Chapitre 7

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This chapter evaluates the taxable income behavioral reactions of French high-income households to a tax change. I focus on a 2013 tax reform creating a unique framework that allows controlling for position in the income distribution. With this framework I temperate the *mean reversion bias* and the *change in the distribution bias* usually associated with the assessment of elasticities with panel data. I can do so because the reform treats differently households based on income but also family composition. The analysis is conducted with a recently released big administrative panel dataset. I run a *triple-difference* regression on the change in taxable income depending on the group an high-income household belongs to : the untreated (no effect), the ones facing only a change in their disposable income (pure income effect), and those facing a change in marginal tax rate and disposable income (income and substitution effect). Quite surprisingly and contrasting with the rest of the literature, I find that the income effect strongly dominates the substitution effect, that women react less than men, and that a significant part of the effect is driven mainly by workers nearing retirement by reacting on the extensive margin.

7.1 Introduction

The question of households behavioural responses to income taxation is central for the public debate as it determines the magnitude of the potential redistribution a society can have.

Behavioral reactions linked to changes in the income tax function is subject to a wide range of estimates and faces numerous methodological issues. As modifications of the tax schedule applies to a certain part of the income distribution, there is thus no available counterfactual as a tax-unit with same income characteristics as a tax-unit facing a tax change will also face that tax change. The tax rate being determined by the taxable income, and the taxable income one will choose being determined by the tax rate, both the tax rate and the tax base being determined simultaneously, the analysis will thus be always constrained by an endogenity issue.

An other challenge is to decompose behavioral reactions between income effect and substitution effects. In the labour demand framework, an increase in the marginal tax rate (MTR) of an individual can have two immediate effect : i) the price of leisure decreases with respect to consumption, ii) the disposable income of the individual will be lower. As the relative price of leisure decreases, the individual faces an incentive to substitute disposable income (by working less) and consume more leisure, this effect is known as the substitution effect. The decrease of the disposable income causes the individual to want to work more since the marginal utility of money will be higher than previously. This effect is known as the income effect/ These two effects are usually difficult to disentangle as a change in MTR also affect (if not at the very beginning of the tax bracket) her disposable income. It is indeed possible to have variability between tax-unit at the beginning of a tax bracket, but when assessing the change in taxable income the impact in change of disposable income is small compare to the change in net-of-tax rate (1-MTR). Moreover, the identification issue is still present as tax-units at the beginning of a changing tax-bracket (with a small variation in disposable income) cannot be directly compared to richer tax-units (with a large variation in disposable income) as the substitution and income effect is not necessarily the same between those two groups.

The motivation of the article is to solve those issues for households by relying on a specific reform of the French tax system.

The behavioural response of tax-units such as households and invidividuals relative to income taxes has been studied extensively studied, both from a theoretical and from an

empirical point of view. The preferred empirical method consists in estimating elasticities of income with respect to the net-of-tax rate. Both the labour economics and the public finance literature rely on this method.

Those two large fields had been extensively surveyed by Blundell and MaCurdy (1999), Keane (2011) in the labor literature and Saez et al. (2012) for the taxation literature. Both report estimates that vary substantially in magnitudes between studies. They generally conclude that individuals do not react to income taxes, to the exception of married women with children. [1]

The two strands of literature address differently the endogeneity issue. The labor literature usually relies on structural assumptions on tax-units utility functions, and the tax literature usually relies on difference-in-differences setting and uses different types of instrument to solve the endogeneity issue.

The approach taken by the labor literature is to make assumptions on the utility function and then calibrate a static model given those hypotheses and as a consequence tackle the endogeneity issue. One of the possible problems with those models, as shown by Bargain and Peichl (2013), is that the evaluation of the labor response is very sensitive to modeling choices. [2]

The difference-in-differences approach taken in the tax literature exploits changes in tax schemes to evaluate net-of-tax rate elasticities of taxable income. This literature is known as the Elasticity of Taxable Income (ETI) literature. The endogeneity is tackled with the predicted net-of-tax income in the absence of tax reform as an instrument. However instrumenting with the counterfactual income tax leaves two sources of bias : the *change-in-the-distribution bias* and the *mean reversion bias*. These two sources of bias have been defined precisely in Weber (2014).

The change-in-the-distribution bias reflects the fact that the part of the distribution that is concerned by a modification of the tax schedule may be on a different trend, that is not due to the tax reform. The solution to this issue proposed by Auten and Carroll (1999) is to introduce base-year income controls, and the common practice is to do so by introducing income splines (or other types of income polynomials). However, this control

1. However Blau and Kahn (2007), and Heim (2007), shows that there exist a trend in women's labor elasticity which is decreasing in the US, and for which estimates are becoming very close to those of men, and the conclusion made on women's behavior up to the beginning of the years 2000 may not hold anymore.

2. Bargain and Peichl (2013) shows that previously used continuous labor supply models Hausman (1981) leads to higher elasticities estimates compared to more recent and new standards discrete-choice models. Löffler et al. (2014), show that the discrete-choice models are highly sensitive to changes in the underlying predicted-wage distribution.

threaten identification by absorbing much of the independent variation in tax rates. It implies that estimating elasticities based on one tax reform (only two years of data) is not feasible. Elasticities must thus be assessed over multiple tax reforms to have the necessary variability between position in the income distribution and tax reforms impacting different positions in the income distribution.

The reversion of the mean phenomenon accounts for the fact that households can have unusually low or high incomes in a period. This can be due to changes such as job-loss that are not related to any change in the tax incentive scheme. If I select households based on their position in the pre-reform income distribution before, the resulting estimates will be biased. For instance, individuals that lose their jobs (unrelated to any tax change) that were on the income tax bracket that had an increase in its MTR will be seen as reacting strongly to the tax reform and will thus induce an upward bias in the assessed elasticities. The inverse reasoning is valid for top income earners that had exceptional income (e.g. independent traders). Weber (2014) defines mean reversion effect as a transitory income that impact income independently of any behavioral reaction and is a noise of mean 0 that is applied to t-1 income. Several solutions have been proposed by the literature to control for such effect, Auten and Carroll (1999) did so by trimming the sample (but Kopczuk (2005) shows that the estimations are very sensitive to the choices made), Gruber and Saez (2002) did so by including income splines but it mixes assumptions about what is due to change in the distribution and mean reversion, Weber (2014) propose to take several years of lag to capture the variance in income, Kopczuk (2005) use log income spline both on income and on transitory income.

Gruber and Saez (2002) introduced a methodology to disentangle substitution effects and income effects by introducing an income effect parameter in their estimation. They find that the income effect is negligible, suggesting that the compensated elasticity is equal to the uncompensated elasticity. As a consequence most studies only report the uncompensated elasticity.

In this article, I implement on the following identification strategy. I use a triple-difference setting of the variation of taxable income. I rely on a large administrative panel dataset recently enriched with fiscal data. The triple-difference setting relies on a specificity of the French taxable income. France has a very particular tax-system that embeds a so-called *family ratio scheme* mechanism (Quotient Familial). The family ratio scheme mechanism divides the taxable income of a fiscal-household before applying it to the piecewise linear

tax scheme. [3] Such a characteristic leads some households earning the same income to have different MTR due to different family compositions. Piketty (1999) emphasized that fact, and leads him to propose a triple-difference estimator that allows the estimation of the households elasticity by controlling not only for the trend associated to a specific family composition but also the trend associated to a specific location in the income distribution to assess the eslasticities. The family ratio scheme mechanism embodies a triple-difference framework in its inner nature. Any modification of the income tax scheme will impact households differently based on their family composition, and being impacted is thus conditional to a specific location in the income distribution. As many studies rely on that specific characteristic of the French income tax to use an extra source of variation to identify some effect, [4] I am not aware of other studies (excluding the one of Piketty) that relies on a triple-difference estimator.

What I propose is a bit different, instead of working with elasticities I will work on the absolute variation of the taxable income. I will focus on a tax reform that has a very particular property. This tax reform will create three separated groups, a group that is unaffected by the tax reform, a group that faces an increase in MTR. An increase in MTR corresponds to an increase in the relative price of consumption with respect to leisure, which would induce both a substitution and an income effect. If a household works less, the income effect dominates, if a household work more the income effect dominates. The third group faces a lump sum increase in their income tax, and will thus generate a *pure income effect*. That specific structure of the reform will allow evaluating the mean impact on the reform in absolute value. That income tax reform affected only the last decile of the income distribution, which represents households earning more than 72 000 €. I am focused on the group of households earning between 50k€ and 200k€ who are married couples or couples under civil union (PACS).

The empirical analysis leads to three main results. First, there are very large income effects for households concerned by a lump sum increase in income tax. For households facing a change in MTR, the income effect dominates the substitution effect to the exception households impacted by the tax reform at the very top of the income distribution, which happened to be those with five children or more. Second, the behavioral reaction of men is greater than the one of women, both at the extensive or intensive margin. Third, older households reacts more on the extensive margin by delaying their retirement date.

3. A comprehensive review of that mechanism can be found in Carbonnier (2016) (in French)
4. Carbonnier (2014), Cabannes et al. (2014) , Carbonnier et al. (2014), Sicsic (2018)(mimeo)

This article contributes to the litterature by providing a clear quasi-natural experiment to assess the income effect linked with a change in income tax and by showing large income effect associated with a tax reform. It is also the first to exploit the triple-difference setting with individualized pannel data (as Piketty (1999) did it with aggregated data).

The paper is organized as follows. Section 1 presents the Institutional background and the implications of the tax reform on household's disposable income. Section 2 presents the empirical approach. Section 3 presents the results. The final section concludes.

7.2 Institutional Background

The reform I use is a lowering of the maximum fiscal gain per child implied by the quotient familial. Roughly speaking that lowering implied that the annual maximum tax reduction implied by the 2 first children dropped from 2336 euros to 1500 euros per child, and from 4672 to 3000 for the third child and above. In order to have a more precise explanation of the reform, I feel that I have first to explain the joint taxation mechanism used in France (the "quotient familial").

The family ratio scheme (FQ) ("Quotient familial" in French) is a mechanism that decreases the tax base amount. For a single without child the income tax function is :

$$T_i(y) = t(y_i),$$

where t is a piecewise linear function, y is the income that constitutes the tax base.
For different familial structure, the tax function is :

$$T_i(y_i, s_i) = t\left(\frac{y_i}{s_i}\right) \times s_i$$

where s_i is the number of fiscal share with respect to the structure of the fiscal household. The action of dividing the taxable income by s_i before applying the linear function, the re-multiplying the output by s_i constitutes the FQ mechanism. It is the core of the joint taxation system in France.

TABLE 7.1 – Number of fiscal shares
for a married couple or a couple under civil union

Number of children	Fiscal Shares
0	2
1	2.5
2	3
3	4
n children ($n \geq 4$)	1+n

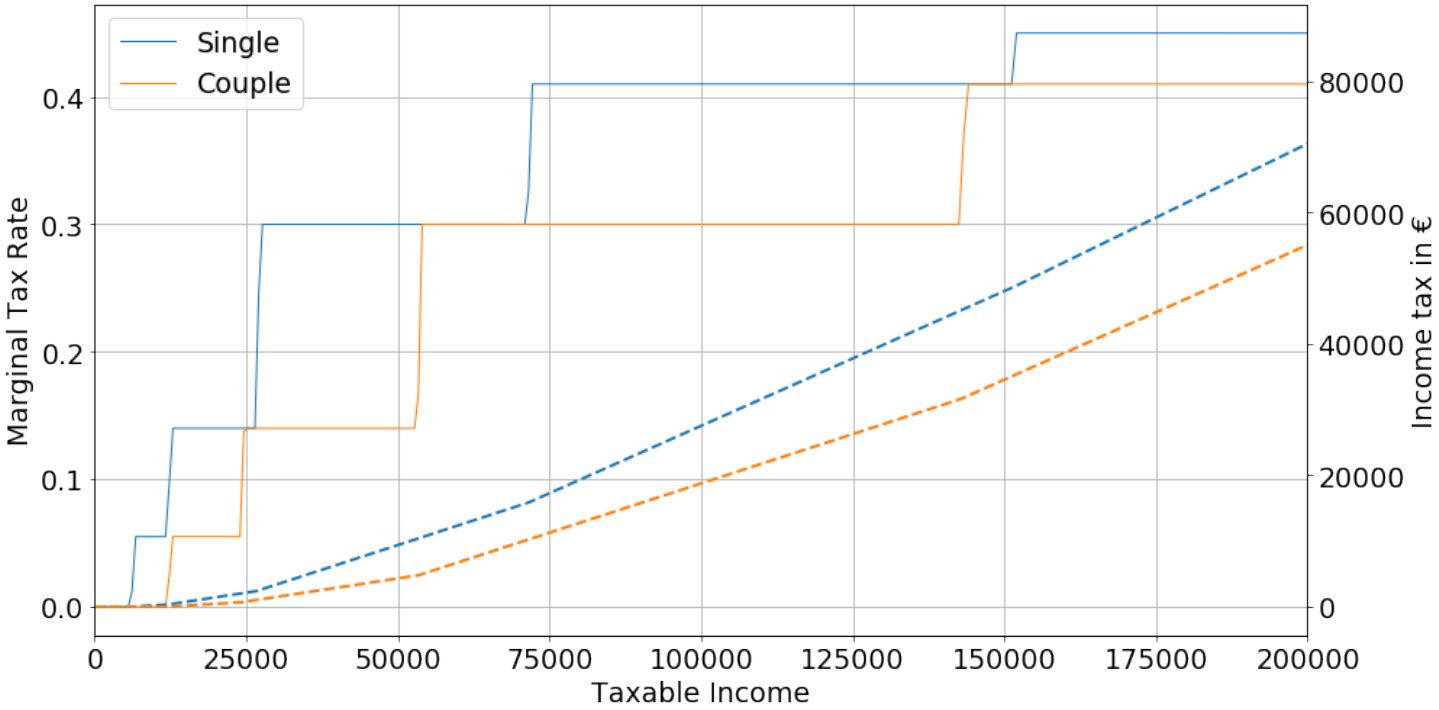
Tableau 7.1 shows the number of fiscal share per number of children, one should note that the number of fiscal shares is half a fiscal share for the two first child, and one full fiscal share starting at the third child and over. As married couples and couples under civil

union face exactly the same fiscal reform and that no difference is made in the analysis, I will, when writing about married couples imply the it is for not only married couples, but also for couples under civil union.

Such a mechanism implies that each bracket of the marginal tax rate (MTR) scheme of a fiscal-household that has n fiscal shares is n times larger than the MTR of the single with one fiscal share. As the total income tax is the result of the integral of the MTR scheme, the fiscal gain derived from children is the difference between the integral of the MTR scheme of a couple without children and the integral of the MTR of the couple with n child.

Figure 7.1 illustrate that fact by comparing single individuals and married couples income taxes. [5]

FIGURE 7.1 – French income tax for a single and a couple



Plain lines represent the marginal tax rate (left scale), I see that for the global income of the household, each tax bracket of the couple is twice the size of the single, including the zero (or exemption) tax bracket. Dashed lines (right scale) represent the income tax liability. The first tax bracket that has a MTR of 5.5% starts at 5,963 €, while it starts at 11'926 € for married couples. The second tax bracket (14% MTR) starts at 11'896 € for the single while it only starts at 23 792 € for the married couple. [6] The span of the first

5. This graph has been generated with the microsimulation software OpenFisca, the code used to produce all the graph in this article can be found at www.github/adrienpacifico/qf_lowering.

6. $27792 = 5963 * 2 + (1896 - 5963) * 2$

bracket is thus of 5'933 euros for a single, 11'866 € which is twice the single tax bracket span size.

Fiscal gain to children : Following the previous reasoning, tax brackets of a couple with children will be larger than the one of a couple without child. [7] As the total income tax function is the integral of the MTR function, the fiscal gain to of n children is simply the area between the marginal tax rate of a couple and the marginal tax rate of a couple with n children.

FIGURE 7.2 – French income tax for a couple wiithout children, and a couple with one child

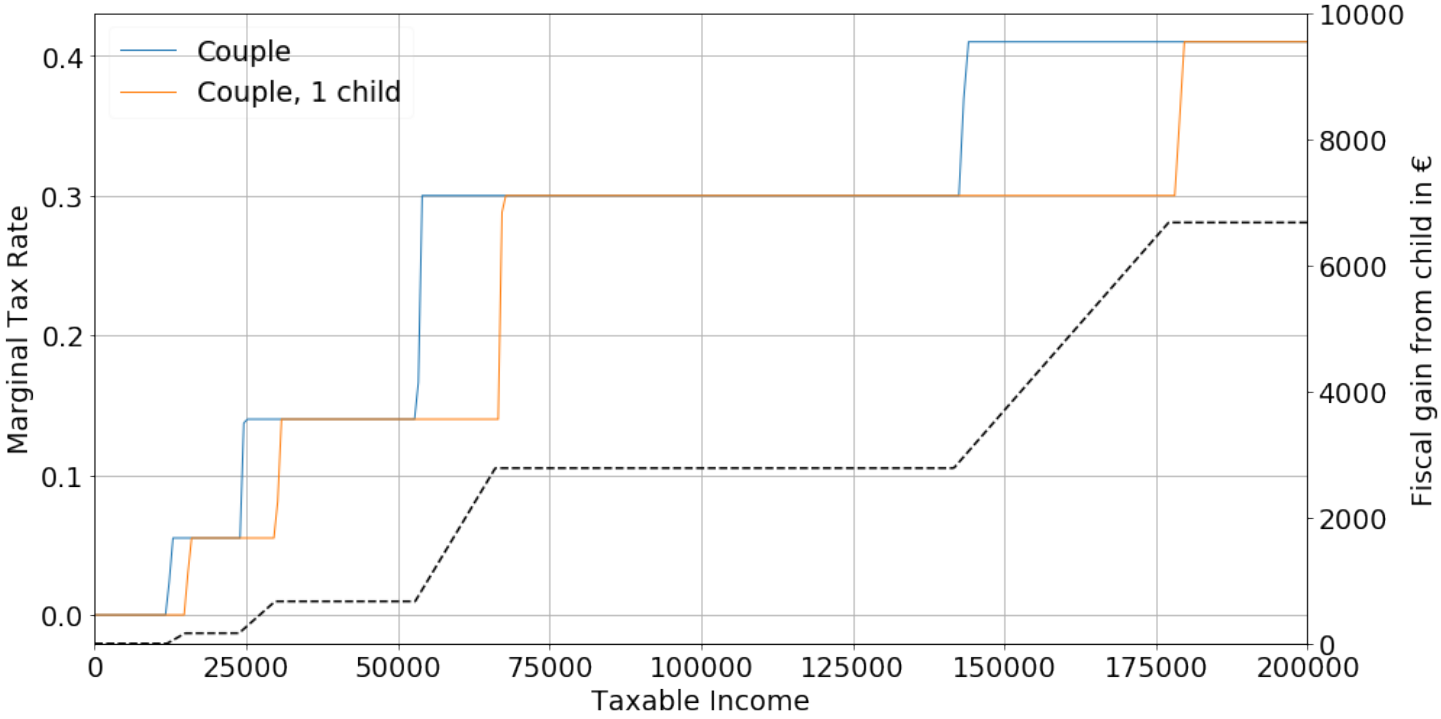


Figure 7.2 shows in plain line the MTR for a couple and a couple with one child. I see that each tax bracket is 1.25 times larger. The fiscal gain that is derived from the child is simply the area between the two MTR curves. [8] The dashed line represents the fiscal gain due to the presence of a child in a fiscal household. I clearly see that the fiscal gain increases only when the two marginal tax rates are not the same, i.e. when the family ratio scheme put the household on a lower tax bracket.

