

# The elasticity of labor income : evidence from French tax and benefit reforms, 2006-2015

Michaël Sicsic \*

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## *Abstract*

I provide estimates of the compensated elasticity of labor income with respect to the marginal net-of-tax rate (MNTR) on the 2006-2015 period for France. I follow the methodology of the ETI literature using panel data (Gruber and Saez, 2002), with several contributions. I exploit not only income tax reforms but also means-tested benefits reforms in order to compare these elasticities. Over the 2006–2015 period covered, the reforms went to different directions (leading to up and downs of MNTR) and some reforms affected MNTR differently for individuals with the same level of income depending of family configuration, which provide good source identification. This variety of reforms enables me to estimate different elasticities for different types of people. I focus on the individual response of labor income but I also compute cross elasticities of other income of the household (spouse labor income and capital income). Finally, I also test various ways to deal with means reversion, heterogeneous income trend, and endogeneity of MNTR, and add lots of controls since the data used provides a great variety of socio-demographic covariates.

My favourite specification yields compensated elasticities of approximately 0.2 for income tax reforms (consistent with previous estimations), 0.1 for in-work (RSA activité) reform, and not significant for other means-tested benefits (family allowance and minimum income support). This can be explained by the fact that income tax reforms are more salient than benefit reforms. Other results include the fact that the elasticities are higher for the top decile, for single people, and for people between 20 and 40 years old are higher. Moreover, cross elasticities are negative, which is consistent with income shifting.

*Keyword* : elasticity of labor income, tax and means-tested benefit reforms, instrumental variable, marginal tax rate

*JEL classification*: H21 ; H24 ; H31 ; J22; C26.

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\* *Affiliation*: INSEE and CRED, Université Paris 2 Panthéon-Assas.

*E-mail*: [sicsic.michael@gmail.com](mailto:sicsic.michael@gmail.com)

*Address*: Insee, 18 boulevard Adolphe-Pinard, 75675 Paris Cedex 14.

## Introduction

Labor supply responsiveness to tax change is a core issue in public economics for tax policy. The value of elasticity of labor supply is a key tax policy parameter as it allows to access the marginal cost and the deadweight loss of taxation in general or partial equilibrium models, and thus the efficiency of taxation<sup>1</sup>. Its value allows to assess the optimal design of tax policy as Piketty (1997) and Saez (2001) showed that the compensated elasticity is a sufficient statistics to compute optimal marginal tax rates. Its value also enables a better forecast of the cost or benefit of a reform for the state budget<sup>2</sup>.

The estimation of elasticity of labor supply has been the subject of an important literature, structural and atheoric (see Blundell and MaCurdy 1999 and Kean 2011 for a survey and appendix A). The structural approach estimates elasticity of hours of work with respect to net-of-tax wage rate, based on a model for optimizing behavior (Hausman, 1985). It has been used to simulate *ex ante* effect of tax reforms which affects incentives to work. This model predicts identical hours of work or income responses to different types of tax reforms that affect incentives to work. Elasticities can be estimated also using quasi experimental framework by exploiting differential changes in tax treatment following tax reforms. These studies exploit one reform to estimate elasticities with a reduced form approach, and can be separate in two part. Firstly, a large literature has estimated the response to means-tested benefit reforms (including in-work benefit reforms, welfare reforms, child support reforms)<sup>3</sup>, mainly on the extensive margin of the labor supply and using diff-and-diff method. Secondly, another large and growing literature has estimated the elasticity of taxable income<sup>4</sup> (ETI) using income tax (surveyed by Saez, Slemrod and Giertz (2012) and in section 1). But at our knowledge, no papers compare response due to income tax and means tested benefits. If theoretical models show that it must be equal, Lehmann et al. (2013) shows that labor income responds differently to income tax and payroll tax reforms, in contradiction with usual models of labor market. The question of the comparison of the response of means tested benefit vs income tax is worth studying since in France benefits are numerous (~30 schemes), have an important weight (~ 4% of GDP), contribute significantly to reduce inequalities (by 2/3, Insee, 2017) and are often reformed.

In this paper, I estimate the response of labor income to income tax reforms and means tested benefit reforms passed in France between 2006 and 2015. I use the framework of ETI literature, also labeled new tax responsiveness (NTR) literature. Even if this literature has initially and mainly estimated the effect of income tax on taxable income, the framework allows to estimate the effect on related measure

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<sup>1</sup> Since the seminal contribution of Hargger (1967), the calculation of the magnitude of the efficiency cost of income taxation in general or partial equilibrium models using elasticities has been widely used, see, Ballard et al. (1985); Auerbach 1985, Browning (1987), Fedstein (1999) and the review of Auerbach and Hines (2001).

<sup>2</sup> Saez (2017) uses elasticities estimation to show most 20% of the projected tax revenue increase from the 2013 tax reform in the US is lost through behavioral responses. In France, Piketty (1998, p11) highlight that the behavioral effect of the reform of Allocation Parental d'emploi (APE) in 2004 has been far higher than the forecast. Behavioral response are taken into account by government via the estimation of the Institute for fiscal studies (IFS) in the UK and CBO in the US (even if the method has been criticize, Feldstein, 2000) but not in France.

<sup>3</sup> The effect of in-work reforms has been extensively studied with reduce form equation, including reforms of the EITC in the US (Eissa and Liebman, 1996, Eissa, and Hoynes 2004, Chetty and Saez 2013, Chetty et al., 2013), WFTC in the UK (Blundell et al. 1998, Blundell and Hoynes 2000), creation of the 'Prime Pour l'Emploi' in France (Stancanelli, 2008, Arnaud et al., 2008). For studies on the effect of welfare reforms, see Meyer and Rosenbaum (2001) in the US, and in France, see Bargain et Vicard (2014), and Simmonet and Danzin (2014) (among others) on the effect of the creation of the RSA. See also the evaluation of the Self-Sufficiency Project in Canada. For the effect of child support reforms, see Piketty (1998), Givord et Marbot (2016), Kosonen (2014) among others. See also the review of Moffitt (1992) for welfare reforms. These studies use difference and difference for the identification, with a treated and a control group. Note that the output variable of these studies are often the number of people (women), and only few studies compute elasticities.

<sup>4</sup> This allows to take into account a broader range of responses to changes in marginal tax rates (than only hours of work), such as effort, hourly wages and tax avoidance (see Feldstein, 1995 and 1999).

of income : adjusted gross income/AGI<sup>5</sup> (Feldstein 1995, Auten and Carroll 1999, Moffitt and Wilhelm 2000, Gruber and Saez 2002...), labor income (Blomquist and Selin 2010, Kleven and Schulz 2014, Lehmann et al. 2013), hourly wage (Blomquist and Selin 2010). Since our main measure of outcome is labor income instead of taxable income, I will privileged the term ‘NTR literature’ (introduced by Goolsbee, 1999) to refer to ETI literature to avoid the potential distraction that comes from the reference to ‘taxable income’. The conceptual framework of this literature departs from an utility-maximizing behavior (but without specifying a structural model) and allows to estimate the compensated elasticity (see Gruber and Saez, 2002) which is the relevant parameter for welfare analysis<sup>6</sup>. Thus, I estimate elasticities of labor income with respect to marginal (compensated) and average (income effect) net-of-tax rates, using panel data. I follow the last econometrical developments of this literature and especially add Weber’s type instrument to deal with endogeneity of the marginal tax rate, function of base-year income and preceding year proposed by Kopczuk (2005) to deal with means reversion and heterogeneous income trend, and specification of income effect of Lehmann et al. (2013).

My first contribution to this literature is to take into account all transfers in the tax function and especially means-tested benefits, and expand the framework (with formula with N transfert) to enable to estimate different elasticities with respect to the marginal net-of- (benefit and income) tax rate. In order to estimate these different elasticities, I use tax and benefit reforms between 2006 and 2015 in France. I use the dataset Enquête revenus Fiscaux et Sociaux (ERFS), a matching between fiscal records and the labor force survey, of more than 100,000 people by year, associated with a tax simulator derived from the microsimulation model INES to simulate marginal and average net-of-tax rates. Using these data and reforms is interesting and useful for many reasons.

First, as in Denmark (see Kleven and Schulz, 2014), French income distribution is stable (see appendix B), which prevents for the heterogeneous income trend issue. Secondly, in this period (never used in previous work in France), there have been many important tax and benefit reforms, with up and down movements in MTR depending on year, and changes in bracket cutoffs that moved large groups of taxpayers to different brackets (as Kleven and Schulz 2014). This makes less severe the issue of controlling for the effects of any general tendency in pre-reform income than in US studies (Saez, Slemrod and Giertz, 2012) and enhances our ability to identify responses to tax reform. Indeed, in this period two very different policies have been implemented by two presidents from very different political backgrounds. In 2007, the new elected president Sarkozy launched several liberal reforms the aims of which were to “make work pay”, and mostly reduce marginal tax rates (MTR), either directly or indirectly by moving large groups of taxpayers to different brackets. It resulted in a decrease of the number of income tax bracket and marginal tax rates (from 48,09 % to 40% for the top MTR), an increase of 27 % of the threshold of the French earned income tax credit (PPE hereafter) and a modification of its MTR (from -6 % to -7 % and from +15 % to 19,3 % in the phase-out), a creation of a new in-work benefit schemes (RSA activité) associated with a MTR of -62% in the phase-in and 38% in the phase-out. In the opposite, after the election of the socialist President Hollande in 2012, most reforms aimed at redistribution and thus, increase MTR. We had an increase of the MTR of income tax for top income in 2012, 2013 and 2014 (in 2014, top MTR is 49%), a bracket creep in 2012 and 2013 for income tax and PPE, a decrease of income tax for poor people (and thus increase in MTR). We also had a large increase of means-tested benefit and especially minimum support (+8% on

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<sup>5</sup> Chetty (2009) highlights that itemized deductions do not produce significant costs (and on the other hand, itemized deductions, as charitable giving, create positive externalities), and thus taxable income elasticity is not a sufficient statistic. This has been shown empirically by Doerrenberg et al. (2014). The « real sufficient statistic » is rather a weighted mean of elasticity of AGI and taxable income according to Chetty (2009).

