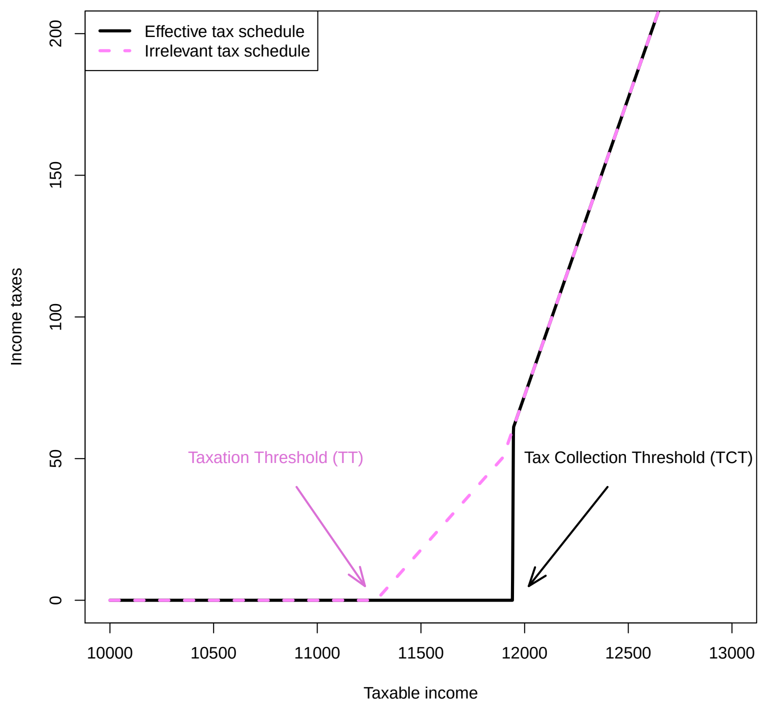
[8] As stressed by Pacifico and Trannoy (2015), this "décote" mechanism (Tax Code, Article 197, I, 4) generates a non-convexity in the tax schedule. In comparison with an explicitly higher threshold, this mechanism limits the loss of tax revenue.

[9] The Income Tax Simulator and the Income Tax Guidebook are both freely available on the website of the public finances services (DGFIP).

[10] This statutory marginal tax rate is different from the effective marginal tax rate of the income tax since it does not take into account the multiplication by $1 + r$ as a result from the application of the "décote". Hence, the effective marginal tax rate is not salient from the point of view of a taxpayer. Thereafter, I assume that taxpayers take into account the statutory marginal tax rate in their budget set and I show in Appendix D that estimated misperceptions are invariant to a proportional transformation of the statutory rates.

The Tax Collection Threshold (TCT) is the level of taxable income where tax liabilities start.[11] As depicted by Figure 1 and in line with Equation (1), due to the Tax Collection Minimum T_0, the effective income tax schedule features a notch at this TCT. However, neglecting this Tax Collection Minimum gives rise to a shadow tax bracket below the TCT (dotted line). In this case, a tax filer may instead focus on the kink at the irrelevant Taxation Threshold (TT) z_k, defined as the solution of $t(z_k) = \frac{rS}{1+r}$ or equivalently $T(z_k|T_0 = 0) = 0$.

Figure 1: Income tax thresholds



Note: Effective (black plain line) and irrelevant (purple dotted line) income tax schedules for a single tax filer in 2010 and 2011.

[11] The Tax Collection Threshold (TCT) defines the tax status (Tax Code, art. 1657 1bis). Above this threshold, tax filers not only start paying income taxes, some of them also loose tax deductions or exemptions. The TCT is especially a condition for unemployment benefits, retirement and invalidity pensions holders to benefit from a lower rate of social contributions (CSG), for retirement pensions holders to benefit from a tax exemption (CASA) and for taxpayers over 65 to have a contribution deduction (for public services broadcasting). These deductions and exemptions do not impact the current analysis since concerned populations are either excluded from the sample or not able to manipulate this legal structure. Other social benefits or tax exemptions depend either on a specific level of reference tax revenue (employment bonus, social contribution exemptions, housing and property tax exemptions, tax credits, scholarships, lower nursery and school canteens tariffs,...) or on the net taxable income level (family, housing and minimum social benefits,...), but never on the taxation threshold. A detailed list of social advantages and tax reductions or exemptions may be found in CPO (2014) (Fiche 1, Annexe 6, p49-51).

The joint mention of these two thresholds may be confusing and further available information does not alleviate this ambiguity. Tabulated values of income taxes, provided by the Income Tax Guidebook, imply that tax liabilities would start at the irrelevant TT. Moreover, Figure 11 in Appendix B displays the result of a simulation from the online tax simulator of the government for a tax filer just below the TCT. Even though she would legally be exempted from the income tax, this simulation still mentions that her net income taxes are equal to 59 €.[12]

2.2 Empirical aspects

2.2.1 Data

Bunching analysis is conducted using the administrative POTE[13] dataset provided by the French Internal Revenue Service[14] on the universe of French income tax returns from 2008 to 2014. In 2013, approximately 35.6 million households filed a tax form. Unless otherwise stated, the whole paper is expressed in years of earnings, rather than in fiscal years - when taxes are collected.

The POTE files gather all the information required by the administration to compute income taxes. Some household characteristics are available: birth date, sex, city of residence, marital status, number of children and dependents (as well as their condition regarding disability or older age). Composition of income is very detailed within seven categories: wage earnings, pensions, capital gains, estate income, agricultural profits, industrial and commercial profits and non-commercial profits. Deductibles as well as (refundable and non-refundable) tax credits are listed. Finally, tax filers reporting their income taxes on the Internet are identified by a user-ID, while filers reporting taxes in hard-copy have none.

Empirical analysis is achieved using directly the taxable income computed by the Internal Revenue Service, hence preventing potential approximations that would occur if the tax system were instead simulated. These large scale data are available for seven consecutive years and an individual identifier enables the use of the panel dimension, to the extent that taxpayers keep the same family situation and do not move house to another French department.[15] This variability is crucial for the estimation of dynamic responses to tax reforms within-individual.

2.2.2 Sample

This paper relies on the tax returns from one-person tax households who report receiving financial transfers from another member of their family (parent, child, grand-parent, step-parent).

[12]In principle, tax filers could also take into account the lower bound of the first tax bracket, but the taxable income distribution shows no bunching at this point. Therefore, I only focus on the TCT and on the TT.

[13]*Fichier Permanent des Occurences de Traitement des Emissions.*

[14]*Direction Générale des Finances Publiques (DGFIP).*

[15]The tax return of married taxpayers does not keep track of the identifier for the second tax filer. The available identifier is specific to the county (*Département*) where the tax household is registered.

These intra-family (IF) transfers give tax filers the ability to flexibly and precisely adjust their reported taxable income. They are defined by the 1803 Civil Code as a maintenance obligation: each citizen has to provide financial support to low income relatives who are "in need".[16] These transfers are deductible for the giver and must be reported by the recipient, especially in order to apply for social benefits. However, legislation enable a flexible adjustment of these transfers: there is no income limit stipulating whether someone is "in need" or not, no indicative amount of deductible transfer (only a cap if the recipient is an adult child), the relevant box of the tax form is never pre-filed by the tax administration and there is no requirement for the giver to provide the identifier of the recipient. See Appendix C for further details about those intra-family transfers.

Table 2: Recipients of intra-family transfers

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Sample	Full	Full	TT	TCT	Above TCT
# tax units	2	1	1	1	1
Age	42	28	26	26	26
Women (%)	95	51	50	49	50
Single (%)	39	91	96	96	94
Divorced or Widowed (%)	59	9	4	4	6
Online filers (%)	44	46	56	61	57
Net taxable income (€)	20,162	8,685	12,031	12,266	12,450
		Composition of income (%)			
Wage		45	57	55	57
IF transfers		42	27	25	27
UI benefits		8	14	17	14
Other		4	2	2	2
Obs.	242,683	416,450	9,819	8,458	4,109

Note: This table displays descriptive statistics on recipients of intra-family transfers. The first column focuses on households of two tax units and the second column on households of one tax unit. The following three columns detail the second one for three subgroups: tax filers located at the TT kink (taxable income between 11,917 and 12,142€), at the TCT notch (between 12,153 and 12,353€) or in a 200€ interval just above the TCT notch. Recipients of intra-family transfers, reporting a positive net taxable income, metropolitan France, except retirement pensions holders. Tax files POTE 2013.

Table 2 describes the composition of this population in 2013. The French income tax return features only one box for all types of maintenance obligation, including child alimony. Among tax filers reporting a positive amount, households of two tax units (Column 1) are mostly women separated from their spouses, who have custody of their children and receive an alimony. Here, the focus is on households of one tax unit who are mainly young, single and have lower earnings (Column 2). In 2013, around 416,000 single tax filers reported a positive amount of intra-family transfers and nearly one fourth of them reported a level of taxable income within 2000 euros

[16] Civil Code, Art. 203-205.

from the Tax Collection Threshold (Table 6 in Appendix B). The last three columns of Table 2 detail the composition of this population depending on their position in the taxable income distribution: at the Taxation Threshold (TT), at the Tax Collection Threshold (TCT) or just above the TCT. On average, tax filers located at the two thresholds are more often single (since these thresholds are relevant for one-unit tax households). More than half of their earnings are wage income and a quarter are IF transfers. Those located at the TCT are more prone to file their tax return online rather than in hard copy.

Finally, recipients of retirement pensions and taxpayers from overseas departments are excluded from the sample since the former benefit from specific tax advantages near the TCT and the latter from an additional tax reduction.[17]

2.3 Bunching evidence

The static evidence shows that some tax filers mistake the irrelevant TT for the effective TCT. The dynamic evidence is much more striking, since a significant group of tax filers who initially found the effective TCT choose to relocate to the irrelevant TT when they perceive a rise in the marginal tax rate at this threshold.

2.3.1 Static evidence

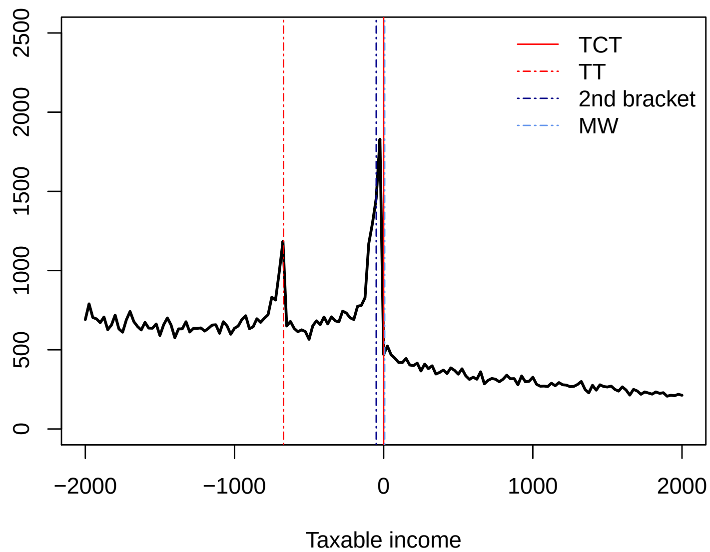
Figure 2 displays the taxable income distribution by 25 € bins in a 2000 € interval centered around the Tax Collection Threshold (TCT) within our sample in 2011. The mass of taxpayers located at the TCT can be related to a local shift in incentives at this point. When faced with a notch, tax filers reduce their taxable income in order to locate just below, which generates a bunching mass by aggregation of individual decisions.

The second bunching mass at the irrelevant Taxation Threshold (TT)[18] reveals that at least some tax filers focus on this threshold, misperceive the tax collection minimum T_0 and react to the shadow tax bracket (dotted line of Figure 1). This behavior cannot be rationalized without tax misperceptions, since the TT has no economic consequences and fully rational tax filers should ignore it when filing their tax returns. Figure 13 in Appendix B shows that these twin peaks are persistent over the 2008 - 2014 period and closely follow the two thresholds over time. However, this static approach is not sufficient to conclude about the dispersion of misperceptions in the sample. It could be that some tax filers ignore the tax collection minimum T_0 and locate at the TT while others are not biased and locate at the TCT. On the opposite, all tax filers could share the same misperceptions and would end-up locating at one threshold or the other depending on their gross earnings.

[17]Their income taxes are reduced by 30 to 40%. Tax Code, Article 197, I, 3.

[18]The two thresholds of interest are not round numbers (Table 1) and rounding behavior does not show up visually, neither annually nor monthly. Hence, we can rule out the hypothesis that bunching at the irrelevant threshold results from a salient round number.

Figure 2: Bunching evidence (2011)



Note: This figure displays the taxable income distribution of intra-family transfer recipients by 25€ bins in a 2000€ interval centered around the TCT in 2011. The vertical plain red line shows the Tax Collection Threshold (TCT), the red dotted line the Taxation Threshold (TT), the light blue line the minimum wage (MW) and the dark blue line the lower bound of the second tax bracket. Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2011.

2.3.2 Dynamic evidence

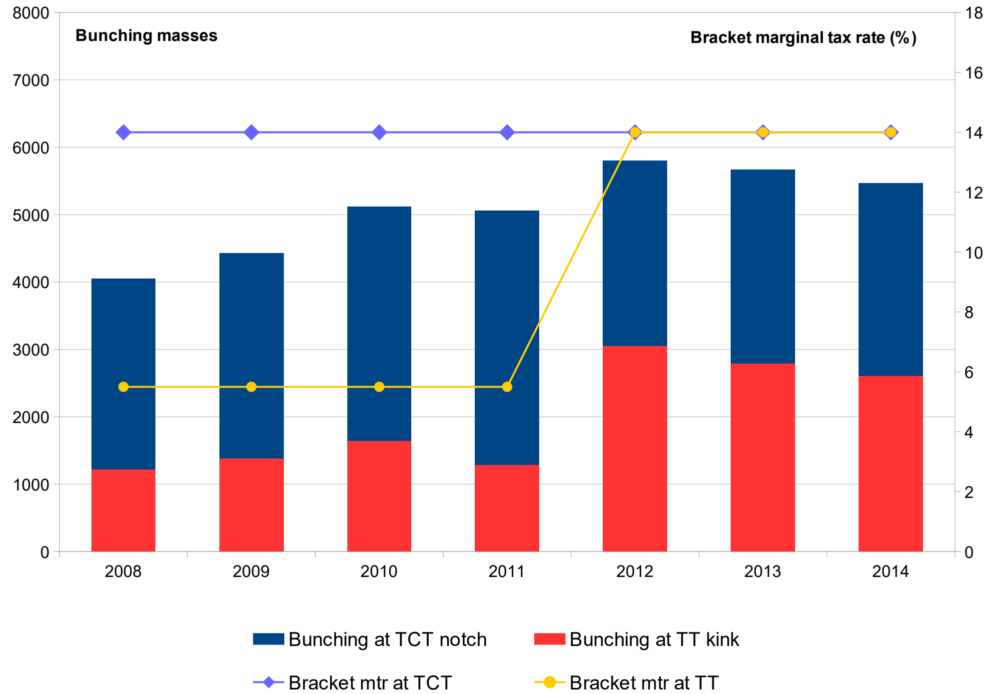
Figure 3 depicts the number of tax filers bunching at each one of the two thresholds (vertical bars, left axis) and the associated statutory marginal tax rate that they *perceive* (lines, right axis). As displayed in Table 1, the TCT is always in the second tax bracket characterized by a statutory rate of 14%. For a single tax filer, the Tax Collection Minimum makes the first tax bracket of the French income tax void.

From 2008 to 2011, the shadow tax bracket between the irrelevant TT and the effective TCT was characterized by a shadow marginal tax rate (MTR) of 5.5%, since the irrelevant TT was located in this first tax bracket. After 2011, an exogenous increase in the parameter S of Equation (1) pushed the TT toward the second tax bracket, meaning that tax filers started to associate a MTR of 14% to this shadow bracket.[19] Thus, between 2011 and 2012, the shadow MTR at the Taxation Threshold has been multiplied by roughly 2.5, whereas effective incentives related to the TCT remained unchanged. The breakdown of bunching masses between the two

[19] In 2012, the Taxation Threshold is still slightly below the lower bound of the second tax bracket. However, tax filers who end-up bunching at this threshold come from further up in the distribution and have in mind a marginal tax rate of 14%, which has for instance been displayed to them after their first online simulation.

thresholds is constant over the two sub-periods 2008-2011 and 2012-2014, but strongly changes between 2011 and 2012. A significant mass of tax filers appears to relocate from the effective TCT to the irrelevant TT.

Figure 3: Bunching and Statutory Tax Rates (2008-2014)

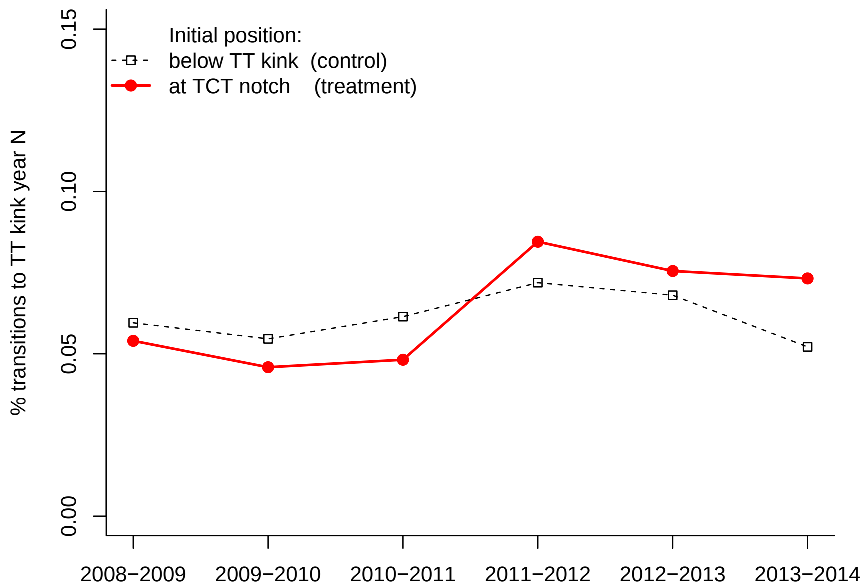


Note: Vertical bars display the number of tax filers bunching at the TT kink (red, left axis) and at the TCT notch (blue, left axis). Blue connected diamonds show the statutory marginal tax rate at the Tax Collection Threshold and yellow circles the statutory marginal tax rate at the Taxation Threshold. Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2008 - 2014.

Figure 4 further investigates these earnings responses at the individual level. The panel dimension is exploited in order to track individual locations in the taxable income distribution over two years. Two groups are considered. A control group is constituted of tax filers initially below the bunching region of the TT kink. Their earnings are too low for them to care about the income tax schedule, so they are expected to display no earnings responses. The treatment group gathers tax filers initially located at the TCT. If they perfectly understand the income tax schedule, they should also display no reaction at all, since the effective tax schedule remained unchanged from 2008 to 2014 and the TT is legally and financially irrelevant.