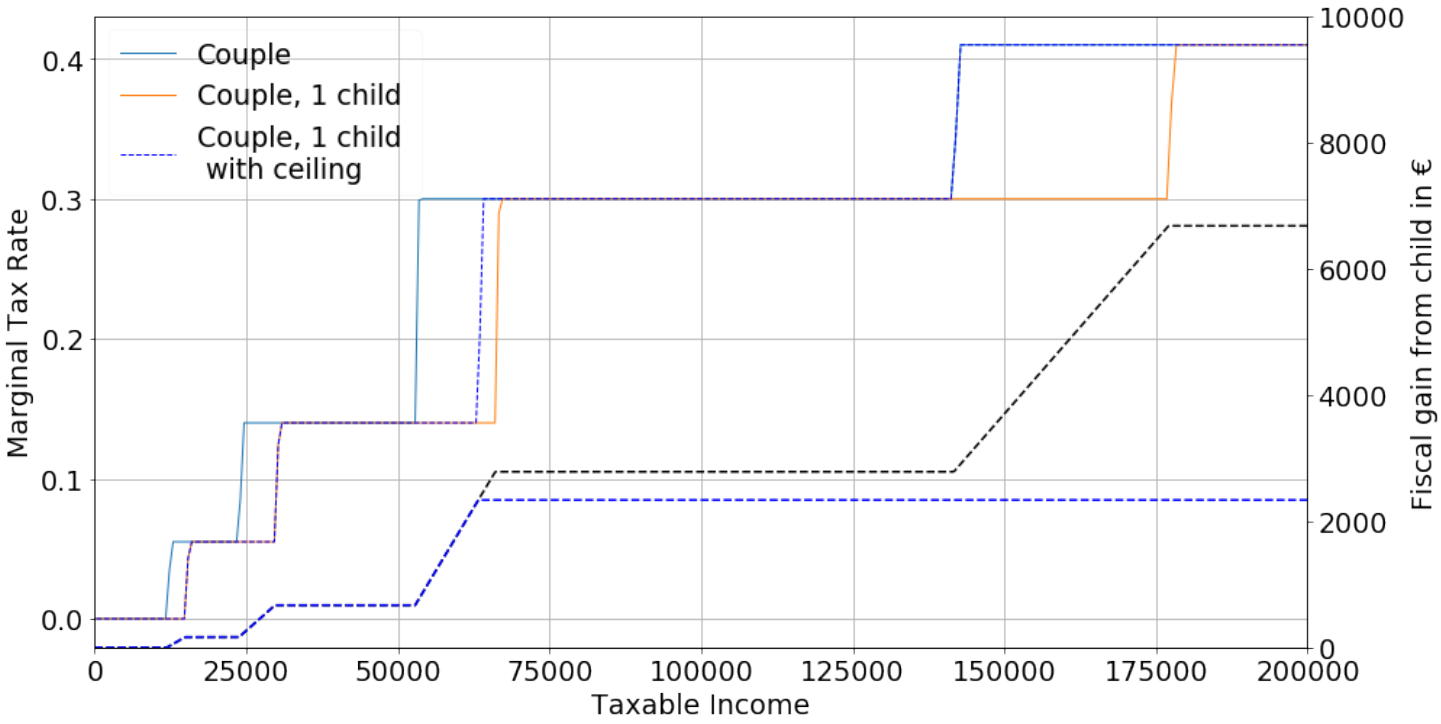
However as the children tax break can be very large as the number of children increases,

7. 25% larger for one child, 50% for two, twice larger for three, and $\frac{n+1}{2}$ times larger for households with $n \geq 3$ children. This is just the result of the ratio $\frac{\text{Number of fiscal shares with children}}{\text{Number of fiscal share without children}}$.

8. Or more specifically the difference between the integral of the couple MTR and the integral of the couple with n child integral

the fiscal gain per half fiscal share is however bonded by a ceiling.

FIGURE 7.3 – French income tax with the tax child break ceiling



This ceiling is a fixed amount per half fiscal share. That amount was of 2336 euros in 2011.

During its presidential campaign that started in March 2011, François Hollande who was seen as very unlikely to win the presidential campaign did not make any announcement about a possible change in the children tax break associated with the family ratio scheme. He won the left-wing primary election in October 2011, and it is only in January 2012 that he released a set of 60 presidential propositions where he made an ambiguous claim about a change in the tax break related to children. [9] In May 2012 he won the presidential election against former president Nicolas Sarkozy with 51.62% of the votes. It is only as late as in September 2012 that the reform of the threshold of the family ratio scheme has bee announced, then voted in December 2012.

The French income tax voted in December 2012 is applied to income earned during the year 2012 (the fiscal rules are thus known by the tax-payer after she has earned her income). As some anticipated behavior could have happened during 2012 about the lowering of the family ratio scheme reform, I claim that anticipation of the tax reform during the year

9. He stated "I'll leave unchanged all the resources allocated to the family policy. [...] I'll make more just the family ratio scheme by lowering its ceiling for richest households, which will concern less than 5% of the fiscal-households"

2011 is extremely unlikely : François Hollande was not seen as a potential winner of the presidential election before October 2011, the potential reform was not announced before 2012, and he only had a narrow victory.

I thus take 2011 taxable income as the pre-reform period. The reform consisted of lowering the family ratio scheme ceiling from 2336 euros to 2000 euros. A year after a new lowering of that threshold from 2000 to 1500 euros happened and was announced as a permanent reform. As the reform was announced in September 2013, to embody fully the effect of the reform I will take 2014 income as the post-reform year.

These two fiscal reforms have overall lowered the maximum child tax break ceiling from 2336 euros to 1500 euros, and in order to use a classical before and after the reform analysis, I will consider from now on that it constitutes a unique fiscal reform.

FIGURE 7.4 – Income tax wich maximum child tax break before and after the reform

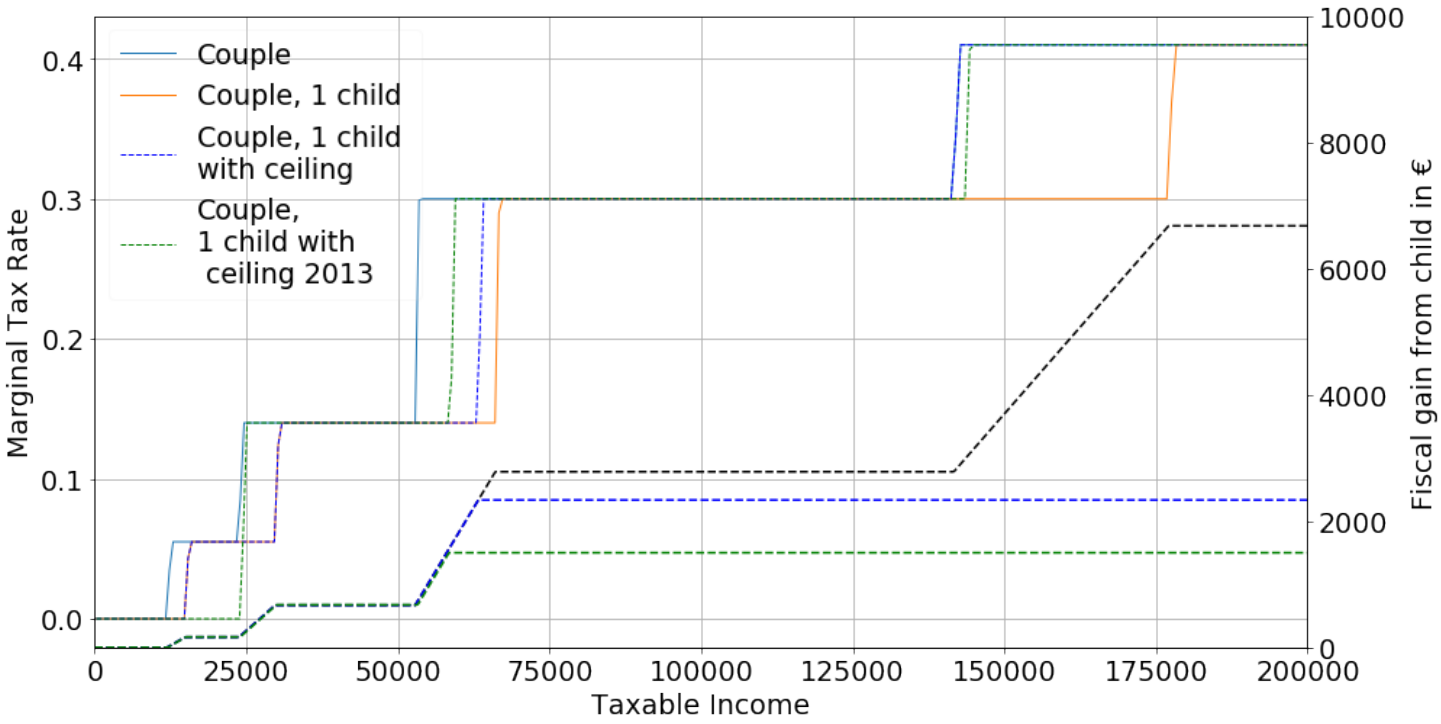


Figure 7.4 shows the ceiling before the reform, and after the reform : it limits the fiscal gain derived from children to 2336 euros in 2011 for couples earning more than 68 000 euros, and to 1500 euros in 2013 for couples earning more than 63 000 euros. What is important here is to see that the impact of reaching the ceiling, is that a household jumps to the marginal tax rate it would have face without children (here the 30% tax bracket). The consequence is that there exists an income threshold at which the 2013 ceiling constraint is saturated and a threshold at which the 2011 ceiling constraint is saturated. This threshold is different for each family composition.

Households have been affected in three ways. Households for which the fiscal advantage per child was lower than 1500 euros are unaffected. Households for which the fiscal advantage per child was between 1500 euros and 2336 euros (or twice that amount over 3 children) face a change in their marginal tax rate. Households for which the fiscal advantage per child was over 2336 euros faced a lump sum loss in disposable income of 836 € per child. The maximum fiscal loss that households can have are far from negligible since it represents up to 1.2% of the disposable income of a family with one child, and respectively up to 2.2%, 3.4%, 4.1%, 4.8%, 5.4% respectively for households from 2 to 6 children. [10]
As the fiscal advantage increases with income, there exists an income threshold at which a household will attain the ceiling. This thresholds is specific for each family composition, and since the ceiling has been lowered between 2011 and 2014,

TABLE 7.2 – Income triggering FQ threshold based on taxable wage

Number of children	2011	2014	Span	Maximum Fiscal Loss
1	67,856	62,519	5,337	836
2	78,895	68,140	10,755	1672
3	101,426	79,166	22,260	3344
4	123,756	90,221	33,535	5016
5	145,188	101,272	43,916	6688
6	159,477	112,324	47,153	8360

Tableau 7.2 shows the location of those thresholds in 2011 and 2014. Fiscal loss is computed by multiplying the number of fiscal shares by the difference between 2336 and 1500 €.
For a given family composition, households being below their 2013 threshold are unaffected by the reform. Households being between 2013 and 2011 thresholds face a change in their marginal tax rate. Households being over 2011 thresholds face a lump sum decrease in their disposable income.

One condition to evaluate correctly the impact of a reform is that it is not polluted by other reform taking place at the same time that concerns our population of interest. I am interested in the lowering of the family ratio scheme threshold, a first reform that could pollute our estimation are modifications in the piecewise linear tax scheme.

10. see Figure 8 in appendix.

TABLE 7.3 – Piecewise linear tax scheme

	2011		2012		2013		2014	
	Rate	Threshold	Rate	Threshold	Rate	Threshold	Rate	Threshold
0	0	0	0	0	0	0	0	0
1	0.055	5,963	0.055	5,963	0.055	6,011	0.14	9,690
2	0.14	11,896	0.14	11,896	0.14	11,991	0.3	26,764
3	0.3	26,420	0.3	26,420	0.3	26,631	0.41	71,754
4	0.41	70,830	0.41	70,830	0.41	71,397	0.45	151,956
5			0.45	150,000	0.45	151,200		

Tableau 7.3 show the evolution of the marginal tax scheme over our period of interest. Two modifications have happened, the first one is the introduction of a new top tax bracket for single's tax-unit earning over 150 000 euros, and the second one is the suppression of the 5.5% tax bracket.

The introduction of a 45% tax bracket doesn't really concern our analysis because I focus on married couples earning from 50 to 200k€, their maximum equivalised taxable income will thus be 100k€ and are thus too poor to be concerned by that reform. Thus suppression of the 5.5% tax bracket has been concomitant to the decrease of the 14% tax bracket threshold, the resulting total impact for households that have an equivalised income of 11'896 euros or greater is of 18 €, [11] and represent a negligible amount of the disposable income of our concerned households (less than 0.01%).

Many other small modifications have taken place during that period (such as very small inflation adjustments of the income tax brackets), but always account for less than 0.02% of disposable income, and I thus choose to consider them as negligible. [12]

Another tax reform that could cause a potential bias is a change of tax base for capital income that happened in 2013. [13] Luckily I have a specific variable for the specific income that was concerned by that tax scheme. [14] I ran the estimation with and without households that had income concerned by that specific tax regime in 2011, the results are all very similar and are provided in the appendix.

Even if the number of tax bracket changes over time, I can see that the 30% tax bracket starts, to the exception of small inflation adjustment, remains the same over the period. The impact of the reform mainly concerns households that will switch from the 14% tax

11. (11896-5963)*0.055 - (11896-9690)*0.14
12. An interactive graph that displays that information that is accessible at the following link : https://adrienpacifico.github.io/docs/bokeh_graph.html
13. The so called "fin du prélèvement forfétaire libératoire" reform.
14. ZIMPVALM in the database

bracket to the 30% tax bracket or that already were on the 30% and that faced a lump sum loss.

7.3 Empirical Approach :

To study the impact of the lowering of the maximum child tax break that happennend in 2012 and 2013 I use the **Echantillon Demographique Permanent** (EDP) the first release of which was in 1999 but that was enriched in March 2017 with new administrative data sources from which I use tax returns pieces of information and pay slips. The database contains over 2.47 million households in 2014 and 2.38 million households for the year 2011. I choose to focus my analysis on married couples and couples under civil union as it is the most standard family composition in France. I thus select this population of interest and I am left with 1.19 million households and 1.16 million that I can observe in 2014 and 2011. There exist two forms of civil contract in France : civil partnership (PACS) and marriage. As there is no difference in the fiscal rules applied to married couples and couples under civil partnership, I will for a matter of convenience I refer to them as married couples.
Singles represent a smaller share of the population and the tax reform implies different thresholds and effect than the one that applies on couples, although the same methodology as the one that I apply on married couples.
Cohabitants are also less common than couples under civil union, the analysis of the reform on those couples would be more complex as cohabitants can choose to allocate their fiscal shares on one of the two fiscal units that compose the household. Moreover, even if that complexity is taken into account, the limitation in the number of concerned households would probably be too small to derive any conclusion.
From those, I end with only 812 000 households present in both years in the database. The attrition of the 350000 households has many factors such as the death of the taxpayers, dissolution of marriage, change of address and so on.

7.3.1 Data-Selection

Income Span When it comes to identifying behavioral income reaction to a tax change, the biggest challenge is that the level of income tax is determined by the income itself and the two variables are thus endogenously linked.
I assume that belonging to a specific income span implies to be treated by the reform.

As it is usual to instrument the counterfactual MTR in the literature by running a 2SLS estimation, this method, however, needs to have access to more than two years of data with multiple tax reforms over the period.

As I want to analyze the impact of one tax reform I cannot do so.

There have been other tax reform that change the fiscal gain to children over the period, but none of them concerned households earning more than 50'000 euros. I then choose to limit the analysis to households earning less than 200'000 euros per year. First for those households well over the last percentile of the income, distribution the number of observations is small, second they are more likely to be able to do income shifting through many channels, third they are less impacted by the reform since for most households the impact of the reform is maximum for households earning less than 100'000 euros.

As emphasized by Kopczuk (2005), estimations are very sensitive to data-selection and data-trimming. As the estimation does not fully concerns the very end of the income distribution I am not upward bounded by the richest household of the distribution.

What I do is to select households that its taxable income located between 50'000 euros and 200'000 euros either in 2011 or in 2014. [15] By doing so I avoid the mean reversion bias. Indeed since I control for the position in the income distribution, differences in trends between high-income earners and low-income earners will be captured which will cancel out the change in distribution bias. By selecting households that were in the 50-200k euros range in either 2011 or 2014 I claim that I control for the remaining mean reversion. Indeed if households face reversion of the mean, by selecting households that were earning between 50-200k euros in 2011 or in 2014, since mean reversion is defined as mean zero shock at each period, if an household face an income shock unrelated to the tax reform that lead it to goes from 150'000 euros to 300'000 euros, it is euqually likely that an other household has an unrelated to the tax reform shock from 300'000 euros to 150'000 euros one I controlled for the position in the income distribution. Thus the effect of mean reversion will be canceled out.