<sup>6</sup> Earlier studies which estimate elasticities by difference and difference estimate only a weighted mean of compensated and uncompensated elasticity (Piketty, 1999, appendix 2).

RSA between 2012 and 2016) and some family allowances (25% of ASF) associated with move from 0% to 100% in MTR for concerned people. In the same time, there was a large decrease of the thresholds of some family allowances which inflated strongly MTR for some people. For instance, in 2015, allocations familiales' (hereafter 'AF', literally 'family allowances'), originally a lump sum transfer for parents of two or more children very popular in France have been means tested : they have been reduced by half when annual income exceeds a threshold and divided by four beyond another threshold with a degressive mechanism to mitigate the threshold effect (inducing a 100% marginal tax rates in the two degressive zones just after the threshold). Thirdly, reforms affect differently individuals at the same income level, which creates very rich identifying variations and alleviates the problem caused by the fact that means reversion controls and tax change instruments depend on the same variable (base year income) which can blur identification if income is the only source of variation<sup>7</sup>. Indeed, I use in particular two reform of the "family-tax-splitting" mechanism (*Quotient Familial*) which lead to different variations of MTR for the same level of income depending on family composition (number of children especially) and is thus a very convincing source of identification<sup>8</sup>. Fourthly, the data we used (ERFS) provide a great variety of labor markets, education, and sociodemographic information, and thus, enables us to control thoroughly for means reversion and trends in the income distribution and minimize the problem of endogeneity of marginal net of tax rate.

We estimate compensated elasticities around 0.2 (depending specifications) for income tax reforms, 0.1 for in-work reforms, and not significant for other means-tested benefits (family allowance and minimum support). This can be explained by the fact that income tax reforms are more salient than benefit reforms, since individual react more to salient tax (Chetty et al., 2009). The estimation of the elasticity of labor income with respect to marginal net-of-income tax is in the range of previous finding of elasticity of total income or labor income. In US, Auten and Carroll (1999) find an elasticity of gross income of 0.66, 0.12 for Gruber and Saez (2002), 0.4 for Saez (2001). As for the elasticity of labor income, Kleven and Schulz (2014) obtained elasticities in a range of 0.05/0.12, Blomquist and Selin (2010) find a responses of 0.2 for men (and 1/1.4 for women) in Sweden, and Lehmann et al. (2013) find a compensated elasticity of labor income of 0.2 in France. This last study is the closest to our about methodology and data, and result are very consistent.

My second contribution to the NTR/ETI literature is to estimate different elasticities for different types of people (poor/median/rich people, women/men, family composition...). The importance of taking into account different elasticities among workers owing to skill differences has been highlighted by recent theoretical and empirical studies (Jacquet and Lehmann, 2017, Kumar & Liang, 2017)<sup>9</sup>. Jacquet and Lehmann emphasize that multidimensional heterogeneity substantially affect optimal marginal tax rates and that "*Our results put the stress on the need for empirical studies on sufficient statistics for different demographic groups e.g., according to gender, age, ethnicity*". Moreover, in his suggested direction for future research on ETI, Feldstein (2008) points that "*New research should distinguish the response by different income levels, marital status, and age/sex groups*". Yet, previous research on ETI estimates mainly elasticities for high income in the US (because they exploit mainly income tax

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<sup>7</sup> Note that this problem is also alleviated by the inclusion of periods both with and without change (in 2008, 2010 and 2011 very few reforms take place).

<sup>8</sup> This type of reform has already been used by Piketty (1999) and Cabannes et al. (2014) to estimate ETI. It can be a response to the call of Saez and al (2012) "researchers should be seeking better sources of identification; for example, parallel income tax systems that differentially affect taxpayers over a long period of time."

<sup>9</sup> It has been first highlighted by Navratil (1995) and Gruber and Saez (2002) showing that Feldstein's grouping method is consistent only if the two groups (treated and control) have identical elasticities, which is not the case.

changes at the top of the income distribution<sup>10</sup>), and in either high or low income in France (Piketty, 1999 and Cabannes et al. 2014 on the top income and, Lehmann et al., 2013 for poor workers) but never for different types of income, at the exception of Gruber and Saez (2002) who estimate elasticity for three groups of income. Computation of heterogeneous elasticities in our studies is allowed by the variety of reforms we use for the identification, which affect the whole income distribution (minimum support and family allowance at the bottom, income tax and PPE in the middle, and income tax and AF and income tax at the top), and which affect family composition differently (“family-tax-splitting” reforms). We find that the elasticities are higher for the top decile and elasticities of people between 20 and 40 years old are also higher.

Our third contribution is to estimate the response of the other members of the family and thus try to attend to Saez et al. (2012) concluding proposal for future work that “*should attempt to measure the components of behavioral responses as well as their sum*”. Indeed, I calculate the elasticity for each individual even if in the same household, since the marginal tax rates can be different for each person in the household (husband, wife, student child..). This is also linked to the fact that we want to exhibit elasticity from other marginal tax rate than income tax, and especially from means tested benefits which depend on a different income base than taxable income<sup>11</sup>. Since our main output variable in the individual labor income<sup>12</sup>, the difference with ETI literature is the other income of the household (labor income, capital income) and deductions. Compare to the ETI literature, we are able to estimate the response of the other members of the family, and some deduction to have the complete behavioral response due to the tax. Little is known about these cross elasticities<sup>13</sup>. I show that cross elasticities of the other income of the household with respect to marginal and average net-of-tax rate of one individual of the household are negative, which is consistent with income shifting.

The rest of this paper is structured as follows. Section I describes previous work estimating elasticities. Section II sets out the theoretical framework and the empirical strategy. Section III describes the French tax and benefit system and the reforms used for the identification. Section IV describes the dataset used and presents descriptive statistics of income and marginal tax rates. Section V presents empirical results. The section VI will be the conclusion.

## **1. New tax responsiveness literature (incomplete)**

We highlight in this section the New Tax Responsiveness literature (NTR) / ETI literature. Note that we do not review the bunching method which provided elasticity of taxable income and have gained widespread popularity recently. While regression methods are typically based on a linearization of the budget constraint and do not use information on the kink points, bunching methods use cross-sectional information only and are very local in nature. See the seminal contribution of Saez (2010) and Kleven

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<sup>10</sup> And especially, the Tax Reform Act of 1986 (TRA86) in the US for identification (Feldstein 1995; Auten and Carroll 1999; Mofitt and Wilhelm 2000; Gruber and Saez 2002; Kopczuk 2005; Weber 2014)

<sup>11</sup> One example is that the household unit is not the tax unit, and deductions and credits are not taken to account. For this purpose, individual labor income response is the only margin of response comparable between all transfers

<sup>12</sup> Since capital income is jointly taxed at the tax unit, the only individual income is labor income. Second, other income begin to be important in the last centile (Piketty, 1998), while I do not focus on this group in this study. Third, the dividend reforms that take place in France in 2013 change the tax base which is hard to taken into account well in this study. Lastly, capital income can be easily manipulated in the short run (Goelbee, 2000). Since we compute a analysis at short term, using capital gains will overestimate elasticities.

<sup>13</sup> Alex Gelber (2007) has shown with Swedish data, that there are important differences between husbands and wives in their income and substitution elasticities and in cross-elasticities. In France, Carbonnier (2014) estimate elasticity of wife's participation with respect to product of the logarithm of the participation retention rate and the logarithm of taxable income per consumption unit minus the wife's wage.

and Wassem (2013), application for France by Lardeux (2017) and Stancheva et al. (2017), and a comparison with the NTR approach by Aronsson et al. (2017)<sup>14</sup>.

The approach taken in the NTR literature departs from an underlying utility-maximizing behavior similar to that in the standard labor supply literature (see Saez, Slemrod and Giertz, 2012) but uses taxable income as the main measure of outcome, as it captures all the public policy relevant to behavioral responses of a reform. Indeed, it allows for a broader range of responses to changes in marginal tax rates (than only hours of work), such as effort, hourly wages, change of job, tax avoidance, evasion, etc. Indeed, in two influential papers, Feldstein (1995 and 1999) pointed out that other margins of behavioral response to marginal tax rates than hours of work must be taken in account to have the real efficiency cost of taxation. Feldstein (1999) shows that the elasticity of taxable income (ETI) with respect to the marginal net-of-tax rate<sup>15</sup> allows to compute the deadweight loss of taxation, which is thus a sufficient statistics (Chetty, 2009) under certain assumption (Saez et al., 2012).

In this method, the identification strategy exploits the fact that policy reforms can be seen as quasi-experiments and thus uses the differential changes in tax treatment following from tax reforms<sup>16</sup>. This method thus uses the quasi experimental framework but compared to simple diff-in-diff studies, an advantage of the NTR/ETI method is to be able to make statements about welfare implications (as explained previously), but without specifying a structural model. As a consequence, this method gives sufficient statistics and allows to make “a bridge between structural and reduce form method” according to Chetty (2009).

ETI are estimated with reduced-form equations by comparing relative changes in taxable income of tax units or groups of tax units between two periods to relative changes in their net-of-tax rates. In the early literature, group-based comparisons of income shares were conducted using longitudinal aggregated (income share) time series of cross-sectional data (Lindsey 1987, Feenberg and Poterba, 1993, Slemrod 1996, Piketty 1999, Saez 2004). But the concern is that the composition of the treated group can changed over time (new people entering the group), which can biased the estimation.