For each group, Figure 4 depicts the share of individuals relocating to the irrelevant TT the next year. Each year, a small share of each group relocates there due to noisy movements in the

Figure 4: Relocations to the irrelevant Taxation Threshold



Note: Probability to relocate at the TT depending on the initial location in the taxable income distribution the previous year: below the TT kink (squares, black dotted line) or at the TCT notch (circles, red plain line). The leftmost circle shows that, among tax filers located at the TCT in 2008, 5% relocate to the Taxation Threshold in 2009. Single recipients of intra-family transfers present two consecutive years in the data set, metropolitan France, except retirement pensions holders. Tax files POTE 2008 - 2014.

income process. However, from 2012 on, compared to the control group, tax filers initially at the TCT are significantly more likely to relocate to the TT. Hence, they should believe - at least a little bit - that the Taxation Threshold might be the starting point of the income tax, *perceive* a stronger tax incentive there (in the form of a multiplication by 2.5 of the statutory rate) and take it into account when optimizing their reported income. Section 3 and 4 present how this dynamic adjustment can be used to identify a behavioral cross-influence and the dispersion of tax misperceptions. Finally, these relocations confirm that neither thresholds are pure focal points, since bunchers appear to react to associated perceived incentives.

3 Identification of Income Tax Misperceptions

In standard taxation models, taxpayers perfectly perceive the income tax schedule and correctly predict their disposable income associated with their earnings level. In contrast, behavioral taxpayers may misperceive the tax system, confuse marginal tax rate with lump-sum taxes (Feldman et al., 2016) or extrapolate the tax schedule from their own earnings level using their average tax rate (Rees-Jones and Taubinsky, 2019). When agents misperceive the income tax schedule, Farhi and Gabaix (2020) show that optimal income taxes may feature a new "behavioral cross-influence", defined as "the elasticity of the earnings of an agent at earnings z to the marginal retention rate at income $z^* \neq z$". In line with this recent literature in behavioral public finance, I build a model of income tax misperception flexible enough to account for potential bias heterogeneity and a behavioral cross-influence of the shadow tax bracket.

3.1 Perceived income tax schedule

Here, I consider a misperception of the conditional tax credit T_0 in Equation (1) leading tax filers to perceive a positive marginal tax rate and a shadow tax bracket below the tax collection threshold where tax liabilities start, as displayed by Figure 1. A general formula for this perceived tax schedule is given by: $T^s(z) = \int\limits_{a \geq 0} T(z|\mathcal{C} = a)\theta(a)\mathrm{d}a$, which means that agents would consider a weighted average of the potential tax schedules associated with different values for the Tax Collection Minimum $\mathcal{C}$.

As long as $\theta(a) > 0 \ \forall a \geq 0$ for at least some tax filers, such a general formulation would generate a diffuse bunching mass starting at the Taxation Threshold z_k and potentially expanding beyond the Tax Collection Threshold z_n. In contrast, Figure 2 displays sharp bunching masses at each threshold and no bunching between them. In particular, the absence of bunching at the starting point of the second tax bracket in Figure 14 of Appendix B confirms that tax filers do not take into account this kink. Figures 11 and 12 of Appendix B are consistent with the assumption that, instead of computing the full tax system, tax filers directly search in the fiscal documentation for local tax incentives at the two thresholds and locally extrapolate the income tax schedule. Therefore, I set $\theta(T_0) \equiv \theta,\ \theta(0) \equiv 1 - \theta$ and $\forall a \notin \{0, T_0\}\,,\ \theta(a) = 0$. Confused by the coexistence of two potential thresholds, tax filers build the following *perceived* income tax schedule:

$$T^s(z) = (1 - \theta)T_k(z) + \theta T_n(z) \tag{2}$$

where the effective tax schedule $T_n(z) = T(z) = [T_0 + \tau_n (z - z_n)] \cdot \mathbb{I}_{[z > z_n]}$ given by Equation (1) is characterized by the conditional tax credit T_0, the marginal tax rate τ_n and defines a notch at the Tax Collection Threshold z_n. The irrelevant tax schedule $T_k(z) = \tau_k (z - z_k) \cdot \mathbb{I}_{[z > z_k]}$ is characterized by the marginal tax rate τ_k and gives rise to a kink at the Taxation Threshold z_k.[20]

This functional form may encompass several behavioral deviations. Confronted with the ambiguous presentation of two potential thresholds in Figure 12, confused tax filers may focus on one of them, for instance choosing the lower one (the TT) in order to minimize the risk to pay taxes. Or they may use an online tax simulator and follow a grid search, in which case they would

[20] I rule out the extreme case where tax filers perceive none of these thresholds, since there is no bunching mass at the lower bound of the first tax bracket.

likely end up at the TCT. It is worth noting that proceeding through trial and error is costly, since a new online form should be filled out at each iteration, which may explain why not all tax filers engage in this process. In order to cope with this uncertain situation, another possibility is that they consider the potential existence of both thresholds and assign a probability for each of them to be the point where tax liabilities start. Identification within the tax misperception model provides a few more insights about individual behaviors.

3.2 Setting

The goal of this income tax misperception model is threefold: separately estimating behavioral deviations and responsiveness to tax incentives, quantifying the dispersion of misperceptions and identifying the behavioral cross-influence. For the sake of simplicity, this framework does not explicitly feature intra-family transfers, which are nested in the reported taxable income. Appendix A shows that within family optimization would lead to the same conclusions.

A tax filer with an ability level ω maximizes utility $U(c, z)$ increasing in disposable income[21] c and decreasing in the cost of effort z/ω, subject to the perceived income tax schedule $T^s(z)$. Adjustments through intra-family transfers involve no work efforts, but hassle costs of searching for information (Hoopes et al., 2015), of record keeping (Benzarti, 2020) and of filling out the income tax return (Rees-Jones, 2017) which are magnified by the complexity of the environment (Bhargava and Manoli, 2015). The subsequent responsiveness to tax incentives is captured by the structural elasticity ε. I further allow tax filers to take into account in their budget constraint the effective retention rate $1-\tau$ resulting from the comprehensive system of taxes and transfers based on earnings.

Misperceptions are identified over a subset of tax filers who pay attention to the starting point of the income tax. Generally, not all tax filers care about finding this starting point, either because the cost of attention is too high or because they rationally care about other financially more important dimensions of reported earnings.[22] Therefore, I set the incidental parameter $m \in \{0, 1\}$ to capture global attention to the low-end of the income tax. Non-optimizers ($m = 0$) do not attend to the starting point of the income tax whereas optimizers ($m = 1$) do. Consequently, the weights $1-\theta$ and θ are estimated conditional on being informed about, paying attention to and optimizing with respect to this starting point. They are not influenced by external features of the tax system. Fully attentive tax filers who end-up at the irrelevant TT mistake this irrelevant threshold for the effective TCT.

[21] In line with Gabaix (2014), a behavioral agent chooses her optimal allocation as a rational agent would do, were she faced with the budget constraint perceived by the behavioral agent. Then, effective consumption is defined such that the budget constraint is binding under the perceived reported income and effective taxes. This effective level of consumption is not the concern here and only perceived allocations are presented.

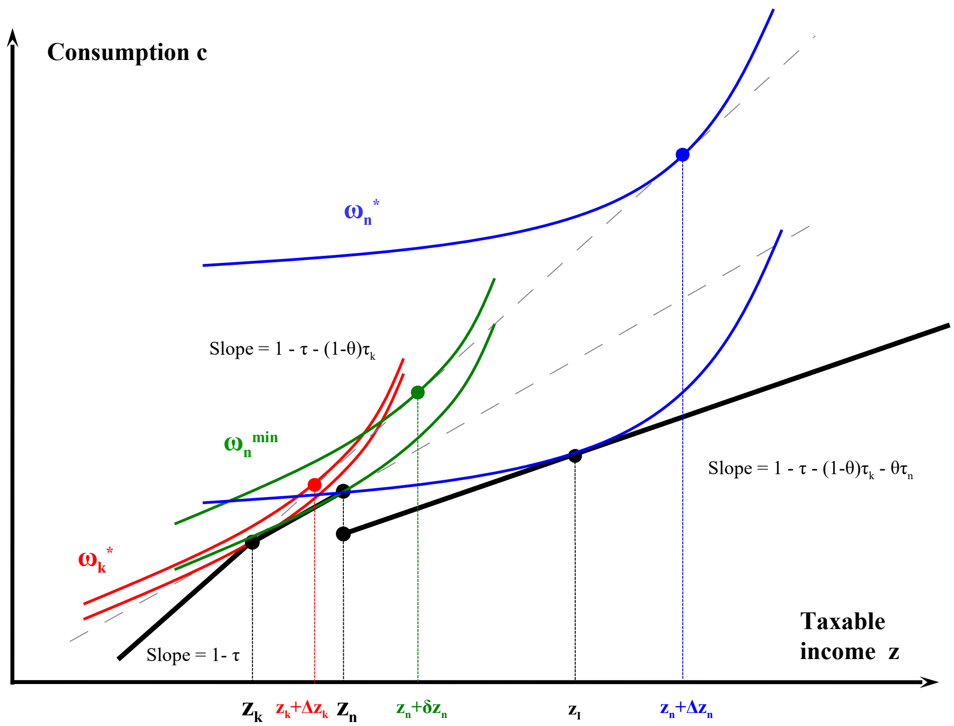
[22] For instance, Akcigit et al. (2018) find that French entrepreneurs interested in a simplified tax regime rather bunch at an eligibility threshold which is not defined with respect to their taxable income.

Finally, the individual maximization program is given by:

$$\max_{\{c,z\}} U(c, z \mid \omega) \quad \text{s.t.} \quad c \leq z(1-\tau) - m \cdot T^s(z) \tag{3}$$

where utility is quasi-linear $U(c, z\, |\omega) = c - \frac{\omega}{1+\frac{1}{\varepsilon}}\left(\frac{z}{\omega}\right)^{1+\frac{1}{\varepsilon}}$ such that there are no income effects.

Figure 5: The tax misperception model



Note: The piecewise-linear budget set is depicted by the black line, with a kink at the Taxation Threshold z_k and a notch at the Tax Collection Threshold z_n. The slope of the budget set depends on marginal tax rates τ_k and τ_n as well as on the weight θ. The red lines are the indifference curves of the marginal buncher ω_k^* at the TT kink, the blue lines are those of the marginal buncher ω_n^* at the Tax Collection Threshold notch and the green lines are those of the minimal buncher ω_n^{min} at the notch (lower ability agent who is bunching at the notch).

Without discontinuity in the tax schedule, the earnings distribution $f_0(z)$ is assumed smooth and the optimal taxable income of a type ω agent is given by $z^* = \omega(1-\tau)^{\varepsilon}$. Introducing a discontinuity where tax liabilities start does not change the decision of non-optimizers. In contrast, optimizing taxpayers adjust their earnings in order to maximize their utility subject to their *perceived* budget set.

Figure 5 illustrates this setting for optimizing tax filers with a given weight θ. The *perceived* budget set is piecewise linear and its slope depends not only on the parameters of the tax system, but also on θ. If $\theta = 1$, individuals perceive only the notch at the Tax Collection Threshold z_n, whereas if $\theta = 0$, they perceive only the kink at the Taxation Threshold z_k. For $\theta \in]0,1[$, this budget set features two discontinuities at each one of the two thresholds and a shadow tax bracket between them. Depending on their ability ω, optimizing agents locate either at the TCT or at the TT, which gives rise to the twin-peaked bunching displayed in Figure 2.

3.3 Homogeneous misperceptions

Under homogeneous misperceptions, all optimizing tax filers assign the same weight θ to the Tax Collection Threshold and $1-\theta$ to the Taxation Threshold. First, as in Saez (2010), tax filers bunching at the TT kink come from an interval $[z_k, z_k + \Delta z_k]$ and react here to a variation in the *perceived* marginal tax rate $(1-\theta)\,\tau_k$. The marginal buncher at the kink has an ability level ω_k^* and locates initially at the taxable income level $z_k + \Delta z_k = \omega_k^*(1-\tau)^\varepsilon$ absent any discontinuity in the tax schedule (red indifference curves, Figure 5). As this discontinuity is introduced, she relocates to the TT kink such that $(z_k/\omega_k^*)^{\frac{1}{\varepsilon}} = 1 - \tau - (1-\theta)\,\tau_k$. These two conditions provide the first equation of the model, characterizing bunching at the TT kink:

$$\frac{z_k}{z_k + \Delta z_k} = \left[1 - (1-\theta)\,\frac{\tau_k}{1-\tau}\right]^\varepsilon \tag{4}$$

If $\theta = 1$, taxpayers only care about the effective tax schedule and do not adjust their taxable income with respect to the TT ($\Delta z_k = 0$). In contrast, if $\theta = 0$, they ignore the tax collection minimum T_0 and only optimize with respect to the TT kink, in which case Equation 4 takes its classic expression.

Second, as in Kleven and Waseem (2013), tax filers bunching at the notch react to the *perceived* pure notch θT_0 and to the *perceived* marginal tax rate $(1-\theta)\,\tau_k + \theta\tau_n$ above. The marginal buncher at the notch is characterized by the ability level $\omega_n^* = (z_n + \Delta z_n)\,/(1-\tau)^\varepsilon$. After the introduction of the discontinuity, she is indifferent between bunching at the TCT notch and getting utility:

$$(1-\tau)\,z_n - (1-\theta)\,\tau_k\,[z_n - z_k] - \frac{z_n + \Delta z_n}{(1-\tau)^\varepsilon\left(1+\frac{1}{\varepsilon}\right)}\left(\frac{z_n(1-\tau)^\varepsilon}{z_n + \Delta z_n}\right)^{1+\frac{1}{\varepsilon}}$$

or locating at an interior point z_I further up in the earnings distribution, on the new budget constraint, in which case she gets utility:

$$(1-\tau)\,z_I - ((1-\theta)\,\tau_k + \theta\tau_n)\,(z_I - z_n) - (1-\theta)\,\tau_k\,(z_n - z_k) - \theta T_0 - \frac{z_n + \Delta z_n}{(1-\tau)^\varepsilon\left(1+\frac{1}{\varepsilon}\right)}\left(\frac{z_I(1-\tau)^\varepsilon}{z_n + \Delta z_n}\right)^{1+\frac{1}{\varepsilon}}$$

At the interior solution z_I, the first-order condition of her maximization program is:

$$\frac{z_I}{z_n + \Delta z_n} = \left(1 - \frac{(1-\theta)\tau_k}{1-\tau} - \frac{\theta\tau_n}{1-\tau}\right)^\varepsilon$$

This indifference condition, depicted by the blue curves in Figure 5, provides the second equation of the model, characterizing bunching at the TCT notch:

$$\frac{z_n\left(1-\frac{(1-\theta)\tau_k}{1-\tau}-\frac{\theta\tau_n}{1-\tau}\right)+\frac{\theta T_0}{1-\tau}}{z_n+\Delta z_n}-\frac{\varepsilon}{1+\varepsilon}\left(\frac{z_n}{z_n+\Delta z_n}\right)^{\frac{1+\varepsilon}{\varepsilon}}-\frac{\left(1-\frac{(1-\theta)\tau_k}{1-\tau}-\frac{\theta\tau_n}{1-\tau}\right)^{1+\varepsilon}}{1+\varepsilon}=0 \quad (5)$$

When taxpayers focus only on the effective tax schedule, this expression is identical to the classic Kleven and Waseem (2013) equation for bunching at a notch.

Equations (4) and (5) relate the structural parameters of the model θ and ε to the earning responses at the TT kink Δz_k and at the TCT notch Δz_n. Empirical estimates for these earning responses can in turn be recovered from bunching masses at each threshold.

Assume as in Kleven and Waseem (2013) that the share of taxpayers who optimize their taxable income with respect to the low end of the income tax is constant over the bunching segment $[z_k, z_n+\Delta z_n]$, such that $m(z)=m$. Then earnings responses Δz_k can be recovered from the bunching mass at the kink:

$$B_k=\int_{z_k}^{z_k+\Delta z_k} m(z)f_0(z)\ \mathrm{d}z \approx m\cdot f_0(z_k)\Delta z_k \quad (6)$$

Taxpayers who bunch at the TCT notch come from an interval $[z_n+\delta z_n, z_n+\Delta z_n]$, where $z_n+\delta z_n$ is the lowest initial income of the minimal buncher with ability ω_n^{min} who locates at the notch after the introduction of the discontinuity (green indifference curves in Figure 5). Her earnings response is given by $\delta z_n=\frac{z_n}{z_k}\Delta z_k$. The minimal buncher at the notch is always located above the marginal buncher at the kink and simply follows the shift in the density of taxable income resulting from the kink. Consequently, the lower bound of the bunching segment at the notch mechanically increases with the slope of the budget set above the kink. Compared to classic bunching identification, this new feature captures the fact that both threshold result from the misperception of a single point where tax liabilities effectively start and should therefore be related to the same counterfactual. The bunching mass at the notch is equal to:

$$B_n=\int_{z_n+\delta z_n}^{z_n+\Delta z_n} m(z)f_0(z)\ \mathrm{d}z \approx m\cdot f_0(z_n)\left(\Delta z_n-\frac{z_n}{z_k}\Delta z_k\right) \quad (7)$$

From the two sets of bunching moments $\left\{\widetilde{B_k}, \widetilde{f}_0(z_k)\right\}$ and $\left\{\widetilde{B_n}, \widetilde{f}_0(z_n)\right\}$ estimated at each one of the twin peaks and from the share of optimizers $\widetilde{m}$, Equations (6) and (7) provide estimates for earning responses $\Delta\widetilde{z}_k$ and $\Delta\widetilde{z}_n$ which can be used in turn within Equations (4) and (5) to recover the structural parameters ε and θ. This identification strategy has a straightforward interpretation. A stronger focus on the effective income tax schedule implies a wider discontinuity at the TCT notch compared to the TT kink, which results in a relatively bigger bunching mass at the TCT. Conditional on tax misperceptions given by θ, a higher responsiveness to incentives will globally induce more bunching at both thresholds. Therefore, the difference in the relative size of the bunching masses at the two thresholds identifies the weight θ while the total bunching mass at both thresholds identifies the structural elasticity ε.

3.4 Heterogeneous misperceptions and behavioral cross-influence

In a standard taxation model, an agent would never respond to changes in τ_k. Here, tax filers above the TCT z_n may react to such variations. In line with Farhi and Gabaix (2020), the *behavioral cross-influence* of the marginal tax rate τ_k for an agent with earnings $z \geq z_n$ is defined as:

$$\zeta_{z_k}(z) \equiv \frac{\mathrm{d}z}{\mathrm{d}(1-\tau_k)} \frac{1-\tau-\tau_k}{z} = (1-\theta)\varepsilon \left[1 + \frac{\theta(\tau_n - \tau_k)}{1-\tau-T^{s\prime}(z)} \mathbb{I}_{[z>z_n]}\right] \tag{8}$$

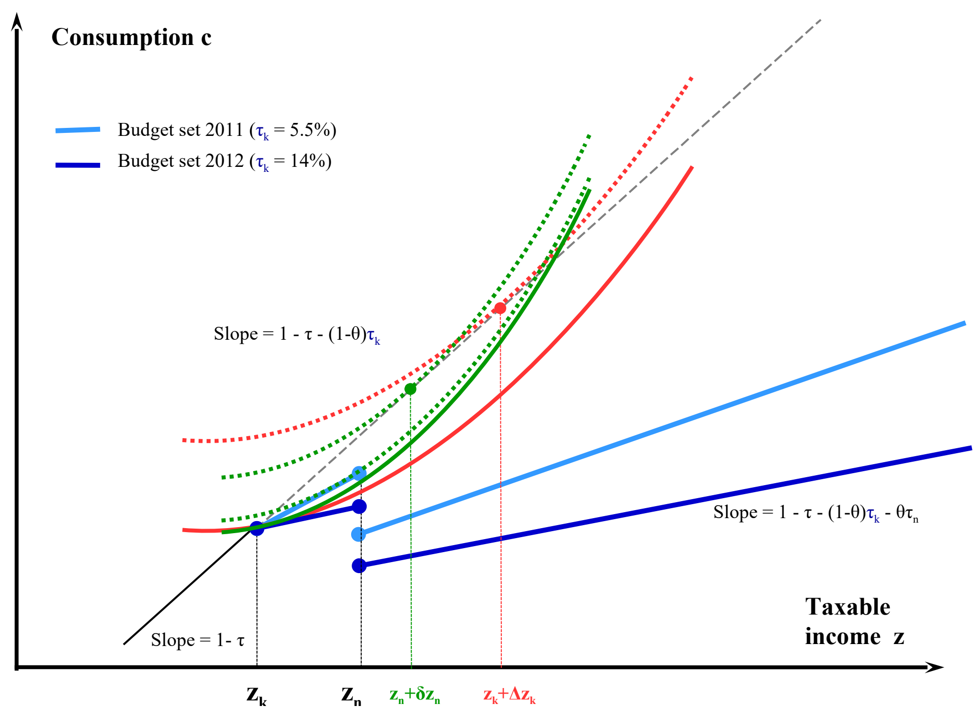
where $T^{s\prime}(z) = (1-\theta)\tau_k + \theta\tau_n$ is the perceived marginal tax rate for optimizers above z_n. For a tax filer purely focusing on the effective tax schedule ($\theta = 1$), this behavioral elasticity is equal to zero. At the TCT, $\zeta = (1-\theta)\varepsilon$: variations in τ_k are taken into account proportionally to the weight $1-\theta$ that tax filers assign to the shadow bracket. In order to identify a positive *behavioral cross-influence*, the twin peaks bunching pattern is not sufficient. We need to introduce heterogeneous misperceptions and further analyze dynamic responses to variations in the slope of the shadow tax bracket.