If I selected households that were on the 50-200k income span only in 2011, households that have transitory shock that leads them to be above the 200k threshold will not be compensated by those who were earning more than 200k euros in 2011 but that has negative transitory income shock. This would lead to overestimating the impact of being over the 2011 maximum child tax break threshold.

15. To be fairly explicit a household earning 40k€ in 2011, and 55k€ in 2014 will be in the sample. A household earning 170k€ in 2011, and 220k€ in 2014 will be in the sample, a household earning 30k€ in 2011 and 45 k€ in 2014 will not be in the sample.

The same reasoning can be applied to households that leave the 50-200k income span for an income lower than 50k euros. To one exception, taxable income is bounded and cannot be lower than 0. This would be a problem as it is not clear that households whose earning falls to zero would be canceled out by households that have income that goes from zero to income in the 50-200k range. To cancels out this problem, I trim the sample based on change in earnings such that no households get a null income in the sample. This leaves out 4% of the sample (2% at the top and 2% at the bottom).

I then take the taxable income present in the database at the tax-unit level and sum them to obtain taxable income.

For now on I will consider that the effect of the reform corresponds to a specific treatment. Households that did not face a change in their income tax are untreated. Households for which the two thresholds are treated with Treatment 1, and the treatment is a change in MTR. And households that are over the 2011 threshold are treated with Treatment 2, and they face a lump sum loss in their disposable income.

The repartition of households in those three groups is reported in Tableau 7.4.

TABLE 7.4 – Number of concerned households

Number of children	Treatment 0	Treatment 1	Treatment 2	Total
0	43960	0	0	43960
1	16110	3324	11638	31072
2	49720	11142	20033	80895
3	21930	4747	5084	31761
4	3571	774	651	4996
5	578	113	42	733
6	159	18	5	182
Total	136028	20118	37453	193599

I see that the non-treated represents 193599 households which represent 56% of the sample. Households facing a change in MTR represent 20118 households (14% of the sample), and households that face a lump sum change represents 37453 households (28% of the sample). I see that the number of households 6 children in the first treatment is of 18 households and only 4 in the second treatment. Such small numbers would likely leads the estimates to be driven by outliers or be subject to micronumerosity/partial colinearity and should be taken with caution. Although all the regression has been run with an iteratively reweighted least squares estimations to control for the impact of potential outliers and leads to very similar results

7.3.2 Tax base and tax computation

The database contains pieces of information at the fiscal household level and at the individual level.[16] To compute the tax base I use a simple rule of thumb : I sum the 7 categories of income present in the database at the household level. I, however, apply the 10% deduction for professional expenses on labor and retirement income.[17] [18]

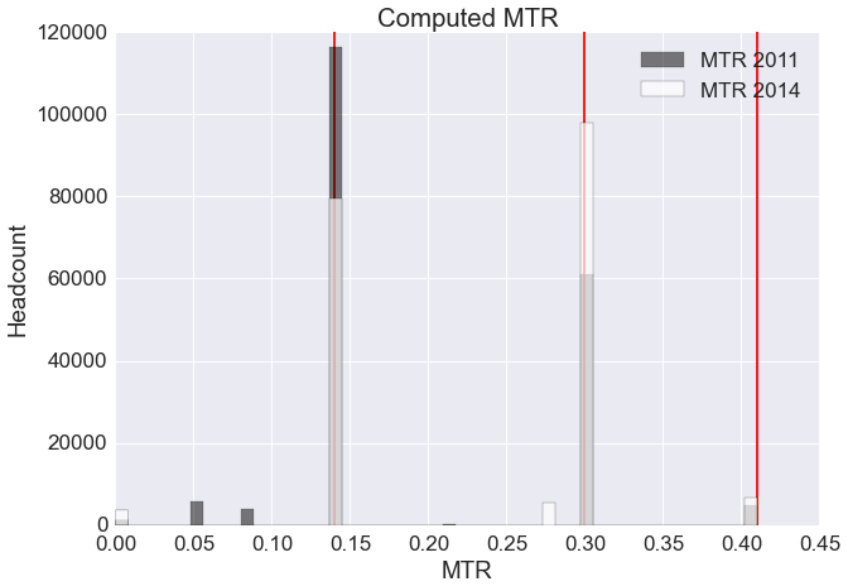
Once the tax base determines, I compute the tax liability by applying OpenFisca income tax formulas.

7.3.3 Descriptive Statistics

The set of administrative databases and administrative surveys provide a very rich set of variables. Those variables do not always cover fully the population. A set of descriptive statistics for each treatment group are reported in Tableau 7.5.

Marginal Tax Rates : The tax reform implied a change in marginal tax rates for households that are between the 2011 and 2014 thresholds.

FIGURE 7.5 – MTR before and after the reform



16. When aggregated individual income match households income, with some exceptions due to tax deductions that are sadly not documented by the data producer (one example is for rented furnished flat : individual income is twice the household income due to a 50% tax rebate on flat rented furnished that is taken into account at the household level but not on the individual level.).

17. The 10% tax deduction is computed by taking into account the different thresholds that can lead to a taxable income reduction greater or smaller than 10%. I took formulas from the OpenFisca microsimulation software

18. However taxpayers can choose to deduce their real expenses to reduce their labor income tax base. Although it was a major concern to me that this may lead to overestimating the tax base, I provide evidence in the appendix that the impact is likely to be minor.

TABLE 7.5 – Summary statistics

	All	Treatment 0	Treatment 1	Treatment 2
Taxable income	66018	55611	71816	100704
Δ Taxable income	6222	6647	5305	5174
Father is working 2011	0.866	0.840	0.932	0.9260
Mother is working 2011	0.766	0.759	0.809	0.7689
Father is employed 2011	0.823	0.809	0.886	0.8408
Mother is employed 2011	0.775	0.767	0.820	0.7812
Father is employed 2014	0.732	0.709	0.815	0.7707
Mother is employed 2014	0.709	0.696	0.768	0.7215
Mother's salary 2011	37389	30812	44103	57667
Δ Mother's salary	224	161	650	226
Father's salary 2011	22251	19676	24706	30281
Δ Father's salary	-761	-724	-137	-1230
Δ Retirement income_wo	665	877	104	196
Δ Retirement income_me	1411	1780	303	663
Δ sel-employed income_wo	13	199	140	-97
Δ sel-employed income_me	-1	-15	-3	-533
Father independant worker 2011	0.054	0.040	0.064	0.0973
Mother independant worker 2011	0.084	0.068	0.086	0.1439
Mother is retired 2011	0.042	0.056	0.008	0.0111
Mother retired	0.029	0.039	0.005	0.0084
Father is retired 2011	0.049	0.067	0.006	0.0082
Father retired	0.044	0.056	0.012	0.0190
Father start working	0.020	0.022	0.016	0.0143
Mother start working	0.009	0.011	0.004	0.0050
Mother stop working (¬retired)	0.064	0.062	0.067	0.0689
Father stop working (¬retired)	0.064	0.063	0.068	0.0666
Centile 2011 (std of living)	81.10	76.746	86.801	93.86
Centile 2014 (std of living)	81.37	78.222	83.612	91.63
Income tax 2014 (administrative)	6797	4700	6402	14624
Income tax 2011 (administrative)	4996	3492	3776	11114
Income tax 2014 (author's computation)	8486	5896	8378	17952
Income tax 2011 (author's computation)	6769	4768	5701	14608
Computed MTR from administrativeIncome tax	0.206	0.171	0.270	0.299
Computed MTR 2011	0.192	0.167	0.140	0.311
Computed MTR 2014	0.231	0.204	0.271	0.308
Share 0 child	0.227	0.323	0.000	0.000
Share 1 child	0.160	0.118	0.165	0.310
Share 2 children	0.417	0.365	0.553	0.534
Share 3 children	0.164	0.161	0.235	0.135
Share 4 children	0.025	0.026	0.038	0.017
Share 5 children	0.003	0.004	0.005	0.001
Age Father	45.717	46.102	43.747	45.37
Age Mother	43.870	44.360	41.792	43.20
Age Eldest Child	8.846	7.847	11.803	10.88
Age Youngest child	6.755	5.825	9.030	8.91

TABLE 7.6 – Effective statutory rates before and after the reform.

	Effective		Counterfactual : 2011 tax on 2014 income
MTR	2011	2014	2014
0 %	00.65	01.88	0.00
5.5 %	03.03	00.00	0.84
8.25%	02.06	00.00	0.69
14 %	60.12	41.12	55.40
21 %	00.05	00.00	0.05
28 %	00.00	02.89	0.00
30 %	31.47	50.60	38.63
41 %	02.54	03.45	3.65

Tableau 7.6 and Figure 7.5 shows the MTR households were subject to in 2011 and 2014. [19] If I ignore the changes due to the suppression of the first tax bracket and the implicit tax brackets created by the decote mechanism, [20] I see that the main change in the repartition of households in the income tax scheme is a change from the 14% tax bracket (from 60% to 41% of the sample) to the 30% tax bracket (from 31% to 51% of the sample).

The fact that households shifted from the 14% MTR to the 30% MTR can be due to two distinct causes. The first one is due to the fact that income has increased over the period. The other one is due to the lowering of the family ratio scheme. To disentangle those the two, I can look at the 2014 counterfactual income tax, which is the income tax a household would have paid if the 2011 income tax schedule would have been applied to its 2014 income. I see that the 19% decrease in households being on the first tax bracket, 5% can be attributed to the general increase in income in the population, and thus 14% is due to the lowering of the family ratio scheme.

7.3.4 Identification Strategy

I am going to estimate the effect of the reform by using a triple difference framework with two treatments per each family type (per children number), and many control groups which has a complex structure based on a non-overlap of treatments with respect to each group. As the French income tax

Our estimation makes, however, some assumption, the first one is that I correctly described

19. I computed those rates by taking the taxable income for a given year

20. which multiplied the statutory rate for households concerned by the mechanism by 1.5 in 2011 and 2 in 2014. That creates the 8.25 and 21% implicit marginal tax rate for 2011 and the 28% implicit MTR for 2014 (e.g for the 5.5% tax bracket $5.5\% \times 1.5 = 8.25$)

the reform and that the tax-base is correctly observed in the database. One concern is that I do not have the information about professional expenses that are to some extent tax deductible which would lead us to overestimate the tax base. However the database contains the income tax that households actually paid, in section A.5 I compare the expected change in tax and expected marginal tax rate, I show that (even if not perfect) the estimates are consistent with a pretty accurate description of the reform.
In order to fit our problem in the classical public policy evaluation literature I am going to start from a simple diff-in-diff problem, then increase the complexity of the estimation towards our preferred regression.

A difference-in-difference is based on the estimates of the dependent variable based on the interaction of two binary variables : the after reform one and the treated group one. An after reform binary is also included in the regression to account for the mean evolution of the dependent variable between, before and after the reform. The treated binary is also included to account for the possible difference between the treated and the control group prior to the policy change.

$$y_{it} = \beta_0 + \beta_1 \text{Post} + \beta_2 \text{Treated} + \delta \text{Treated} \times \text{Post} + c_i + \epsilon_{it} \tag{7.1}$$

When using individual-level panel data c_i, the individual fixed effect is included to control for individual unobserved effect.
The OLS estimate of $\hat{\delta}$ implies : $\hat{\delta} = \Delta \bar{y}_{\text{treated}} - \Delta \bar{y}_{\text{untreated}}$,
which represent the dependent mean evolution of the treated group minus the one of the untreated group, which is stated as the effect of the treatment.
This equation can be evaluated through a first difference setting which leads to :

$$\Delta y_i = \beta_1^{'} + \delta_1^{'} \text{Treated} + \epsilon_i^{'} \tag{7.2}$$

And I have $\delta_1^{'} = \delta_1$, and $\beta_1^{'} = \beta_1$.

Back to our case, I have a change in the tax scheme happening between 2012 and 2013. This change in tax scheme gives three groups : the control group, the group facing the first treatment (i.e. being between the 2011 and 2013 thresholds), and the one facing the second treatment (i.e. being over the 2011 threshold). I can thus run a difference in difference regression with two treatments.

$$\Delta y_i = \beta_0 + \delta_1 \text{Treatment}_1 + \delta_1 \text{Treatment}_2 + \epsilon_i \tag{7.3}$$

δ_1 account for being between the two brackets, a negative sign would imply that the substitution effect due to the increase of the leisure price dominates the income effect, a positive sign would imply that the income effect dominates. δ_2 represent the effect of being above the 2013 bracket since it implies a reduction in disposable income without a change in the marginal tax rate, I would expect a positive sign.

Some assumptions are conditional for δ_1 and δ_2 to capture the refom.

One key assumption is that the counterfactual without the reform would imply that the taxpayers would still have its income in the treatment span.

Such a regression doesn't take into account the position in the income distribution. It is possible that being on a specific position of the income distribution the variation of income will have a different trend and that this trend concerns more specifically the treated. It is also possible that the variation of income depends on the number of children in the household and that the parameters capture mainly a big part of the difference between the mean evolution of households with children against households without children. I thus run the regression by including control variables for the number of children, and a binary is added for the effect of being over the 2011 thresholds (from 1 to 6 children).

This leads to a Difference-in-Differences-in-Differences estimation that allows to control for potentially confounding trends : change in income due to the position in the distribution, the number of children in the household, and possible interactions between the two. Such a property of the French family ratio scheme is quite remarkable and has indeed been emphasized by Piketty (1999).

This regression also considers Treatment 1 and Treatment 2 as different treatments for each number of children in the household, which allows to see the specific impact of the reform for a given number of children. The result is the following estimator, which is formally a triple-difference estimator with 12 treatments.

$$
\begin{aligned}
\Delta y_i = \beta_0 &+ \sum_{i=1}^{6} \beta_i \text{Children}_i + \sum_{j=1}^{6} {}_b\delta_j \text{Between}_j + \sum_{j=1}^{6} {}_o\delta_j \text{Over}_j \\
&+ \sum_{i=1}^{6} {}_b\gamma_i \text{Children}_i \times \text{Between}_i \\
&+ \sum_{i=1}^{6} {}_o\gamma_i \text{Children}_i \times \text{Over}_i \\
&+ \epsilon_i
\end{aligned}
\tag{7.4}
$$

Δy_i represent the change in taxable income between 2011 (before the reform) and 2014 (after the reform).

The intersect β_0 captures the time trend, i.e., the mean change in wage between 2011 and 2014. Children_i is a dummy indicating for the number of children (the reference being 0 children), β_i thus captures the variation in income for i children in the household.

δ capture the effect of being on a specific part of the distribution : ${}_b\delta_i$ captures the effect of being on the position in the distribution where the treatment 1 applies to households having 1 child. ${}_o\delta_i$ captures the effect of being above the 2011 threshold for a given number of children i.

The parameters of interest are γ_i, i.e., the triple difference estimators. Those are the parameters that capture the interaction between being on the specific location of the income distribution, where for a given number of children in the household the treatment took place, interacted with that given number of children. The left subscripts b, and o, account for respectively the first treatment (between thresholds), and the second treatment (over 2011 threshold).

The first parameters of interest ${}_b\gamma_i$, captures the effect of the change in marginal tax rate (MTR). The sign of the parameter determines whether the income effect dominates, or the substitution effect dominates. If the sign is positive, the income effect dominates (the loss in income due to the reform implied an increase in the effort to compensate for the loss in income). It the sign is negative, the substitution effect dominates : the increase in MTR leads to favor leisure over income.

Such estimation makes it hard to determine what is the control group. The control groups is constituted first of households without children. Then it is also constituted by households with children that are below the 2013 ceiling. More surprisingly treated households also constitute a control group, but deflated of the mean estimated effect of the reform.

This is because the estimate of interest (all the γ) capture the mean effect of being in the treatment group. [21]

For example the OLS estimate ${}_b\hat{\gamma}_3$, accounts for the effect of the 2012/2013 reform on the household with three children for which income was between 79 166 euros and 101 426 euros can be expressed as follow :

$$\begin{aligned} {}_b\hat{\gamma}_3 = &\left(\bar{y}_{T^1_{3,3C,2014}} - \bar{y}_{T^1_{3,3C,2011}}\right) \\ &- \left(\bar{y}_{T^1_{3,\{0,1,2,4,5,6\}C,2014}} - \bar{y}_{T^1_{3,\{0,1,2,4,5,6\}C,2011}}\right) \\ &- \left(\bar{y}_{\neg T^1_{3,3C,2014}} - \bar{y}_{\neg T^1_{3,3C,2011}}\right) \end{aligned} \tag{7.5}$$

The first line of the left-hand side represents the mean change in income for the households of three children being between the 2014 and 2011 thresholds.

The second line represents the mean change in income for the households for which the number of children is not 3, but being between the 2014 and 2011 thresholds.

The third line represents the mean change in income for the households for which the number of children is 3, but not being between the 2014 and 2011 thresholds. I have thus controlled for two kinds of potentially confounding trends.

Flatten Thresholds : The series of thresholds $\sum_{i=1}^{6} {}_b\gamma_i \text{Children}_i \times \text{Between}_i$, and $\sum_{i=1}^{6} {}_o\gamma_i \text{Children}_i \times \text{Over}_i$ are overlapping. For instance, as shown in Tableau 7.2, a household with a taxable income of 95 000 euros, dummies will be true for Over_1 and Over_2 since the taxable income is greater than the 2011 threshold for 1 and 2 children. For that same exemple, the dummies Between_3 and Between_4 will also be true. One consequence is that it is difficult to interpret the parameters linked with the dummies $Over_i$ and $Between_i$. However, each possible configuration of these dummies variables is a linear combination of all thresholds intervals once they have been ordered. The result is (for 6 children), 11 income span plus a twelve one for households over the highest threshold.

x

By substituting $\sum_{i=1}^{6} {}_b\gamma_i \text{Children}_i \times \text{Between}_i + \sum_{i=1}^{6} {}_o\gamma_i \text{Children}_i \times \text{Over}_i$ in Équation 7.4 with

$\sum_{i=1}^{12} \text{Income\_Span}_i$ the regression is strictly equivalent for all other parameters while

21. This fact has been checked with numerical simulations.

allowing to have a clearly interpretable effect of being on a specific position in the income distribution. This is the way the results will be reported.