Feldstein (1995) was the first study to use panel data of individual tax return to tackle this issue. He finds elasticity between 1 and 3, bigger than in previous studies. Following this seminal work, a large body of literature has emerged regarding estimation of ETI (see Saez et al., 2012 for a review). This literature computed considerably lower estimates, in part because of improved methodology and better data and the variety of tax rate. One concern about Feldstein’s grouping method is that it is consistent only if the two groups (treated and control) have identical elasticities, which is not the case<sup>17</sup>. Later panel studies did not use grouping methods and, instead, exploited the entire continuous variation in the marginal net-of-tax rate (MNTR) change along the income scale. These studies exploit that tax reforms often result in substantial tax changes for some tax-payers, whereas others are more or less unaffected. Another issues (concerning Feldstein’s work but more generally all panel studies) concern the existence of non tax related changes in gross labor income which can affect differently the two group (for instance, widening of the pre-tax income distribution due to skill-biased technological

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<sup>14</sup> They show that the bunching method are more precise than the regression estimators (based on Webers approach), knowing that, according to the author, the Weber approach leads to considerably less bias combined with a large decrease in precision (compared to the Gruber-Saez estimator).

<sup>15</sup> equal to one minus the marginal income tax rate.

<sup>16</sup> This method thus use the quasi framework but compared to simple diff-in-diff studies, an advantage of the ETI method is to be able to gives statements about welfare implications (as explain previously), but without specifying a structural model.

<sup>17</sup> It has been noted by Navratil (1995) and Saez et al. (2012, p.26).

change), and means reversion which can cause high income taxpayers in one year to appear low income in the next, aside from any true behavioral response

Gruber and Saez (2002) suggested pooling several first-differences to exploit base-year income-by-year variation, which allows addressing trend heterogeneity by controlling for base-year income using splines of lagged income level. Kopczuk (2005) and Giertz (2008) have examined many of these proposals simultaneously and shown that there is a large degree of variations in the ETI estimates based on U.S. data (ranging from -1 to 1) depending on the specifications chosen.

But one difficulty with this control is that means reversion controls and tax change instruments depend on the same variable (base year income) which can blur identification if income is the only source of variation. Another contribution from Gruber and Saez (2002) is to decompose behavioral responses into substitution and income effects. Indeed, an increase in the financial gains can create both income and substitution effects because individuals may also value leisure.

Gruber and Saez (2002) and all the following studies use the procedure proposed by Auten and Carroll (1999) to deal with the endogeneity of the marginal tax rate. Indeed, the MNTR may increase with the level of a taxpayer's income and so the MNTR is positively correlated with potential log-income. So, any positive income shock unrelated to behavioral responses to tax can push a taxpayer into a higher tax bracket, thus creating a spurious correlation between tax rate and income variations. Therefore, it is necessary to find instruments correlated with the MNTR, but uncorrelated with potential log-income, to identify the elasticity. The instrument proposed by Auten and Carroll (1999) is the log change in the net-of-tax rate if there is no behavioral response, ie individuals earned their base-year income. All studies that employ this instrument have also included some function of base-year income in order to prevent means reversion and heterogeneous income trend which can cause remaining endogeneity of the instrument. The issue of instrument validity has received a lot of attention in the literature and alternative related instruments based on some other income levels have been suggested (see, e.g., Carroll, 1998; Kopczuk, 2005; Blomquist and Selin, 2010; Weber, 2014). Indeed, including a base-year income control function, is not a satisfactory solution as Weber (2014) shows. She, and Blomquist and Selin (2010) point out that these so-called predicted net-of-tax rate instruments are not necessarily exogenous and that replacing base-year income with lagged base-year income and mid-year income, respectively, would better account for trend heterogeneity bias. Other proposed instruments include using local institutional features of the tax system (Matikka, 2015), indirect inference (Aronsson, Jenderny and Lanot, 2017), or weight each constant-income net-of tax rate change by the income level's observed probability density (Kumar & Liang, 2017). The latter authors highlight that the identifying income-by-year variation is endogenous to elasticity heterogeneity also for methods of Weber and Blomquist and Selin, and propose this last instrument to allow to take into account elasticity heterogeneity.

Several other issues have been studied by the ETI literature (see Saez, Slemrod and Giertz, 2012). They include timing response (Goolsbee 2000, Sammartino and Weiner 1997), income shifting (Slemrod 1996, Gordon and Slemrod 2000, Saez 2004), sensibility to difference lengths for the output variable (Weber, 2014), change in tax base definition (Slemrod 1995, Slemrod and Kopczuk 2002, Gruber and Saez 2002)... Focus has also been made on related measure of income than taxable income : adjusted gross income (Feldstein 1995, Auten and Carroll 1999, Moffitt and Wilhelm 2000, Gruber and Saez 2002...), labor income (Blomquist and Selin 2010, Kleven and Schulz 2014, Lehmann et al. 2013), hourly wage (Blomquist and Selin 2010).

If the seminal contribution, used US data (Feldstein, 1995; Auten and Carroll, 1999; Mofitt and Wilhelm, 2000; Gruber and Saez, 2002), recent studies estimate ETI in different countries, especially Scandinavian countries (Hansson 2007, Blomquist and Selin 2010; Gelber 2012, Kleven and Schulz, 2014, Matikka, 2015, Thoresen and Vatto, 2015), Canada (Sillamaa and Veall 2001; Saez and Veall 2005) and Germany (Jenderny and Werdt, 2015; Doerrenberg et al., 2017). In France, Piketty (1999) estimates the elasticity of high-income taxpayers' taxable income with respect to marginal tax rates using reforms focusing on top marginal income tax rates between 1970 and 1996. Lehmann et al. (2014) estimate elasticity on using reform similar to EITC, thus on poor workers. Cabannes et al. (2014) proposes estimate the elasticity of taxable income using French tax reforms between 1998 and 2006, mainly on the top income.

Finally, note that, compared to structural models, the estimated elasticities reflect average treatment effects of the treated, and will therefore differ dependent on the reform used to obtain identification.

## **2. Conceptual Framework**

### **2.1. Theoretical Model**

#### *2.1.1. The model*

I follow the usual framework on ETI (see Saez et al., 2012) based on classical labor supply model, and especially the framework of Lehmann et al. (2014), who indentifies income effects in a more consistent way with the theoretical framework. I add monetary means-tested benefits to this framework and I generalize it with N different type of tax schedule.

Individuals choose  $(c, z)$  where  $c$  is disposable income and  $z$  the labor income ( $z=wl$  where  $l$  is labor supply (hours of work) and  $w$  the hourly wage rate<sup>18</sup>). Individuals maximize a utility function  $U(c, z)$  which is increasing with  $c$  and decreasing with  $z$  because earning a higher labor income  $z$  requires the worker to work harder (increasing  $l$ ). The individual is subject to a budget constraint that we will define later. The tax-benefit system is composed by N transfers : income tax, and various means tested and in-work benefits (see the next section on institutional background in France).  $y^j$  is labor income  $z$  minus the  $j^{\text{th}}$  transfert  $T^j(z) : y^j = z - T^j(z)$ . The marginal net of tax J is  $\tau^J$ , and the average-net-of tax of J is  $\rho^J$  with  $J= 1$  to  $N$ . This is a static model where there is no savings and consumption is equal to disposable income.

On the linear part of each tax schedule, noting virtual (non labor) income  $R^J$ , we have :

$$y^1 = z\tau^1 + R^1$$

...

$$y^j = z\tau^j + R^j$$

...

$$y^n = z\tau^n + R^n$$

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<sup>18</sup> Note that in the classical labor supply literature,  $w$  is the exogenous, but here, individual's wage rate  $w$  depends on effort and tax rates and is thus endogenous.



And for  $j=1$  to  $n$ , we have  $\rho^j = \frac{y^j}{z} = \tau^j + \frac{R^{j-1}}{z}$

So, the amount of tax for each transfert is :

$$T^1(z) = z - y^1 = (1 - \tau^1)z - R^1$$

...

$$T^j(z) = z - y^j = (1 - \tau^j)z - R^j$$

...

$$T^n(z) = z - y^n = (1 - \tau^n)z - R^n$$

Disposable income/consumption is thus :

$$c = z - \sum_{j=1}^n T^j(z) = z - \sum_{j=1}^n ((1 - \tau^j)z - R^j) = z \left[ 1 - n + \sum_{j=1}^n (\tau^j) \right] + \sum_{j=1}^n (R^j) \quad (1)$$

Labor income is determined by the behavioral marshallian function  $z = Z(\tau^1, \tau^2, \dots, \tau^n, R^1, R^2, \dots, R^n)$

$$\begin{aligned} \text{Then : } \Delta z &= \sum_{j=1}^n \left( \Delta \tau^j \frac{\partial Z}{\partial \tau^j} + \Delta R^j \frac{\partial Z}{\partial R^j} \right) \\ \frac{\Delta z}{z} &= \sum_{j=1}^n \left( \frac{\Delta \tau^j}{\tau^j} \left( \frac{\tau^j}{z} \frac{\partial Z}{\partial \tau^j} \right) + \frac{\Delta R^j}{z} \left( \frac{\partial Z}{\partial R^j} \right) \right) \quad (2) \end{aligned}$$

with  $\left( \frac{\tau^j}{z} \frac{\partial Z}{\partial \tau^j} \right)$  the uncompensated elasticity

But we are more interested in the compensated elasticity which is the relevant paramter for welfare analysis. A compensated tax reform is defined as a simultaneous change in the marginal net-of-tax rate  $\Delta \tau$  and in the virtual income  $\Delta R$  such that the amount of tax paid at the initial labor income  $z$  is kept unchanged. Thus, if the reform is compensated at  $j=k$  then  $\Delta R^k = -\Delta \tau^k z$  (and if  $j \neq k$  then  $\Delta \tau^j = \Delta R^j = 0$ ). Then, replacing in (2) and rearranging, we have

$$\frac{\Delta z}{z} = \frac{\Delta \tau^k}{\tau^k} \left( \frac{\tau^k}{z} \frac{\partial Z}{\partial \tau^k} - \tau^k \frac{\partial Z}{\partial R^k} \right)$$