Assume that each tax filer is now characterized by her own weight θ that she assigns to the Tax Collection Threshold. This weight θ is distributed over the $[0,1]$ interval according to a CDF $H(\theta)$ with a PDF $h(\theta)$, including the polarized case where $\theta \in \{0,1\}$. With heterogeneous misperceptions, ε and the expected value of θ are not identified anymore. Earnings responses Δz_k and Δz_n are now functions of θ and bunching masses B_k and B_n only identify average earnings responses $\mathbb{E}_\theta[\Delta z_k]$ and $\mathbb{E}_\theta[\Delta z_k]$. Since the model is non-linear, $\mathbb{E}[\theta]$ cannot be directly inferred from those average earnings responses.

Recovering the dispersion of misperceptions requires another moment condition, given by the response of optimizing tax filers to the rise in τ_k between 2011 and 2012, illustrated by Figures 3 and 4 at the aggregate and individual levels respectively. Under a parametric assumption for the distribution of misperceptions θ, the behavioral cross-influence and the dispersion of misperceptions can be identified from the share of tax filers initially located at the effective TCT in 2011 who relocate to the irrelevant TT in 2012 because of the rise in the shadow marginal tax rate τ_k.

Figure 6 illustrates the identification of heterogeneous misperceptions. The rise in τ_k from 5.5% in 2011 to 14% in 2012 flattens the budget set above z_k. As a consequence, for a given probability θ assigned to the effective tax schedule, a whole range of tax filers between the minimal buncher at the notch in 2011 (in green) and the marginal buncher at the kink in 2012 (in red) relocates from the effective TCT to the irrelevant TT. This range is positive for each value of θ up to θ^*, which is the level such that the minimum buncher at the notch in 2011 is also the marginal buncher at the kink in 2012. Details about the computation of θ^* and of the share of relocations are provided in Appendix A.

Figure 6: Relocation from the TCT to the TT in 2012



Note: This figure illustrates relocations to the Taxation Threshold occurring in 2012. The rise in τ_k reduces the slope of the budget set above z_k. As a consequence, a whole range of tax filers between the 2011 minimal buncher at the TCT notch (green indifference curves) and the 2012 marginal buncher at the TT kink (red indifference curves) relocate from the TCT notch toward the TT kink in 2012.

The range of tax filers who relocate from the TCT to the TT in 2012 is given by:

$$B_r = \int_0^{\theta^*} \int_{z_n+\delta_{z_{n,2011}}}^{z_k+\Delta z_{k,2012}} m(z) f_0(z|\theta) h(\theta) \, \mathrm{d}z\mathrm{d}\theta \approx m \cdot f_0(z_n) \int_0^{\theta^*} z_k + \Delta z_{k,2012} - z_n - \delta z_{n,2011} \, \mathrm{d}H(\theta)$$

where the distribution of earnings conditional on θ is assumed locally constant. Let S_r be the share of tax filers initially bunching at the TCT in 2011 who relocate at the TT in 2012 due to the rise in the *perceived* marginal tax rate τ_k. This share S_r is defined as:

$$S_r \equiv \frac{B_r}{B_n} = \frac{\kappa}{\delta} \frac{H(\theta^*)}{1-\theta^*} \left(\theta^* - \mathbb{E}\left[\theta | \theta \leq \theta^*\right]\right) \tag{9}$$

where $\kappa = \varepsilon z_k \left[(z_n/z_k)^{\frac{1}{\varepsilon}} - 1 \right] \left(\tau_{k,2012} - (z_n/z_k)^{1-\frac{1}{\varepsilon}} \tau_{k,2011} \right) / \left(\tau_{k,2012} - \tau_{k,2011} \right) > 0$ depends on the parameters of the tax schedule and the elasticity ε, while $\delta = \mathbb{E}_\theta\left[\Delta z_n(\theta)\right] - \frac{z_n}{z_k}\mathbb{E}_\theta\left[\Delta z_k(\theta)\right] \geq 0$ captures earnings responses.

The behavioral cross-influence of the shadow marginal tax rate τ_k on optimizers initially located at z_n is given by:

$$\zeta_{z_k}(z_n) = \int_0^{\theta^*} \varepsilon(1-\theta)\mathrm{d}H(\theta) = \varepsilon H(\theta^*)\left(1 - \mathbb{E}\left[\theta|\theta \leq \theta^*\right]\right) \tag{10}$$

From Equation (9) and (10), it is straightforward to see that:

$$S_r = \frac{\kappa}{\delta}\left[\frac{\zeta}{\varepsilon(1-\theta^*)} - H(\theta^*)\right]$$

Since all tax filers assigning a weight θ up to θ^* to the effective tax schedule are expected to relocate to the irrelevant TT, we should have $\zeta > \varepsilon(1-\theta^*)H(\theta^*)$ and $S_r > 0$. In contrast, $S_r = 0$ if agents are not strongly biased and the dispersion of weights is concentrated around its mean or in some circumstances if weights θ are misspecified as homogeneous, in which case the *behavioral cross-influence* would not be identified.[23]

Further assuming that θ follows a Beta distribution characterized by a mean $\overline{\theta}$ and a variance σ_θ^2 provides the last equation required to recover the shape of income tax misperceptions:

$$S_r = \frac{\kappa}{\delta}\left(\frac{\theta^* - \overline{\theta}}{1-\theta^*}H(\theta^*) + \frac{\theta^*\sigma_\theta^2}{\overline{\theta}\left(1-\overline{\theta}\right) - \sigma_\theta^2}h(\theta^*)\right) \tag{11}$$

For a causal estimate of $\widetilde{S}_r$ and from Equations (4) to (11), we can identify the mean $\overline{\theta}$ and the variance σ_θ^2 of tax misperceptions. Similarly, the behavioral cross-influence can be recovered from its structural expression:

$$\zeta = \varepsilon(1-\theta^*)\left(\frac{1-\overline{\theta}}{1-\theta^*}H(\theta^*) + \frac{\theta^*\sigma_\theta^2}{\overline{\theta}\left(1-\overline{\theta}\right) - \sigma_\theta^2}h(\theta^*)\right)$$

which simplifies to $\zeta = \varepsilon(1-\overline{\theta})$ under homogeneous misperceptions.

This analysis builds a new bunching method for inference when agents are heterogeneous. Kleven (2016) shows that non-linearity of notches prevents the estimation of the expected value of heterogeneity parameters and develops a non-parametric upper bound for this aggregation bias. Here, I deal with this issue specifying a parametric distribution for the probability θ assigned to the effective tax schedule,[24] which is identified from the re-allocation of bunchers between

[23] $S_r = 0$ iif $\theta^* = \mathbb{E}\left[\theta|\theta \leq \theta^*\right]$ which is equivalent to $\forall\theta \in [0, \theta^*],\ H(\theta) = 0$. This is true if no agent is biased, if they all assign the same weight $\overline{\theta} \geq \theta^*$ to the effective tax schedule or if misperceptions are weakly heterogeneous such that the domain of the distribution of weights is bounded below by θ^*. Intuitively, in these cases, the variation in τ_k would not be large enough to triggers relocations to the TT, hence preventing the estimation of a behavioral cross-influence. Therefore, if we misspecify misperceptions as homogeneous while they are truly heterogeneous on the full $[0, 1]$ domain with $\overline{\theta} \geq \theta^*$, then the behavioral cross-influence is not identified.

[24] This distribution is assumed constant over time, but does not require for individual tax filers to have the same θ each year.

the two thresholds following the perturbation of τ_k. Estimation of the average θ relies on this parametric assumption, requires the extra identifying Equation (11), but provides estimates for the behavioral cross-influence and the dispersion of misperceptions in the population.

4 Estimation

The income tax misperception model depends on three structural parameters: the mean $\overline{\theta}$ and variance σ_θ^2 of the distribution of weights θ as well as the elasticity ε. These three parameters are identified from three empirical moments: the bunching masses B_k and B_n, scaled by the height of the counterfactual distribution and the share of optimizers, as well as the share S_r of relocations from the TCT to the TT due to the rise in the perceived τ_k in 2012.

This section presents the estimation of those three moments. First, $\widetilde{B}_k$ is estimated through difference-in-bunching at the TT kink. Second, $\widetilde{B}_n$ is estimated through polynomial approximation of a counterfactual earnings density around the TCT notch. Third, the share S_r of relocations is estimated through difference-in-difference at the individual level. Finally, the structural parameters are recovered with a method of simulated moments.

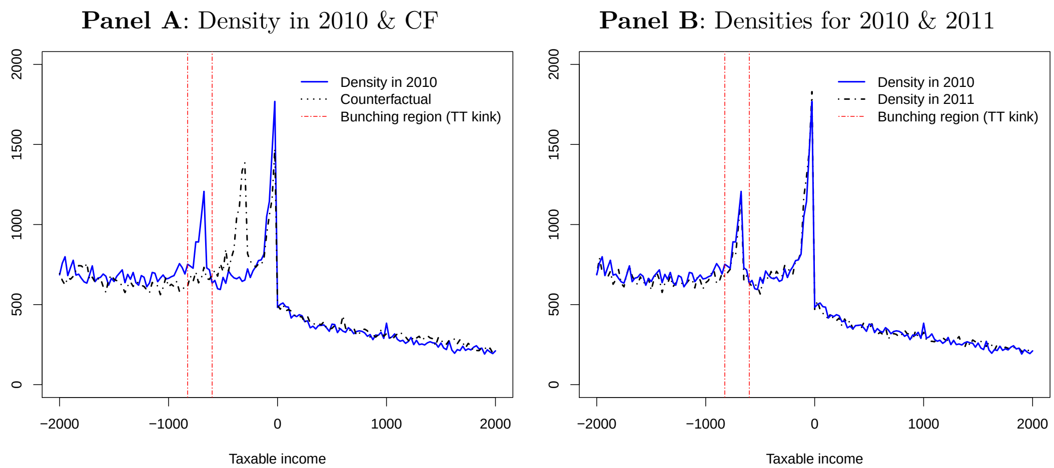
4.1 Difference in bunching at the TT kink

The accuracy and the very large scale of the income tax return data enable a precise estimation of the taxable income distribution over the 2008 - 2014 period. Following Brown (2013), I take advantage of repeated cross-sections in order to estimate the bunching mass B_k and the height of the counterfactual density $f_0(z_k)$ from the difference in bunching at the TT kink over time. In 2012, the rise in the "decote" parameter S mechanically reduced the gap between the two thresholds (Table 1) and the two peaks became closer to each other (Figure 13). Estimation of bunching moments relies on the difference between the actual and counterfactual densities, where a post-2011 taxable income density is taken as a counterfactual for each one of the pre-2012 densities and vice versa.[25]

Figure 7 illustrates this estimation strategy. Panel A depicts the 2010 taxable income distribution (solid blue line) and its counterfactual, the 2013 distribution (black dotted line), which has been rescaled so that both integrate at the same population level within the estimation window. Both densities are centered around their respective TCTs. The bunching mass $\widetilde{B_k}$ is given by the area between the two densities within the bunching region (delimited by red dotted lines) and $\widetilde{f}_0(z_k)$ is directly measured as the height of the counterfactual density at the TT.

[25] In the baseline, I take the 2013 and 2011 densities as counterfactuals and I show in Appendix D that results are unaffected by alternative counterfactuals. The validity of this estimation relies on the absence of persistence in bunching: tax filers focus on the current exact location of a threshold provided by explanatory files and do not keep track of previous values.

Figure 7: Difference-in-Bunching at the Taxation Threshold



Note: *Panel A*: the plain blue line displays the distribution for 2010 and the dotted line its counterfactual, which is the 2013 distribution rescaled by the size of the 2010 population within the ±2000 interval. *Panel B*: quasi-perfect superposition of the 2010 and 2011 distributions. Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2010-2013.

Inference is driven through a comparison of the 2010 and 2011 densities. Income tax parameters remained unchanged between 2010 and 2011 (Table 1). The nearly perfect superposition of these densities (Figure 7, Panel B) confirms the stability of the bunching pattern and suggests that any difference must be related to a natural variability which can be used to recover confidence intervals for the main estimates. Hence, there is no need to rely on residuals from outside the bunching region to extrapolate the variability within the bunching region.

4.2 Polynomial approximation at the TCT notch

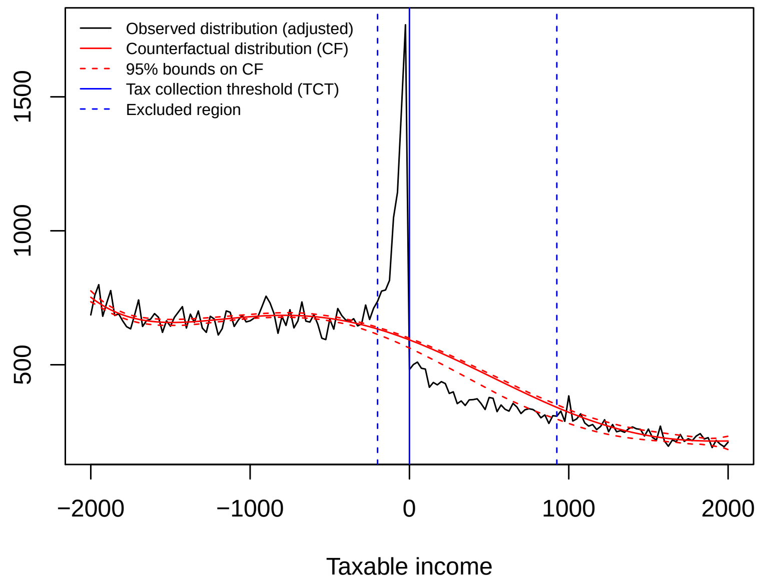
In a second step, bunching at the TT kink is suppressed by locally replacing the density by its counterfactual in the bunching region.[26] Bunching moments at the TCT notch and the share of optimizers can then be recovered from this corrected density.

Bunching estimates $\widetilde{B_n}$ and $\widetilde{f_0}(z_n)$. Following the "bunching-hole" method of Kleven and Waseem (2013), the counterfactual distribution $\widetilde{f_0}(z)$ (red line in Figure 8) is estimated through polynomial approximation of the corrected distribution, excluding a range $[z_L, z_U]$ (vertical dotted lines) around the TCT. Given z_L, the upper bound z_U is defined such that the bunching mass $\widetilde{B}_n$ above the counterfactual distribution on the $[z_L, z_n]$ range is equal to the hole below

[26]Technically, it would be necessary to correct the counterfactual distribution above the kink to take into account intensive responses, as proposed by Chetty et al. (2011). However, Kleven (2016) (p.451) explains that this correction may be ignored when distributions are broadly flat.

the counterfactual within $[z_n, z_U]$. The confidence interval for $\widetilde{B}_n$ is constructed by resampling residuals of the polynomial approximation outside of the bunching region, as in Chetty et al. (2011).

Figure 8: Polynomial approximation at the Tax Collection Threshold



Note: Corrected taxable income distribution in 2010 (black line) and its counterfactual density around the TCT notch (red line) with 99% confidence intervals computed from 1000 bootstrap replications (red dotted lines). The vertical plain blue line locates the Tax Collection Threshold and the vertical blue dotted lines delimit the bunching window $[z_L, z_U]$. Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2010 and 2013.

Share of optimizers $\widetilde{m}$. According to Kleven and Waseem (2013), optimizing taxpayers should never locate in a strictly dominated area just above the notch $[z_n, z_d]$ since net income is strictly decreasing with the level of taxable income (Figure 5). Therefore, any taxpayer in this region does not optimize with respect to the low-end of the income tax ($m = 0$), either because she is facing optimization frictions preventing her to adjust her taxable income or because she optimizes with respect to other features of the tax schedule. The share of local optimizers is given by $\widetilde{m} \equiv 1 - \int_{z_n}^{z_d} f(z)\mathrm{d}z / \int_{z_n}^{z_d} f_0(z)\mathrm{d}z$.[27] Scaling earnings responses by the share of optimizers, as shown in Equations (6) and (7), is necessary in order to measure earnings responses among tax

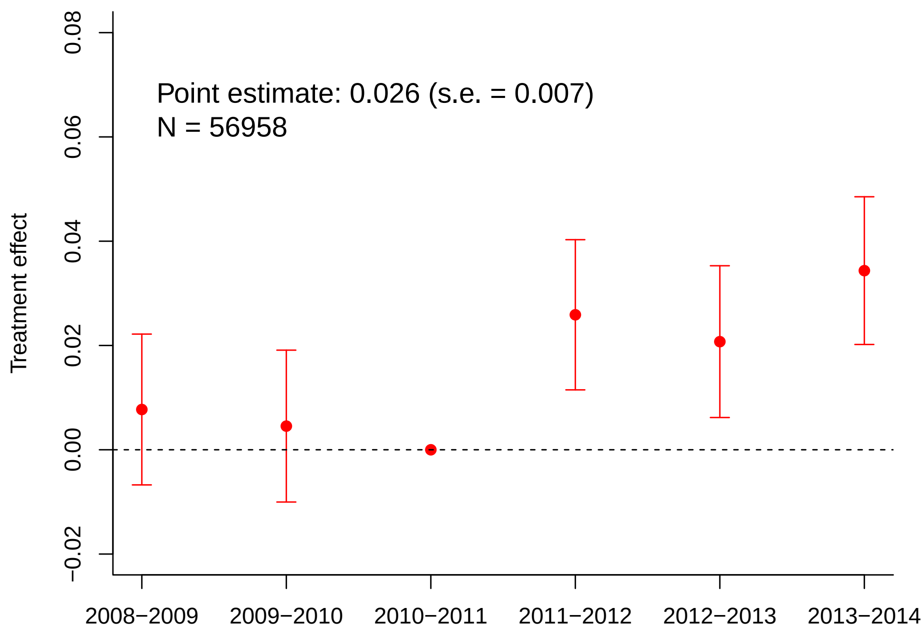
[27] Here, the size of the dominated area is increasing with θ: $z_d - z_n = \theta T_0 / (1 - (1-\theta)\tau_k - \theta\tau_n)$ and reaches its maximum if taxpayers purely focus on the effective tax schedule. In practice, I consider a fixed dominated region and I show in Appendix D that results are stable when changing the width of this area.

filers optimizing with respect to the low-end of the income tax schedule.[28]

4.3 Difference-in-difference on relocations to the irrelevant TT in 2012

The share S_r should be estimated as the causal impact of the rise in the shadow marginal tax rate τ_k in 2012 on the share of tax filers initially bunching at the Tax Collection Threshold in 2011 and relocating toward the Taxation Threshold in 2012.