7.4 Results :

In order that tables keep a reasonable size, standard errors or parameters may be taken out when they are not crucial for the analysis. Although all the results in that section are available at https://github.com/adrienpacifico/fq_lowering/ with all parameters and standart errors, and with the exact code used to produce the results.

Triple Diff : I run the triple-diff estimation in three different manners. First, I run a classical ordinary least square (OLS) estimation that captures the average change in taxable income between 2011 and 2014. However, because I can expect that richer households would be more prone to –in absolute values– larger income variations compare to poorer households, the estimation is likely to be subject to heteroscedasticity.
The literature on tax elasticity of entire population has focused on young working-age population and considers that older population de-facto less elastic (Alpert and Powell, 2013; Messacar et al., 2017), younger workers were more prone to changes and has broader prospects to make their income vary.

I propose two estimates : an OLS on all the population, an OLS with the age of the oldest parent as control.
Before looking at the parameters of interest let's first focus on the variables that capture general trends. The $Child_n$ rows of Tableau 7.7 show that the family composition has a strong influence on the evolution of income. Effect of the reform taken out, families of one child will have an increase in income between 2011 and 2014 of 1829 € on average. As the number of children increases, the greater the mean evolution of income (free of the reform effect).
The economic conjuncture was not good between 2011-2014 and high earners were negatively impacted, this is translated by those negatives parameters. However the constant is positive with an average trend in income (without the trend due to an income location variables) increasing by 6381 euros on average, which implies that over the period, income tends to converge between middle-income households and high-income households.
The fact that those income location parameters are significant implies that evaluation in a classical diff-in-diff estimate would have lead to biased estimates if control variables for

TABLE 7.7 – Triple-diff estimate

	Triple	Triple age controls
$Over_1 \times Child_1$	2292***	2446***
	(232)	(231)
$Over_2 \times Child_2$	4314***	4363***
	(237)	(236)
$Over_3 \times Child_3$	3996***	3925***
	(399)	(398)
$Over_4 \times Child_4$	3120***	3032***
	(1054)	(1052)
$Over_5 \times Child_5$	5174	4846
	(3955)	(3961)
$Over_6 \times Child_6$	−198	−727
	(13784)	(13843)
$Between1 \times Child_1$	621**	622 ∗ ∗
	(255)	(254)
$Between2 \times Child_2$	2487***	2496***
	(197)	(197)
$Between3 \times Child_3$	4234***	4224***
	(316)	(315)
$Between4 \times Child_4$	2780***	2706***
	(754)	(752)
$Between5 \times Child_5$	−4147*	−4254∗
	(2194)	(2190)
$Between6 \times Child_6$	−9431**	−9655**
	(4765)	(4834)
$Child_1$	1829***	372***
$Child_2$	2662***	507***
$Child_3$	4388***	2327***
$Child_4$	6234***	4269***
$Child_5$	7406***	5585***
$Child_6$	8987***	7066***
Taxable income ∈ [58291, 63233]	-5399***	-5186***
Taxable income ∈ [63233, 63530]	-5806***	-5600***
Taxable income ∈ [63530, 73516]	-6564***	-6305***
Taxable income ∈ [73516, 73806]	-7736***	-7443***
Taxable income ∈ [73806, 84103]	-7683***	-7363***
Taxable income ∈ [84103, 94368]	-8164***	-7783***
Taxable income ∈ [94368, 94451]	-8325***	-7989***
Taxable income ∈ [94451, 104633]	-7289***	-6854***
Taxable income ∈ [104633, 115185]	-7523***	-7017***
Taxable income ∈ [115185, 135941]	-7466***	-6896***
Taxable income ∈ [135941, 150684]	-6456***	-5844***
Taxable income over 150684 euros	-8524***	-7897***
Age oldest parent		-206.13***
(Age oldest parent)^2		0.31
Intercept	6381***	16642***
Adjusted R-square in %	4.52	5.20
Number of observations	193555	193555

children were not introduced. Income splines usually introduced to mitigate the change in the distribution effect captures a part of the reform effect and leads to under-estimate the potential effects of a reform. By using the triple-diff estimate I am not facing those issues and thus justify the benefits of such an estimation.

The effect of being over the 2011 threshold : The interaction $Over \times Child$ gives the effect of the change in disposable income and thus account for a pure income effect. The effect is significant from one to four children. The impact of facing a loss of 836 euros for a family of one child implies an average increase of 2292 euros. Which suggest that the income effect had a strong impact on households taxable income.

The effect of being between the two thresholds : The interaction $Between \times Child$ gives the effect of the change in the marginal tax rate for each child rank. The effect is not significant for families with one child, while the effect is significant and positive for families from 1 to 4 children. Indeed the average effect of the reform is of 621 euros, 2847 euros, 4234 euros, and 2780 euros for families of respectively 1 to 4 children. Following our framework, since the average change in taxable income is positive, I can conclude that the income effect dominates the substitution effect, which is contrasting with the established literature. However, I see that for 5 children, households earn less on average (-4147 €), which means that the substitution effect dominates. One explanation could be that as the utility function is concave, as the income effect should become negligible as households become richer, and the higher the number of children the higher the income at which the treatment takes place. This can be confirmed by the fact that the effect is increasing from one to three children, and is decreasing afterward. The behavioral reactions are large compared to the change in income tax. The fact that for households of 3 children in treatment 2, that face a loss of 1672 euros in disposable income, leads to an average increase of 3996 euros in taxable income is quite puzzling and seems too large.

The introduction of the age controls leaves nearly unchanged the effect of the treatments, the trend due to position in the income distribution are 4% smaller, but it changes the variables that captures the trends associated with the number of children, , the constant is increasing from 6381 euros to 16642 euros. [22]

22. To make the argumentation clearer, only the age of the oldest parent is taken intoo account, but the effect of introducing the age of both parents in the regression has very similar effect as there is a strong correlation between the age of spouses.

The effect in the position of the income distribution moves only slightly with the parameters being 4% lower on average suggesting that the variation in income due to a specific position of the income distribution is more linked with a skill level than age characteristics and reinforce my feeling that the triple-diffrence specification captures correctly the change in the distribution bias. The rest of the variation can be explained by a simple composition effect. Older workers earn more but have their income increasing at a slower rate. The reference group earning less than 58291 euros being younger, the age variable is capturing the heterogeneous composition.

As the parents get older the change in income over the 2011-2014 period decreases, one additional year implies a negative growth of 206 euros. The effect of the number of children is smaller, families with two children has an average increase of 2662 euros when the effect of age is not take into account. It decreases down to 567 euros when taking the age into account, which represent a decrease of 79%. Not surprisingly it reveals a link between the age and the family composition.

The fact that the effects of the treatments are very stable while other variables changes across specification are reassuring about the fact that the trend captured is specific the group treated. The treatments are very stable across many other specifications shown in section A.1 including dummies for localities (communes), houses characteristics such as living floor space, age of the house, and so on.

Two things can temperate such a large effect. First, the change in income is the before-tax income, and since these households face a MTR of 30%, the variation in disposable income is thus 70% of the income variation reported in Tableau 7.7. [23] Such an average behavioral reaction is still too big to be believable. Indeed the fact that a lump sum decrease in disposable income implies an increase in disposable income greater than the loss due to the tax would implies that the cost of effort is concave, which deviate from classical assumptions made in the literature but also empirical evidences.

Another fact that can explain so big behavioral reaction could be that households react on the extensive margin since I observe top decile households and that assortative matching is strong, the reaction of a potential secondary earner starting to work full time could explain such big behavioral reactions.

Controlling for the age of the oldest parent, while it reduces considerably the impact of having children on the change of taxable income between 2011 and 2014, it does not seem

23. Applying a the 30% marginal tax rate implies a lump sum loss of 1672 euros in tax leads to an increase of $3996 \times 0.7 = 2797$ euros on average.

to have a significant impact on the behavioral assessment of the reaction to the reform. Curiously enough, I see that this effect is much smaller for young households than for old ones. Older households thus mainly drive the behavioral reaction. This is surprising as the literature usually claim that prime age males are the most elastic taxpayers, and thus the one that should react the most.

By sex and type of income The empirical literature has concluded that as independent have more flexible income than wage owner, and that women have a bigger behavioral reaction than men. To test that result for France, I run the same OLS triple-difference estimator, by taking as the change in wage income or sel-employed income as the dependent variable. I run this estimation for men and women separately. The population used for the estimation is the population that has a non-null income of interest in 2011 or in 2014. For a matter of concision, I only report the parameters of interest. Complete tables can be found in the appendix.

TABLE 7.8 – Triple-dff by income and sex

	Wage income father	Wage income mother	sel-employed income father (BNCI)	sel-employed income mother (BNCI)
$Over_1 \times Child_1$	2713***	1425***	149	−86
$Over_2 \times Child_2$	5576***	1599***	563**	313*
$Over_3 \times Child_3$	4725***	150	805	848*
$Over_4 \times Child_4$	2289	3997**	464	1739*
$Over_5 \times Child_5$	−10499	−2363	5321	3921*
$Between1 \times Child_1$	1563***	803.12**	−91	−85
$Between2 \times Child_2$	2439***	1282***	107	−247*
$Between3 \times Child_3$	4783***	1888***	626	152
$Between4 \times Child_4$	−2525	552.13	687	69
$Between5 \times Child_5$	24230**	523.83	3909	−2126
Age oldest parent	−12262.07***	−3541.92***	1375***	115
Age oldest parent squared	100.98***	27.91***	−12***	−1
adjusted-R2	5.39	3.74	1.06	0.47
N	60283	60283	60283	60283

The first column of Tableau 7.8 represent the change in wage income for women that had a wage income either in 2011 or in 2014. Surprisingly I see that women have smaller reactions than man (second column of the table). This can be due to the fact that their wage is smaller, but it is quite unexpected for one that would expect that women react on the extensive margin. Treated households that are between the two ceiling, the income effect still dominates for both men and women, even if it is not significant for men at 4,

and 5 children.

When looking at income derived by sel-employement, the behavioral reaction is small and less significant (but the sample size is smaller). I do not observe a consistent effect for households between the two thresholds and parameters are mostly positive. This seems to indicate that self-employed workers that are supposed to be the ablest to do income shifting do not do so as I would have expected negative parameters for all treated households.

This shows two interesting things, first, that man reacts more than women, second that wage earner reacted in larger magnitude than sel-employed.

To that point the analysis is puzzling, I observe too large to be true aggregated reactions due to variation in mean wage, one explanation for such large behavioral reaction would be a large behavioral reaction by entering the labor market.

7.4.1 Behavioral reactions on the extensive margin :

TABLE 7.9 – Extensive margins

	Father start working	Mother start working	Father stop working	Mother stop working
$Over_1 \times Child_1$	0.0032**	0.0058***	-0.0256***	0.0001
$Over_2 \times Child_2$	0.0086***	0.0010	-0.0480***	0.0007
$Over_3 \times Child_3$	0.0064***	-0.0147***	-0.0519***	0.0057
$Over_4 \times Child_4$	0.0017	-0.0206**	-0.0602***	0.0140
$Between_1 \times Child_1$	0.0013	0.0085***	-0.0093	0.0011
$Between_2 \times Child_2$	0.0065***	0.0040**	-0.0113**	0.0047
$Between_3 \times Child_3$	0.0047***	-0.0054*	-0.0286***	-0.0032
$Between_4 \times Child_4$	0.0017	-0.0168**	-0.0382***	-0.0017
$Child_1$	-0.0019	-0.0011	0.0808***	-0.0052*
$Child_2$	-0.0053***	0.0064***	0.0629***	-0.0189***
$Child_3$	-0.0020	0.0250***	0.0529***	-0.0257***
$Child_4$	0.0030	0.0462***	0.0388***	-0.0264***
Taxable income $\in [58291, 63233]$	-0.0090***	-0.0140***	0.0209***	0.0085***
Taxable income $\in [63233, 63530]$	-0.0067**	-0.0137***	0.0312***	0.0165**
Taxable income $\in [63530, 73516]$	-0.0120***	-0.0153***	0.0374***	0.0071***
Taxable income $\in [73516, 73806]$	-0.0147***	-0.0166***	0.0604***	0.0071
Taxable income $\in [73806, 84103]$	-0.0128***	-0.0126***	0.0684***	0.0092***
Taxable income $\in [84103, 94368]$	-0.0118***	-0.0101***	0.0838***	0.0108***
Taxable income $\in [94368, 94451]$	-0.0182***	-0.0248***	0.0869**	-0.0314
Taxable income $\in [94451, 104633]$	-0.0135***	-0.0044**	0.0947***	0.0012
Taxable income $\in [104633, 115185]$	-0.0151***	-0.0065***	0.1084***	0.0064
Taxable income $\in [115185, 135941]$	-0.0144***	-0.0074***	0.1185***	0.0091**
Taxable income $\in [135941, 150684]$	-0.0147***	-0.0057**	0.1406***	0.0067
Taxable income over 150684 euros	-0.0170***	-0.0052**	0.1605***	0.0125**
Intercept	0.0877***	0.1316***	-1.1587***	-0.0323**
Age_wo	0.0012***	-0.0058***	0.0063***	0.0070***
Age_me	-0.0046***	0.0012**	0.0959***	0.0002
I(Age_wo_squared / 10 ** 4)	-0.1025***	0.5614***	-1.1955***	-0.9674***
I(Age_me_squared / 10 ** 4)	0.5090***	-0.1009**	-11.8298***	-0.0203
I(Age_Elder_child / 10 ** 4)	0.9410**	-1.4765**	-0.9211	-13.8524***
adjusted-R2	0.54%	0.94%	26.85%	0.44%
N	192640	192640	192640	192640

Tableau 7.9 shows for a linear probability model, that being treated increases the probability for men to start working, while the effect is mixed for women depending on the child rank. Although the probability that men stop working (without getting retired) while treated by the reform is negative. A father of three children in the treatment 2 is 5.19% less likely to stop to work if impacted by the reform. Surprisingly and contrasting with the rest of the literature, being impacted by the tax reform has no impact on the probability that a mother stop to work.

It shows that men reacting to the reform by keeping their job more often. While I could have expected that women concerned by treatment 1 reacted on the extensive margin by stopping to work, it is not what I observe.

Building on the fact that older households react more than younger household, I test another extensive margin : the retirement margin.

TABLE 7.10 – Change in Retirement Income and probability to get retired

	OLS men	OLS women	LPM men	LPM women
$Over_1 \times Child_1$	-1787^{***}	-414.33^{***}	-0.0196^{***}	-0.0092^{***}
$Over_2 \times Child_2$	-3165^{***}	-550.43^{***}	-0.0290^{***}	-0.0090^{***}
$Over_3 \times Child_3$	-2734^{***}	-283.27	-0.0256^{***}	-0.0065^{**}
$Over_4 \times Child_4$	-2230^{**}	-347.90	-0.0239^{***}	-0.0019
$Between1 \times Child_1$	-492^{*}	118.89	-0.0016	-0.0012
$Between2 \times Child_2$	-1773^{***}	-316.72^{**}	-0.0214^{***}	-0.0067^{***}
$Between3 \times Child_3$	-2176^{***}	-390.09^{**}	-0.0258^{***}	-0.0096^{***}
$Between4 \times Child_4$	-1720^{**}	-404.94	-0.0256^{***}	-0.0067^{*}
Age controls	x	x	x	x
Adjusted R^2 in %	4.9	7.9	11.72	9.43

Tableau 7.10 gives the variation of retirement income for women and men, I see that a large part of the total effect of the reform is due to changes in retirement income which decreases. Moreover, the linear probability model shows that the probability to get retired either for men of women is lower for households treated by the reform. The effect is stronger as the magnitude of the fiscal loss increases.

I can conclude that the reform had a positive impact on income mainly because men nearing retirement chose to stay on the labor market to cope with the effect of the reform. The difference between men and women in behavioral reaction could be because men are 3 years older on average, they are more likely to be able to choose to delay their retirement decision.

7.5 Conclusion

I analyzed a fiscal reform that happened between 2011 and 2014 for which I were able to measure the pure income effect of the top decile, and to which extent the income effect or the substitution effect dominates.

As the literature usually consider only uncompensated elasticity assuming that there is no income effect, several articles show that income effect does exist and may be quite substantial. Research that looks at lottery winners shows consistently the existence of income effect in multiple countries, Imbens et al. (2001) shows that the effect is stronger for individuals close to the standard retirement age, which is consistent with the income effect I find. Kindermann et al. (2018) calibrate an increase in inheritance taxation based on the lottery literature results and they show that an increase in inheritance taxation would increase tax revenues by more than the mechanical effect due to heir working more to compensate for the loss in expected income. This is similar to the effect that I observe; by increasing the tax on households they increase their labor supply either because the increase is a change in MTR or when it is a lump sum increase. What is interesting here is that it concerns households in the last decile of the income distribution which could be expected to be less subject to the income effect than the bottom of the distribution. Moreover, as the tax is progressive, households of the last decile pay most of the French income tax. It is likely that the government could increase its tax revenue as in Kindermann et al. (2018) by increasing the income tax through a mechanical effect, but also through a behavioral effect. With that regards, the equity-efficiency tradeoff might not be a tradeoff anymore.

I also show that women react less than men to the tax reform. [24] This is quite unexpected as the taxation and labor economic literature usually shows that only women react, and they react on the extensive margin. Several facts could explain why it is no so here. First, Blau and Kahn (2007) and Heim (2007) show there is a trend for elasticities of women to decrease in the US and converges to the ones of men (which is usually close to zero). It is possible that France has the same trend that happened and that it is stronger for the top of the income distribution. Second, a large part of the effect is driven by households reacting on the retirement extensive margin. Pedrant (2018) study French couples joint retirement decisions of couples with a collective model framework and shows that men are taking the burden of unexpected change in income. If it is so that men are absorbing

24. An estimation ran on couples that are under 40 years old show no behavioral reaction of women, while men react very little

more income shocks than women it would make sense to see men react more than women. Moreover, Sicsic (2018) also finds smaller elasticities for women than for men in France over the period 2006-2015.

An original contribution to this article is also to try to evaluate the precision of the assessment of the reform.