Then, we find the slusky equation into the bracket. Indeed, by definition the compensated elasticity of

$$\text{transfert } k \text{ is defined by : } \beta_{\tau^k} \equiv \frac{\tau^k}{z} \frac{\partial Z}{\partial \tau^k} - \tau^k \frac{\partial Z}{\partial R^k} \quad (3)$$

And rearranging (3) gives :

$$\begin{aligned} \frac{\tau^k}{z} \frac{\partial Z}{\partial \tau^k} &= \beta_{\tau^k} + \tau^k \frac{\partial Z}{\partial R^k} \\ \frac{\tau^k}{z} \frac{\partial Z}{\partial \tau^k} \frac{\Delta \tau^k}{\tau^k} &= \beta_{\tau^k} \frac{\Delta \tau^k}{\tau^k} + \frac{\partial Z}{\partial R^k} \Delta \tau^k \quad (4) \end{aligned}$$

By putting (4) in (2) we have

$$\frac{\Delta z}{z} = \sum_{k=1}^n \left( \beta_{\tau^k} \frac{\Delta \tau^k}{\tau^k} + \frac{\partial Z}{\partial R^k} \left( \Delta \tau^k + \frac{\Delta R^k}{z^*} \right) \right) \quad (5)$$

Then we exprime  $\Delta\tau^k$  with  $\Delta\bar{\rho}^k$  (the change in the average net-of-transfert i rate being computed while keeping the gross labor income fixed at its initial value  $z^*$ ).

$$\rho^k = \frac{y^k}{z^*} = \tau^k + \frac{R^k}{z^*}$$

$$\Delta\bar{\rho}^k = \Delta\tau^k + \frac{\Delta R^k}{z^*} \quad (6)$$

So putting (6) in (5)

$$\frac{\Delta z}{z} = \sum_{k=1}^n \left( \beta_{\tau}^k \frac{\Delta\tau^k}{\tau^k} + \frac{\partial Z}{\partial R^k} (\Delta\bar{\rho}^k) \right)$$

It gives the folowing final equation provided that we define :  $\beta_{\rho}^k = \rho^k \frac{\partial Z}{\partial R^k}$  (8) the compensated average net-of-tranfert n°i elasticity

$$\frac{\Delta z}{z} = \sum_{k=1}^n \left( \beta_{\tau}^k \frac{\Delta\tau^k}{\tau^k} + \beta_{\rho}^k \frac{\Delta\bar{\rho}^k}{\rho^k} \right) \quad (9)$$

### 2.1.2. Comparison with benchmark model of labor supply

In the benchmark labor supply model,  $z$  (or  $l$  if  $z=wl$  and  $w$  is exogenous) is determined by maximization of  $U(c, z)$  subject to the budget constraint  $c = z\tau + R$ , and thus:

$$z = \arg \max_z U\{z\tau + R, z\} = \Omega(\tau; R)$$

In this model, the paramater that matter are the global marginal net-of-tax rate  $\tau$  and the global virtual income  $R$ . The budget constraint equation (1) in our model allows to define :  $\tau = 1 - n + \sum_1^n (\tau^j)$  and

$$R = \sum_1^n (R^j)$$

In our theoretical model, the labor income  $z$  is determined by the behavioral function  $z = Z(\tau^1, \tau^2, \dots, \tau^n, R^1, R^2, \dots, R^n)$

Thus we have :  $\Omega(\tau; R) = Z(\tau^1, \tau^2, \dots, \tau^n, R^1, R^2, \dots, R^n)$

Differentiating both sides of the equation gives :

$$\frac{\partial Z}{\partial \tau^k} = \frac{\partial \Omega}{\partial \tau} \text{ and } \frac{\partial Z}{\partial R^k} = \frac{\partial \Omega}{\partial R} \text{ for } k \text{ between } 1 \text{ and } n$$

$$\text{Using (3) we have } \beta_{\tau}^k = \frac{\tau^k}{z} \frac{\partial Z}{\partial \tau^k} - \tau^k \frac{\partial Z}{\partial R^k} = \tau^k \left( \frac{1}{z} \frac{\partial \Omega}{\partial \tau} - \frac{\partial \Omega}{\partial R} \right)$$

$$\text{Using (8) we have } \beta_{\tau}^k = \rho^k \frac{\partial Z}{\partial R^k} = \rho^k \left( \frac{\partial \Omega}{\partial R} \right)$$

$$\text{And thus, } \frac{\beta_{\tau}^1}{\tau^1} = \frac{\beta_{\tau}^2}{\tau^2} = \dots = \frac{\beta_{\tau}^n}{\tau^n} \text{ and } \frac{\beta_{\rho}^1}{\rho^1} = \frac{\beta_{\rho}^2}{\rho^2} \dots = \frac{\beta_{\rho}^n}{\rho^n} \quad (10)$$

We will test this prediction by estimate each elasticities empirically (see the next section).

## **2.2. Empirical model and identification**

We estimate the following empirical counterpart of (9) for an individual  $i$  employed at data  $t-1$  and  $t$  :

$$\Delta \log z_{i,t} = \alpha + \sum_{k=1}^n \left( \beta_{\tau}^k \Delta \log \tau_{i,t}^k + \beta_{\rho}^k \Delta \log \bar{\rho}_{i,t}^k \right) + \gamma X_{i,t-1} + \xi I_t + u_{i,t} \quad (11)$$

where  $\Delta$  is the time-difference operator between dates  $t$  and  $t-1$ ,  $X_{i,t-1}$  is a vector of observed individual and firm characteristics measured in the base period (i.e.  $t-1$ ),  $I_t$  is a dummy for years, and  $u_{i,t}$  is an error term that captures unobserved and time-varying heterogeneity. The time difference is one lag since our data only allow us to calculate marginal tax rate for two consecutive year<sup>19</sup>. Thus, we estimate a short term response to tax reform. Some paper have used different lag, 3 often (Gruber & Saez 2002, Kleven & Schulz 2014) to capture medium term responses but Weber (2014) highlight that theses 3 year difference captures a combination of short-run, medium-run, and long-run responses. Moreover the literature has found overall similarity of estimates across different difference lengths (Weber, 2014). As a consequence, our result should not be much affected by another choice of lag.

According to (9) we include log change in average net-of-tax rates, computed while keeping the real labor income fixed at its pre-reform value.

$$\text{Then, } \Delta \log \bar{\rho}_{i,t}^k = \log \bar{\rho}_{i,t}^k - \log \rho_{i,t-1}^k \quad \text{and} \quad \bar{\rho}_{i,t}^k = 1 - \frac{T_j(\bar{z}_{i,t-1})}{z_{i,t-1}} \quad \text{with } k=1 \text{ to } n ; \text{ and}$$

$\bar{z}_{i,t-1} = z_{i,t-1} \times \pi_{t-1}$  where  $\pi_{t-1}$  denote the inflation between years  $t-1$  and  $t$ . Thus  $\Delta \log \bar{\rho}_{i,t}^k$  is the value of  $\rho_{i,t}^k$  given the tax reform if individuals earned their base-year income (in year  $t-1$ ).

The most apparent methodological challenge to estimate eq. (11) is that the marginal and average net-of-tax rate are endogenous to the choice of labor income, which creates a correlation between  $\Delta \log \tau_{i,t}^k$ ,  $\Delta \log z_{i,t}$ , and the error term. To address the endogeneity of the net-of-tax rate  $\tau_{i,t}^k$  we need an instrument. By far the most frequently used instrument (Auten & Carroll 1999, Gruber & Saez 2002...) is the value of  $\tau_{i,t}^k$  if the income of individual  $i$  was  $\bar{z}_{i,t-1}$  (income of year  $t-1$  adjusted for inflation between  $t-1$  and  $t$ ) and the tax code was that of year  $t$ . This instrument is thus exogenous to post-reform incomes.

Then our instrument (that we will call “type I” as in Lehmann et al., 2013) for  $\Delta \log \tau^y$  is

$$\Delta \log \bar{\tau}_{i,t}^k = \log \bar{\tau}_{i,t}^k - \log \tau_{i,t-1}^k \quad \text{with} \quad \bar{\tau}_{i,t}^k = 1 - \frac{\partial T_j(\bar{z}_{i,t-1}; t)}{\partial z}$$

But the instrument is depend on pre-reform incomes, and hence, may be correlated with the error term if the pre-reform income is correlated with the error term. This may occur through two channels largely discussed by NTR literature: (1) heterogeneous income trends, and (2) mean reversion. First, heterogeneous income trends is a problem if there is non tax related changes in gross labor income

<sup>19</sup> we have data for labor income for three consecutive year but that is not sufficient to calculate marginal tax rate : we need family composition, capital income, and individual characteristics.

between income groups, due for instance to skill-biased technical progress resulting from globalization. The risk when evaluating a tax reform is to attribute changes in gross labor income to the reform rather than to these non-tax causes, thereby causing a bias in the estimation. Second, permanent and transitory income components are included in pre-reform income, which creates a mean-reversion problem : an individual with an unusually low (respectively high) labor income in period  $t-1$  is very likely to have a higher (lower) one at  $t$ , if she find (lose) a job for instance. This non-tax causes can be absorb in the estimation effect if not controlled for.

We will treat these problem in the following section but three reason make us think that these problem could be less severe in France in the 2000' than in the US :

1/ Heterogeneous income trends is particularly important in US where top income shares has increase a lot (Piketty & Saez 2003). In France, it is not the case : the evolution of share of income group have been very stable in the period we focus and even since 1980 (see figure in appendix B). As in Denmark (Kleven & Schulz, 2014), the stable income distribution in France eliminates the threat to identification coming from non-tax changes in inequality.

2/ The issue of controlling for the effects of pre-reform income is particularly relevant when the tax reform used is targeted to high-income earners, as in most US studies (Kopczuk 2005, Weber, 2014). Since the reforms we take in account are targeted to different group of earnings (poor, median or rich household) and provide shifts in the tax system that goes in different direction (up and down, next section), the tax variation we use are not systematically correlated with income pre reform level, which make less severe the problem of mean reversion (as Lehmann et al, 2013 and Kleven & Schulz 2014) and enhance our ability to identify responses to tax reform.