Figure 9: Diff-in-Diff on relocations to the Taxation Threshold



Note: This figure displays the gaps between the two lines of Figure 4, which are estimated on individual-level transitions between different positions in the taxable income distribution and where the relative probability to relocate at the TT in 2011 is normalized to zero. Starting from 2012, the probability to relocate to the TT kink increases by 2.6 pts for a tax filer initially at the TCT compared to a tax filer initially below the TT the previous year. This estimate should be rescaled in order to recover the statistic $\widetilde{S}_r$. Single recipients of intra-family transfers present two consecutive years in the data set, metropolitan France, except retirement pensions holders. Tax files POTE 2008 - 2014.

Figure 9 rationalizes the intuition provided by Figure 4 within a difference-in-difference framework. This figure displays the additional probability of a tax filer initially at the TCT year N

[28]On a more technical note, bunching at the kink is estimated within a 225€ width interval and bunching at the notch within a 200€ width interval ($z_L = -200$). The counterfactual density is based on a fifth-order polynomial. I take 25€ bins to insure a very local estimation and benefit from variability in the distribution. m is estimated on the extended interval $[0, z_U/2]$. Regarding the resampling process, the earnings response are bounded from below by the dominated region and from above by the earning response of the convergence method, as in Kleven and Waseem (2013). Appendix D shows that this estimation is robust to alternative calibrations of these parameters.

(treatment group) to relocate at the irrelevant TT year $N+1$, compared to a tax filer initially below the bunching region of the TT kink (control group), for each year N from 2008 to 2013. Within a linear probability model, these estimates are basically given by the difference between the two lines of Figure 4, where the estimate for relocations between 2010 and 2010 has been normalized to 0.

From 2012 on, the rise in the shadow marginal tax rate τ_k significantly and persistently increases by 2.6 points the probability for a tax filer initially at the effective TCT to relocate at the irrelevant TT. Since S_r is the share of relocations among individuals initially bunching at the TCT and not among all filers in the bunching region around the TCT, this statistic should be rescaled by the ratio of these two populations $\int_{z_L}^{z_n} \widetilde{f}\left(z_{2011}\right) \mathrm{d}z / \widetilde{B}_{n,2011}$, which implies that we could take $\widetilde{S}_r = 0.026 \times \frac{9299}{3774} = 6.4~\%$ as an estimate of S_r. One could be concerned that higher transitions from the TCT to the TT are just the consequence of the two thresholds becoming closer to each other from 2012 on, whereas the distance between the control group and the TT remains constant. Figure 15 in Appendix B provides evidence against this interpretation. Considering tax filers initially located above the TCT as an alternative control group leaves the results unchanged.[29]

Before proceeding to the estimation of the whole model, we can already conclude that a significantly positive $\widetilde{S}_r$ necessarily implies a positive *behavioral cross-influence* $\zeta_{z_k}(z_n)$ of the shadow marginal tax rate τ_k on bunchers located at the TCT z_n. This empirical fact confirms the tax misperception model: even tax filers initially located at the effective TCT assign a positive weight to the shadow tax bracket, such that they relocate to the irrelevant TT when they perceive stronger incentives there.

Finally, the difference-in-difference estimator would provide a point estimate for S_r if, each year, tax filers could only locate at the two thresholds. In practice, some taxpayers experience earnings shocks pushing them higher or lower in the income distribution, such that the starting point of the income tax stops being their primary concern. Hence, this estimate might be considered as a lower bound for S_r. An aggregate upper bound is given by the percent change in the number of bunchers at the TCT notch (Figure 3), in which case we consider that the whole mass of bunchers who disappeared from the TCT notch in 2012 moved in fact to the TT kink. The main advantage of this aggregate approach is to consolidate the flows in and out of the influence zone of the two thresholds, rather than focusing on individuals staying there two consecutive years.

[29] Since this alternative control group partly overlaps with the dominated region, these tax filers are less likely to optimize their earnings with respect to the perceived income tax schedule. The treatment effect is smaller in 2013 and 2014 though, since stronger incentives at the TT attract even tax filers initially from above the TCT. In this sense, this alternative control group is not as "pure" as the original one.

4.4 Structural parameters and inference

Under homogeneous misperceptions, earnings responses $\Delta\widetilde{z}_k$ and $\Delta\widetilde{z}_n$ can be recovered using Equations (6) and (7) from five empirical moments: the bunching masses $\widetilde{B}_k$ and $\widetilde{B}_n$, the height of the counterfactual density at each threshold $\widetilde{f}_0(z_k)$ and $\widetilde{f}_0(z_n)$ as well as the share of optimizers $\widetilde{m}$. Then parameters θ and ε are exactly identified from Equations (4) and (5). Further considering that $z_I \geq z_n$ ensures unicity of the solution.[30]

Heterogeneous misperceptions prevent such a clear estimation since earnings responses are not observed at the individual level. Parameters are estimated through a method of simulated moment according to the following steps:

1. Set initial values for the parameters of the Beta distribution α_0, β_0 and the elasticity ε_0.

2. Approximate the Beta density for I points (Gauss-Jacobi quadrature).

3. At each point θ_i, solve Equations (4) and (5) for $\Delta z_{k,i}$ and $\Delta z_{n,i}$.

4. Compute $\mathbb{E}_\theta\left[\Delta z_{k,i}\right]$ and $\mathbb{E}_\theta\left[\Delta z_{n,i}\right]$.

5. Compute the threshold θ^*.

6. Compute $S_r\left(\varepsilon_0, \alpha_0, \beta_0\right)$ from the right-hand side of Equation (11).

7. Find $\varepsilon, \alpha, \beta$ minimizing:

$$\left(\mathbb{E}_\theta\left[\Delta z_{k,i}\left(\varepsilon, \alpha, \beta\right)\right] - \widetilde{\Delta z_k}\right)^2 + \left(\mathbb{E}_\theta\left[\Delta z_{n,i}\left(\varepsilon, \alpha, \beta\right)\right] - \widetilde{\Delta z_n}\right)^2 + \left(S_r\left(\varepsilon, \alpha, \beta\right) - \widetilde{S}_r\right)^2$$

8. Recover the mean $\overline{\theta} = \alpha/(\alpha+\beta)$ and variance $\sigma^2_\theta = \alpha\beta/((\alpha+\beta)^2(\alpha+\beta+1))$.

Estimation of structural parameters only requires earnings responses for one year of data. Since income tax returns are available over seven years, Section 5 presents parameters estimated over this whole period from a generalized method of moments. Appendix B shows the same parameters estimated for each year from 2008 to 2014.

Confidence intervals are generated by bootstrap replications. Since $\widetilde{\Delta z_n}$ depends on the estimate $\widetilde{\Delta z_k}$ through Equation (7), I construct each iteration of $\widetilde{\Delta z_n}$ from a different bootstrapped value of $\widetilde{\Delta z_k}$. The share of optimizers m is taken as a constant scale parameter and its value is set to be equal to its point estimate. For a set of bootstrapped replications of Δz_k and Δz_n, I draw a set of S_r of the same size from a Gaussian with mean and variance given by the estimator $\widetilde{S_r}$. These steps are repeated for each bootstrap replication and the resulting distributions of parameters are used to compute the confidence intervals of the structural parameters.

[30] The system given by Equations (4) and (5) has two numerical solutions in $[0,1]^2$, but one can be rejected since it would generate an interior solution below the TCT ($z_I < z_n$).

5 Results

This section first presents the estimated values of the bunching moments, the earnings responses and the structural parameters of the income tax misperception model. Contrasting hard-copy versus online tax filers, the misperception model stresses a better understanding of the income tax system by the latter and therefore confirms heterogeneity of tax misperceptions.

5.1 Under the influence of a shadow tax bracket

Bunching estimates. The first six columns of Table 3 display the number of bunchers $\widetilde{B}_i$, the relative bunching scaled by the height of the counterfactual distribution $\widetilde{b}_i \equiv \widetilde{B}_i/\widetilde{h}_0(z_i)$ and the average earnings response $\Delta\widetilde{z}_i$ among optimizers, at the TT kink and at the TCT notch ($i \in \{k, n\}$). Bunching is significantly positive at both thresholds. Average earnings responses are non-negligible: the marginal buncher at the notch adjusts her taxable income by roughly 850 € to locate at the Tax Collection Threshold (TCT) while the marginal buncher at the kink adjusts her taxable income by 300 € to locate at the Taxation Threshold (TT).

Table 3: Bunching estimates

	Bunching mass		**Scaled bunching**		**Income resp. (€)**		**Non-opt.**
Threshold	TT	TCT	TT	TCT	TT	TCT	Both
Estimate	$\widetilde{B}_k$	$\widetilde{B}_n$	$\widetilde{b}_k$	$\widetilde{b}_n$	$\widetilde{\Delta z_k}$	$\widetilde{\Delta z_n}$	$1-\widetilde{m}$
2008	1221	2830	1.51	3.87	253	917	0.85
	[980, 1450]	[2676, 3078]	[1.20, 1.79]	[3.63, 4.37]	[203, 300]	[857, 1012]	[0.83, 0.94]
2009	1382	3047	1.79	4.37	213	745	0.79
	[1140, 1610]	[2906, 3297]	[1.47, 2.09]	[4.16, 4.82]	[176, 248]	[698, 817]	[0.77, 0.89]
2010	1638	3478	2.20	5.04	248	829	0.78
	[1395, 1864]	[3330, 3729]	[1.86, 2.51]	[4.77, 5.63]	[211, 282]	[781, 908]	[0.76, 0.87]
2011	1281	3774	1.75	5.46	184	769	0.76
	[1038, 1507]	[3599, 4045]	[1.40, 2.06]	[5.18, 6.08]	[149, 216]	[727, 842]	[0.74, 0.87]
2012	3053	2747	3.81	3.79	416	842	0.77
	[2803, 3282]	[2540, 3042]	[3.51, 4.09]	[3.51, 4.32]	[382, 447]	[797, 911]	[0.74, 0.90]
2013	2790	2876	3.23	3.75	399	872	0.80
	[2542, 3017]	[2638, 3231]	[2.94, 3.49]	[3.41, 4.45]	[363, 431]	[818, 955]	[0.76, 0.95]
2014	2610	2858	3.52	4.41	427	969	0.79
	[2364, 2837]	[2651, 3169]	[3.19, 3.82]	[4.07, 5.10]	[387, 464]	[903, 1061]	[0.76, 0.93]

Note: $1-\widetilde{m}$ is the share of tax filers who are not optimizing with respect to the low-end of the income tax. $\widetilde{B}_k$ and $\widetilde{B}_n$ refer to total numbers of bunchers at the kink and at the notch respectively. $\widetilde{b}_k$ and $\widetilde{b}_n$ denote relative bunching at the kink and at the notch, scaled by the height of the counterfactual density. $\widetilde{\Delta z_k}$ and $\widetilde{\Delta z_n}$ are estimates of average earnings responses at the kink and at the notch in euros. 95% confidence intervals computed from 1000 bootstrap iterations are in brackets below estimates. Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2008-2014.

The last column of Table 3 shows that, each year, between 75 % and 80 % of tax filers in our sample do not optimize their taxable income with respect to the low end of the income tax. Considering that recipients of intra-family transfers have the ability to modulate their reported earnings, this lack of adjustment does not appear related to an economic cost. Even after removing agents whose intra-family transfers obey another rationale, such as reporting a reference value or a round number, $1 - \widetilde{m}$ remains as high as 70% (Table 10 in Appendix C). According to the theoretical framework developed in Section 3, at most one fourth of these tax filers with adjustment capacities pay attention to the starting point of the income tax. The others may be inattentive or rationally attentive to other dimensions of the tax system more relevant for their situation (special tax regimes, other deduction thresholds,...). Considering that the income tax stands for around 9 % of total taxes on earnings for the marginal buncher at the notch[31], global attention appears quite in line with the meta-analysis in Figure 1 of Gabaix (2019).

Main parameters. The structural parameters of the misperception model displayed in Table 4 are estimated among optimizers who pay attention to the low-end of the income tax. The effective marginal tax rate τ where tax liabilities start is high and heterogeneous among the population due to the phase-in of taxes and the phase-out of social benefits. In line with evidence from French administrative reports (CPO (2010, 2014)), I take $\tau = 0.5$ and I show in Appendix D that the estimated θ is not sensible to this calibrated value.

Tax misperceptions are substantial and heterogeneous. Faced with an ambiguity about the location of the threshold where income tax liabilities start, tax filers assign an average probability of 75 % to the shadow tax bracket and of only 25 % to the effective tax schedule. As shown by Table 7 in Appendix B, these estimated probabilities are relatively stable over time, apart from a slight drop between 2011 and 2012, that could be related to a temporarily increased focus on the shadow tax bracket (the associated probability increases from 77 % to 84 %) resulting from the rise in τ_k.

Considering homogeneous or heterogeneous misperceptions does not impact the average probability $\overline{\theta}$. The variance of tax misperceptions is significantly positive, which confirms that θ is heterogeneous. The maximum variance for a variable distributed on a $[0, 1]$ interval with a mean $\overline{\theta} = 0.25$ is $\overline{\theta}(1 - \overline{\theta}) = 18.75 \cdot 10^{-2}$, which is strictly above the upper bound of the confidence interval for σ_θ^2. Therefore, this estimation rejects an extreme situation where tax filers focus exclusively either on the effective tax schedule ($\theta = 1$) or on the shadow tax bracket ($\theta = 0$). In contrast, they appear to take both possibilities into account simultaneously, which is consistent

[31] In 2012, the marginal buncher at the notch is characterized by $z_n = 12141$ € and $\Delta z_n = 842$ €, such that $T(z_n + \Delta z_n) = 238$ €. According to the simulation model of the French tax system Ines developed by the National Institute of Statistics and Economic Studies, the average tax rate at the threshold where income tax liabilities start, computed for a single tax filer with only wage earnings as the percent change between gross and disposable income, is equal to 21 %. Hence, for this marginal buncher, income taxes represent $238/(0.21 \times 12983) = 9$ % of total taxes on gross income.

Table 4: Main parameters

Model	Period	Weight		Elasticities	
		$\overline{\theta}$	σ_θ^2	ε	$\zeta_{z_k}(z_n)$
Homogeneous	2008-2014	0.23	-	0.17	0.11
		[0.22, 0.25]	-	[0.15, 0.18]	
Homogeneous	2011	0.23	-	0.18	0.14
		[0.20, 0.28]	-	[0.16, 0.21]	
Heterogeneous	2011	0.25	$5.3 \cdot 10^{-2}$	0.19	0.10
		[0.20, 0.33]	$[6.3 \cdot 10^{-4}, 1.7 \cdot 10^{-1}]$	[0.17, 0.21]	

Note: $\overline{\theta}$ and σ_θ^2 are respectively the mean and variance of the distribution of individual weights θ. ε is the structural elasticity and $\zeta_{z_k}(z_n)$ the behavioral cross-influence of the shadow marginal tax rate τ_k on tax filers at the TCT z_n. The homogeneous model is estimated assuming that $\theta = \overline{\theta}$ for each tax filer. $\tau = 0.5$. 95% confidence intervals computed from 1000 bootstrap iterations are in brackets below estimates. Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2008-2014.

with the mention of both thresholds on the same page of the Income Tax Guidebook (Figure 12).

Elasticity ε captures the responsiveness of tax filers to *perceived* incentives: a 1 point rise in the *perceived* retention rate given by the slope of the *perceived* budget constraint induces an average increase by 0.19 points in the reported taxable income. Table 7 in Appendix B displays the structural parameters estimated from the homogeneous model for each year between 2008 and 2014. Extensive responses to the multiplication of τ_k by 2.5 in 2012 are not sufficient for the elasticity ε to keep the same level. As explained by Chetty et al. (2011), informational frictions generally prevent such a strong adjustment in the short run. I come back on this point in more details below in the predictive exercise.

The behavioral cross-influence $\zeta_{z_k}(z_n)$ states that a 1 point increase in the shadow marginal tax rate τ_k at the irrelevant Taxation Threshold leads agents located at the Tax Collection Threshold to reduce their reported earnings by 0.10 points on average. These elasticity estimates have two consequences for empirical public finance. First, a naive approach considering only "rational" adjustments with respect to the TCT notch using Equation (5) with $\theta = 1$ would substantially underestimate the structural elasticity ε, since part of the earnings responses would be ignored (the estimated value would be 0.05). Second, earnings responses to seemingly irrelevant incentives can be substantial and, as theoretically advised by Farhi and Gabaix (2020), should not be ignored.

Robustness. Appendix D shows that the average weight θ is very robust to alternative values for the main parameters of the bunching estimation, for the marginal tax rates at the two thresholds, for the level of global attention m and for the scale parameter τ.

Bunching at a specific threshold has been related to reference-dependent preferences (Allen et al. (2017)). Rees-Jones (2017) finds evidence of loss-aversion depending on the balance due on tax day: taxpayers who face a payment engage much more in tax reduction activities than taxpayers owed a refund. Here, one could similarly argue that tax filers dislike paying taxes. Their preferences would feature a probabilistic reference point, located either at the TCT with probability θ or at the TT with probability $1 - \theta$. Exceeding a threshold would be characterized by a discontinuously higher marginal disutility, in line with the reference-dependent preferences developed by Kőszegi and Rabin (2006). However, Appendix E shows that even a high level of loss-aversion cannot rationalize the empirical findings of Section 2 without strong tax misperceptions.

Validation in prediction. As advised by DellaVigna (2018), the external validity of this behavioral structural model is assessed through a validation in prediction. The structural parameters for 2011 when $\tau_k = 5.5$ % are retrieved and used to evaluate the ability of the model to predict bunching masses and earnings responses in 2012 when $\tau_k = 14$ %. Since the effective tax schedule remains unchanged between 2011 and 2012, a traditional taxation model would predict a stability of the bunching mass. In contrast, the bunching mass at the TCT in 2012 is far below the lower bound of the confidence interval for this value in 2011 (Table 3). Standard taxation models cannot rationalize these empirical findings.

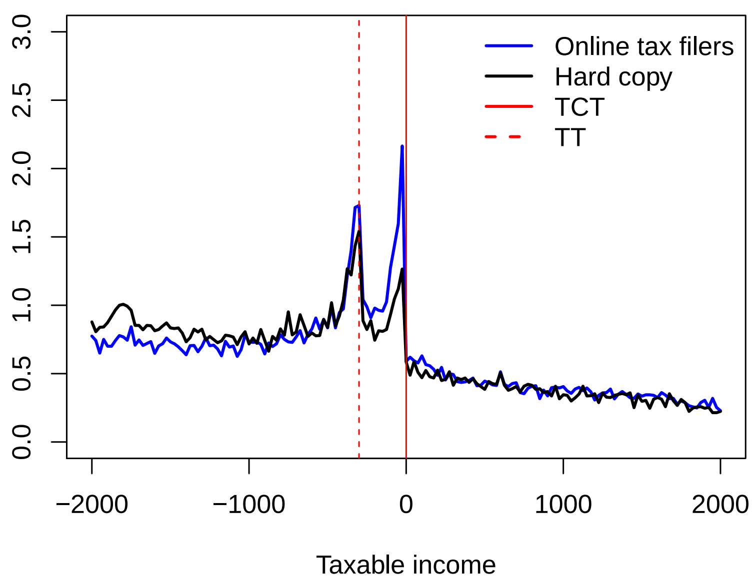
Now, consider a reverse-engineering exercise within the homogeneous misperception model. Take the value of the structural parameters for 2011 ($\overline{\theta} = 0.23$ and $\varepsilon = 0.18$) and the policy parameters for 2012 ($z_k = 11,791$, $z_n = 12141$ and $\tau_k = \tau_n = 14\%$). The predicted earnings responses at the kink and at the notch are respectively $\Delta z_k^p = 527$ and $\Delta z_n^p = 1059$. The predicted bunching masses at each threshold are: $B_k^p = 3668$ and $B_n^p = 3392$. The tax misperception model correctly predicts the significantly stronger earnings responses at the TT kink, the bigger bunching mass there, as well as the reduction in bunching at the notch.