These effects would thus not be useful to determine an optimal tax policy in the long run and would correspond to short-run behavioral reactions. A way to test such a fact would be to do an analysis in cross-section instead of using the panel dimension of the dataset. However, this gives pieces of information on a relatively unexplored field of the tax literature of older workers tax responsiveness. Indeed, Alpert and Powell (2013) find large elasticities for older workers on the extensive margin with a positive income effect. Such findings have not been followed by many studies on a subject and could have broader implications on evaluating changes in the retirement pension scheme if there exist interactions with the income tax scheme.

A.1 Alternative specifications

	Only treatment	Treatmt_var_w_child_var	Treatment_var_w_income_thrsh_var	Triple_diff	Triple_diff_w_child_only	Tripl_age_parents	Triple_age	Triple_control_local	Triple_countrol_housing	Triple_control_local_dep	Triple_no_othr_income	Triple $\Delta y > 0$	Triple $\Delta y < 0$
Over_1_X_1_child[T.True]	-3389.23***	-4952.11***	2953.23***	2292.83***	-772.31***	2422.92***	2429.31***	2460.59***	2416.68***	2372.25***	2377.17***	595.97**	1272.42***
	(163.90)	(186.10)	(203.04)	(232.70)	(290.44)	(232.00)	(232.01)	(231.88)	(232.27)	(232.04)	(310.12)	(262.88)	(383.16)
Over_2_X_2_child[T.True]	-986.05***	-2423.35***	6260.48***	4314.50***	962.87***	4317.02***	4300.71***	4322.09***	4272.98***	4133.43***	4442.20***	1886.52***	624.73
	(139.33)	(143.62)	(222.86)	(237.59)	(356.05)	(236.45)	(236.44)	(236.41)	(236.60)	(236.35)	(355.99)	(298.39)	(394.83)
Over_3_X_3_child[T.True]	599.51*	-1438.33***	7766.49***	3996.62***	949.88**	3904.08***	3866.70***	3838.07***	3748.40***	3559.68***	3467.60***	935.30*	-1178.63*
	(314.88)	(324.34)	(388.57)	(399.75)	(481.87)	(398.79)	(398.94)	(398.95)	(398.99)	(398.53)	(647.36)	(529.75)	(698.34)
Over_4_X_4_child[T.True]	1464.34	-1637.15	8738.61***	3120.05***	532.95	3029.54***	3028.25***	3004.94***	2891.17***	2705.92***	416.68	-1789.80	-3485.37*
	(987.46)	(1016.26)	(1028.33)	(1054.45)	(1086.45)	(1052.39)	(1053.31)	(1051.53)	(1050.30)	(1050.22)	(1807.96)	(1507.56)	(1927.17)
Over_5_X_5_child[T.True]	4430.19	729.05	11961.57***	5174.49	3063.37	4835.13	4865.81	4764.39	5100.01	5033.21	-4217.48	-7831.69	-2304.41
	(3888.23)	(3947.93)	(3896.92)	(3955.09)	(3961.72)	(3955.97)	(3953.59)	(3913.77)	(3953.83)	(3923.64)	(7195.10)	(5802.81)	(4310.23)
Over_6_X_6_child[T.True]	-1.30	-4677.39	8173.92	-198.49	-1700.65	-727.41	-604.79	-847.64	-1118.43	-1068.10	-9909.33	12244.27***	-25752.38***
	(13707.07)	(13777.08)	(13716.11)	(13784.48)	(13787.77)	(13765.45)	(13731.98)	(13806.69)	(13651.01)	(13568.30)	(24459.81)	(3672.75)	(875.21)
Between_1_X_1_child[T.True]	-3214.53***	-4777.40***	144.02	621.81**	-271.70	626.09**	627.49**	636.42**	614.27**	599.53**	238.44	126.78	695.31*
	(215.98)	(233.28)	(233.74)	(255.94)	(262.36)	(255.28)	(255.05)	(254.73)	(255.68)	(255.41)	(298.43)	(272.08)	(403.25)
Between_2_X_2_child[T.True]	-1680.61***	-3117.92***	3288.60***	2487.83***	225.91	2473.23***	2471.83***	2472.00***	2478.17***	2441.96***	2927.02***	1457.34***	396.17
	(130.58)	(135.14)	(183.35)	(197.85)	(246.29)	(197.20)	(197.15)	(197.10)	(197.48)	(197.08)	(255.74)	(227.19)	(329.38)
Between_3_X_3_child[T.True]	477.89**	-1559.94***	7845.43***	4234.29***	1453.84***	4193.74***	4165.46***	4122.14***	4030.32***	3908.92***	3996.09***	1747.00***	-591.33
	(239.89)	(252.18)	(302.12)	(316.23)	(403.21)	(315.51)	(315.47)	(315.18)	(315.40)	(315.03)	(445.07)	(380.75)	(541.95)
Between_4_X_4_child[T.True]	1041.09	-2060.40***	8361.99***	2780.14***	28.38	2688.63***	2631.27***	2588.11***	2572.11***	2465.29***	171.14	-1306.13	-1160.62
	(688.15)	(728.87)	(718.36)	(754.96)	(790.90)	(752.94)	(754.21)	(753.47)	(754.33)	(754.52)	(1146.58)	(959.02)	(1373.10)
Between_5_X_5_child[T.True]	-4420.06**	-8121.20***	2641.40	-4147.12*	-6685.45***	-4265.55*	-4207.59*	-4543.61**	-4517.74**	-4642.18**	-11294.10**	-6203.39*	-4429.10
	(2075.34)	(2185.06)	(2088.49)	(2194.87)	(2206.40)	(2193.33)	(2193.46)	(2184.36)	(2172.62)	(2181.67)	(4442.52)	(3347.44)	(4500.83)
Between_6_X_6_child[T.True]	-7911.55*	-12587.63***	-1058.74	-9431.32**	-11624.12**	-9718.80**	-9733.74**	-9786.13**	-10093.97**	-9914.62**	-7623.90	9116.62**	-28295.77***
	(4565.00)	(4770.54)	(4564.87)	(4765.82)	(4769.40)	(4846.61)	(4818.36)	(4756.52)	(4874.64)	(4887.58)	(13973.82)	(4173.10)	(7774.08)
Flatten_thresholds_104633_115185[T.True]			-9157.98***	-7523.49***	-3777.70***	-6934.17***	-6937.51***	-7260.27***	-7513.43***	-8088.93***	-5980.52***	6188.80***	-11821.68***
			(363.44)	(367.74)	(479.56)	(366.84)	(366.77)	(367.23)	(367.76)	(368.99)	(621.11)	(497.63)	(644.87)
Flatten_thresholds_115185_135941[T.True]			-9099.23***	-7466.62***	-3731.01***	-6817.63***	-6832.77***	-7260.44***	-7544.35***	-8227.40***	-5815.00***	7816.68***	-11827.81***
			(357.50)	(361.85)	(476.94)	(360.66)	(360.58)	(361.72)	(362.40)	(364.09)	(623.15)	(526.11)	(608.34)
Flatten_thresholds_135941_150684[T.True]			-8072.70***	-6456.94***	-2557.07***	-5770.78***	-5785.53***	-6241.93***	-6573.56***	-7283.45***	-5407.50***	9502.48***	-12968.81***
			(534.97)	(537.63)	(641.13)	(536.24)	(536.14)	(536.78)	(537.10)	(537.54)	(997.28)	(844.74)	(958.51)
Flatten_thresholds_58291_63233[T.True]			-5336.14***	-5399.22***	-4505.71***	-5158.23***	-5161.95***	-5202.98***	-5258.79***	-5405.99***	-3377.73***	-1119.59***	-1686.44***
			(105.02)	(105.28)	(120.05)	(105.29)	(105.29)	(105.36)	(105.85)	(106.02)	(122.15)	(107.22)	(174.99)
Flatten_thresholds_63233_63530[T.True]			-5833.21***	-5806.61***	-4671.18***	-5560.79***	-5577.65***	-5608.47***	-5672.23***	-5871.44***	-4110.38***	-1432.28***	-1237.54***
			(389.07)	(382.53)	(435.82)	(381.72)	(381.53)	(381.33)	(381.76)	(380.91)	(420.57)	(377.84)	(475.98)
Flatten_thresholds_63530_73516[T.True]			-6946.81***	-6564.94***	-4142.69***	-6257.34***	-6266.15***	-6356.29***	-6464.73***	-6706.92***	-4877.19***	-405.74**	-3662.39***
			(140.03)	(146.22)	(207.37)	(145.85)	(145.80)	(145.96)	(146.44)	(146.71)	(201.91)	(179.95)	(242.88)
Flatten_thresholds_73516_73806[T.True]			-8521.52***	-7736.87***	-4816.01***	-7371.03***	-7388.66***	-7504.45***	-7561.64***	-7853.27***	-6012.01***	-36.51	-4314.68***
			(641.66)	(634.84)	(722.48)	(630.52)	(630.00)	(629.62)	(624.76)	(623.57)	(791.66)	(718.20)	(939.57)
Flatten_thresholds_73806_84103[T.True]			-9096.58***	-7683.04***	-4439.60***	-7295.47***	-7295.84***	-7450.51***	-7577.15***	-7908.41***	-6093.05***	784.59***	-5976.63***
			(203.26)	(210.34)	(338.57)	(209.44)	(209.38)	(209.70)	(209.95)	(210.43)	(316.12)	(269.67)	(344.73)
Flatten_thresholds_84103_94368[T.True]			-9709.69***	-8164.76***	-4546.02***	-7704.38***	-7704.79***	-7924.87***	-8118.67***	-8564.36***	-6131.71***	2383.38***	-8252.37***
			(245.30)	(251.56)	(376.67)	(250.47)	(250.38)	(250.91)	(251.44)	(252.36)	(382.30)	(315.72)	(433.31)
Flatten_thresholds_94368_94451[T.True]			-9851.21***	-8325.28***	-5803.28***	-7912.76***	-7940.60***	-8151.58***	-8387.66***	-8755.70***	-5387.70*	2921.66	-6228.21**
			(1865.07)	(1868.30)	(2093.32)	(1847.77)	(1847.85)	(1844.47)	(1828.72)	(1845.95)	(2863.76)	(2049.30)	(2970.13)
Flatten_thresholds_94451_104633[T.True]			-8902.85***	-7289.21***	-3469.19***	-6778.84***	-6779.43***	-7045.56***	-7302.51***	-7837.31***	-5998.52***	3750.55***	-9688.88***
			(299.62)	(304.50)	(422.90)	(303.05)	(302.99)	(303.67)	(304.25)	(305.50)	(480.97)	(397.99)	(524.51)
Flatten_thresholds_more_then_150684			-10152.82***	-8524.53***	-5431.11***	-7827.61***	-7832.30***	-8471.54***	-8845.14***	-9654.07***	-6135.83***	12358.62***	-15187.22***
			(489.25)	(492.74)	(605.76)	(492.52)	(492.58)	(494.69)	(495.25)	(496.36)	(981.99)	(808.91)	(844.94)
Intercept	6647.34***	3114.95***	8624.94***	6381.12***	8210.22***	16514.36***	15681.85***	15071.09***	14581.91***	12635.56***	14645.73***	33507.36***	-28649.44***
	(37.81)	(79.28)	(40.15)	(83.26)	(95.92)	(927.29)	(962.70)	(971.66)	(1100.92)	(1157.97)	(1222.73)	(1066.93)	(2079.96)
child_1		5095.27***		1829.10***		261.82*	506.64***	448.89***	435.52***	332.97**	-63.65	-1083.99***	1311.42***
		(124.43)		(127.01)		(144.68)	(154.47)	(154.42)	(154.86)	(155.04)	(178.23)	(158.66)	(267.82)
child_2		4969.70***		2662.71***	673.29***	480.99***	1085.98***	917.31***	871.55***	751.01***	-112.33	-1867.36***	3083.11***
		(94.48)		(95.21)	(110.38)	(128.78)	(151.13)	(152.23)	(152.68)	(152.73)	(181.96)	(158.84)	(269.85)
child_3		5570.23***		4388.28***	1947.29***	2308.96***	3220.32***	2869.99***	2819.11***	2664.22***	2213.87***	-763.10***	4950.92***
		(117.31)		(114.56)	(134.55)	(144.77)	(180.45)	(182.50)	(182.99)	(183.31)	(224.04)	(196.33)	(327.84)
child_4		6633.89***		6234.57***	3441.44***	4235.92***	5331.24***	4771.26***	4650.07***	4348.42***	6853.97***	2173.96***	6549.69***
		(255.73)		(251.00)	(264.81)	(266.06)	(296.70)	(298.47)	(299.03)	(299.00)	(504.99)	(484.16)	(651.77)
child_5		7233.54***		7406.48***	4345.47***	5520.99***	6782.30***	6039.10***	5762.08***	5336.85***	13111.00***	7164.88***	5995.69**
		(689.22)		(683.37)	(687.41)	(686.31)	(703.53)	(703.56)	(707.43)	(707.95)	(2250.60)	(2021.37)	(2786.50)
child_6		8208.48***		8987.94***	5567.58***	7040.73***	8438.46***	7518.04***	7322.09***	6899.55***	7843.50***	-1631.06	13892.20***
		(1387.78)		(1373.81)	(1372.81)	(1385.20)	(1396.30)	(1401.27)	(1412.75)	(1408.99)	(2634.93)	(3601.30)	(622.14)
Age_Elder_child							-121.70***	-120.43***	-118.72***	-115.68***	-61.54***	29.37	-26.88
							(17.52)	(17.50)	(17.51)	(17.44)	(23.06)	(19.68)	(32.99)
Age_Youngest_child							81.40***	77.38***	76.42***	75.25***	37.03	-64.11***	18.87
							(18.03)	(18.00)	(18.01)	(17.95)	(23.49)	(20.02)	(34.62)	
Age_me						-103.75**	-78.43*	-72.65	-59.94	-42.90	-118.65**	-607.48***	601.36***
						(46.34)	(46.72)	(46.73)	(46.90)	(47.05)	(57.40)	(50.51)	(94.58)
Age_me_squared						0.06	-0.21	-0.32	-0.44	-0.61	0.33	6.28***	-6.32***
						(0.51)	(0.51)	(0.51)	(0.51)	(0.52)	(0.63)	(0.56)	(1.00)
Age_wo						-101.11**	-84.16**	-76.41*	-75.46*	-64.30	-13.17	-333.23***	319.71***
						(41.69)	(42.02)	(41.98)	(42.15)	(42.10)	(52.21)	(42.97)	(81.87)
Age_wo_squared						0.14	-0.07	-0.21	-0.23	-0.37	-1.02*	3.02***	-3.47***
						(0.48)	(0.48)	(0.48)	(0.48)	(0.48)	(0.60)	(0.50)	(0.89)
House_age								3.68***	3.02***	2.79***			
								(0.94)	(0.95)	(0.97)			
Living floor space								14.33***	16.84***	23.41***			
								(1.02)	(1.05)	(1.11)			
Social_housing[T.True]								109.58	-124.05	-655.50**			
								(260.39)	(263.16)	(266.66)			
Proprietaire[T.True]								-1223.55***	-1038.77***	-702.81***			
								(149.85)	(150.97)	(152.46)			
Code_departement										X			
Code_commune									X	X			
adjusted-R2	0.43%	2.30%	3.66%	4.52%	2.34%	5.21%	5.25%	5.43%	5.55%	5.85%	4.38%	7.26%	18.12%
N	193555	193555	193555	193555	149604	193555	193555	193480	193480	193480	87773	69144	18629

A.2 Common trend assumption and income dynamic

The results of any difference-in-differences is conditional to having the same trend in the treated group and the control group. Sadly this is not the case as shown in Tableau 11 it is not the case and the common trend assumption is not respected at all. Tableau 11 endogenous variable is the variation in taxable income between 2010 and 2011 for the group that were between or over the before and after reform thresholds in 2011. As the Tableau 7.7 is ran over 3 years (between 2011 to 2014) the coefficients of Tableau 11 must be multiplied by 3 in order to be compared to Tableau 7.7.

TABLE 11 – Placebo : Change in taxable income between 2010 and 2011

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
child_1 :Over_threshold_1_child[T.True]	1013.7136	291.3228	3.4797	0.0005	442.7313	1584.6959
child_2 :Over_threshold_2_child[T.True]	2003.7273	346.2298	5.7873	0.0000	1325.1295	2682.3252
child_3 :Over_threshold_3_child[T.True]	1074.8791	510.1980	2.1068	0.0351	74.9093	2074.8488
child_4 :Over_threshold_4_child[T.True]	1312.4529	1378.3050	0.9522	0.3410	-1388.9752	4013.8810
child_5 :Over_threshold_5_child[T.True]	4303.2466	5118.3928	0.8407	0.4005	-5728.6190	14335.1122
child_6 :Over_threshold_6_child[T.True]	-15548.6533	2368.2153	-6.5656	0.0000	-20190.2699	-10907.0366
child_1 :Between_threshold_1_child[T.True]	-418.8438	264.3425	-1.5845	0.1131	-936.9455	99.2580
child_2 :Between_threshold_2_child[T.True]	576.4065	198.9304	2.8975	0.0038	186.5101	966.3030
child_3 :Between_threshold_3_child[T.True]	1308.1298	372.5270	3.5115	0.0004	577.9903	2038.2693
child_4 :Between_threshold_4_child[T.True]	2033.9523	1032.1475	1.9706	0.0488	10.9803	4056.9244
child_5 :Between_threshold_5_child[T.True]	582.5841	2211.6896	0.2634	0.7922	-3752.2479	4917.4160
child_6 :Between_threshold_6_child[T.True]	10807.8874	6803.4378	1.5886	0.1122	-2526.6056	24142.3804
child_1	-761.4231	164.7657	-4.6212	0.0000	-1084.3579	-438.4883
child_2	-885.6099	177.5007	-4.9893	0.0000	-1233.5048	-537.7150
child_4	-853.3973	495.7822	-1.7213	0.0852	-1825.1126	118.3180
child_3	-603.9164	195.7742	-3.0848	0.0020	-987.6267	-220.2060
child_5	326.5476	486.3644	0.6714	0.5020	-626.7090	1279.8042
child_6	355.2790	2212.2645	0.1606	0.8724	-3980.6798	4691.2378
Flatten_thresholds_58291_63233[T.True]	1805.9904	101.9668	17.7116	0.0000	1606.1391	2005.8416
Flatten_thresholds_63233_63530[T.True]	1768.9434	372.3513	4.7507	0.0000	1039.1482	2498.7386
Flatten_thresholds_63530_73516[T.True]	1821.6234	162.5337	11.2077	0.0000	1503.0632	2140.1835
Flatten_thresholds_73516_73806[T.True]	967.4151	543.6417	1.7795	0.0752	-98.1031	2032.9332
Flatten_thresholds_73806_84103[T.True]	1877.6617	309.7642	6.0616	0.0000	1270.5350	2484.7884
Flatten_thresholds_84103_94368[T.True]	2664.5254	354.4948	7.5164	0.0000	1969.7283	3359.3225
Flatten_thresholds_94368_94451[T.True]	3890.5815	1375.0332	2.8294	0.0047	1195.5660	6585.5970
Flatten_thresholds_94451_104633[T.True]	3887.9329	381.3415	10.1954	0.0000	3140.5172	4635.3485
Flatten_thresholds_104633_115185[T.True]	5406.4239	429.0085	12.6021	0.0000	4565.5827	6247.2651
Flatten_thresholds_115185_135941[T.True]	6567.8691	610.7410	10.7539	0.0000	5370.8387	7764.8994
Flatten_thresholds_135941_150684[T.True]	8134.5162	781.1546	10.4135	0.0000	6603.4813	9665.5511
Flatten_thresholds_more_then_150684	10870.8475	822.5024	13.2168	0.0000	9258.7725	12482.9225
Age_wo	-141.5416	47.8843	-2.9559	0.0031	-235.3932	-47.6900
Age_me	12.8352	50.2110	0.2556	0.7982	-85.5766	111.2470
Age_wo_squared	0.3549	0.5572	0.6369	0.5242	-0.7371	1.4469
Age_me_squared	-1.2148	0.5578	-2.1777	0.0294	-2.3082	-0.1215
Age_Elder_child	-8.4385	19.2949	-0.4373	0.6619	-46.2559	29.3789
Age_Youngest_child	23.8394	19.8137	1.2032	0.2289	-14.9948	62.6737
Intercept	8885.6160	1204.9986	7.3740	0.0000	6523.8622	11247.3699

As I am not able to see why there is a common trend due to the interaction of a specific position in the income distribution and a specific number of children, I conclude that the effects on the placebo seems too big to draw any hindsight of the impact of the reform of the lowering of the maximum tax child break ceiling.
It might be possible to see if I can extract hindsight from the income dynamic of the treated group.