3/ More generally, the quality of the data we use with detailed labor market, education, and sociodemographic information allows us to have good control variable and thus tend to minimize the problem of endogeneity of marginal net of tax rate.

In any case, we treat these two different problems as proposed by Kopczuk (2005) by including a 10-piece spline of the log difference between base-year income and income in the preceding year,  $\log z_{i,t-1} - \log z_{i,t-2}$ , to account for mean reversion and other transitory income effects, and a 10-piece spline of the gross labor income in the year preceding the base year,  $\log z_{i,t-2}$ , to control for heterogeneous shifts in the income distribution.

Weber (2014) proves that these inclusions doesn't solve completely the endogeneity problem (as pointed also by Blomquist and Selin, 2010). She<sup>20</sup> proposes another instrument which resolve better this issue, based one a function of some lag of  $\log z_{i,t}$ . Then, the instrument would be the value of  $\tau_{i,t}^J$  given the tax reform if individuals earned income of previous year (in year  $T-2$ ,  $T-3$ , ...). She highlights that the instruments is exogenous with two lag (using  $\log z_{i,t-2}$ ) and become more exogenous as the lags of income used to construct the instruments increase. Since our dataset provides information on gross labor income in year  $t-1$  and  $t-2$ , we follow this by implementing our type II instrument (or also called 'Weber type' in the literature) which is the value of  $\tau_{i,t}^J$  if the income of individual  $i$  was  $\bar{z}_{i,t-2}$  in year  $t$  (adjusted by mean wage change) and the tax code and family composition was that of year  $t$ . This specification has been recently been implemented by the majority of paper on ETI since then.

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<sup>20</sup> This instrument has been also used by type Lehmann et al. (2013).

Then our type II (or Weber type) instrument for  $\Delta \log \tau^y$  is  $\Delta \log \bar{\tau}_{i,t}^y = \log \bar{\tau}_{i,t}^y - \log \tau_{i,t-1}^y$  with

$$\bar{\tau}_{i,t}^J = 1 - \frac{\partial T_j(\bar{z}_{i,t-2}; t)}{\partial z}$$

We make several alternative specification depending of instrument and controls but our preferred specification include time dummies, a 10-piece spline of the log of t–2 labor income and a 10-piece spline of the difference in log between t–1 and t–2 labor income.

### **3. Institutional Background and source of variation**

I describe in this section the tax and benefit reforms that occurred in France during the 2006–2015 period, that I use as a source of identification. I focus here only on reforms that affect the marginal tax rates (MTR) of people<sup>21</sup>, and thus I describe first very shortly each transfer, focusing on MTR induced by these transfers. I will only consider income tax and means tested benefits, for which the amount of money taxed or received is a function of individual's income  $y_i$  or household's  $y_h$ . Note that income taken into account by the tax function is different for each transfer<sup>22</sup>. I do not go into further detail on this issue thereafter for simplification<sup>23</sup> because this doesn't affect MTR at the individual level, but these differences are fully taken into account in the simulation of each transfer (cf. infra).

Reforms can affect MTR in two ways : either changing directly the MTR inside a bracket, or either due to a change in a threshold which leads an individual to have an income in a zone with a different MTR. I highlight only the parameter changed by the reforms which affected MTR or threshold leading to different MTR.

#### **3.1. Income tax reforms**

Before focusing on income tax reforms, let's first have a shortly overview of the French income tax system.

The main specificity of the French income tax system is the income splitting mechanism which is worth explaining. Income tax in France is calculated at the tax household level (which differs from the usual notion of household<sup>24</sup>). This is a joint income taxation system where spousal incomes and any income that the couple's children's might have are jointly taxed along with the husband income (see Carbonnier, 2014 for an extensive description of the joint taxation system in France). A number of tax units  $k$  (*quotient familial*) is affected to each tax household depending on its composition<sup>25</sup>. The taxable income earned one year by all members of the tax household (income net of social contributions, abatement, and tax deductions, which I will note  $y_h$ ) is added up and then divided by the number of tax units to determine the taxable income per tax unit taxed the following year ( $y_h/k$ ). This taxable income per tax unit is taxed according to a classical progressive tax schedule (noted function  $TS_{IR}(\cdot)$ ) composed by numerous brackets associated with a marginal tax rate (see table 1). Finally, the

<sup>21</sup> There exist lump sum allowance conditionnal to other characteristics than income in France (handicap, children...). I don't describe either benefits which has not been affected be reforms since 2006, such as housing allowances.

<sup>22</sup> Depending on the inclusion of family and housing benefits, capital, and of the definition of the household taken into account.

<sup>23</sup> nor use specific notation when explaining each tax function.

<sup>24</sup> Indeed, two persons who live as a couple are considered by the administration as a single fiscal household only if they are married or linked by a civil pact.

<sup>25</sup> Husband and wife count as one unit, the first two dependent persons count as half a unit each, the third and subsequent count as one unit each.

income tax of the tax household ( $T_{IR}$ ) is computed by multiplying the taxable income per tax unit by the number of tax unit  $k$  :  $T_{IR}=kTS_{IR}(y_h/k)$ .

As a consequence of the joint taxation and application of the *quotient familial*, taxation diminishes the tax of households with more dependent persons. Given the convexity of the income tax schedule  $TS_{IR}(\cdot)$ , the income splitting mechanism reduces the income tax burden of households if  $k$  is larger than one. However, there exists a ceiling of the tax advantage due to dependent persons link to *quotient familial* in order to ensure that wealthy household with a large number of children still pay the income tax.

Last<sup>26</sup> but not least, the *décote* system contributed to change income marginal tax rate for the bottom of the scale.

The *décote* is a tax deduction for income which raises the point of entry in the income tax as well as the marginal tax rate just above. This mechanism is characterized by two parameters,  $S$  and  $r$ . Taxpayers are exempted from taxes as long as  $T_{IR} < Sr/(1+r)$  and face a marginal tax rate multiplied by a factor  $1 + r$  if  $rS/(1 + r) < T_{IR} < S$  (see Pacifico and Trannoy, 2015 and Lardeux, 2017 for more details). Thus, this haircut mechanism creates a new first hidden tax bracket (21 % instead of 14 % in 2014) at the beginning of the scale for single taxpayers.

Since 2001, an income tax credit for low-paid earners had been created, the *Prime pour l'emploi* (hereafter *PPE*), in the model of the EITC and WTC in US and UK. The amount of PPE depends on the individual full-time equivalent annual labor income, but also on the total income earned by the household. As the EITC, the PPE has two phases: a progressive phase-in (for full-time equivalent annual labor income between 0.3 and 1 time the annual minimum wage for a single worker) and a degressive phase-out (between 1 and 1.4 times the annual minimum wage). The phase-in involves negative marginal rates (-6 % in 2006) while the phase-out implies positive marginal rates (+15 % in 2006) because an increase in income reduces the area on which PPE applies and therefore its amount. We use hereafter the term “income tax” to denote both the income tax per se and the PPE.

Over the 2006–2015 period covered by our study, there have been several changes in the income tax code.

1/ First the number of brackets and the marginal tax rates have been modified many times (table 1) :

- In 2007, the number of brackets has been reduced from seven to five and the rates have decreased<sup>27</sup> : from 48,09 % to 40% for the top marginal tax rate (see table 1).
- In 2012, two additional MTR of 3 % above 250 000 euros (for single people, twice for couples) and 4% above 250 000 euros have been created. It leads to a top MTR of 45%.
- In 2013, an additional bracket has been created at 45% for income above 150 000 euros. It leads to a top MTR of 49 % taking account the 2012 reform.
- In 2014, an exceptional tax reduction took place for the bottom of the scale. This reduction is 350 euros for a single person with a net taxable income of less than 13,795 euros. Then, between 13,795 euros and 14,144 euros (differential zone) for a single person, when the reference tax income increases by one euro, the exceptional reduction also drops by one euro. This mechanism increases the marginal rate to 121% in the differential zone for single people and 114 % for couples (see Sicsic, 2017).

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<sup>26</sup> Various schemes come to complete this calculation of income tax, including reductions and tax credits and a tax collection threshold.

<sup>27</sup> It has been accompanied by a broadening of the tax base (removal of the 20% deduction on all wages).

- In 2015, the first bracket has been deleted and the parameter  $r$  of the *décote* has been modified (from 0.5 to 1), which consequently multiply the MTR in the first bracket by 2 and not by 1,5 as previously.
- The marginal tax rates of the PPE has also been widely modified in 2007 : from -6% in 2006 to -7,7% in the phase-in and from 15% to 19,3% in the phase-out.

2/ The tax thresholds of income tax *per se*, *décote* and, PPE have been modified :

- Between 2011 and 2013, tax thresholds of income tax have not been adjusted for inflation, which generated a “bracket creep” (used by Saez 2003 as source of identification). This reform was significant and salient, it led to 200 000 households to pay income tax between 2011 and 2012 and led to a saving of 20 Mds Euros for the state in 2013. It led to a massive feeling of “enough is enough”.
- Tax thresholds of *décote* (table 1) have increased a lot more than inflation in 2013, 2014 and 2015 (+9,3%, +5,5% and +11,7% for single people and +84% for couples in 2015).
- Tax thresholds of the PPE for the fiscal unit have increased by +27,2% in 2007 increasing the number of people eligible to the PPE, and since then, all thresholds have not been adjusted for inflation which generated a “bracket creep”.

3/ The ceiling of the tax advantage due to dependent persons link the “family-tax-splitting” mechanism (*Quotient Familial*) has decreased in 2013 and 2014 (from 2336 to 2000 euros in 2013 and 1500 euros in 2014). This reform led to different variations of marginal tax rate for the same level of income depending on family composition (see figure 1) and is thus a very convincing source of identification<sup>28</sup>.