With the 2011 elasticity, the model overpredicts empirical adjustments. The multiplication by 2.5 of the marginal tax rate τ_k should theoretically attract much bigger bunching masses, but there is a lack of extensive responses. Indeed, stronger bunching at the TT kink mostly comes from a reallocation of optimizing tax filers between the twin peaks, whereas total bunching at both peaks is not increasing fast enough to compensate for the rise in τ_k. As explained by Chetty et al. (2011), it takes time for non-optimizers to react to new incentives. In any case, the magnitude of this elasticity is related to the size of the total bunching mass at both thresholds, and not to behavioral considerations driving the division of this bunching mass between the two thresholds. Instead, taking the average elasticity estimated between 2011 and 2014 ($\varepsilon = 0.14$) provides predictions much closer to the bunching estimates for 2012 displayed in Table 3: $\Delta z_k^p = 408$, $\Delta z_n^p = 850$, $B_k^p = 2839$ and $B_n^p = 2825$. This predictive exercise confirms the external validity of the misperception model, which is able to predict behavioral responses to a multiplication by 2.5 of the shadow marginal tax rate τ_k.

5.2 Hard-copy vs. online tax reports

In a complex fiscal environment, it can be mentally costly to establish with certainty the threshold where income tax liabilities start. First, tax filers have to find relevant information, then they should be able to forge an estimate of the associated tax incentives and finally, they should understand how the intra-family transfers they report impact their taxable income.[32] Availability of information technologies may alleviate these costs and assist them during their income reporting process.

Figure 10: Hard copy vs. Internet - Bunching 2013



Note: Distribution of taxable income by 25€ bins for online tax filers (blue line) and filers in hard-copy (black line) centered on the Tax Collection Threshold (TCT). The vertical red dotted line shows the Taxation Threshold (TT). Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2013.

The Internet appears as a relevant source of information, increasingly used by households when filing their tax returns (Hoopes et al. (2015)). Online tax filing has been introduced in 2002 in France. It is strongly encouraged by the government through deadline extensions and it

[32] This third step is not straightforward. Received intra-family transfers p enter the taxable income according to the following formula: $\max\{0, \min(p - p_{min}, 0.9 \times p), p - p_{max}\}$, where parameters p_{min} and p_{max} change every year.

became mandatory in 2019 for each tax household having access to the Internet.[33] During the last two decades, there has been a surge in the number of tax filers reporting their taxes on the Internet, from 3.8 millions in 2005 to 21.3 millions in 2016 (Figure 16 in Appendix B). In 2014, online tax filers stand for half of my sample.

The link between online tax filing and (mis)perception of income taxes is not straightforward. On the one hand, reporting taxes on the Internet could increase the focus on the effective tax system through the access to tax simulators and background documentation. On the other hand, global attention could be reduced by the automation of the tax filing process (Finkelstein (2009)). To assess this relation, I divide the population into two groups, depending on whether tax households report their taxes online or in hard copy.

Figure 10 shows taxable income distributions centered around the TCT for these two groups.[34] Compared to people filing their tax return in hard copy, online filers display a globally bigger bunching mass at both peaks and appear relatively more responsive to the effective Tax Collection Threshold. Since both groups face the same tax schedule, discrepancies may be driven by differences in elasticities ε, in assigned probability $\overline{\theta}$ or in the share m of optimizers. Estimations on these two subpopulations provide evidence on the underlying mechanism.

Table 5: Hard copy vs. Internet - structural parameters

	Weight	**Elasticity**	**Non opt.**
	$\overline{\theta}$	ε	$1-m$
Full sample	0.22	0.14	0.78
	[0.21, 0.24]	[0.13, 0.15]	[0.75, 0.91]
Internet	0.27	0.13	0.75
	[0.27, 0.30]	[0.13, 0.14]	[0.72, 0.88]
Hard copy	0.14	0.14	0.81
	[0.13, 0.16]	[0.13, 0.15]	[0.77, 0.94]

Note: $\tau = 0.5$. 95% confidence intervals displayed in brackets are computed from 1000 bootstrap iterations. Information about paper/online tax filing is only available from 2011 on. Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2011-2014.

Table 5 displays $\overline{\theta}, \varepsilon$ and $1-m$ estimated from the homogeneous misperception model on the full sample and on each one of the two subgroups. The elasticity ε is the same among each group: conditional on information, online tax filers and filers in hard copy display the same responsiveness to incentives. In contrast, filling out taxes on the Internet is associated with a significantly higher probability $\overline{\theta} = 27$ % assigned to the effective tax schedule, while it is only

[33] This law is entitled "Law for the state in the service of a society of trust". For tax returns filed between 2016 and 2018, this constraint already applied for taxpayers above some income thresholds and having access to the Internet.

[34] Figure 17 displays similar distributions for each year from 2011 to 2014.

14% among filers of paper forms. Finally, global attention m to the starting point of the income tax is slightly–although not significantly–bigger among online filers, which is also consistent with the Internet being a useful resource to optimize reported earnings. Table 8 in Appendix B displays these parameters for each year from 2011 to 2014. Without implying any causal effect of Internet on tax knowledge, the capacity of this behavioral model to disentangle responses to incentives from misperception of taxes confirms the heterogeneity of tax misperceptions along an observable dimension.

6 Conclusion

Relying on earnings responses to the threshold where French income tax liabilities start, this paper makes several contributions to the literature on income taxation of behavioral agents.

First, these empirical investigations provide a few insights on tax filers' mental representations of the income tax. Rather than computing and optimizing over a comprehensive income tax schedule, they appear to search for economically relevant thresholds, tax credits and associated tax incentives. In a complex environment, they would favor information on a salient local optima over an exhausting search for the global optimum.

Facing an ambiguous communication from the government, tax filers appear to assign positive probabilities to each potential tax schedule in order to cope with uncertainty. Misperception of some features such as the Tax Collection Minimum may lead them to relocate away in the income distribution, but they stay responsive to the incentives that they *perceive*.

Second, failing to account for tax misperceptions could explain very low elasticity estimates. When the behavioral cross-influence is positive, agents may respond to perceived incentives at other earnings levels. Standard approaches would miss these adjustments and severely underestimate earnings responses.

Third, from a methodological perspective, this paper highlights the contribution of bunching techniques to inference in behavioral economics. Bunching methods provide convincing evidence of behavioral deviations in the form of bunching masses at seemingly irrelevant thresholds. When agents can easily and flexibly adjust their reported income, they prove useful to disentangle responses to incentives from misperceptions, to estimate a behavioral cross-influence as well as the magnitude and dispersion of misperceptions.

Fourth, beyond traditional tax instruments, there is definitely room for informational interventions. On the one hand, because it maintains an ambiguity about the threshold where tax liabilities start, the Income Tax Guidebook does trigger the twin peaks bunching pattern. On the other hand, the development of online tax filing, documentation and tax simulators could really improve tax filers' attention to and understanding of the tax system. A major enhancement would be the provision of an easily accessible tool summarizing a comprehensive tax schedule from the various earnings taxes and social benefits, which would convey a broader view of the tax incentives that matter.

Further developments include an exploration of the correlation between tax misperceptions and ability levels, which could not only lead to reassess the redistributive consequences of income taxes, but also to question the use of tax schedules as truthful mechanisms to deal with information asymmetries. A systematic analysis of the determinants and transmission channels of misperceptions may help for the design of efficient tax policies.

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Appendix

A Theoretical appendix

A.1 Family optimization

The model of Section 3 is framed as if recipients of intra-family transfers were optimizing on their own. Here, I show that a model of earnings adjustment within the family would have the same structure and lead to the same predictions.

Consider a family with a giver G and a recipient R. They maximize a quasi-linear utility taking into account all the family resources. Intra-family transfers are deductible for the giver and should be reported by the recipient. If the giver and the recipient report different values, then the giver should always report the maximum amount and the recipient should report zero. Since it is not consistent with the empirical distribution of received transfers, assume that the giver and the recipient report the same value a, which can be different from the true amount of transfer a^*. The giver is in the tax bracket characterized by a marginal tax rate τ_G and a lower bound $\overline{z}$, such that $y_G - a >> \overline{z}$. t_G captures the part of income taxes stemming from lower brackets. Consistently with the timing of the French income tax, effective earnings are fixed the former year and cannot be manipulated. The recipient has earnings y_R which are below the threshold where tax liabilities start. If her taxable income $z_R = y_R + a$ is in the low-end of the income tax, she expects to face the *perceive* income tax schedule $T^s(z_R) = \theta\left[\tau_k\left(z_R - z_k\right)\mathbb{I}\left\{z_R \geq z_k\right\}\right] + (1-\theta)\left[T_0 + \tau_n\left(z_R - z_n\right)\mathbb{I}\left\{z_R \geq z_n\right\}\right]$ (Here I consider $\tau = 0$ for simplicity). The budget constraint of this family is given by:

$$c \leq \underbrace{y_G - a^* - \tau_G\left(y_G - a - \overline{z}\right) - t_G}_{\text{Giver's budget}} + \underbrace{y_R + a^* - T^s(z_R)}_{\text{Receiver's budget}} = Y + \tau_G \cdot z_R - T^s(z_R)$$

where $Y = \tau_G\overline{z} + (y_G + y_R)(1-\tau_G) - t_G$ is the part of net income that is independent from reported intra-family transfers. The remainder of this budget set depends only on the taxable income reported by the recipient of IF transfers. Setting $\tau_G = 1 - \tau$, it is straightforward to see that she will maximize the same utility as in the baseline model of Section 3.[35]

Furthermore, Figure 20 in Appendix D shows that the estimated θ does not depend on the calibrated value of τ, since θ is identified by the difference in bunching between the two thresholds once we account for differences in incentives. In the family model, τ_G does not impact θ.

A.2 Identification with heterogeneous misperceptions

The level θ^* is defined by the equality:

$$z_n + \delta z_{n,2011} = z_k + \Delta z_{k,2012}$$

where the thresholds z_k and z_n are those of 2012, $\delta z_{n,2011}$ is the earnings response of the minimal buncher at the notch in 2011 where she faced with the 2012 thresholds and $\Delta z_{k,2012}$ is the earnings response of the marginal buncher at the kink in 2012. $\delta z_{n,2011}$ can be viewed as a counterfactual earnings responses in 2011 if the TT and TCT were the same as in 2012 but $\tau_k = 5.5\%$ instead of 14%. From $\tau_{k,2011} = 5.5\%$,

[35] The constant Y does not change the first-order conditions of the maximization program nor the indifference condition at the notch.

$\tau_{k,2012} = 14\%$ and using Equation (4) as well as the definition of δz_n, we have:

$$\begin{aligned}
z_n \left[1 + \frac{\delta z_{n,2011}}{z_n}\right] &= z_k \left[1 + \frac{\Delta z_{k,2012}}{z_k}\right] \\
z_n \left[1 - \frac{(1-\theta^*)\,\tau_{k,2011}}{1-\tau}\right]^{-\varepsilon} &= z_k \left[1 - \frac{(1-\theta^*)\,\tau_{k,2012}}{1-\tau}\right]^{-\varepsilon} \\
\left(\frac{z_n}{z_k}\right)^{\frac{1}{\varepsilon}} &= \frac{1 - \frac{(1-\theta^*)\tau_{k,2011}}{1-\tau}}{1 - \frac{(1-\theta^*)\tau_{k,2012}}{1-\tau}} \\
1-\theta^* &= (1-\tau)\frac{z_n^{\frac{1}{\varepsilon}} - z_k^{\frac{1}{\varepsilon}}}{z_n^{\frac{1}{\varepsilon}}\tau_{k,2012} - z_k^{\frac{1}{\varepsilon}}\tau_{k,2011}}
\end{aligned}$$

Using the log-approximation $\Delta z_k / z_k \approx -\varepsilon \log\left(1 - \frac{(1-\theta)\tau_k}{1-\tau}\right)$, we have:

$$z_n - z_k - z_n\varepsilon \log\left(1-\tau-(1-\theta^*)\tau_{k,2011}\right) + \varepsilon z_n \log(1-\tau) + z_k\varepsilon \log\left(1-\tau-(1-\theta^*)\tau_{k,2012}\right) - \varepsilon z_k \log(1-\tau) = 0$$

The number B_r of tax filers relocating from the TCT to the TT in 2012 is given by:

$$\begin{aligned}
&\frac{B_r}{m f_0(z_n)} \\
= & \int_0^{\theta^*} z_k + \Delta z_{k,2012} - z_n - \delta z_{n,2011}\ \mathrm{d}H(\theta) \\
= & \int_0^{\theta^*} z_k - z_n - z_k\varepsilon \log(1-\tau-(1-\theta)\tau_{k,2012}) + \varepsilon z_k \log(1-\tau) + z_n\varepsilon \log(1-\tau-(1-\theta)\tau_{k,2011}) - \varepsilon z_n \log(1-\tau)\ \ \mathrm{d}H(\theta) \\
= & \int_0^{\theta^*} -z_k\varepsilon \left[\log(1-\tau-(1-\theta)\tau_{k,2012}) - \log\left(1-\tau-(1-\theta^*)\tau_{k,2012}\right)\right] + z_n\varepsilon\left[\log(1-\tau-(1-\theta)\tau_{k,2011}) - \log\left(1-\tau-(1-\theta^*)\tau_{k,2011}\right)\right]\ \mathrm{d} \\
= & \int_0^{\theta^*} -z_k\varepsilon \log\left(1 - \frac{(\theta^*-\theta)\tau_{k,2012}}{1-\tau-(1-\theta^*)\tau_{k,2012}}\right) + z_n\varepsilon \log\left(1 - \frac{(\theta^*-\theta)\tau_{k,2011}}{1-\tau-(1-\theta^*)\tau_{k,2011}}\right)\ \mathrm{d}H(\theta) \\
\approx & \int_0^{\theta^*} z_k\varepsilon \frac{(\theta^*-\theta)\tau_{k,2012}}{1-\tau-(1-\theta^*)\tau_{k,2012}} - z_n\varepsilon\frac{(\theta^*-\theta)\tau_{k,2011}}{1-\tau-(1-\theta^*)\tau_{k,2011}}\ \mathrm{d}H(\theta) \\
= & \int_0^{\theta^*} \varepsilon(\theta^*-\theta)\frac{z_n^{\frac{1}{\varepsilon}}\tau_{k,2012} - z_k^{\frac{1}{\varepsilon}}\tau_{k,2011}}{(1-\tau)(\tau_{k,2012}-\tau_{k,2011})}\left[z_k^{1-\frac{1}{\varepsilon}}\tau_{k,2012} - z_n^{1-\frac{1}{\varepsilon}}\tau_{k,2011}\right]\ \mathrm{d}H(\theta) \\
= & \ \varepsilon\left[z_n^{\frac{1}{\varepsilon}} - z_k^{\frac{1}{\varepsilon}}\right]\frac{z_k^{1-\frac{1}{\varepsilon}}\tau_{k,2012} - z_n^{1-\frac{1}{\varepsilon}}\tau_{k,2011}}{\tau_{k,2012}-\tau_{k,2011}}\int_0^{\theta^*}\frac{\theta^*-\theta}{1-\theta^*}\ \mathrm{d}H(\theta) \\
= & \ \varepsilon z_k\left[\left(\frac{z_n}{z_k}\right)^{\frac{1}{\varepsilon}} - 1\right]\frac{\tau_{k,2012} - \left(\frac{z_n}{z_k}\right)^{1-\frac{1}{\varepsilon}}\tau_{k,2011}}{\tau_{k,2012}-\tau_{k,2011}} H(\theta^*)\frac{\theta^* - \mathbb{E}\left[\theta|\theta<\theta^*\right]}{1-\theta^*} \\
= & \ \kappa H(\theta^*)\frac{\theta^* - \mathbb{E}\left[\theta|\theta<\theta^*\right]}{1-\theta^*}
\end{aligned}$$

where $\kappa = \varepsilon z_k \left[\left(\frac{z_n}{z_k}\right)^{\frac{1}{\varepsilon}} - 1\right] \frac{\tau_{k,2012} - \left(\frac{z_n}{z_k}\right)^{1-\frac{1}{\varepsilon}} \tau_{k,2011}}{\tau_{k,2012} - \tau_{k,2011}}$ depends only on the parameters of the tax schedule and the elasticity ε and where I used the fact that:

$$\begin{aligned}
1 - \tau - (1-\theta^*)\tau_{k,2012} &= (1-\tau)\left[1 - \frac{z_n^{\frac{1}{\varepsilon}} \tau_{k,2012} - z_k^{\frac{1}{\varepsilon}} \tau_{k,2012}}{z_n^{\frac{1}{\varepsilon}} \tau_{k,2012} - z_k^{\frac{1}{\varepsilon}} \tau_{k,2011}}\right] \\
&= (1-\tau) \frac{z_k^{\frac{1}{\varepsilon}} \left(\tau_{k,2012} - \tau_{k,2011}\right)}{z_n^{\frac{1}{\varepsilon}} \tau_{k,2012} - z_k^{\frac{1}{\varepsilon}} \tau_{k,2011}} \\
1 - \tau - (1-\theta^*)\tau_{k,2011} &= (1-\tau) \frac{z_n^{\frac{1}{\varepsilon}} \left(\tau_{k,2012} - \tau_{k,2011}\right)}{z_n^{\frac{1}{\varepsilon}} \tau_{k,2012} - z_k^{\frac{1}{\varepsilon}} \tau_{k,2011}}
\end{aligned}$$

Assume that θ is distributed over $[0,1]$ according to a Beta distribution characterized by parameters α and β. The quantile of θ^* is given by $H(\theta^*;\alpha,\beta) = \frac{B(\theta^*;\alpha,\beta)}{B(\alpha,\beta)}$, where $B(\alpha,\beta)$ is the beta function for parameters α and β.