TABLE 12 – Triple-diff income dynamic

	Δ2010_2011	Δ2011_2012	Δ2012_2013	Δ2013_2014	sum_delta_rbg_2011_2014	Δ2011_2014	Delta - common trend
child_1 :Between_threshold_1_child[T.True]	-345.73	336.22	487.45	-0.71	822.96	822.96	1860.13
child_2 :Between_threshold_2_child[T.True]	596.24	524.34	855.02	948.67	2328.03	2328.03	539.30
child_3 :Between_threshold_3_child[T.True]	1406.99	1201.89	1125.62	1872.06	4199.57	4199.57	-21.39
child_4 :Between_threshold_4_child[T.True]	2450.07	1404.61	1384.90	180.41	2969.92	2969.92	-4380.29
child_5 :Between_threshold_5_child[T.True]	3102.30	-2213.25	-226.89	-1151.09	-3591.23	-3591.23	-12898.12
child_6 :Between_threshold_6_child[T.True]	11309.54	-9056.82	-2063.65	2340.45	-8780.02	-8780.02	-42708.66
child_1 :Over_threshold_1_child[T.True]	700.16	610.08	741.05	1056.78	2407.91	2407.91	307.43
child_2 :Over_threshold_2_child[T.True]	2247.33	1343.61	862.20	2074.99	4280.80	4280.80	-2461.18
child_3 :Over_threshold_3_child[T.True]	1408.91	2137.46	742.77	1268.34	4148.57	4148.57	-78.15
child_4 :Over_threshold_4_child[T.True]	1952.02	1991.49	-305.29	1446.08	3132.28	3132.28	-2723.78
child_5 :Over_threshold_5_child[T.True]	3380.27	3458.37	5491.63	-4752.35	4197.65	4197.65	-5943.15
child_6 :Over_threshold_6_child[T.True]	13285.67	-23328.78	23431.79	-23106.26	-23003.26	-23003.26	-62860.26
Flatten_thresholds_58291_63233[T.True]	1568.13	-1889.56	-1390.36	-1987.60	-5267.52	-5267.52	-9971.90
Flatten_thresholds_63233_63530[T.True]	1752.43	-2400.85	-1620.98	-1855.76	-5877.60	-5877.60	-11134.89
Flatten_thresholds_63530_73516[T.True]	1558.36	-2309.65	-1667.61	-2347.87	-6325.13	-6325.13	-11000.22
Flatten_thresholds_73516_73806[T.True]	724.91	-2990.47	-1846.51	-2949.05	-7786.03	-7786.03	-9960.77
Flatten_thresholds_73806_84103[T.True]	1518.25	-2929.14	-1673.85	-2907.07	-7510.06	-7510.06	-12064.81
Flatten_thresholds_84103_94368[T.True]	2131.44	-3105.64	-1811.44	-3134.73	-8051.82	-8051.82	-14446.15
Flatten_thresholds_94368_94451[T.True]	3821.03	-1629.95	-1720.68	-4277.41	-7628.04	-7628.04	-19091.12
Flatten_thresholds_94451_104633[T.True]	3404.73	-3219.80	-1640.32	-2362.77	-7222.89	-7222.89	-17437.07
Flatten_thresholds_104633_115185[T.True]	5039.77	-3301.09	-1573.51	-2549.85	-7424.45	-7424.45	-22543.76
Flatten_thresholds_115185_135941[T.True]	5537.94	-3860.17	-1346.77	-2328.80	-7535.74	-7535.74	-24149.57
Flatten_thresholds_135941_150684[T.True]	7669.91	-3262.88	-2143.53	-875.76	-6282.18	-6282.18	-29291.92
Flatten_thresholds_more_then_150684	9939.53	-4932.77	-1426.38	-1817.95	-8177.11	-8177.11	-37995.70
child_1	1443.93	562.68	605.43	740.68	1908.79	1908.79	-2422.99
child_2	1962.69	961.19	979.84	895.19	2836.22	2836.22	-3051.85
child_3	2178.43	1401.89	1592.11	1619.58	4613.58	4613.58	-1921.71
child_4	1776.74	1866.71	1861.48	2597.42	6325.60	6325.60	995.39
child_5	2270.77	2359.50	1240.16	4153.05	7752.72	7752.72	940.41
child_6	3111.88	3529.84	2559.65	2537.93	8627.42	8627.42	-708.21
Intercept	-632.30	2072.31	1958.87	2013.81	6 677.29	6 677.29	-8573

A.3 Retirement pension reform

The legal retirement age has been progressively increased from 60 to 62 years old by one quarter every year in 2011. It implies a shift from 40 to 42 contributive years to the pension system to be entitled to a full retirement pension. Thus individuals being born after 1951 up to 1959 (aged between 60 to 52 years old in 2011) face an increase in their legal retirement age of one quarter every year, and individuals born after 1959 face increase of two year of their retirement age. The reform has been implemented progressively base on the date of birth. As I cannot observe the numbers of years of work over a citizen career, I use the date of birth as a proxy in order to control a potential polution of the retirement pension system in the estimation. Do do so I use each birth date as a dummy to capture the effect of being born a particular year.

TABLE 13 – Triple-diff with age as binary control

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
child_1 :Over_threshold_1_child[T.True]	2243.1657	231.6777	9.6823	0.0000	1789.0858	2697.2456
child_2 :Over_threshold_2_child[T.True]	3973.8246	236.4942	16.8031	0.0000	3510.3045	4437.3447
child_3 :Over_threshold_3_child[T.True]	3473.0517	399.0729	8.7028	0.0000	2690.8832	4255.2202
child_4 :Over_threshold_4_child[T.True]	2640.2053	1052.0227	2.5096	0.0121	578.2786	4702.1320
child_5 :Over_threshold_5_child[T.True]	4547.3686	3921.6337	1.1596	0.2462	-3138.8922	12233.6295
child_6 :Over_threshold_6_child[T.True]	-766.0383	13918.7543	-0.0550	0.9561	-28046.2955	26514.2190
child_1 :Between_threshold_1_child[T.True]	618.9482	254.3004	2.4339	0.0149	120.5286	1117.3677
child_2 :Between_threshold_2_child[T.True]	2297.4942	197.0133	11.6616	0.0000	1911.3552	2683.6333
child_3 :Between_threshold_3_child[T.True]	3809.5045	315.2478	12.0842	0.0000	3191.6301	4427.3789
child_4 :Between_threshold_4_child[T.True]	2314.2887	753.3694	3.0719	0.0021	837.7117	3790.8657
child_5 :Between_threshold_5_child[T.True]	-4903.4519	2190.3352	-2.2387	0.0252	-9196.4299	-610.4738
child_6 :Between_threshold_6_child[T.True]	-9942.1393	4724.4496	-2.1044	0.0353	-19201.8904	-682.3881
Flatten_thresholds_58291_63233[T.True]	-5190.7402	105.2154	-49.3344	0.0000	-5396.9586	-4984.5217
Flatten_thresholds_63233_63530[T.True]	-5571.4843	381.5813	-14.6010	0.0000	-6319.3700	-4823.5987
Flatten_thresholds_63530_73516[T.True]	-6241.5960	145.5886	-42.8715	0.0000	-6526.9443	-5956.2477
Flatten_thresholds_73516_73806[T.True]	-7407.0879	627.8722	-11.7971	0.0000	-8637.6947	-6176.4810
Flatten_thresholds_73806_84103[T.True]	-7225.4272	209.2301	-34.5334	0.0000	-7635.5107	-6815.3438
Flatten_thresholds_84103_94368[T.True]	-7696.6296	250.4800	-30.7275	0.0000	-8187.5614	-7205.6978
Flatten_thresholds_94368_94451[T.True]	-7887.1417	1850.3264	-4.2626	0.0000	-11513.7149	-4260.5685
Flatten_thresholds_94451_104633[T.True]	-6815.9814	303.0218	-22.4934	0.0000	-7409.8932	-6222.0695
Flatten_thresholds_104633_115185[T.True]	-7011.4571	366.8651	-19.1118	0.0000	-7730.4995	-6292.4146
Flatten_thresholds_115185_135941[T.True]	-7046.4945	361.4348	-19.4959	0.0000	-7754.8936	-6338.0954
Flatten_thresholds_135941_150684[T.True]	-6065.0892	536.6178	-11.3024	0.0000	-7116.8408	-5013.3377
Flatten_thresholds_more_then_150684	-8251.9731	494.6747	-16.6816	0.0000	-9221.5178	-7282.4285
child_1	464.6482	156.3648	2.9716	0.0030	158.1789	771.1175
child_2	1098.7501	155.5636	7.0630	0.0000	793.8510	1403.6492
child_3	2866.5910	185.3396	15.4667	0.0000	2503.3320	3229.8501
child_4	4601.1786	300.6287	15.3052	0.0000	4011.9571	5190.4000
child_5	5733.1544	705.6158	8.1250	0.0000	4350.1728	7116.1360
child_6	7006.8130	1391.9004	5.0340	0.0000	4278.7384	9734.8876
C(Age_wo)[T.50.0]	542.6539	236.8836	2.2908	0.0220	78.3707	1006.9371
C(Age_wo)[T.51.0]	1133.1939	251.8190	4.5000	0.0000	639.6376	1626.7501
C(Age_wo)[T.52.0]	1020.2100	260.6817	3.9136	0.0001	509.2833	1531.1367
C(Age_wo)[T.53.0]	1469.8300	291.2241	5.0471	0.0000	899.0412	2040.6189
C(Age_wo)[T.54.0]	695.5606	333.5230	2.0855	0.0370	41.8675	1349.2536
C(Age_wo)[T.55.0]	1100.0672	379.2515	2.9006	0.0037	356.7479	1843.3864
C(Age_wo)[T.56.0]	1067.4572	430.2747	2.4809	0.0131	224.1343	1910.7802
C(Age_wo)[T.57.0]	1815.4634	480.7970	3.7759	0.0002	873.1186	2757.8082
C(Age_wo)[T.58.0]	1987.2349	540.2914	3.6781	0.0002	928.2832	3046.1866
C(Age_wo)[T.59.0]	1321.9794	602.8238	2.1930	0.0283	140.4663	2503.4924
C(Age_wo)[T.60.0]	-695.5008	656.3893	-1.0596	0.2893	-1982.0003	590.9986
C(Age_wo)[T.61.0]	1373.5815	717.5480	1.9143	0.0556	-32.7867	2779.9497
C(Age_wo)[T.62.0]	2514.0143	777.7267	3.2325	0.0012	989.6981	4038.3306
C(Age_wo)[T.63.0]	2984.8348	850.5679	3.5092	0.0004	1317.7524	4651.9172
C(Age_wo)[T.64.0]	3469.6938	927.2696	3.7418	0.0002	1652.2789	5287.1088
C(Age_me)[T.50.0]	-160.5817	208.2169	-0.7712	0.4406	-568.6794	247.5159
C(Age_me)[T.51.0]	66.7941	222.2471	0.3005	0.7638	-368.8023	502.3904
C(Age_me)[T.52.0]	378.9331	266.1091	1.4240	0.1545	-142.6311	900.4972
C(Age_me)[T.53.0]	185.6191	337.7049	0.5496	0.5826	-476.2703	847.5086
C(Age_me)[T.54.0]	-113.3918	414.8424	-0.2733	0.7846	-926.4680	699.6844
C(Age_me)[T.55.0]	440.5090	504.2093	0.8737	0.3823	-547.7230	1428.7411
C(Age_me)[T.56.0]	159.2252	596.7438	0.2668	0.7896	-1010.3713	1328.8216
C(Age_me)[T.57.0]	1119.3161	693.0513	1.6151	0.1063	-239.0394	2477.6716
C(Age_me)[T.58.0]	127.0113	799.1201	0.1589	0.8737	-1439.2353	1693.2578
C(Age_me)[T.59.0]	-34.4622	904.5000	-0.0381	0.9696	-1807.2497	1738.3253
C(Age_me)[T.60.0]	-1573.0397	1010.7747	-1.5563	0.1196	-3554.1217	408.0422
C(Age_me)[T.61.0]	-711.6908	1114.2865	-0.6387	0.5230	-2895.6522	1472.2706
C(Age_me)[T.62.0]	1073.4737	1226.6859	0.8751	0.3815	-1330.7864	3477.7338
C(Age_me)[T.63.0]	1617.3854	1338.6283	1.2082	0.2270	-1006.2778	4241.0487
C(Age_me)[T.64.0]	2274.1967	1452.6444	1.5656	0.1175	-572.9340	5121.3273
Age_Elder_child	-53.3198	18.0070	-2.9611	0.0031	-88.6128	-18.0268
Age_Youngest_child	3.0025	18.5842	0.1616	0.8717	-33.4218	39.4268
Intercept	19257.4313	2684.2274	7.1743	0.0000	13996.4423	24518.4203
Number of observations : 77669						
Adj. R-squared : 0.013						

Tableau 13 shows that controlling for age with dummies (which is equivalent to controlling for date of birth) gives estimates that are extremely close to the one provided in the main analysis. I see that to have a particular age for men does not have a significant impact on the change in the household taxable income, while women having a woman that has the age to be impacted by the retirement pension reform shows a positive impact on taxable income which suggest that women reacted on the extensive margin to the reform by delaying their retirement.
But it still leaves the possibility that there exists a trend specific to households touched by both the lowering of the ceilings and the retirement pension reform. To control for that hypothesis I ran a quadruple difference on those most hardly impacted by the reform : those born between 1951 and 1959.

$$
\begin{aligned}
\Delta y_i = \beta_0 &+ \sum_{i=1}^{6} \beta_i \text{Children}_i + \sum_{j=1}^{6} {}_b\delta_j \text{Between}_j + \sum_{j=1}^{6} {}_o\delta_j \text{Over}_j \\
&+ \alpha \text{ Born between 1951 and 1959} \\
&+ \sum_{i=1}^{6} {}_b\zeta_i \text{Children}_i \times \text{Between}_i \times \text{Born between 1951 and 1959} \\
&+ \sum_{i=1}^{6} {}_o\zeta_i \text{Children}_i \times \text{Over}_i \times \text{Born between 1951 and 1959} \\
&+ \sum_{i=1}^{6} {}_b\gamma_i \text{Children}_i \times \text{Between}_i \\
&+ \sum_{i=1}^{6} {}_o\gamma_i \text{Children}_i \times \text{Over}_i \\
&+ \epsilon_i
\end{aligned}
\tag{6}
$$

The estimates ${}_b\gamma_i$ and ${}_o\gamma_i$ does not vary much. The ζ terms are not significant which suggest that there is not a behavioral reaction due to the interaction between the lowering of the child tax break ceiling and the retirement pension reform.