4/ Overtime hours have been exempted from income tax in 2007, and have been taxed again in 2013<sup>29</sup>.

**Table 1 : Income tax schedule in France**

	parameter	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015		
		Income tax per se	Brackets	b1	0	0	0	0	0	0	0	0	0
b2	4 412			5 614	5 687	5 852	5 875	5 963	5 963	5 963	6 011	0	
b3	8 667			11 198	11 334	11 673	11 720	11 896	11 896	11 896	11 991	9 690	
b4	15 274			24 872	25 195	25 926	26 030	26 420	26 420	26 420	26 631	26 764	
b5	24 731			66 679	67 546	69 505	69 783	70 830	70 830	70 830	71 397	71 754	
b6	40 241									250 000	150 000	151 200	151 956
b7	49 624									500 000	250 000	250 000	250 000
b8										500 000	500 000	500 000	500 000
Marginal tax rate	mtr1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
	mtr2	6,83%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	5,5%	0%		
	mtr3	19,14%	14%	14%	14%	14%	14%	14%	14%	14%	14%		
	mtr4	28,26%	30%	30%	30%	30%	30%	30%	30%	30%	30%		
	mtr5	37,38%	40%	40%	40%	40%	41%	41%	41%	41%	41%		
	mtr6	42,62%							44%	45%	45%	45%	
	mtr7	48,09%							45%	48%	48%	48%	
	mtr8								49%	49%	49%	49%	
<i>Décote</i>	S	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	1		

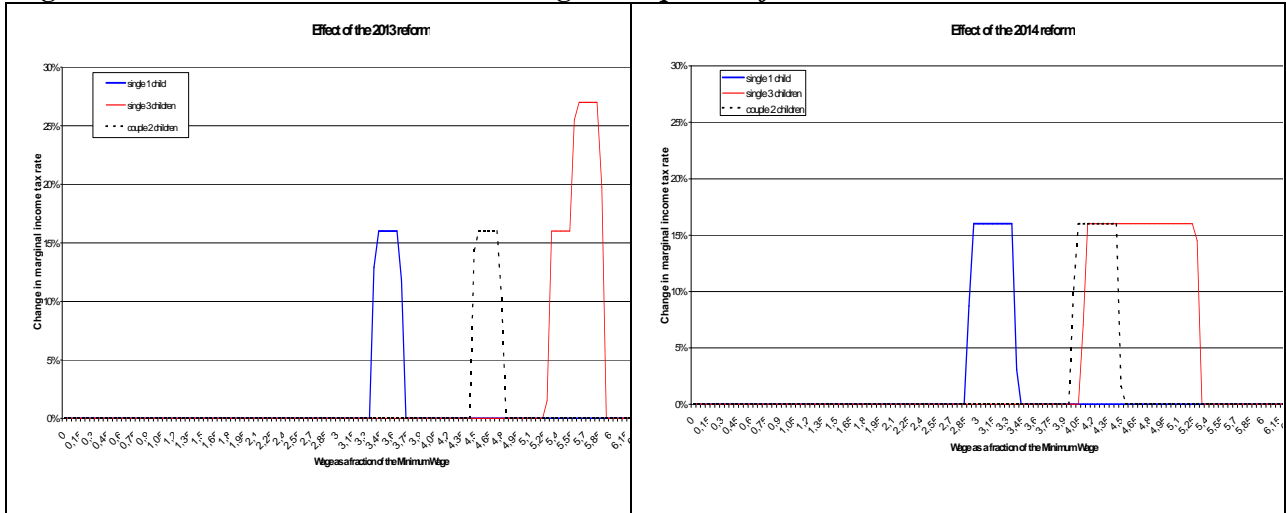
<sup>28</sup> This type of reform has already been used by Piketty (1999) and Cabannes et al. (2014) to estimate ETI.

<sup>29</sup> Cf. Cahuc and et Carcillo (2014) for more details. They shows that this reform has had no significant impact on hours worked but has had on optimization.

r1 (single)	814	828	838	862	866	878	878	960	1016	1135
r2 (couple)	814	828	838	862	866	878	878	960	1016	1870

How to read? : Individual face MTR mtr2 if taxable income is between b2 and b3.

**Figure 1 : Effect of the reforms of the ceiling of the *quotient familial***



Source : author

### 3.2. Means-tested benefits reforms

The principle of these means tested benefits is globally the same: a benefit is given under a threshold, and the benefit decreases after this threshold, leading to a positive marginal tax rate between the threshold and another threshold (income level where benefit is not longer paid<sup>30</sup>). I will note  $A_X$  the amount of the benefit  $X$  and  $Th_X$  the threshold  $N$ . We focus here on minimum income supports, in-work transfer and family allowances which have been affected by reforms between 2006 and 2015.

In France, there are several minimum income supports (/social statutory minimum) which guarantees a minimum monthly income ( $X_{\text{minimum}}$ ) to every household. The main minimum income support in 2006 was Revenu Minimum d'Intégration (RMI). As the other statutory minimum it was associated to a 100% marginal tax rate with respect to net labour income between the first euros earned and  $X_{\text{RMI}}$ : an increase of income is cancelled out by a fall of the same amount of the benefit. Other minimum income supports are targeted towards specific populations like the handicapped (AAH) or the elderly (ASPA), or invalid (ASI). In the case of ASI, the benefit is a lump sum under a threshold and then decreases after (the income zone associated with a 100% MTR is thus shifted on the right).

In 2009, the Earned Income Supplement (RSA) was created, replacing both the RMI and the Single Parent Allowance (API). The RSA is a new welfare benefit based on a specific scale so that a rise in income from working is not cancelled out by a fall in income from transfers.

Concretely, RSA is composed of two parts : RSA socle which replaces exactly RMI and is a pure minimum income support; and RSA activity, an in-work subsidy scheme whose aim is to guarantee that returning to work systematically increases the income of poor households. RSA activity has a

<sup>30</sup> Note that MTR can be infinite because of the threshold under which the benefit is not paid. This threshold exist also for income tax (Lardeux, 2017 provides detail on the consequence of this studies this threshold by bunching).



phase-in associated with a negative marginal tax rate (-62%), and a positive marginal tax rate in the phase-out (+38%). Thus in 2009, the real novelty was the introduction of the RSA activity and we will separate it from RSA socle.

Since, 2012 and the election of the socialist president in France, there has also been an increase of the amount of social statutory minimum ( $y_{\text{minimum}}$ ) above the inflation, and thus the income zone associated with a 100% MTR increased by the same amount :

- The RSA (socle and activity) has been increased of 2% each year above the inflation since 2013.
- The minimum for elderly person and invalid has been increased by 5% in 2012;

Some family allowances have also been modified :

- 'Allocations Familiales' (hereafter 'AF', literally 'family allowances') is a family allowance for parents of two or more children. Before 2014, this allowance was a "universal" lump sum and was very popular : 5 million families received Family Allowance in France. In 2015, this allowance has been means tested : it has been reduced half when annual resources exceed 67,140 euros and divided by four beyond 89,490 euros. There is a degressive mechanism to mitigate the threshold effects, inducing a 100% marginal tax rates in the two degressive zone just after the threshold.
- PAJE" (Prestation d'accueil du Jeune Enfant: literally "welcome benefit for the young child") is a monthly subsidy provided for low-income families with young children. The basic allowance amounts to 185 euros per month in 2015, provided that the total income of the families is under a threshold  $Th_{\text{paje}1}$ , then divided by 2 after, and canceled after a second threshold ( $Th_{\text{paje}2}$ ). This allowance has been reformed for families with a child born after April 1, 2014. The means conditions for benefiting from the basic allowance are tightened (thresholds  $Th_{\text{paje}1}$  and  $Th_{\text{paje}2}$  have been reduced). In addition, the wealthiest households among the eligible persons now receive the basic allowance at a reduced rate. This reform generates relatively high income losses (-1,100 euros per year on average per concerned household), for 3320,000 households (cf. FPS)<sup>31</sup>.
- The ARS ("Allocations de Rentrée Scolaire", literally a "back to school allowance") is a social benefit, means tested, paid annually at the start of the school year to families with one or more children aged 6 to 18<sup>32</sup>. After a threshold  $Th_{\text{ARS}1}$ , the benefit is degressive (associated with a MTR of 100 %) until the threshold  $Th_{\text{ARS}2}=Th_{\text{ARS}1}+A_{\text{ARS}}$ . The amount of ARS has been increased by 150 euros in 2009 exceptionally and by 25% in 2012 following the presidential election (which increases  $Th_{\text{ARS}2}$  of the same amount)<sup>33</sup>.
- The CF ("Complément familial", literally the family supplement) is a social benefit, means tested, paid annually for families with at least 3 children between 6 to 18 years old. The income ceiling ( $Th_{\text{CF}1}$ ) varies based on the number of dependent children and household makeup. A majoration of the CF has been created in 2014 for single persons with 3 children, and the CF ( $A_{\text{CF}}$ ) has been increased by 9 % in 2015.

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<sup>31</sup> In addition, the increase of the free choice of activity supplement (CLCA) for the non-beneficiaries of this allowance is eliminated.

<sup>32</sup> The amount of the benefit depends on the age of school children. In 2011, it was 285, 300 and 311 euros respectively per child from 6 to 10 years, 11 to 14 years and 15 to 18 year, and in 2012 356, 375 et 388 euros.

<sup>33</sup> It was a promise of the candidate Francois Hollande who has been elected.

## **4. Data and descriptive statistics**

### **4.1. Data**

The dataset we use is the Enquête Revenus Fiscaux et Sociaux (hereafter ERFS), which combines income tax records from the fiscal administration with administrative information from organizations in charge of distribute benefits<sup>34</sup>, and with the French Labor Force Survey (hereafter LFS).