Here is a reminder about the CDF $H(\theta)$ and some useful properties of the Beta distribution:

$$\begin{aligned}
H(\theta^*;\alpha,\beta) &\equiv \frac{B(\theta^*;\alpha,\beta)}{B(\alpha,\beta)} = \int_0^{\theta^*} h(\theta;\alpha,\beta)\mathrm{d}\theta = \int_0^{\theta^*} \frac{\theta^{\alpha-1}(1-\theta)^{\beta-1}}{B(\alpha,\beta)}\mathrm{d}\theta \\
\overline{\theta} &\equiv \mathbb{E}[\theta] = \frac{\alpha}{\alpha+\beta} \\
\sigma_\theta^2 &\equiv Var[\theta] = \frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)} \\
\alpha &= \overline{\theta}\left(\frac{\overline{\theta}(1-\overline{\theta})}{\sigma_\theta^2} - 1\right) \\
\beta &= \left(1-\overline{\theta}\right)\left(\frac{\overline{\theta}(1-\overline{\theta})}{\sigma_\theta^2} - 1\right) \\
B(\alpha+1,\beta) &= \frac{\alpha}{\alpha+\beta} B(\alpha,\beta) = \overline{\theta} B(\alpha,\beta) \\
H(\theta^*;\alpha,\beta)\mathbb{E}\left[\theta|\theta<\theta^*\right] &= \frac{1}{B(\alpha,\beta)} \int_0^{\theta^*} \theta^\alpha (1-\theta)^{\beta-1}\ \mathrm{d}\theta = \overline{\theta} H(\theta^*;\alpha+1,\beta) \\
H(\theta^*;\alpha+1,\beta) &= H(\theta^*;\alpha,\beta) - \frac{\theta^*(1-\theta^*)}{\alpha} h(\theta^*;\alpha,\beta)
\end{aligned}$$

Using these properties, we have:

$$\begin{aligned}
H(\theta^*;\alpha,\beta)\frac{\theta^* - \mathbb{E}\left[\theta|\theta<\theta^*\right]}{1-\theta^*} &= \frac{\theta^* H(\theta^*;\alpha,\beta) - \overline{\theta} H(\theta^*;\alpha+1,\beta)}{1-\theta^*} \\
&= \frac{\theta^* - \overline{\theta}}{1-\theta^*} H(\theta^*;\alpha,\beta) + \frac{\overline{\theta}\theta^*}{\alpha} h(\theta^*;\alpha,\beta) \\
&= \frac{\theta^* - \overline{\theta}}{1-\theta^*} H(\theta^*;\alpha,\beta) + \frac{\theta^*\sigma_\theta^2}{\overline{\theta}\left(1-\overline{\theta}\right) - \sigma_\theta^2} h(\theta^*;\alpha,\beta)
\end{aligned}$$

Finally, the share of tax filers relocating from the TCT to the TT following the 2012 rise in perceived incentives is given by:

$$S_r \equiv \frac{B_r}{B_n} = \kappa \frac{\frac{\theta^* - \overline{\theta}}{1-\theta^*} H(\theta^*;\alpha,\beta) + \frac{\theta^*\sigma_\theta^2}{\overline{\theta}\left(1-\overline{\theta}\right) - \sigma_\theta^2} h(\theta^*;\alpha,\beta)}{\mathbb{E}_\theta\left[\Delta z_n(\theta)\right] - \frac{z_n}{z_k}\mathbb{E}_\theta\left[\Delta z_k(\theta)\right]}$$

The behavioral cross-influence of the shadow marginal tax rate τ_k on optimizers initially located at z_n is given by:

$$\begin{aligned}
\zeta_{z_k}(z_n) &= \int_0^{\theta^*} \varepsilon(1-\theta)\mathrm{d}H(\theta) \\
&= \varepsilon H(\theta^*)\left(1-\mathbb{E}\left[\theta|\theta \leq \theta^*\right]\right) \\
&= \varepsilon(1-\theta^*)\left(\frac{1-\overline{\theta}}{1-\theta^*}H(\theta^*;\alpha,\beta) + \frac{\theta^*\sigma_\theta^2}{\overline{\theta}\left(1-\overline{\theta}\right)-\sigma_\theta^2}h(\theta^*;\alpha,\beta)\right)
\end{aligned}$$

A.3 Approximating the Beta distribution from Gauss-Jacobi quadrature

We want to compute integrals of the form:

$$\mathbb{E}\left[g(\theta)\right] = \int_0^1 g(\theta)h(\theta)\ \mathrm{d}\theta = \int_0^1 g(\theta)\frac{\theta^{\alpha-1}(1-\theta)^{\beta-1}}{B(\alpha,\beta)}\ \mathrm{d}\theta$$

where θ is distributed according to a Beta density with parameters α and β. From $x = 1-2\theta$, we have:

$$\begin{aligned}
\mathbb{E}\left[g(\theta)\right] &= \frac{1}{2^{\alpha+\beta-1}B(\alpha,\beta)}\int_{-1}^{1} g\left(\frac{1-x}{2}\right)(1-x)^{\alpha-1}(1+x)^{\beta-1}\ \mathrm{d}x \\
&\approx \frac{1}{2^{\alpha+\beta-1}B(\alpha,\beta)}\sum_{i=1}^{N} w_i g\left(\frac{1-z_i}{2}\right)
\end{aligned}$$

where the set of N weights w_i and nodes z_i is given by a Gauss-Jacobi quadrature rule.

B Figures and Tables

Figure 11: Online simulation of income taxes (2014)

CALCUL DE L'IMPOT 2015 SUR LES REVENUS 2014

(simulation réalisée sur le site www.impots.gouv.fr)

Le présent document constitue une évaluation du montant de l'impôt sur le revenu calculé, pour l'année indiquée, à partir des informations que vous avez saisies et qui sont reproduites ci-dessous.
Il ne saurait engager l'administration sur le montant définitif de l'impôt à acquitter par le demandeur
Ce document ne peut en aucun cas constituer un avis d'impôt. Dès lors il ne doit pas être présenté à des organismes pour bénéficier d'un paiement ou d'un avantage quelconque.

Compte tenu des éléments que vous avez saisis, le montant de votre impôt net à payer s'élève à 0 euros

Résultat

Nombre de personnes à charge	0
Nombre de parts	1
Revenu brut global ou déficit	13957
Revenu net imposable ou déficit à reporter	13957
Droits simples	597
Décote	538
Impôt avant imputations	59
Prime pour l'emploi	0
Impôt sur le revenu net	59
TAUX MOYEN D'IMPOSITION	0
Revenu fiscal de référence	13957
Montant net des prélèvements sociaux (sur revenus du patrimoine et revenus d'activité et de remplacement de source étrangèr	0
MONTANT NET À PAYER *	0
MONTANT NET À RESTITUER *	0

* Ce montant est la somme de l'impôt sur le revenu net et des prélèvements sociaux.

Détail des charges déductibles	
Détail des réductions d'impot et crédit d'impot	
Pour information	
Taux marginal d'imposition (revenus soumis au barème)	14
Plafond de déduction pour les revenus 2014 au titre de l'épargne retraite, pour déclarant 1	3755

Note: Simulation of taxes for 2014 earnings according to the online tax simulator of the government. Income taxes are simulated for a single tax filer born in 1980, who earns only wage income and in such amount that her taxable income is 1€ below the TCT. Even though her *"net income tax is equal to 0€"*, this report also indicates 59€ of *"taxes on net income"*. It further displays her taxable income, her average income tax rate and the official marginal tax rate of the bracket, but not the effective marginal tax rate resulting from the "décote" mechanism.

Figure 12: Extract from the French income tax guide

DÉCOTE

Si votre impôt sur les revenus soumis au barème (y compris l'impôt relatif aux revenus et plus-values imposés selon un système de quotient) est inférieur à **960 €**, vous bénéficiez d'une décote égale à la différence entre 480 € et la moitié de votre impôt.

Cette décote est applicable quel que soit votre nombre de parts. Toutes les réductions d'impôt s'imputent après application éventuelle de la décote.

EXEMPLE

Votre impôt avant décote s'élève à 549 €.
La décote est égale à 480 € − 274,50 € = 205,50 € arrondi à 206 €.
Votre impôt après décote s'élève à 549 € − 206 € = 343 €.

LIMITES D'EXONÉRATION

Vous êtes non imposable (votre impôt est égal à zéro) lorsque votre revenu net imposable[3] est inférieur aux limites indiquées dans le tableau 6.

Votre cotisation d'impôt sur le revenu est inférieure à 61 € (seuil de mise en recouvrement) et vous n'avez donc pas d'impôt à payer, si votre revenu net imposable[3] (après tous abattements) est inférieur aux limites indiquées dans le tableau 7.

Vous êtes exonéré d'impôt si votre revenu net de frais professionnels n'excède pas 8 610 € ou 9 410 € si vous avez plus de 65 ans ou êtes invalide *(CGI, art. 5-2 bis)*.

TABLEAU DE CALCUL DE L'IMPÔT

Le tableau 8 donne le montant de l'impôt brut (avant application du plafonnement des effets du quotient familial).

EXEMPLE

Un couple marié avec deux enfants à charge (3 parts) dispose d'un revenu net imposable de 45 000 €.
− Calculer le revenu par part : 45 000 €/3 = 15 000 €
Cette somme est comprise entre 11 896 € et 26 420 €
− Multiplier le revenu net imposable par le taux correspondant à cette tranche de revenu :
45 000 € × 0,14 = 6 300 €
− Déduire du résultat 1339,13 € × 3 = 4 017,39 €
− Impôt brut : 6 300 € − 4 017,39 € = 2 282,61 € arrondi à 2 283 €

Tableau 6. Seuils d'imposition.

NOMBRE DE PARTS	1	1,5[1]	2	2,5	3	3,5	4	4,5	5	5,5	6
Revenu net imposable	11 791	14 772	17 754	20 735	23 717	26 698	29 680	32 661	35 643	38 624	41 606

1. Pour les contribuables vivant seuls et ayant coché la case E, ce revenu est égal à 12 712 €.

Tableau 7. Seuils de mise en recouvrement.

NOMBRE DE PARTS	1	1,5[1]	2	2,5	3	3,5	4	4,5	5	5,5	6
Revenu net imposable	12 141	15 500	18 481	21 463	24 444	27 426	30 407	33 389	36 370	39 352	42 333

1. Pour les contribuables vivant seuls et ayant coché la case E, ce revenu est égal à 12 998 €.

Tableau 8. Calcul de l'impôt.

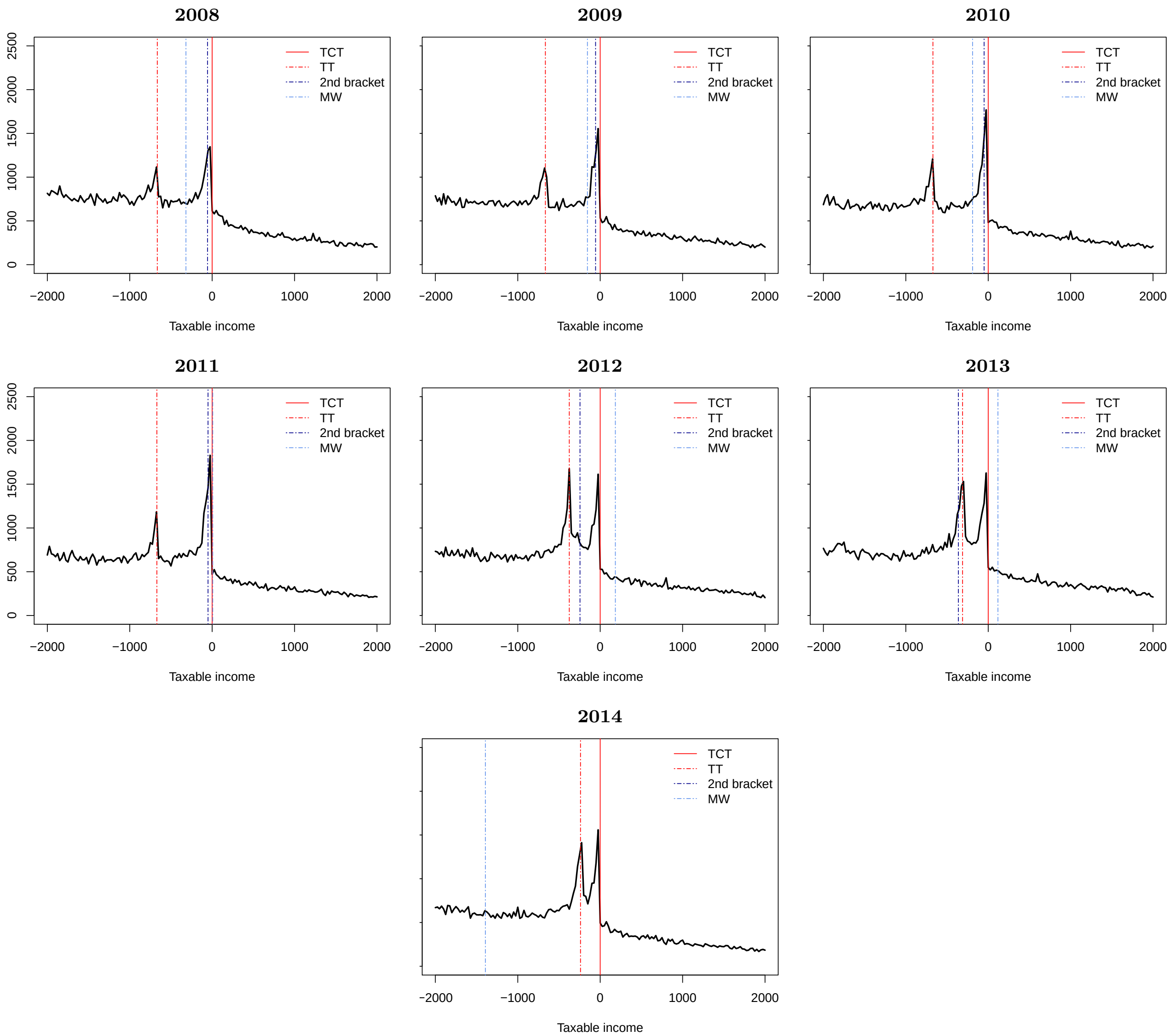
Si le revenu net imposable par part R/N[1] est compris entre…	0 et 5 963	5 963 et 11 896	11 896 et 26 420	26 420 et 70 830	70 830 et 150 000	Supérieur à 150 000
… multipliez le revenu net imposable par le taux correspondant	-	R × 0,055	R × 0,14	R × 0,30	R × 0,41	R × 0,45
… et déduisez du résultat	-	327,97 × N	1339,13 × N	5 566,33 × N	13 357,63 × N	19 357,63 × N

1. revenu net imposable divisé par le nombre de parts.

3. Hors plus-values taxées à un taux forfaitaire.

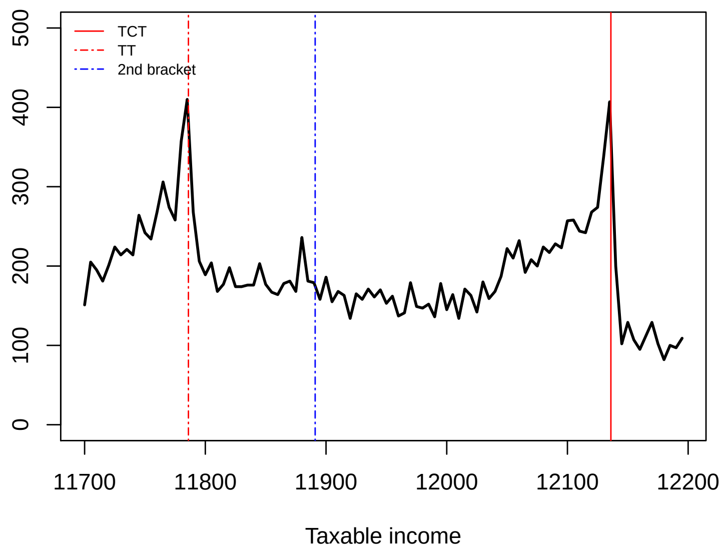
Note: This page is taken from the 2013 Income Tax Guidebook (*Brochure Pratique*), which details how tax returns should be filed. The upper-right paragraph "Exemption limits" mentions: *"You are not taxable (your taxes are equal to 0) when your net taxable income is below the limits indicated in Table 6"*. (**Taxation Threshold** of 11,791€ for a single tax filer) and *"Your income tax is less than 61€ and you do not have to pay income taxes if your net taxable income is below limits indicated in Table 7."* (**Tax Collection Threshold** of 12,141 euros for a single tax filer).

Figure 13: Twin Peaks where tax liabilities start



Note: Distribution of taxable income for recipients of intra-family transfer by 25€ bins in a 2000€ interval centered around the Tax Collection Threshold, from 2008 to 2014. The vertical red plain line shows the Tax Collection Threshold (TCT), the red dotted line the Taxation Threshold (TT), the light blue line the minimum wage (MW) and the dark blue line the lower bound of the 2^{nd} tax bracket. Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2008-2014.

Figure 14: No bunching at the lower bound of the second tax bracket



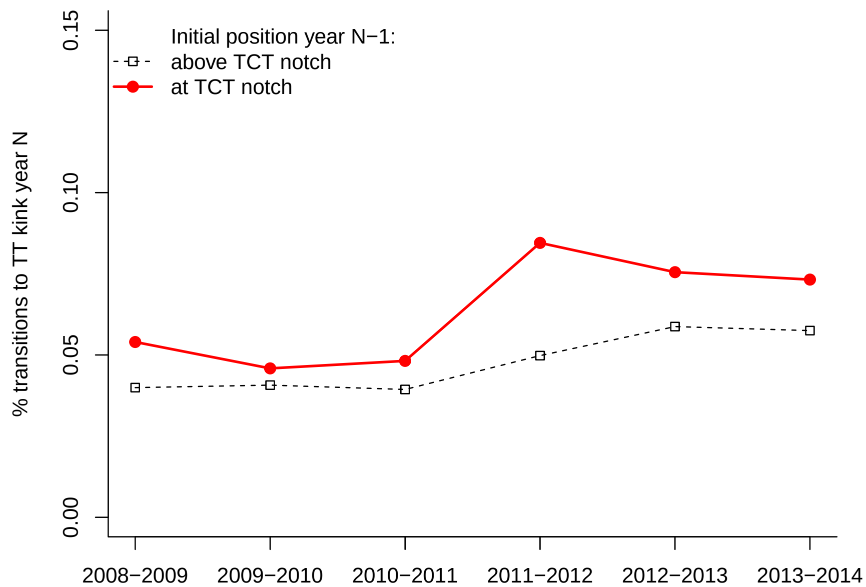
Note: Distribution of taxable income for recipients of intra-family transfer by 5€ bins in 2012. The vertical red plain line shows the Tax Collection Threshold (TCT), the red dotted line the Taxation Threshold (TT) and the blue line the lower bound of the 2nd tax bracket. Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2012.

Table 6: Number of observations

Year	**(1)** IF transfers	**(2)** ±2000€ around TCT
2008	392,157	90,547
2009	371,337	86,207
2010	366,930	84,347
2011	352,915	83,109
2012	376,268	88,899
2013	416,450	93,027
2014	446,446	77,586

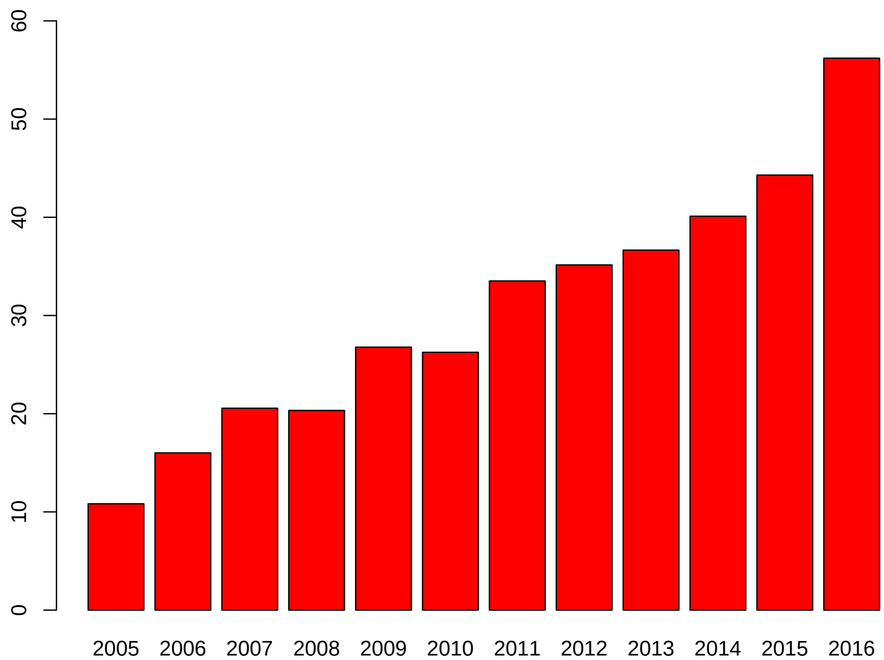
Note: Column (1) displays the number of single tax filers reporting that they received a positive amount of intra-family transfers. Column (2) is a restriction of this sample to individuals reporting a taxable income within 2000€ of the Tax Collection Threshold. Metropolitan France, except retirement pensions holders. Tax files POTE 2008-2014.