A.4 Both parents working

TABLE 14 – Results : Triple-diff with both parents working

Model :	OLS	Adj. R-squared :	0.013
Dependent Variable :	I(Delta_Rbg)	AIC :	1671774.1863
Date :	2019-05-21 16 :05	BIC :	1672107.5706
No. Observations :	77705	Log-Likelihood :	-8.3585e+05
Df Model :	35	F-statistic :	1288.
Df Residuals :	77669	Prob (F-statistic) :	0.00
R-squared :	0.014	Scale :	1.2909e+08

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
child_1 :Over_threshold_1_child[T.True]	246.8448	271.4298	0.9094	0.3631	-285.1478	778.8374
child_2 :Over_threshold_2_child[T.True]	1387.2756	297.4113	4.6645	0.0000	804.3601	1970.1911
child_3 :Over_threshold_3_child[T.True]	2081.1183	503.2011	4.1358	0.0000	1094.8622	3067.3743
child_4 :Over_threshold_4_child[T.True]	3903.0588	1433.8105	2.7222	0.0065	1092.8418	6713.2758
child_5 :Over_threshold_5_child[T.True]	5047.2409	3528.6668	1.4304	0.1526	-1868.8189	11963.3006
child_6 :Over_threshold_6_child[T.True]	-0.0000	0.0000	-0.0601	0.9521	-0.0000	0.0000
child_1 :Between_threshold_1_child[T.True]	-330.4153	248.6065	-1.3291	0.1838	-817.6751	156.8446
child_2 :Between_threshold_2_child[T.True]	349.6620	217.7322	1.6059	0.1083	-77.0853	776.4093
child_3 :Between_threshold_3_child[T.True]	1997.9937	365.9863	5.4592	0.0000	1280.6737	2715.3137
child_4 :Between_threshold_4_child[T.True]	1680.2392	945.4314	1.7772	0.0755	-172.7722	3533.2506
child_5 :Between_threshold_5_child[T.True]	-1832.2186	3491.6331	-0.5247	0.5998	-8675.6938	5011.2566
child_6 :Between_threshold_6_child[T.True]	-562.1307	6828.9470	-0.0823	0.9344	-13946.6210	12822.3595
Flatten_thresholds_58291_63233[T.True]	-639.1458	106.0119	-6.0290	0.0000	-846.9252	-431.3663
Flatten_thresholds_63233_63530[T.True]	-1152.8044	380.4688	-3.0300	0.0024	-1898.5094	-407.0993
Flatten_thresholds_63530_73516[T.True]	-299.1475	175.1890	-1.7076	0.0877	-642.5117	44.2167
Flatten_thresholds_73516_73806[T.True]	-893.5035	729.9807	-1.2240	0.2209	-2324.2395	537.2325
Flatten_thresholds_73806_84103[T.True]	-325.1272	266.0109	-1.2222	0.2216	-846.4990	196.2445
Flatten_thresholds_84103_94368[T.True]	253.3638	309.4332	0.8188	0.4129	-353.1142	859.8418
Flatten_thresholds_94368_94451[T.True]	1963.0885	1594.1770	1.2314	0.2182	-1161.4409	5087.6180
Flatten_thresholds_94451_104633[T.True]	773.0929	374.5901	2.0638	0.0390	38.9099	1507.2760
Flatten_thresholds_104633_115185[T.True]	874.2987	455.3999	1.9198	0.0549	-18.2686	1766.8660
Flatten_thresholds_115185_135941[T.True]	538.1627	465.7563	1.1555	0.2479	-374.7028	1451.0282
Flatten_thresholds_135941_150684[T.True]	357.7510	699.1873	0.5117	0.6089	-1012.6309	1728.1329
Flatten_thresholds_more_then_150684	-892.1601	667.7760	-1.3360	0.1815	-2200.9770	416.6568
child_1	244.2386	172.1133	1.4191	0.1559	-93.0972	581.5744
child_2	301.4730	174.0273	1.7323	0.0832	-39.6142	642.5602
child_3	1061.4543	211.1551	5.0269	0.0000	647.5980	1475.3106
child_4	1416.1906	358.4432	3.9509	0.0001	713.6548	2118.7264
child_5	3869.5820	1356.6704	2.8523	0.0043	1210.5569	6528.6071
child_6	3596.6017	2655.2763	1.3545	0.1756	-1607.6442	8800.8477
Age_wo	4.9460	77.8095	0.0636	0.9493	-147.5578	157.4499
Age_me	-800.2358	85.8936	-9.3166	0.0000	-968.5842	-631.8874
Intercept	26575.9724	1646.3590	16.1423	0.0000	23349.1680	29802.7768
Age_Elder_child	-41.2613	21.1743	-1.9487	0.0513	-82.7622	0.2396
Age_Youngest_child	10.6676	21.5395	0.4953	0.6204	-31.5491	52.8842

Omnibus :	12060.035	Durbin-Watson :	2.004
Prob(Omnibus) :	0.000	Jarque-Bera (JB) :	99305.082
Skew :	0.508	Prob(JB) :	0.000
Kurtosis :	8.444	Condition No. :	10463403898658132

As shown in Tableau 7.9 and Tableau 7.10 a part of the effect is due to reaction on the extensive margin, Tableau 14 contains only couples where both member of the couple are working before and after the reform. I identify working couples as couples for which both individuals have a labor income greater than 20 000 euros in 2011 and in 2014. I take

such a large threshold to rule out part time to full time extensive behavioral reactions. The estimates of the triple-difference shows that the effect is not sollely due to reactions on the extensive margin. The effects are still positive and significant. Although the effects are smaller a significant share of the effect is due to reactions at the intensive margin.

A.5 Quality of the Estimations

In this section, I am going to compare *computed MTR* to the *effective MTR*. To do so I compute a two marginal tax rate, first by applying classical microsimulation analysis, second by relying on the specific triple-difference structure of the tax reform. Then by exploiting the actual tax liability that is present in the database, I compute the *effective MTR*. I comment on the results and claim that the assumptions made in the triple-difference assessment of the behavioral reaction to the reform, even though not perfect, holds quite well.

The taxation literature that aims to assess the behavioral reaction of households with panel data usually compute MTR based on the tax base a household has. Then as taxable income changes, the *counterfactual MTR* is computed to assess in a first stage least square to compute what would have been the MTR in the absence of tax reform. Then this *counterfactual MTR* is used as an instrument to assess the change in taxable income due to a change or changes in the marginal tax scheme.

However, the general tax rules are complex. To handle that complexity microsimulations models are used to determine the MTR [25]. These models, are not perfect and handle only a subset of the fiscal rules. Especially when it comes to high income, there exist very specific tax deductions, sometimes that is the result of negotiations with the tax administration or other political entity.

As far as I know, the quality of the estimation, meaning how well MTR are computed by those microsimulation models and how are not very well documented.

One way to proceed is to take the piecewise linear tax function $P(y)$ then look at the corresponding rate. Although simple, this approach can lead to large errors in the assessment of the marginal tax rate if there is a fiscal mechanism that can reduce either the tax base or the MTR.

Another way is the use a microsimulation model that can be represented as a function $M(y, X) = T$ where y is the taxable income on which I want to capture behavioral reactions and X is a set of other characteristics (such as family structure, age, etc.), and T the final tax liability.

One way to capture the MTR for a change in a specific tax base would be to compute

$$MTR = \frac{M(y + \epsilon, X) - M(y, X)}{\epsilon} \tag{7}$$

For a step ϵ small enough such that no household change of tax bracket, most of the rates will be close to the statutory rates (if the tax base y is equal to the tax base where the statutory rates apply), or to the effective statutory rate (the statutory rates once all the fiscal mechanism has been included).

Another way to compute such a marginal tax rate could be through econometric estimation. Indeed if I have the tax liability that a household has paid T, then the variation in

25. TAXIM is the usual microsimulation tool used for the US, the code is not entirely freely accessible.

MTR could be estimated through

$$\Delta T = \beta \Delta y + \mu_i$$

since the change in tax is simply the change in taxable income times the marginal tax rate.
In the presence of a lump sum change in the income tax, a constant can be introduced to captures the lump sum change :

$$\Delta T = \beta_0 + \beta_1 \Delta y + \mu_i$$

These estimations are true under the condition that the tax scheme is a simple flat tax, or that all the households stay on the same tax bracket. A piecewise linear tax can be written the following way : A series of marginal rates $0 < m_0 < m_1 < ... < m_p$ and $0 = \omega_0 < \omega_1 < ... < \omega_p$ Then for an income y such that $\omega_k < y < \omega_{k+1}$
Then the tax liability T is equal to

$$T(y) = \sum_{j \leq k-1} m_j \left(\omega_{j+1} - \omega_j\right) + m_k(y - \omega_j))$$

If an household change of tax bracket, for a higher one, then

$$\Delta T = \sum_{j \leq k_1 - 1} m_j \left(\omega_{j+1} - \omega_j\right) + m_{k_1}(y_1 - \omega_j)) - \sum_{j \leq k_0 - 1} m_j \left(\omega_{j+1} - \omega_j\right) - m_{k_0}(y_0 - \omega_j))$$

Since $k_1 = k_{0+1}$

$$\Delta T = \sum_{j \leq k_0} m_j \left(\omega_{j+1} - \omega_j\right) + m_k(y_1 - \omega_j)) - \sum_{j \leq k_0 - 1} m_j \left(\omega_{j+1} - \omega_j\right) - m_k(y_0 - \omega_j))$$

In our case, each specific subgroup (if their tax bracket does not change) face either a change in MTR or a change in lump sum income. One of my assumptions is that households would not have changed of tax bracket in the absence of the reform.

FIGURE 6 – Effective and statutory MTR

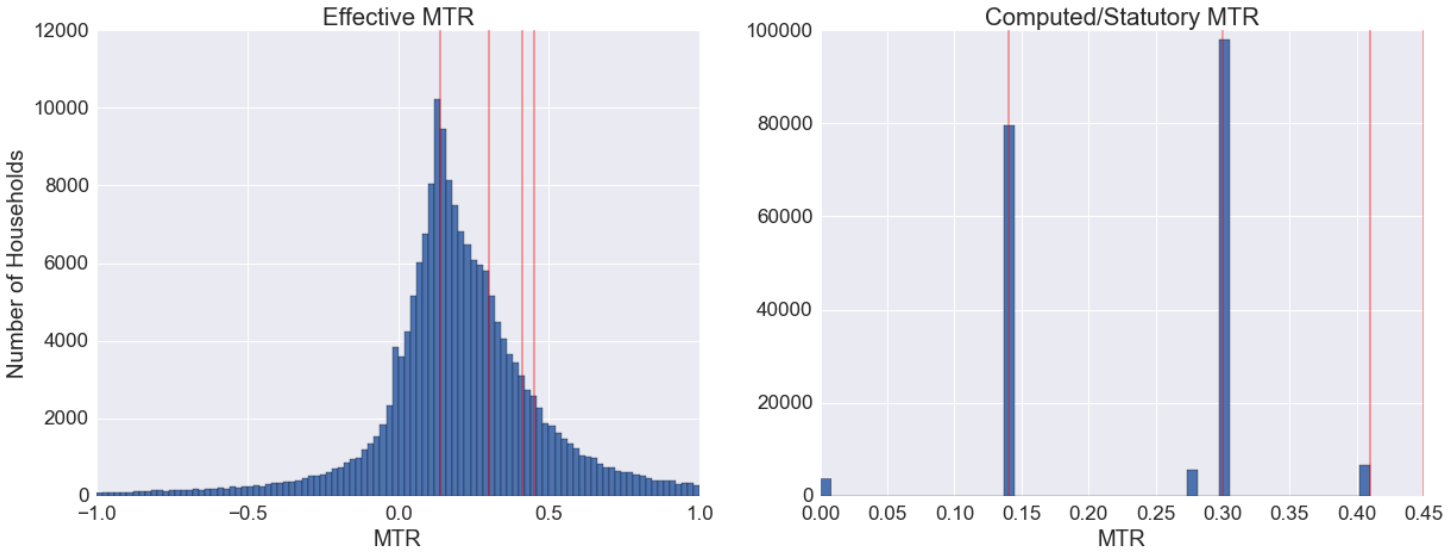


Figure 6 shows the effective MTR on the left and statutory rate on the right. The effective marginal tax rate is computed by taking the difference in the tax paid in 2014 and in 2012 divided by the change in taxable income over the same period. [26] Interestingly enough, I see that the distribution of an effective marginal tax rate is not a plurimodal distribution where each mode would be a mass at a given statutory MTR. In the case that households would not have changed their income such that they remain in the same tax bracket, I would have observed the distribution on the right distribution of Figure 6 which represent a probability mass function. [27]

The effective marginal tax rate distribution is not a probability mass function for two reasons, first households change or tax brackets from one year to another, and thus their MTR is a weighted average rate of the different MTR between the 2011 statutory rate and the 2014 statutory rate. Second households use tax credit and reductions. Tax credit and reductions explain that some households have a negative effective MTR : if a household that has an increase in taxable income, start to claim a tax credit such that the final tax liability is smaller despite the increase in taxable income, the effective MTR will appear to be negative.

But what I am interested in this article is the variation in the tax base with respect to a tax reform that will be applied to the piecewise linear tax scheme. Even though the reform may imply behavioral reaction by increasing the usage of tax credits, in the absence of transaction cost to claim those tax credit, microeconomic theory state that it should not be so.

Namely, I have

$$T_i(y_i, s_i) = \underbrace{t\left(\frac{y_i}{s_i}\right) \times s_i}_{\text{Observed}} - \underbrace{\text{tax credits}}_{\text{Unobserved}}$$

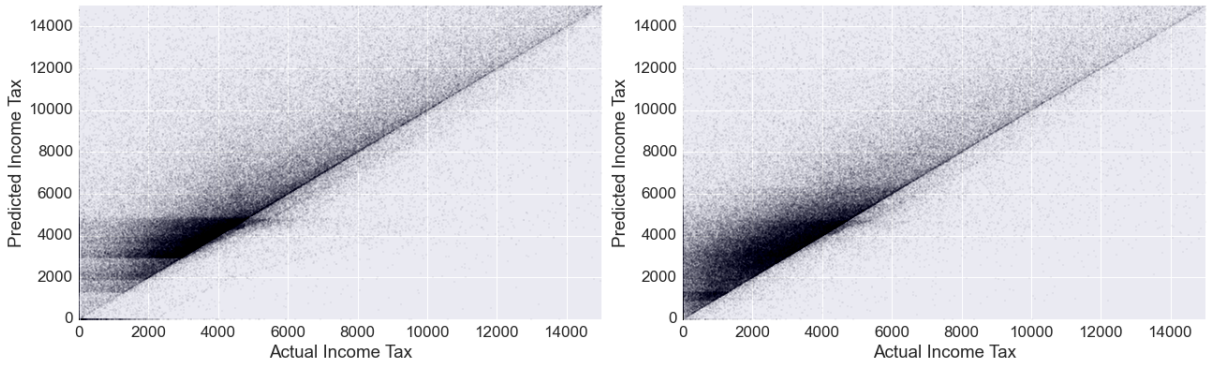
As I have very little information about tax credit and reduction in the database [28] Tax credits lead to overestimating the tax liability of a household.

26. $MTR = \frac{\Delta T}{\Delta y}$

27. These MTR has been computed with the tax formulas taken in Openfisca by computing the tax with Équation 7 for an ϵ of 10 euros.

28. it is not precisely documented, and subtracting the tax credits and reductions to the computed tax scheme do not lead to a better match between the computed income tax and the actual tax liability.

FIGURE 7 – Income tax matching



(a) Income tax 2011

(b) Income tax 2014

Figure 7 shows that the computed tax is overestimated compare to actual tax liability present in the administrative database. As I see a 45 degree line that corresponds to the case where the computed income tax is equal to the actual income tax. That is the case where households do not claim any income tax credit or reduction that happened after the piecewise linear tax scheme. [29]
The assumptions I make in the evaluation of the impact of the reform are : first that the households taxable income is precisely assessed, second that households would not have changed its tax bracket in the absence of the reform. As I know that these two statement is false I can still evaluate how false it is.
If I make the assumption that the use of tax credit is perpendicular to the tax reform, I can predict the change in tax liability by the fact that a household has been impacted or not by the reform with a regression close to the triple diff estimation. Indeed, I know that households treated by treatment 1 faced a change in their MTR from 14% to the MTR they would have had in the absence of children in the household which is of 30% for households with less than 4 children. Then I have to add the difference between the two MTR (16% here) times the distance from the beginning of the new tax bracket (the 2014 threshold, e.g. 79,166 euros for a family of 3 children), which gives the lump sum loss that households that were between the two thresholds had.
Thus the change in their tax liability would be :

$$\Delta T = 0.3 \times \Delta y \ + \text{Lump sum loss for a given position between the thresholds}$$

Households that were were impacted by the treatment 2 faced a lump sum increase of the tax equal to 836 euros times the number of fiscal shares. Thus their change in tax liability if in the 30% tax bracket would be :

$$\Delta T = 0.3 \times \Delta y \ + 836 \times \text{fiscal shares}$$

I can thus estimate the change in tax liability with the following specification :

29. including the family ratio scheme threshold and the decote.

$$\Delta T = \underbrace{\sum_{i=1}^{6} \beta_i^O child_i \times Over_i}_{\substack{\text{Lump sum increase} \\ \text{for Treated 2 group}}} + \underbrace{\sum_{i=1}^{6} \beta_i^{MTR_O} \Delta y \times child_i \times Over_i}_{\substack{\text{Average MTR for Treatment 2} \\ \text{(same as before the reform)}}} \tag{8}$$

$$+ \underbrace{\sum_{i=1}^{6} \beta_i^{MTR_B} \Delta y \times child_i \times Between_i}_{\substack{\text{MTR of Treated group 1} \\ \text{after the reform}}} + \underbrace{\sum_{i=1}^{6} \beta_i^B child_i \times Between_i}_{\substack{\text{Lump sum loss of group 1} \\ \text{after the reform}}} \tag{9}$$

$$+ \underbrace{\sum_{i=1}^{6} \theta_i \text{Not touched by reform} \times child_i}_{\substack{\text{Average increase in tax} \\ \text{for the untreated group}}} + \underbrace{\sum_{i=1}^{6} \gamma_i \Delta y \times \text{ Not touched by reform} \times child_i}_{\substack{\text{Average MTR by child rank} \\ \text{for the untreated group}}}$$

$$\tag{10}$$

$$+ \epsilon_i \tag{11}$$

Where line (8) concerns household over the 2011 thresholds. β_i^O measures the lump sum loss for each child range that should be equal to respectively 836, 1672, 3344, 5016 6688 and 8360 for households of respectively 1 to 6 children. $\beta_i^{MTR_O}$ the average MTR for each child rank that was in treatment 2.
Line (9) concerns households have their 2011 taxable income between 2014 and 2011 thresholds (Treatment 1). $\beta_i^{MTR_B}$ captures the marginal tax rate of these households, it should be of 30% for households from 1 to 4 children [30]. β_i^B captures the average lump sum loss for each rank of children, it should be equal to the weighted average difference between the 2011 tax and the 2014 tax when computed with the 2011 taxable income and should thus be lower than 836 × n euros.
Line (refline :3) those not impacted by the reform. θ account lump sum change in tax for households not touched by the reform which should be equal to zero if households did not change of MTR bracket which should be equal to zero. But since taxable income is on average increase over the period, it would be positive. To remedy that I include γ to the regression that captures the average MTR in the non treated group. Since the non treated group are quite heterogeneous in terms of MTR, I include an heterogeneous effect for each child rank.

30. (and a bit more for 5 and 6 children, since some households between the thresholds, jump directly on the 41 MTR.