The core of this base is thus constituted by administrative data, which have the advantage of providing exhaustive and reliable data. The income variable used in the estimation come from this source. Indeed, administrative income tax records report in year  $t$  the annual posted labor income earned at dates  $t-2$ ,  $t-1$  and  $t$  (for each member of the tax unit). The variable is reported by the employer and controlled by the fiscal administration, and as such is reliable. Income tax records provides also other type of income for the whole tax unit, family size, age, matrimonial status, deductions asked, and furthermore, all pieces of information contained in taxpayers tax forms.

But since there is limited information on individual characteristics in these administrative data, LFS is matched with, which provide a great variety of socio-demographic variable. The LFS is a rotating 18-month panel in which individuals are interviewed during six consecutive quarters. Individuals interviewed at the 4th quarter of year- $t$  in the LFS are matched with their year- $t$  administrative income tax records to generate the year- $t$  wave of the ERFS dataset. So 1/3 of the individual in LFS is thus present during two consecutive years in the ERF dataset and two ERFS can thus be matched.

The matching between LFS and income tax records reduces the size of the data, but this allows to have a lot more information, and so : (1) to better simulate income tax and transfers by microsimulation (see below), and (2) to control in a rich way for mean reversion and trends in the income distribution. Note that ERFS data are representative of the population residing in France using weight computed by Insee.

### **4.2. Sample used**

We first match each ERFS database between 2007 and 2015 with the ERFS of the preceding year, and then pooled of these database, which lead a database composed of 9 panel of two years (with information of year  $t-1$  and  $t-2$  also as previously explained in the previous section) and approximately 100,000 individuals.

We then restrict the sample to individuals who experienced no change in their marital status between dates  $t-1$  and  $t$ , since those who marry, divorce, or become widowed have to make several tax returns before 2013. In addition, we exclude public sector workers, as they are subject to very specific labor market regulations, and the self-employed due to the complexity of their system. Moreover, we just keep individuals whose income in base year is more a quater of the annual minimum wage (around 3000 euros), since means reversion is very strong under this income level. Finally, we restrict the sample to employees who report a positive labor income at dates  $t-2$ ,  $t-1$  and  $t$ . Our final sample comprises 64,403 individuals.

### **4.3. Computation issues of MTR**

Since marginal and average tax rates are not directly observed in the data, and we therefore have to simulate them for each taxpayer. In order to do that, we compute the tax and benefit system in France

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<sup>34</sup> Caisses nationales d'allocations familiales (Cnaf) et d'assurance vieillesse (Cnav) et de la Caisse centrale de la mutualité sociale agricole (CCMSA).

very precisely using a tax simulator adapted from the INES, a micro-simulation model provided by INSEE and DREES<sup>35</sup> which is based on the ERFIS data. While this model simulate the tax schedule of year N depending on the income of year N-1 for income tax and N-2 for some benefits, we adapt it to simulate the tax schedule of the same year that the income. We obtain very close simulated transfer compared to level observed<sup>36</sup>.

Thanks to these simulation, we are able to compute marginal tax rates (MTR) of each tax and benefit, by increasing labor income by 5% for each individual. Indeed, even if in the same household, the marginal tax rates can be different for each person in the household (husband, wife, student child..). Since, disposable income is calculated at the household level, it need to simulate the tax and benefit as many times as there are people in the household. Finally, as administrative tax records also provide informations on the labor income at  $t-1$  and  $t-2$ , we are able to compute our two types of instruments: instrument I based on  $w_{i,t-1}$  and instrument II based on  $w_{i,t-2}$ .

#### **4.4. Descriptive statistics** *(incomplete)*

### **5. Results** *(incomplete)*

#### **5.1. baseline results**

We estimate equation (11) with the following transfer taken into account : income tax ('IT'), RSA activité, Minimum income support ('mimumum'), PAJE, ARS, CF, Allocation familiales ('AF').

My preferred specification uses type II instrument (Weber type) and includes all covariates, a 10-piece spline in the log of  $t-2$  income to control for divergence in the income distribution and a 10-piece spline of the log difference between base-year income and income in the previous year, to control for mean-reversion (following Kopczuk, 2005).

The estimation yields compensated elasticity of income tax of approximately 0.2 for income tax reforms (see table 3), 0.1 for in-work reforms, and not significant for other means-tested benefits (family allowance and minimum support). This can be explain by the fact that income tax reforms (and in-work reforms to a lesser extent) are more salient than benefit reforms. Ideed Chetty et al. (2009) show that consumers underreact to taxes that are not salient.

I test various grouping of benefits in table 3 but that don't change the whole picture. The compensated elasticity of income tax don't change much (at 0.23/0.24). When RSA activity is grouped with other means tested benefit, it is no longer significant. Other grouping of means tested benefit are neither significant.

Our estimation of the elasticity of labor income with respect to marginal net-of-income tax is in the range of previous finding of elasticity of total income or labor income. In US, Auten and Carroll (1999) find an elasticity of gross income of 0.66, 0.12 for Gruber and Saez (2002), 0.4 for Saez (2001). As for the elasticity of labor income, Kleven and Schulz (2014) obtained elasticities in a range of 0.05/0.12,

<sup>35</sup> The model Ines is in open access since June 2016. A detailed description and its source code can be found on the Adullact website (<https://adullact.net/projects/ines-libre>). A less technical description can be found on the INSEE website: <http://www.insee.fr/en/methodes/default.asp?page=modeles/modele-ines.htm>.

<sup>36</sup> The Ines model simulates relatively well the benefits and deductions taken into account: the vast majority are simulated with less than 10% of errors, and the largest in terms of mass with less than 5% (for example the income tax, CSG and CRDS or family allowances). See the document which presents the deviations to the targets on the following link: [https://adullact.net/docman/?group\\_id=940&view=listfile&dirid=2135](https://adullact.net/docman/?group_id=940&view=listfile&dirid=2135).

Blomquist and Selin (2010) find a responses of 0.2 for men (and 1/1.4 for women) in Sweden, and Lehmann et al. (2013) find a compensated elasticity of labor income of 0.2 in France. This latter study is the closest to our about methodology and data, and results are very consistent.

**Table 3 : Estimates of the elasticities with respect to net-of-tax rates depending transfers aggregation**

	(1)	(2)	(3)	(4)	(5)	(6)
$\beta_{\tau}^{IT}$	0.233***	0.233 ***	0.243 ***	0.231 ***	0.242***	0.232***
$\beta_{\tau}^{RSAactivity}$	0.083 ***	0.089 ***	0.002	0.089 ***	0.003	-0.020
$\beta_{\tau}^{\min\text{imun}}$	0.002	0.002		0.002		
$\beta_{\tau}^{PAJE}$	0.103	-0.052	0.101	-0.040	-0.063	
$\beta_{\tau}^{ARS}$	-0.001		-0.125			
$\beta_{\tau}^{CF}$	-0.036		-0.033			
$\beta_{\tau}^{AF}$	0.347	0.301	0.382			
$\beta_{\rho}^{IT}$	0.889 ***	0.903 ***	0.887 *	0.911***	0.907 ***	0.900***
$\beta_{\rho}^{RSAactivity}$	0.636 ***	0.712 ***	0.076 *	0.738***	0.094 ***	0.095 ***
$\beta_{\rho}^{\min\text{imun}}$	0.031	0.033		0.034		
$\beta_{\rho}^{PAJE}$	-0.104	-0.091	-0.040	0.082**	0.110 ***	
$\beta_{\rho}^{ARS}$	1.968 ***		2.118 *			
$\beta_{\rho}^{CF}$	-0.074		0.051			
$\beta_{\rho}^{AF}$	0.044	0.425 ***	-0.022			
Covariates	√	√	√	√	√	√
G&S splines	√	√	√	√	√	√
Kopczuk controls & splines	√	√	√	√	√	√
Observations	64 403	64 403	64 403	64 403	62 258	

Note : Estimation of equation (11) by 2SLS using type II instruments, splines and covariates

IT= Income tax

PAJE=Prestations d'Accueil du Jeune Enfant

ARS= Allocations de rentrée Scolaire

CF= Complément familial

AF= Allocations Familiales

Respectively \*, \*\*\*, and \*\*\* denotes significance at 10 %, 5% and 1%

Sample : employees present two consecutive years, whose income is more a quarter of the annual minimum wage (3000 euros).

Source : ERFS

## **5.2. Robustness checks**

Hereafter, we group PAJE, ARS, and CF since these schemes are very close and few individuals face change in MNTR of these transfers. We test in table 4 different inclusion of covariate, controls of base-year income and instrument.

**Table 4: Elasticities for different controls of base-year income and instrument**

	(1) Type I Instrument	(2) Type I Instrument & covariates	(3) Type I Instrument & covariates & G&S splines	(4) Type I Instrument & Kopczuk controls & splines	(5) Type II Instrument & controls & G&S splines	(5) Type II Instrument & Kopczuk controls & splines
$\beta_{\tau}^{IT}$	<b>0.158</b>	<b>0.109 ***</b>	<b>0.072 ***</b>	<b>0.044 ***</b>	<b>0.331 ***</b>	<b>0.233 ***</b>
$\beta_{\tau}^{RSAactivity}$	0.391	0.331 ***	0.060 ***	0.037 ***	0.104 ***	0.089 ***
$\beta_{\tau}^{\min\text{imun}}$	-0.067	-0.058 ***	-0.012 ***	-0.022 ***	-0.009	0.002
$\beta_{\tau}^{ARS+CF+PAJE}$	0.003	-0.001	-0.003	-0.003	0.023	-0.052
$\beta_{\tau}^{AF}$	-0.023	0.070	0.345	0.255	0.306	0.301
$\beta_{\rho}^{IT}$	1.721	1.133 ***	0.953 ***	0.780 ***	1.122 ***	0.903 ***
$\beta_{\rho}^{RSAactivity}$	2.580	1.386 ***	0.364 ***	0.570 ***	0.447 ***	0.712 ***
$\beta_{\rho}^{\min\text{imun}}$	0.529	0.285 ***	-0.095 ***	0.012	-0.028	0.033
$\beta_{\rho}^{ARS+CF+PAJE}$	1.040	0.416 ***	-0.037	-0.214 ***	-0.083	-0.091
$\beta_{\rho}^{AF}$	-0.235	-0.156 **	-0.065	-0.301 ***	0.128	0.425 ***
Covariates		√	√	√	√	√
G&S splines			√	√	√	√
Kopczuk controls & splines				√		√
Instrument	Type 1	Type 1	Type 1	Type 1	Type 2	Type 2
Observations	64 403	64 403	64 403	64 403	62 258	62 258

Note : Estimation of equation (11) by 2SLS using instruments I and II. All regressions include time dummies.