Figure 15: Relocation: alternative control group



Note: Probability to relocate at the TT depending on the initial location in the taxable income distribution the previous year: above the TCT notch (squares, black dotted line) or at the TCT notch (circles, red plain line). The leftmost circle shows that, among tax filers located at the TCT in 2008, 5% relocate to the Taxation Threshold in 2009. Single recipients of intra-family transfers present two consecutive years in the data set, metropolitan France, except retirement pensions holders. Tax files POTE 2008 - 2014.

Figure 16: Share of online tax filers (in %)



Note: Percentage of tax filers reporting their income taxes online. DGFIP annual business reviews (2006-2017).

Table 7: Homogeneous misperception model (2008 - 2014)

Year	$\boldsymbol{\theta}$	$\boldsymbol{\epsilon}$
2008	0.21	0.25
	[0.18, 0.26]	[0.21, 0.29]
2009	0.19	0.20
	[0.16, 0.22]	[0.17, 0.23]
2010	0.18	0.23
	[0.16, 0.22]	[0.20, 0.26]
2011	0.23	0.18
	[0.20, 0.28]	[0.16, 0.21]
2012	0.16	0.13
	[0.14, 0.19]	[0.12, 0.14]
2013	0.19	0.13
	[0.17, 0.24]	[0.12, 0.14]
2014	0.22	0.12
	[0.19, 0.26]	[0.11, 0.13]

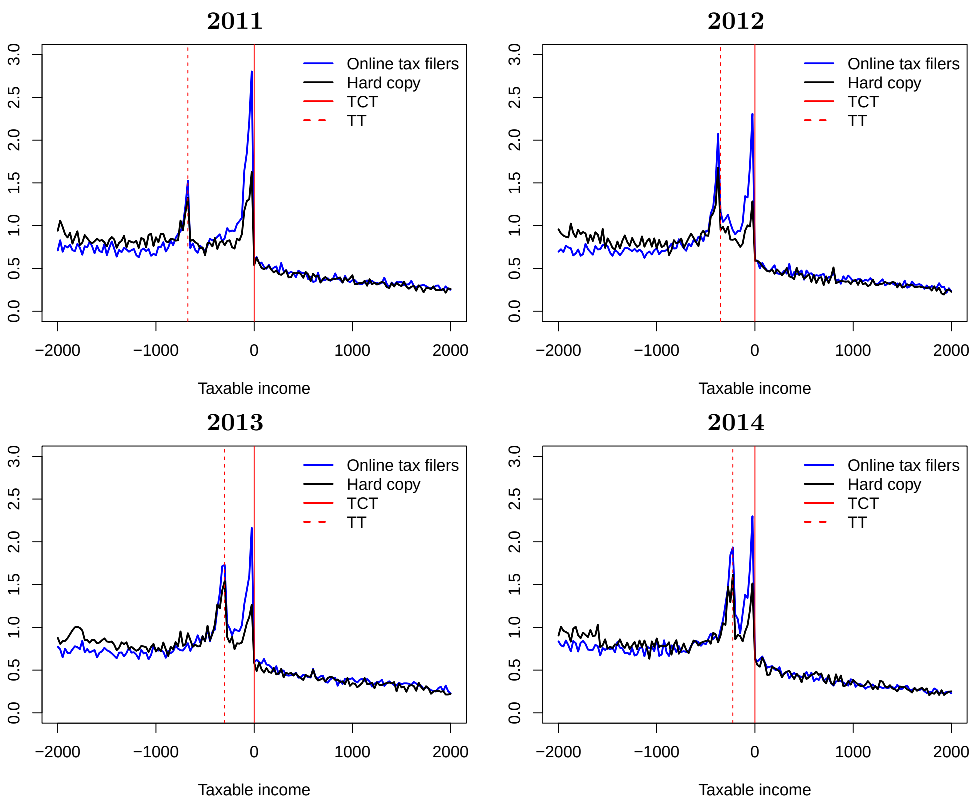
Note: Probability θ assigned to the TCT and elasticity ε estimated within the homogeneous misperception model. 95% confidence intervals displayed in brackets are computed from 1000 bootstrap iterations. Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2008-2014.

Table 8: Structural parameters : Internet vs. Paper

	Internet			**Hard copy**		
Year	$\overline{\boldsymbol{\theta}}$	$\boldsymbol{\varepsilon}$	$\boldsymbol{a}$	$\overline{\boldsymbol{\theta}}$	$\boldsymbol{\varepsilon}$	$\boldsymbol{a}$
2011	0.26	0.20	0.73	0.19	0.15	0.79
	[0.24, 0.29]	[0.20, 0.22]	[0.70, 0.84]	[0.17, 0.22]	[0.15, 0.16]	[0.77, 0.93]
2012	0.20	0.12	0.73	0.11	0.15	0.83
	[0.18, 0.23]	[0.12, 0.13]	[0.69, 0.87]	[0.08, 0.14]	[0.14, 0.15]	[0.78, 0.95]
2013	0.25	0.11	0.77	0.11	0.12	0.81
	[0.23, 0.30]	[0.11, 0.12]	[0.74, 0.91]	[0.09, 0.15]	[0.12, 0.13]	[0.76, 0.94]
2014	0.27	0.11	0.76	0.14	0.13	0.83
	[0.25, 0.32]	[0.10, 0.12]	[0.74, 0.89]	[0.12, 0.18]	[0.13, 0.14]	[0.79, 0.94]

Note: $\tau = 0.5$. 95% confidence intervals displayed in brackets are computed from 1000 bootstrap iterations. Information about paper/online tax filing is only available from 2011 on. Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2011-2014.

Figure 17: Taxable income distribution : Hard copy vs. Internet.



Note: Normalized distributions of taxable income by 25€ bins for online filers (blue line) and hard-copy filers (black line) centered around the Tax Collection Threshold (TCT). The vertical red dotted line shows the Taxation Threshold (TT). Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2011-2014.

C Recipients of intra-family transfers

C.1 Legal framework

Intra-family (IF) transfers paid within the legal framework of the maintenance obligation are due to poor relatives in the direct ascending or descending line (children, parents, grand-parents or parents-in-law). These transfers may be in money or in kind (food, clothes, health expenses, housing...). They are defined by the Civil Code of 1803 (art. 203, 205-211).

The transfer paid by the donor is deductible from income taxes, but the recipient should report it as part of her own taxable income and she cannot be registered as a member of the donor's tax household. In practice, there is no straightforward manner for the government to check that both amounts are equal. Moreover, there is no precise amount specified in the legislation. It is only mentioned that the size of this transfer should be determined by the resources of the donor and the needs of the recipient. In the tax form, corresponding boxes are never pre-filed. When the recipient is an adult child, the transfer is capped. Table 9 displays the value of this cap from 2008 to 2014 as well as a valuation of in kind transfers to a relative living with the giver provided by the Income Tax Guidebook. This valuation also applied to maintenance obligation transfers toward elderly relatives.

Table 9: Intra-family transfers

	2008	2009	2010/11	2012	2013	2014
Cap (adult child†)	5,729	5,753	5,698	5,698	5,698	5,726
Valuation (ascendant‡)	3,296	3,309	3,359	3,359	3,386	3,403

Note: Maximum deductible transfer to an adult child and valuation of in kind transfers to relative living with the giver, in euros by income year. †: multiplied by two if the adult child is married or has children and does not receive benefits from her parents-in-law. ‡: applies for parents, parents-in-law and grandparents living with the donor and for maintenance obligation transfers toward elderly relatives. CGI Art. 156, 196B.

If the recipient is an adult child, the transfer can be made independently from her age and from her student status. Yet, if she is either under 21 or still a student and under 25, her parents face a tradeoff between registering her in their tax household and benefiting from supplementary tax units or opting for separate tax returns and reporting the maintenance obligation they pay as a tax deductible. The computation of the family quotient implies that richer families have a greater interest in benefiting from the first solution. Hence, young recipients of IF transfers are more likely to come from a modest background.

Maintenance obligation transfers belong to the general category of alimony transfers, but should be distinguished from child support and compensatory allowances, which are paid in case of a divorce and are out of the scope of this paper. Indeed, in those cases, the amount may be commonly decided by the spouses but should always be approved by the judge, which prevents tax optimization. Child support refers to intra-family transfers toward children occurring after a divorce. In this case, the parent without custody can report the transfer as a deductible and the exact same amount should be reported as part of her taxable income by the parent with custody. Compensatory allowances refers to transfers paid to an ex-spouse in order to compensate for the gap in standard of living consecutive to a divorce. In this case, the amount is deductible only if it has been determined by a judge. In this paper, in order to focus on maintenance obligation transfers, I exclude the former case by restricting the population to single taxpayers and I show that divorced taxpayers represent a very small fraction of the sample.

In the data, there is no identifier to match donors and recipients of IF transfers. Since they do not live in the same place, it is not even possible to match them according to their physical address. Therefore, it is not possible to verify that IF transfers reported by the giver are equal to the amount reported by the recipient. In particular, in-kind donations are difficult to evaluate and may be misreported. Moreover, in the 2042 form, there is only one box to report maintenance obligation transfers, child support and compensatory allowances received. The giver reports the transfer in different boxes whether the recipient is an adult child or not, but again the different types of transfers are mixed in the same box. Focusing on single tax filers and removing divorced individuals only imperfect selection of recipients of maintenance obligation transfers. For instance, a divorcee receiving maintenance obligation transfers would be excluded from the sample while an adult child receiving alimony consecutive to her parents' divorce would be included. In this paper, received IF transfers should only be interpreted as a mechanism to adjust the reported taxable income and not as directly related to inter-generational solidarity.

In France, family solidarity takes precedence over welfare benefits (principle of subsidiarity). When applying for social benefits (especially the *Revenu de Solidarité Active*), a claimant should in principle report the maintenance obligation transfers she receives from her relatives[36]. If her resources including these transfers are low enough, she may qualify for these benefits. If she does not receive IF transfers, she should provide a list of relatives obligated to pay her those transfers and possibly bring out proof that they do not have sufficient resources themselves to comply with this obligation. In practice, department councils are responsible for the enforcement of this law and may monitor more or less strictly this condition regarding maintenance obligation transfers. Since reporting higher IF transfers results in lower social benefits, potential recipients may face a tradeoff between family and public financial support. However, this tradeoff is not a concern in this paper since it is independent from the Taxation and Tax Collection thresholds.

C.2 General depiction of IF transfers recipients

In 2013, among single tax filers from metropolitan France without retirement pensions, more than 416,000 report receiving maintenance obligation transfers. The average amount is around 4,300€ and the median amount is 3,386€, which is the valuation for a transfer to an ascendant or a relative living with the giver. The distribution of IF transfers reported by recipients is quite flat, with a first quartile equal to 3,104€ and a third quartile equal to 5,698€, the latter being the upper bound mentioned on the tax documentation in the case the recipient is an adult child. Most of these recipients are young people who report transfers from their parents.

Recipients of IF transfers represent 7% of non-taxable individuals and slightly more than 11% if we further restrict the sample to tax filers below 30. This statistic may be seen as a lower bound for effectively received IF transfers, since some tax filers can choose not to report those donations in order not to loose social benefits, whereas it seems very unlikely that they report donations they do not effectively receive.

C.3 Adjustment through IF transfers

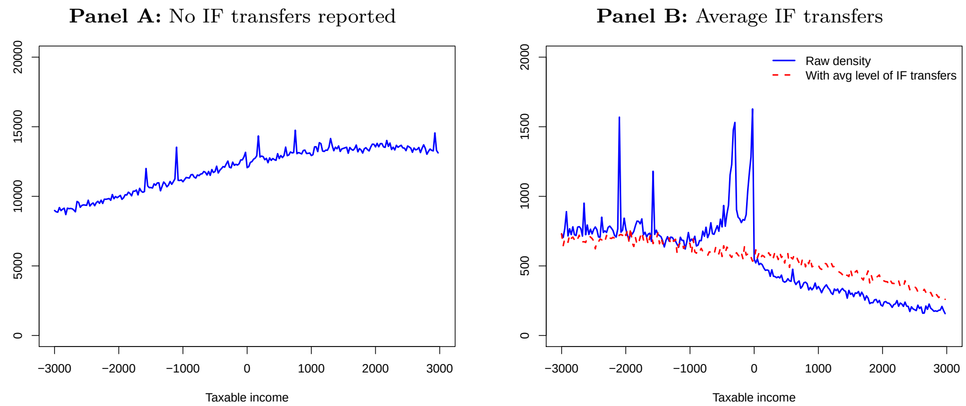
It is easy to adjust intra-family transfers, but determining the precise amount to report is not straightforward. Not only is the income tax system complex and the threshold where tax liabilities start hard to find, but in addition, taxable income is not a simple sum of earnings. Even in the very simple case of a tax filer reporting only wage earnings w and intra-family transfers p, her taxable income is given by $z = 0.9w + \max\left(0, \min\left(p - p_{min}, 0.9p\right), p - p_{max}\right)$ where parameters p_{min} and p_{max} change over time.

Figure 18 confirms that the bunching does result from received intra-family transfers reported by tax filers. First, Panel A shows that the distribution of taxable income for single tax filers who report no received IF transfers is smooth around the two thresholds. There is no evidence of bunching among this population. Second, for recipients of IF transfers, Panel B contrasts the actual distribution of taxable income (plain blue curve) with the distribution that would have been computed if tax filers had reported the average level of intra-family transfers instead of the amount they effectively declared (dotted red curve). As a result, bunching masses observed in raw data are completely smoothed. Randomly assigning IF transfer to tax filers would lead to similar conclusions. These exercises confirm that adjustment goes through the reported level of received IF transfers.

Moreover, the mechanism I focus on involves individual-level tax optimization. Theoretically, unequal families should always report the highest amount of intra-family transfers since the tax schedule is roughly

[36] *Code de l'action sociale et des familles (CASF), Art. R 132-9.*

Figure 18: Bunching and IF transfers received



Note: Taxpayers with a taxable income within a 3000€ interval around the TCT. The plain blue curve is the density of taxable income by 25€ bins. *Panel A* displays the distribution for tax filers reporting zero IF transfers received. *Panel B* shows the distribution for tax filers reporting a positive amount of IF transfers. The dotted red curve is a density of a the taxable income that would have been computed if every tax filer had reported the average level of IF transfer in the sample rather than the amount she effectively declared. Single taxpayers, without retirement pensions, metropolitan France. Tax files POTE 2013.

convex. However, this strategy does not seem widespread since, in this case, there would be no reason for recipients of IF transfers to bunch where income tax liabilities start. The model of Family optimization developed in Appendix A shows that considering earnings adjustments within the family would lead to similar conclusions.

C.4 The reported amount of IF transfers received

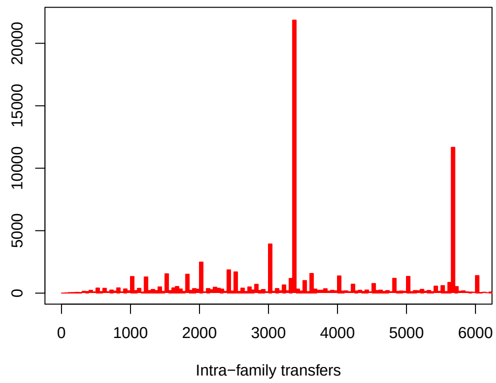
In 2013, among the 93,000 tax filers of the sample whose taxable income lies in a 2000€ interval around the TCT: 23% report intra-family transfers exactly equal to the valuation for elderly relatives (3,386€ or 3,359€ depending on whether they consider the current or the previous year), 12% report transfers equal to the upper bound for an adult child (5,698€) and 14% report a multiple of 1000€. Reporting such amounts is unlikely to allow them to bunch at the threshold where income tax liabilities start. Panel A of Figure 19 shows evidence of a strong bunching in the density of these transfers, at the two reference values mentioned in Table 9.

However, these taxpayers do not completely ignore the tax collection threshold. Panel B of Figure 19 depicts the taxable income distribution of taxpayers reporting a level of transfer received equal to a reference value mentioned in Table 9 (pooling income years 2012 to 2014). Around the two thresholds of interest, this density is clearly smoother than the baseline one, but the slope of the density is steeper in the region where tax filers start paying taxes. This global deformation of the distribution indicates wide-scale adjustments: taxpayers are more likely to report the maximum amount of IF transfer if they do not become taxable.

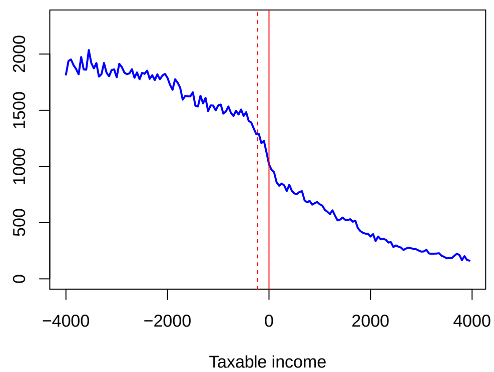
Finally, excluding recipients who report a reference value for the IF transfers they receive (i.e. a value in Table 9) increases the proportion of bunchers in the sample. Consequently, the share of non-optimizers α is lower than in the baseline, while earnings responses at both thresholds and the elasticity ε are higher, as depicted by Table 10. However, θ remains unchanged, since the individuals removed from the sample where located in roughly the same proportions at the TT and at the TCT (as shown by Panel B of Figure 19).

Figure 19: Reported IF transfers

Panel A: Distribution of IF transfers



Panel B: Distribution of taxable income (tax filers at reference values)



Note: *Panel A*: Distribution of IF transfers by 50€ bins for taxpayers with a taxable income within a 2000€ interval around the TCT. Bunching appears at round-numbers, as well as at the upper bound for transfers to adult children (5,698€) and at the valuation of in kind transfers to a relative living with the giver (3,386€). Interestingly, a thorough examination shows that, in the last case, some people report the previous year's amount (3,358€). Single recipients of IF transfers, without retirement pensions, metropolitan France. Tax files POTE 2013. *Panel B*: Taxpayers with a taxable income within a 2000€ interval around the TCT, reporting IF transfers at reference point given by Table 9 for 2012, 2013 or 2014. Tax files POTE 2012-2014 (pooled).