TABLE 15 – Change in tax liability

	All	NTCI	$\Delta y > 0$	$\Delta y < 0$	Expected
$child_i \times Over_1$	1224***	1138***	908***	907***	836
$child_i \times Over_2$	1987***	1859***	1525***	1727***	1672
$child_i \times Over_3$	3682***	3184***	2970***	2827***	3344
$child_i \times Over_4$	5204***	5119***	4797***	5634***	5016
$child_i \times Over_5$	13121***	6920***	7628***	7602*	6688
$child_i \times Over_6$	5967***	6154***	–	–	8360
$\Delta y \times child_i \times Over_1$	0.259***	0.249***	0.267***	0.224***	> 0.3
$\Delta y \times child_i \times Over_2$	0.279***	0.275***	0.296***	0.254***	> 0.3
$\Delta y \times child_i \times Over_3$	0.310***	0.305***	0.316***	0.280***	> 0.3
$\Delta y \times child_i \times Over_4$	0.325***	0.328***	0.338***	0.343***	> 0.3
$\Delta y \times child_i \times Over_5$	0.335***	0.404***	0.378***	0.462**	> 0.3
$\Delta y \times child_i \times Over_6$	0.366***	0.389***	0.573***	0.214***	> 0.3
$\Delta y \times child_i \times Between_1$	0.179***	0.183***	0.193***	0.128***	0.3
$\Delta y \times child_i \times Between_2$	0.214***	0.223***	0.258***	0.121***	0.3
$\Delta y \times child_i \times Between_3$	0.224***	0.230***	0.271***	0.111***	0.3
$\Delta y \times child_i \times Between_4$	0.236***	0.233***	0.290***	0.112***	0.3
$\Delta y \times child_i \times Between_5$	0.262***	0.225***	0.294***	0.111**	> 0.3
$\Delta y \times child_i \times Between_6$	0.025	-0.019	-0.095	-0.777***	> 0.3
$child_i \times Between_1$	923.167***	910.641***	852.372***	433.385***	< 836
$child_i \times Between_2$	1336.725***	1248.149***	859.358***	590.550***	< 1672
$child_i \times Between_3$	1963.651***	1783.027***	1189.992***	801.837***	< 3344
$child_i \times Between_4$	2830.866***	2262.656***	1295.585***	1127.314**	< 5016
$child_i \times Between_5$	3454.794***	2941.539***	1908.865**	741.941	< 6688
$child_i \times Between_6$	3446.676***	10059.622***	12934.249	-17583.224***	< 8360
Not_touched_by_reform $\times child_0$	122.484***	109.484***	350.708***	416.135***	0
Not touched by reform $\times child_1$	385.765***	368.151***	295.760***	299.237***	0
Not touched by reform $\times child_2$	391.394***	268.565***	162.901***	268.073***	0
Not touched by reform $\times child_3$	236.062***	-31.953	-219.547***	82.923	0
Not touched by reform $\times child_4$	215.635**	-33.818	-199.747	2.925	
Not touched by reform $\times child_5$	253.683	-567.608	-1040.817*	64.932	
Not touched by reform $\times child_6$	194.868	1096.854	1868.347*	-0.000	
$\Delta y \times$ Not touched by reform$\times child_0$	0.199***	0.183***	0.164***	0.216***	> 0.3
$\Delta y \times$ Not touched by reform$\times child_1$	0.131***	0.128***	0.134***	0.102***	> 0.14
$\Delta y \times$ Not touched by reform$\times child_2$	0.139***	0.148***	0.157***	0.110***	> 0.14
$\Delta y \times$ Not touched by reform$\times child_3$	0.120***	0.156***	0.170***	0.096***	> 0.14
$\Delta y \times$ Not touched by reform$\times child_4$	0.093***	0.141***	0.150***	0.085	> 0.14
$\Delta y \times$ Not touched by reform$\times child_5$	0.075***	0.157***	0.177***	0.135	> 0.14
$\Delta y \times$ Not touched by reform$\times child_6$	0.112***	0.046	0.002	0.844	> 0.14
adjusted-R2	40.15%	62.82%	57.39%	47.19%	
N	193555	87773	69144	18629	

The first column represents the above equation on the total population. I see that I do not perfectly structurally match the tax reform, but that the order of magnitude is quite consistent from 1 to 4 children. [31] The impact of the lump sum increases are overestimated, but I see that the MTR of treated 2 groups are underestimated up to 2 children. Once the constant for each group is correctly assessed, I see that the lump sum increase in tax is pretty well assessed.

Double Differences : As the reform embodies a triple diff in its inner nature, it might not be obvious what a double diff could be. It could be for each child rank to compare what happened above or below thresholds. It could be to run a regression on a specific treated

31. For 5 and 6 children, it is not the case. The number of observation (respectively 42 and 5) will make it very dependent to outliers, regressions with iteratively reweighted least squares lower significantly the figures for 5 children)

group with households without children in the same position of the income distribution as the reference group.
Another solution would be to implement a simple DD with two treatments as in Équation 7.3. This is what is done in the first (1) regression of Tableau 16 where I regress the tax reform would have impacted the change in taxable income between 2011 and 2014 based on whether or not a household if its income did not change. This shows that the reform had a negative impact on both households that face a change in MTR and a lump sum decrease. The interpretation would be that the substitution effect dominates for households that face an increase in their MTR (Treatment 1). Households that face a lump sum decrease in their disposable income would have reacted by decreasing their taxable income. This last interpretation would not be consistent with microeconomic theory as it would imply that households utility is decreasing either in income or in leisure. [32] However, that regression is biased since it does not take into account trends that could be specific to change a specific location in the income distribution.
I can look at column (2) once I controlled for the income location.

32. Marginal rate of substitution supposes that taxpayers are willing to trade one unit of leisure for n of disposable income. If households increase their leisure when their disposable income decreases, it implies that the sign of n is negative and thus that either leisure or disposable income is (at least locally) a bad

TABLE 16 – Double Differences with different types of controls

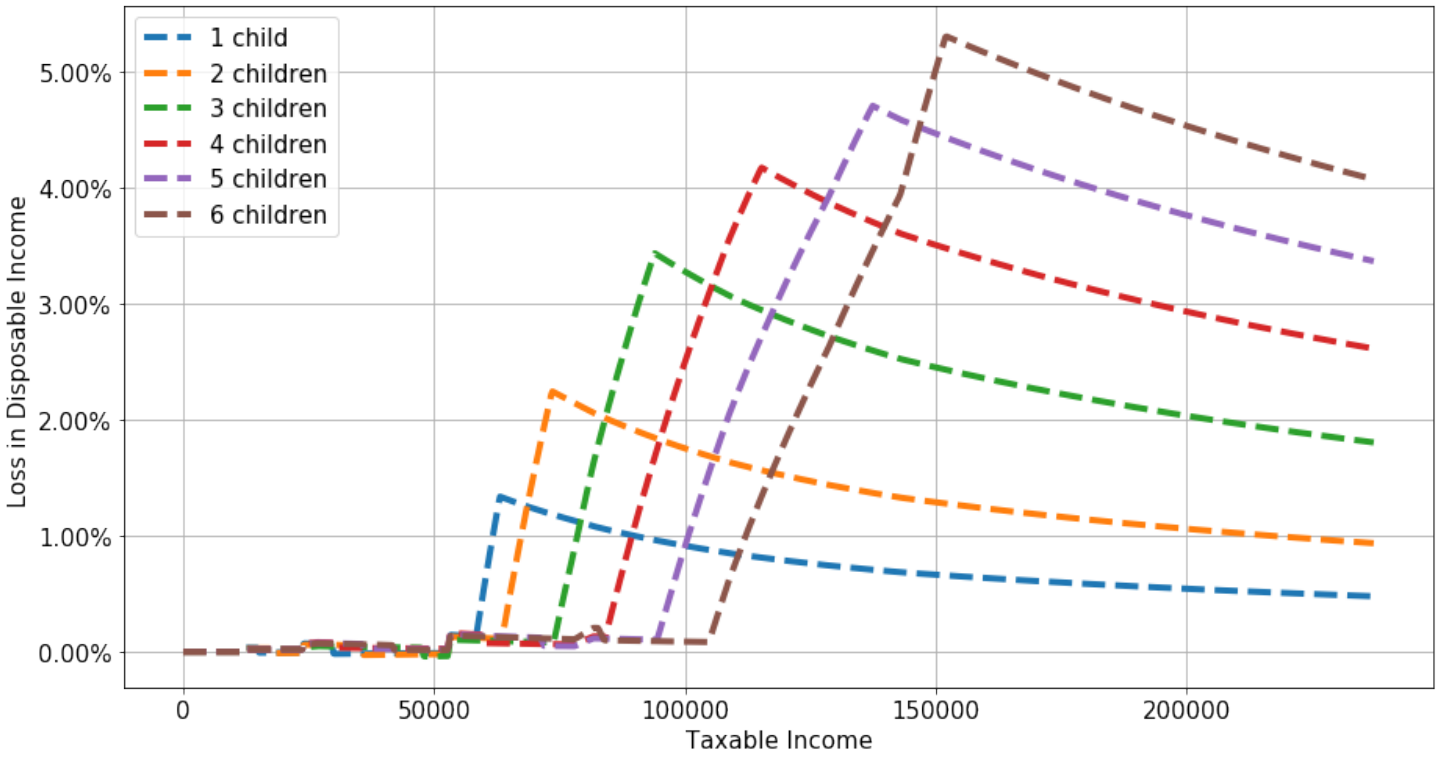
	(1)	(2)	(3)	(4)
Treatment 1	-1342***	3990***	-3033***	2490***
	(107)	(139)	(107)	(147)
Treatment 2	-1472***	4148***	-2883***	3313***
	(105)	(169)	(108)	(192)
Intercept	6647***	8625 ***	3113***	6335***
	(37)	(40)	(79)	(83)
Taxable income $\in [58291, 63233]$		-5973***		-5707***
		(100)		(99)
Taxable income $\in [63233, 63530]$		-6020***		-5977***
		(390)		(382)
Taxable income $\in [63530, 73516]$		-7439***		-6738***
		(125)		(129)
Taxable income $\in [73516, 73806]$		-7815***		-7480***
		(637)		(632)
Taxable income $\in [73806, 84103]$		-7717***		-7129***
		(178)		(189)
Taxable income $\in [84103, 94368]$		-8120***		-7574***
		(221)		(231)
Taxable income $\in [94368, 94451]$		-8230***		-7723***
		(1848)		(1856)
Taxable income $\in [94451, 104633]$		-7300***		-6942***
		(282)		(292)
Taxable income $\in [104633, 115185]$		-7530***		-7187***
		(347)		(355)
Taxable income $\in [115185, 135941]$		-7380***		-7170***
		(338)		(348)
Taxable income $\in [135941, 150684]$		-6290***		-6110***
		(524)		(529)
Taxable income over 150684 euros		-8273***		-8167***
		(473)		(481)
1 child1			4135***	1244***
			(117)	(124)
2 child2			5073***	2898***
			(94)	(94)
3 child3			6021***	4715***
			(116)	(112)
4 child4			6948***	6189***
			(253)	(249)
5 child5			6658***	6432***
			(674)	(672)
6 child6			7216***	7626***
			(1364)	(1362)
Number of observations	193555	193555	193555	193555

As the mean increase in the population is of 8625 euros, I see that being on a specific

location of the income distribution has a negative effect. As an example, the marginal impact of earning between 84103 and 94368 euros in 2011 is a decrease in declared taxable income of 8230 euros in 2014 compared to households earning less than 58291 euros. Treatments have both a positive impact on the change in the tax base, households when controlling only for the position in the income distribution. Wich would mean that the income effect strongly dominates the substitution effect. However, when controlling just for the number of children (3), the effect is strongly negative with a decrease in taxable income of about 3000 euros for both treated group.
When controlling for both income position and the number of children (4), both difference in trends for the number of children, the impact of each treatment is positive. Meaning that I indeed observe a pure positive income effect (Treatment 2), and a substitution effect that the dominates the income effect (Treatment 1). However, I can note that regression (4) is just a pooled triple-diff, namely the weighted average of the triple diff.

A.6 Loss in precentage of disposable income.

FIGURE 8 – Loss in relative disposable income due to the reform.



A.7 Extensive margins, probability linear models :

	Me_start_working	Wo_start_working	Me_stop_working_not_retired	Wo_stop_working_not_retired	Me_get_retired	Wo_get_retired
$Over_1 \times Child_1$	0.0032**	0.0058***	-0.0256***	0.0001	-0.0196***	-0.0092***
	(0.0015)	(0.0017)	(0.0057)	(0.0038)	(0.0034)	(0.0027)
$Over_1 \times Child_2$	0.0086***	0.0010	-0.0480***	0.0007	-0.0290***	-0.0090***
	(0.0012)	(0.0016)	(0.0050)	(0.0033)	(0.0034)	(0.0029)
$Over_1 \times Child_3$	0.0064***	-0.0147***	-0.0519***	0.0057	-0.0256***	-0.0065**
	(0.0015)	(0.0026)	(0.0067)	(0.0046)	(0.0036)	(0.0031)
$Over_1 \times Child_4$	0.0017	-0.0206**	-0.0602***	0.0140	-0.0239***	-0.0019
	(0.0034)	(0.0082)	(0.0149)	(0.0110)	(0.0042)	(0.0047)
$Between1 \times Child_1$	0.0013	0.0085***	-0.0093	0.0011	-0.0016	-0.0012
	(0.0018)	(0.0023)	(0.0078)	(0.0056)	(0.0037)	(0.0027)
$Between1 \times Child_2$	0.0065***	0.0040**	-0.0113**	0.0047	-0.0214***	-0.0067***
	(0.0012)	(0.0017)	(0.0051)	(0.0036)	(0.0028)	(0.0023)
$Between1 \times Child_3$	0.0047***	-0.0054*	-0.0286***	-0.0032	-0.0258***	-0.0096***
	(0.0016)	(0.0028)	(0.0067)	(0.0045)	(0.0035)	(0.0029)
$Between1 \times Child_4$	0.0017	-0.0168**	-0.0382***	-0.0017	-0.0256***	-0.0067*
	(0.0036)	(0.0079)	(0.0138)	(0.0091)	(0.0043)	(0.0039)
$Child_1$	-0.0019	-0.0011	0.0808***	-0.0052*	-0.0338***	-0.0260***
$Child_2$	-0.0053***	0.0064***	0.0629***	-0.0189***	-0.0301***	-0.0184***
$Child_3$	-0.0020	0.0250***	0.0529***	-0.0257***	-0.0344***	-0.0180***
$Child_4$	0.0030	0.0462***	0.0388***	-0.0264***	-0.0377***	-0.0186***
Taxable income $\in [58291, 63233]$	-0.0090***	-0.0140***	0.0209***	0.0085***	-0.0005	-0.0018
Taxable income $\in [63233, 63530]$	-0.0067**	-0.0137***	0.0312***	0.0165**	-0.0040	-0.0059
Taxable income $\in [63530, 73516]$	-0.0120***	-0.0153***	0.0374***	0.0071***	0.0149***	0.0021
Taxable income $\in [73516, 73806]$	-0.0147***	-0.0166***	0.0604***	0.0071	0.0165**	-0.0012
Taxable income $\in [73806, 84103]$	-0.0128***	-0.0126***	0.0684***	0.0092***	0.0210***	0.0040
Taxable income $\in [84103, 94368]$	-0.0118***	-0.0101***	0.0838***	0.0108***	0.0196***	0.0026
Taxable income $\in [94368, 94451]$	-0.0182***	-0.0248***	0.0869**	-0.0314	0.0033	-0.0145***
Taxable income $\in [94451, 104633]$	-0.0135***	-0.0044**	0.0947***	0.0012	0.0214***	0.0031
Taxable income $\in [104633, 115185]$	-0.0151***	-0.0065***	0.1084***	0.0064	0.0179***	0.0018
Taxable income $\in [115185, 135941]$	-0.0144***	-0.0074***	0.1185***	0.0091**	0.0136***	-0.0034
Taxable income $\in [135941, 150684]$	-0.0147***	-0.0057**	0.1406***	0.0067	0.0104**	-0.0026
Taxable income over 150684 euros	-0.0170***	-0.0052**	0.1605***	0.0125**	0.0067	-0.0020
Intercept	0.0877***	0.1316***	-1.1587***	-0.0323**	0.3897***	0.3532***
Age_wo	0.0012***	-0.0058***	0.0063***	0.0070***	-0.0017***	-0.0118***
	(0.0003)	(0.0007)	(0.0012)	(0.0004)	(0.0006)	(0.0005)
Age_me	-0.0046***	0.0012**	0.0959***	0.0002	-0.0186***	-0.0066***
	(0.0006)	(0.0005)	(0.0018)	(0.0007)	(0.0008)	(0.0006)
I(Age_wo_squared / 10 ** 4)	-0.1025***	0.5614***	-1.1955***	-0.9674***	0.2693***	1.7518***
	(0.0348)	(0.0721)	(0.1369)	(0.0527)	(0.0713)	(0.0650)
I(Age_me_squared / 10 ** 4)	0.5090***	-0.1009**	-11.8298***	-0.0203	2.5521***	0.7521***
	(0.0653)	(0.0477)	(0.1955)	(0.0747)	(0.0865)	(0.0708)
I(Age_Elder_child / 10 ** 4)	0.9410**	-1.4765**	-0.9211	-13.8524***	-2.3328***	-0.8657
	(0.4754)	(0.6009)	(1.8390)	(1.2051)	(0.8539)	(0.6875)
adjusted-R2	0.54%	0.94%	26.85%	0.44%	11.72%	9.43%
N	192640	192640	192640	192640	192640	192640

Conclusion

Cette thèse a visée à ouvrir des pistes d'amélioration des politiques publiques. Le premier en explorant un détail technique, la temporalité de l'impôt, relativement inexploré par la littérature. Le second en documentant des comportements de non-optimisation de la part des ménages documente de nouveaux comportements vis à vis d'un système fiscal lié a des choix d'optimisation lors de la déclaration fiscale. Le troisième en essayant d'identifier via une nouvelle méthodologie le comportement des ménages aisés vis à vis des modifications de l'impôt, tout en identifiant séparément les effets revenus des effets de substitution.

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