IT= Income tax

PAJE=Prestations d'Acceuil du Jeune Enfant

ARS= Allocations de rentrée Scolaire

AF= Allocations Familiales

Respectively \*, \*\*, and \*\*\* denotes significance at 10 %, 5% and 1%

Sample : employees present two consecutive years, whose income is more a quater of the annual minimum wage (3000 euros).

Source : ERFS

Previous estimation has not been weight (neither with income or with the weight of the sample of the LFS). In table 6, we test to weight estimation.

### Table 5 Weight effects

Work in progress

## 5.2. Heterogenous effets

In his section, we estimate equation (11) with our preferred specification across various subsamples.

We just estimate elasticities of income tax to keep enough people in the sample. Indeed, since other schemes affect few people, there will not be enough people to estimate other elasticities.

First, we create subsamples depending on the income level of the base year (table 6). The compensated elasticity is higher for the top decile (1.4). This is consistent with the finding of Gruber and Saez (2002).

**Table 6 : Elasticities depending level of income**

	(1) Bottom 50%	(2) Middle 40%	(3) Top 10%
$\beta_{\tau}^{IT}$	<b>0.247***</b>	<b>0.402***</b>	<b>1,385***</b>
$\beta_{\rho}^{IT}$	1.736 ***	1.024 ***	0.229 ***
Covariates	√	√	√
G&S splines	√	√	√
Kopczuk controls & splines	√	√	√
Observations	30224	25993	7345

Note : Estimation of equation (11) by 2SLS using type II instruments, splines and covariates

IT= Income tax

Respectively \*, \*\*\*, and \*\*\* denotes significance at 10 %, 5% and 1%

Sample : employees present two consecutive years, whose income is more a quarter of the annual minimum wage (3000 euros).

Source : ERFS

Table 7, 8 and 9 compute elasticities for different type of people. Main findings are the following : compensated elasticities is close depending gender (but income effect are higher for women), elasticities are higher for single, and for people between 20 and 40 years old.

**Table 7 : Elasticities depending gender**

	(1) women	(2) men
$\beta_{\tau}^{IT}$	<b>0.227***</b>	<b>0.273***</b>
$\beta_{\rho}^{IT}$	1.116 ***	0.823 ***
Covariates	√	√
G&S splines	√	√
Kopczuk controls & splines	√	√
Observations	27872	35756

Note : Estimation of equation (11) by 2SLS using type II instruments, splines and covariates

IT= Income tax

Respectively \*, \*\*\*, and \*\*\* denotes significance at 10 %, 5% and 1%

Sample : employees present two consecutive years, whose income is more a quarter of the annual minimum wage (3000 euros).

Source : ERFS

**Table 8 : Elasticities depending family composition**

	(1) Single without children	(2) Single with children	(3) couple without kids	(4) couple with kids
$\beta_{\tau}^{IT}$	<b>0.464 **</b>	<b>0.517 **</b>	<b>0,353 **</b>	<b>0.030</b>

$\beta_{\rho}^{IT}$	2.860 ***	2.828 ***	0.988 ***	0.448 ***
Covariates	√	√	√	√
G&S splines	√	√	√	√
Kopczuk controls & splines	√	√	√	√
Observations	8447	1570	13706	21630

Note : Estimation of equation (11) by 2SLS using type II instruments, splines and covariates

IT= Income tax

Respectively \*, \*\*\*, and \*\*\* denotes significance at 10 %, 5% and 1%

**Table 9: Elasticities depending age**

	(1) 20/30	(2) 30/40	(3) 40/50	(3) 50+	
$\beta_{\tau}^{IT}$	<b>0.793 ***</b>	<b>0.073</b>	<b>0.032</b>	<b>0.174 **</b>	
$\beta_{\rho}^{IT}$	2.916 ***	0.741 ***	0.474 ***	0.890 ***	
Covariates	√	√	√	√	
G&S splines	√	√	√	√	
Kopczuk controls & splines	√	√	√	√	
Observations	6648	14786	20071	18187	

Note : Estimation of equation (11) by 2SLS using type II instruments, splines and covariates

IT= Income tax

Respectively \*, \*\*\*, and \*\*\* denotes significance at 10 %, 5% and 1%

Sample : employees present two consecutive years, whose income is more a quarter of the annual minimum wage (3000 euros).

Source : ERFS

### 5.3. Effect on other margins / cross elasticities (to be completed)

**Conclusion** (to be completed)

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## Appendix A : Literature on structural labor supply model

Structural models of labor supply can be separate in two main categories : continuous supply models (a) and discrete choice models (b).

The continuous structural labor supply model is based on the standard labor supply framework but several enrichments have been added to make it more realistic by taking into account the fixed cost of work using the two step procedure of Heckman, the labor market imperfection (and existence of the minimum wage), intra familial decisions...

This literature has pointed small elasticities for male workers (see Pencavel, 1986 for a survey and Triest, 1990) and much larger for female workers (Killingsworth and Heckman, 1986, Heckman, 1993, Eissa, 1995) but decreasing over time (Blau and Kahn, 2007). See also Blundell and MaCurdy, 1999, Kean 2011, for extensive survey<sup>37</sup>.

However, the continuous structural labor supply model based on marginal calculus becomes very complicated when more general and flexible model specifications are used. Thus, discrete choice models of labor supply, based on the random utility modeling approach, have gained widespread popularity, mainly because they are much more practical than the conventional continuous approach based on marginal calculus. Indeed, it allows to deal more easily with nonlinear and nonconvex economic budget constraints, and to apply general functional forms of the utility. Creedy and Kalb (2005) surveyed the literature on discrete choice models, and for applications, see van Soest (1995), Duncan and Giles (1996), Bingley and Walker (1997), Blundell et al. (2000), Van Soest et al. (2002), Haan and Steiner (2005), Bargain (2005), Bargain and Orsini (2006), Creedy et al. (2006), Labeaga et al. (2008), Blundell and Shephard (2012), and Bargain et al. (2014).

In this method, identification is based on difference of taxation for individuals with the same income and on variation of income depending on localization. But labor supply elasticities of discrete choice models are not analytically deduced from the supply function and must be calculated numerically by performing repeated simulations a large number of times (Bargain et al., 2014). This computation of elasticities can make comparison difficult depending on the method used. Moreover, the non linearity of discrete choice models add to the difficulty of comparing them : depending on the variation of the incentives to work taken into account (to simulate the ex ante effect of a welfare reform for instance), results can be different.

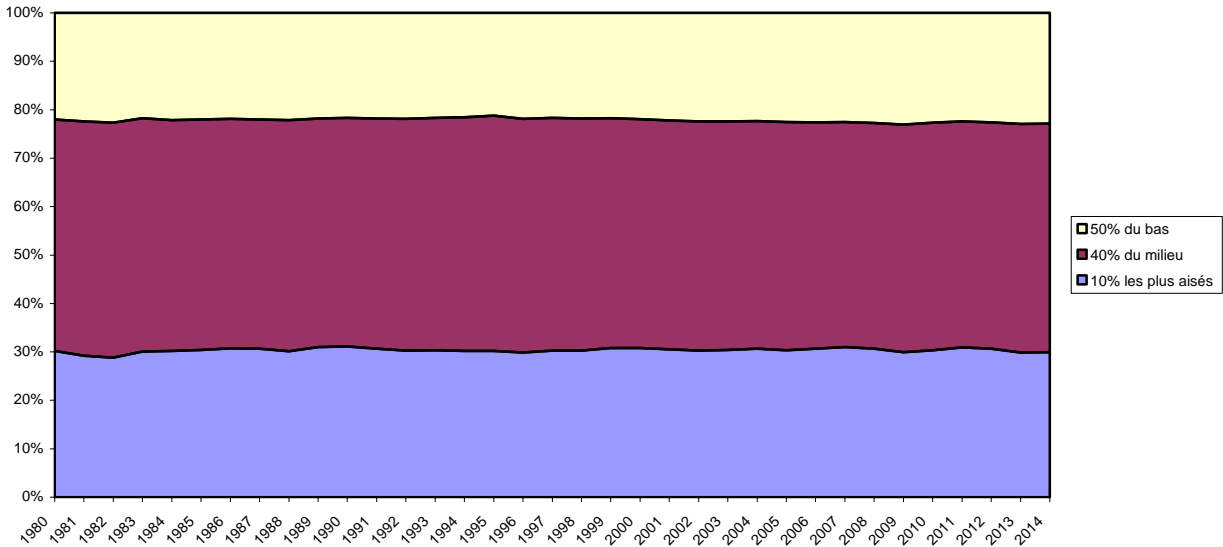
Compared to reduced form estimate, the advantage of the structural approach is that the model can be used for any hypothetical tax reform, and it should have high general applicability because it endeavors to estimate the deep underlying structural parameters. But, serious concerns have been raised about the ability of structural models to generate robust predictions about the effects of policy changes (Thoresen and Vatto (2015).

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<sup>37</sup> Hausman (1985) HPE, vol. 1, Moffitt (2003) HPE, vol. 4, Blundell, MaCurdy and Meghir (1985) HPE, vol. 1)

# Appendix B : Evolution of share of different income group since 1980

Part du revenu fiscal total détenu par les ...



source : WID