Table 10: Exclusion of recipients reporting a reference value for IF transfers

	$\boldsymbol{B_k}$	$\boldsymbol{\Delta z_k}$	$\boldsymbol{B_n}$	$\boldsymbol{\Delta z_n}$	$\boldsymbol{\alpha}$	$\boldsymbol{\varepsilon}$	$\boldsymbol{\theta}$
Reference	1281	184	3774	769	0.76	0.18	0.23
	[1038, 1507]	[149, 216]	[3599, 4045]	[727, 842]	[0.74, 0.87]	[0.16, 0.21]	[0.20, 0.28]
Restricted	1314	310	3243	1071	0.70	0.30	0.21
sample	[1106, 1467]	[261, 346]	[3140, 3415]	[1012, 1157]	[0.68, 0.79]	[0.27, 0.32]	[0.18, 0.26]

Note: 95% confidence intervals displayed in brackets are computed from 1000 bootstrap iterations. Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders and excluding tax filers reporting a reference value for IF transfers (value mentioned in Table 9 or multiple of 1000€). Tax files POTE 2011.

D Robustness

D.1 Estimation framework

The bunching estimation relies on different assumptions regarding the estimation window, bunching regions, the dominated region, counterfactual distributions. Tables 11 and 12 show that these choices do not alter the estimation results.

Table 11: Robustness to counterfactual distributions at the TT kink

	$\boldsymbol{B}_k$	$\boldsymbol{\Delta} z_k$	$\boldsymbol{B}_n$	$\boldsymbol{\Delta} z_n$	$\widetilde{\boldsymbol{a}}$	$\boldsymbol{\theta}$	$\boldsymbol{\varepsilon}$
2008	1541	332	2873	1013	0.85	0.17	0.31
	[1304, 1767]	[281, 381]	[2715, 3137]	[948, 1115]	[0.83, 0.93]	[0.14, 0.23]	[0.28, 0.34]
2009	1686	273	3094	825	0.79	0.16	0.25
	[1450, 1912]	[235, 310]	[2942, 3350]	[775, 897]	[0.77, 0.90]	[0.13, 0.20]	[0.23, 0.27]
2010	1863	292	3509	884	0.78	0.16	0.26
	[1624, 2089]	[254, 327]	[3341, 3780]	[837, 959]	[0.76, 0.87]	[0.13, 0.20]	[0.24, 0.29]
2011	1503	223	3804	819	0.76	0.20	0.21
	[1265, 1729]	[188, 257]	[3622, 4121]	[770, 900]	[0.74, 0.87]	[0.16, 0.26]	[0.19, 0.24]
2012	3237	470	2813	929	0.78	0.16	0.15
	[2993, 3465]	[435, 503]	[2609, 3107]	[882, 1002]	[0.75, 0.93]	[0.12, 0.20]	[0.14, 0.15]
2013	3097	474	2962	984	0.80	0.18	0.15
	[2854, 3327]	[437, 509]	[2716, 3343]	[925, 1085]	[0.77, 0.95]	[0.14, 0.23]	[0.14, 0.16]
2014	2927	510	2809	1058	0.80	0.19	0.14
	[2686, 3152]	[468, 549]	[2644, 3100]	[1005, 1145]	[0.77, 0.92]	[0.15, 0.24]	[0.14, 0.15]

Note: Bunching moments, earnings responses and structural parameters are estimated with alternative counterfactual distributions in the difference-in-bunching at the kink: the 2014 distribution is taken as a counterfactual for estimations until 2011 and the 2009 distribution afterwards (instead of the 2013 and 2011 distributions respectively). Tax files POTE 2008-2014.

In the difference-in-bunching procedure, the distribution of taxable income for 2013 is taken as a counterfactual for the for the estimation of bunching at the kink from 2008 to 2011, while the distribution for 2011 is taken as a counterfactual for 2012 to 2016. This choice is arbitrary, but as displayed by Table 11, considering instead the distributions for 2014 and 2009 respectively leaves the results unchanged.

Table 12 shows similarly that results are robust to different values for the size of the dominated region above the TCT notch Δz_D, the width of the estimation window, the order of the polynomial for the counterfactual density at the notch or the width of the bunching regions around each threshold. Point estimates for θ are between 0.20 and 0.26, which is within the confidence interval for the baseline estimate.

D.2 Calibrated parameters

The misperception model relies on assumptions about the calibration of some underlying parameters: the effective marginal tax rate τ characterizing the comprehensive tax and transfers system just below the starting point of the income tax, and the "décote" parameter r. Here, I discuss the consequences of different calibrations for these parameters in the misperception model and I explain why it would leave the estimated probability θ unchanged. Since θ is estimated conditional on being an optimizer ($m = 1$), I also discuss the consequences of considering different values of the share of non-optimizers $1 - m$.

Figure 20 shows the probability θ and elasticity ε for different calibrations of the share of non-optimizers $1 - m$ (left graph) and the effective marginal tax rate τ (right graph). A lower m implies that the bunching masses result from a smaller share of very responsive tax filers. Therefore, ε is strongly decreasing in m. Probability θ can be seen as the remaining discrepancy between the two bunching masses once we accounted for differences in incentives at the two thresholds. Hence, θ is much less

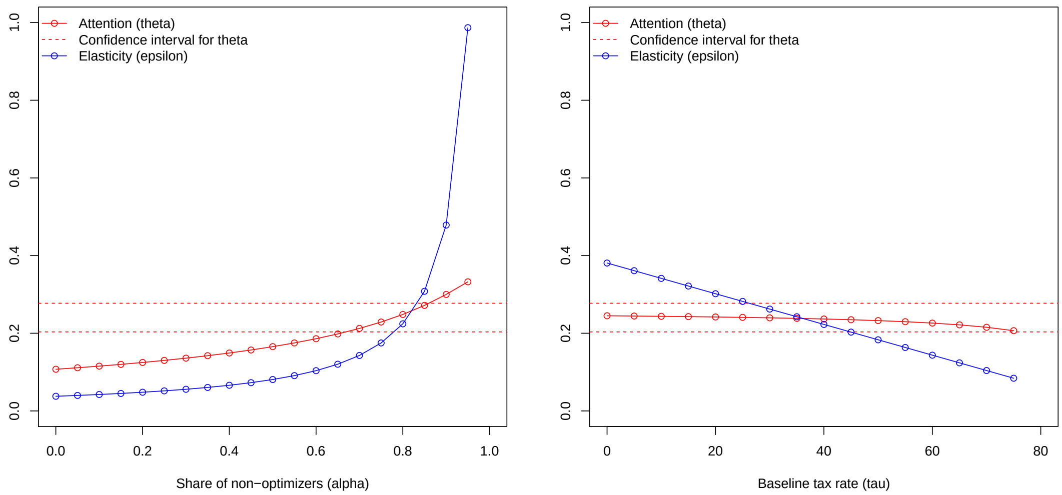
Table 12: Robustness checks

		ε	θ	$\widetilde{a}$
Reference		0.18	0.23	0.76
		[0.16, 0.21]	[0.20, 0.28]	[0.74, 0.87]
		Size of the dominated region Δz_D		
100		0.23	0.25	0.80
		[0.20, 0.25]	[0.20, 0.31]	[0.76, 0.87]
200		0.20	0.24	0.78
		[0.17, 0.22]	[0.19, 0.30]	[0.75, 0.84]
$z_U/3$		0.19	0.23	0.77
		[0.17, 0.21]	[0.19, 0.30]	[0.74, 0.84]
500		0.18	0.23	0.76
		[0.16, 0.21]	[0.19, 0.30]	[0.74, 0.84]
700		0.19	0.23	0.76
		[0.16, 0.21]	[0.19, 0.30]	[0.74, 0.84]
		Width of the estimation window		
± 1800		0.18	0.22	0.76
		[0.16, 0.20]	[0.18, 0.29]	[0.73, 0.87]
± 2200		0.19	0.24	0.77
		[0.17, 0.22]	[0.19, 0.30]	[0.74, 0.86]
± 2500		0.21	0.26	0.78
		[0.18, 0.23]	[0.21, 0.32]	[0.75, 0.84]
		Order of polynomial		
4		0.18	0.23	0.75
		[0.16, 0.20]	[0.19, 0.29]	[0.72, 0.84]
6		0.16	0.20	0.74
		[0.14, 0.18]	[0.16, 0.27]	[0.72, 0.84]
7		0.17	0.21	0.75
		[0.15, 0.19]	[0.16, 0.27]	[0.72, 0.87]
		Range of bunching regions		
Kink	*Notch*			
$[-75, 75]$	-200	0.16	0.27	0.76
		[0.14, 0.18]	[0.22, 0.33]	[0.74, 0.86]
$[-150, 75]$	-150	0.18	0.21	0.76
		[0.15, 0.20]	[0.16, 0.27]	[0.74, 0.86]
$[-75, 75]$	-150	0.15	0.24	0.76
		[0.13, 0.17]	[0.19, 0.30]	[0.74, 0.86]

Note: Reference is estimated with $\Delta z_D = z_U/2$, an estimation window of 2000, a bunching region of $[-150, 75]$ for the TT kink and $z_L = -200$ for the TCT notch and a 5$^{\text{th}}$ order polynomial. For the width of the estimation window, the upper bound for excluded range is respectively 1600, 1900 and 2200 (1700 in the baseline). Tax file POTE 2011.

sensible to m, but still decreasing with m due to the non-linearity of the model. A percent variation in the marginal tax rate implies much stronger incentives when starting from an initial effective marginal tax rate of 70% rather than 0%. Given an estimate for earnings responses, the resulting elasticity is therefore much lower in the former case. In contrast, θ is quasi-constant over the whole range of τ since this parameter does not impact relatives incentives at the TCT compared to the TT.

Figure 20: Sensibility to m and τ (2011)



Note: Probability θ (red line) and elasticity ε (blue line) are represented for different values of the share of non-optimizers $1 - m$ (graph on the left) and of the effective marginal tax rate τ (graph on the right) for the empirical moments estimated in 2011. The red dotted lines show the bounds of the 95% confidence interval for the baseline θ estimated in 2011 (cf. Table 7).

Table 13: Policy parameters

	$\boldsymbol{\varepsilon}$	$\boldsymbol{\theta}$
Baseline	0.17	0.23
$(\tau_k = 5.5\%, \tau_n = 14\%)$	[0.15, 0.18]	[0.22, 0.25]
With "décote"	0.11	0.26
$(\tau_k = 8.25\%, \tau_n = 21\%)$	[0.10, 0.12]	[0.25, 0.28]

Note: Structural parameters in the baseline scenario where tax filers respond to the statutory rates vs. in the case where they understand that these rates are multiplied by 1.5 due to the "décote" mechanism. Tax file POTE 2008-2014.

In the baseline estimation, I assume that tax filers respond to the statutory marginal tax rates, which are mentioned in the Income Tax Guidebook and are salient in the outcome of an online tax simulation (Figure 11). In practice, due to the "décote" mechanism, marginal tax rates are multiplied by $1 + r$ in the neighborhood of the two thresholds, with r given by Table 1. As for the calibration of τ, changes in r impact the estimated elasticity ε, but leave θ unchanged since r does not change the relative incentives at the two thresholds (Table 13).

D.3 Optimization method

The baseline estimation is achieved through the generalized method of moments (GMM). Alternatively, estimating structural parameters through nonlinear least-squares (NLS) leads to very similar results. Table 14 replicates Table 5 with NLS instead of GMM. The elasticity remains unchanged while the estimated θ is slightly higher for each one of the three samples.

Table 14: Structural parameters (NLS)

	Weight $\overline{\theta}$	**Elasticity** ε
Full sample	0.25	0.14
	[0.23, 0.27]	[0.13, 0.15]
Internet	0.32	0.14
	[0.31, 0.34]	[0.14, 0.15]
Hard copy	0.15	0.14
	[0.14, 0.18]	[0.14, 0.14]

Note: Replication of Table 5 with NLS. $\tau = 0.5$. 95% confidence intervals displayed in brackets are computed from 1000 bootstrap iterations. Information about paper/online tax filing is only available from 2011 on. Single recipients of intra-family transfers, metropolitan France, except retirement pensions holders. Tax files POTE 2011-2014.

E A Model with Reference-Dependent Preferences

Independently from tax incentives, agents could feel the pain of paying income taxes. Loss-averse tax filers would have a reference taxable income level at the point where tax liabilities start and, for a given level of consumption, any increase in their income above this reference point would be extremely hurtful.

This alternative explanation cannot account for the fact that tax filers misperceive the wrong Taxation Threshold for the effective Tax Collection Threshold, since there is no reason for reference-dependent preferences to imply mistakes about the tax schedule. However, if true preferences are reference-dependent instead of classical, model misspecification may bias the estimates.

Consider that tax filers have the same quasi-linear preferences as in the baseline economy, which now feature a reference point at the threshold of taxable income z_r. Preferences are modeled following Kőszegi and Rabin (2006) and Kőszegi and Rabin (2006):

$$u(c, z) \equiv c - (1 - \eta)v(z) - \eta n(z|z_r)$$

where the reference-dependent component is given by:

$$n(z|z_r) \equiv \mathbb{1}[z < z_r] \cdot (v(z) - v(z_r)) + \mathbb{1}[z > z_r] \cdot \lambda\,(v(z) - v(z_r))$$

where the disutility from labor is still given by $v(z) = \frac{\omega}{1+\frac{1}{\varepsilon}} \left(\frac{z}{\omega}\right)^{1+\frac{1}{\varepsilon}}$. Reference-dependent preferences are continuous, strictly decreasing. They feature a kink point at $z = z_r$ characterized by a stronger marginal disutility above this point than below, which captures loss aversion. As in Kőszegi and Rabin (2006), $0 \leq \eta \leq 1$ is the weight people attach to gain-loss utility and $\lambda \geq 1$ is the coefficient of loss aversion.

The specificity of the current framework is that it features two potential reference-points resulting from the misperception of the tax schedule: the effective Tax Collection Threshold z_n and the irrelevant Taxation Threshold z_k. In order for tax filers' preferences to feature reference-points at both threshold, they should at least consider that z_k could be the threshold where tax liabilities start with some probability $1 - \theta$, while it would be z_n with probability θ.

Moreover, the dynamic evidence presented in Section 2.3.2 cannot be accounted by a pure reference point, since tax filers would not relocate from the TCT to the TT if they were not taking the tax schedule into account. Hence, the program of the tax filer becomes:

$$\begin{array}{ll} \max & c - (1 - \eta)v(z) - [(1 - \theta)\eta n(z|z_k) + \theta\eta n(z|z_n)] \\ \text{s.t} & c \leq (1 - \tau)z - [(1 - \theta)T_k(z) + \theta T_n(z)] \end{array}$$

Reference-dependent preferences are not differentiable in the reference point, so we have to make sure that the first equation of this system is given by the value of the right derivative of preferences at the Taxation Threshold z_k. Following the same resolution method as in Section 3, we find the two equations characterizing earnings responses at the TT kink and at the TCT notch respectively:

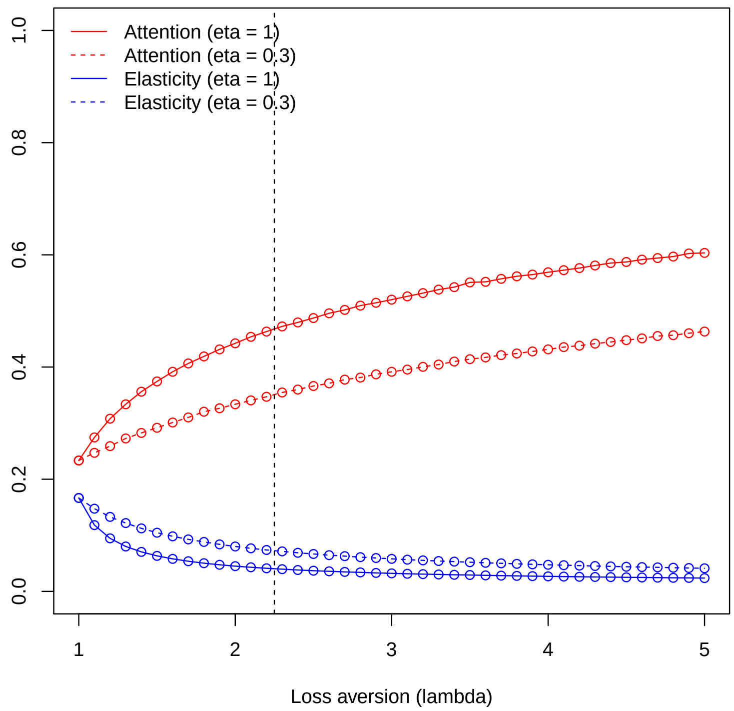
$$\begin{aligned} \frac{z_k}{z_k + \Delta z_k} &= \left[\frac{1 - \tau - (1 - \theta)\tau_k}{(1 - \tau)\,(1 - \eta(1 - \theta)(1 - \lambda))}\right]^{\varepsilon} \\ \frac{\varepsilon}{1 + \varepsilon}\left(\frac{z_n}{z_n + \Delta z_n}\right)^{\frac{1+\varepsilon}{\varepsilon}} &= \frac{z_n\,(1 - \tau - (1 - \theta)\,\tau_k - \theta\tau_n) + \theta T_0}{(z_n + \Delta z_n)\,(1 - \tau)\,(1 - \eta(1 - \lambda))} - \frac{1}{1 + \varepsilon}\left[\frac{(1 - \tau - (1 - \theta)\,\tau_k - \theta\tau_n)}{(1 - \tau)\,(1 - \eta(1 - \lambda))}\right]^{1+\varepsilon} \end{aligned}$$

We are back with the equations of Section 3 when reference-dependent preferences disappear from the utility function ($\eta = 0$) or when agents are not loss averse ($\lambda = 1$).

Now, we have four parameters to estimate and only two empirical moments, thus it is not possible to estimate the coefficients of reference-dependent preferences. However, we can see how the probability θ assigned to the effective tax schedule and the elasticity ε vary for different values of η and λ.

In the literature on reference-dependent preferences, the estimated coefficient of loss aversion is generally around $\lambda = 2.25$ (Tversky and Kahneman (1992); DellaVigna (2009); Thakral and Tô (2020)).

Figure 21: Reference-dependent preferences



Note: The red lines depict the weight θ and the blue lines the elasticity ε as a function of loss aversion λ. The plain lines correspond to estimation with a weight $\eta = 0.8$ on the reference-dependent component of preferences and the dotted lines to estimations with a weight $\eta = 0.3$. GMM estimation on empirical moments 2008-2014.

Figure 21 displays the elasticity ε and the weight θ estimated from a model with income tax misperceptions and reference-dependent preferences, for different a wide range of values for the loss aversion coefficient λ and the weight η. Higher loss aversion induces a stronger kink at the reference point and the estimated elasticity gets lower than in the baseline. Intuitively, tax filers now bunch at a threshold not only because they perceive locally higher taxes, but also because they would not like their income to exceed this threshold. Even inelastic tax filers will bunch, hence a low elasticity can rationalize this behavior.

In contrast, misperceptions are increasing with loss aversion. In the baseline model, even though the bunching mass is bigger at the effective TCT, the focus on the irrelevant TT is stronger ($1 - \theta$ larger) because higher tax disincentives at the TCT capture part of the reactions of tax filers at this threshold. Here, reference-dependent preferences provide an alternative rationale to tax incentives for the bunching behavior. Therefore, a bigger part of the bunching mass at the notch should be accounted by a focus on this threshold, hence a higher weight θ.

Most importantly, Figure 21 shows that even for a high level of loss-aversion, the probability assigned to the effective Tax Collection Threshold is far below 1. For the usual value of $\lambda = 2.25$ and when preferences are fully reference-dependent ($\eta = 1$), θ is below 0.5. Therefore, reference-dependence cannot by itself account for the empirical pattern of twin-peaked bunching. Secondly, if we believe reference-dependence to be part of the explanation for the bunching patter, then the estimates for θ and

ε in the baseline misperception model should be respectively considered as a lower bound for the weight θ and an upper bound for the elasticity.