Institut sur la retraite et l'épargne
HEC MONTRÉAL

Labor Supply Responses to Income Taxation among Older Couples: Evidence from a Canadian Reform

CAHIER DE RECHERCHE Nº 10
WORKING PAPER No. 10

Derek Messacar

Novembre / *November* 2022

Retirement and Savings Institute

Dépôt légal : Bibliothèque et Archives nationales du Québec et Bibliothèque et Archives Canada, 2022.
ISSN 2561-9039

SDG-13359

Labor Supply Responses to Income Taxation among Older Couples: Evidence from a Canadian Reform*

Derek Messacar†

November, 2022

Abstract

This paper estimates real and avoidance responses to income taxation among older couples in Canada. Using administrative data and exploiting a unique reform affecting tax on pension income, I observe large effects on labor supply using an instrumental variables approach. However, workers respond to compensated changes in their average rather than marginal tax rates, consistent with 'schmeduling' behavior. Further, I show that taxable incomes vary with the availability of deductions, offering credible evidence of tax planning within couples. These findings provide new insights into the black box of intra-household labor supply and have implications for estimating excess burden of taxation.

JEL Codes: D13, H24, H26
Keywords: Elasticity of taxable income; tax avoidance; unitary model; collective model; schmeduling; empirical density design; instrumental variables

*I thank Luc Bissonnette, David Gray, Kory Kroft, Robert McMillan, Pierre-Carl Michaud, René Morissette, James Poterba, Tammy Schirle, Sita Slavov, Michael Smart, Julie Turcotte, and Shintaro Yamaguchi for comments and advice. I also thank the Economic Studies and Policy Analysis Division of the Department of Finance Canada and the Social Analysis and Modelling Division of Statistics Canada. This paper benefitted from the feedback of seminar participants at HEC Montréal, Canadian Labour Economics Forum (CLEF) inaugural conference, National Tax Association (NTA) 109th Annual Conference on Taxation, Quebec Inter-University Centre for Social Statistics (QICSS) Future Well-Being of the Elderly conference, and Canadian Economics Association (CEA) 51st Annual Conference. Any errors are my own.

†Department of Economics, Memorial University; Retirement and Savings Institute, HEC Montréal.

1 Introduction

The aging workforce poses challenges for economic growth, national saving, and the solvency of public pension systems (OECD, 2014). To address these concerns, governments have been increasing retirement ages and strengthening work incentives to raise employment rates among older workers (OECD, 2012). These reforms are based on a large literature in economics that finds pension receipt and retirement decisions respond to the incentives that public pensions create (Baker and Benjamin, 1999; Feldstein and Liebman, 2002; Baker et al., 2003; French and Jones, 2012). In contrast to these reforms, the tax codes of many countries offer age-related deductions and reduced taxation of pension income (OECD, 2011), which lower effective tax rates and create ambiguous labor supply incentives. The extent to which older workers respond to income taxes—so that the tax code is a viable policy lever for influencing labor supply—has not received considerable attention in empirical research (Schmidt and Sevak, 2009; Alpert and Powell, 2014). A better understanding of how older workers respond to changes in personal income tax rates and liabilities would inform the optimal designs of both income tax and retirement income systems.

This paper provides new insights into this empirical issue by estimating both market-based ('real') and avoidance responses to changes in personal income taxation, focusing on a unique reform from Canada that explicitly targeted the tax liabilities of older couples. Specifically, in 2007, the federal government of Canada introduced pension income 'splitting,' which permits pensioners to notionally allocate a share of their private pension income to their lower-income spouses for tax planning purposes. This was designed to provide older couples with dependent spouses who have reduced ability to pay taxes with a method of lowering their combined tax burdens. When income is split, the effective tax rate of each individual may either decrease or increase depending on whether that individual sends or receives income, respectively. Using administrative data for a 20 percent nationally representative sample of tax filers and employing several quasi-experimental methods around the timing of this reform, I show that couples are very responsive to income tax changes along both real and perceived margins, but not always in a manner consistent with expectations. Implications of these findings for estimating the excess burden of taxation are also discussed.

To that end, the empirical analysis proceeds in two stages. First, I estimate the labor income responses of individuals to the introduction of this tax avoidance technology using an instrumental variables (IV) approach.[1] In addition to the different effects that pension income

[1] In practice, changes in labor income over time may result from both real and evasion responses to personal income taxation. I posit that the introduction of pension income splitting did not meaningfully alter the relative incentive for pensioners to evade paying labor income taxes so that any change in this source of income can be interpreted as a market-based response.

splitting had on the taxes of high- versus low-income spouses within couples, key design features of the policy resulted in couples being affected differently based on the pensioners' age and whether the pension income being split derives from employer-sponsored pension plans (EPPs), as described later. This creates several margins of variation to exploit empirically. Following Auten and Carroll (1999) and Gruber and Saez (2002), instruments are constructed for tax rates and liabilities that vary over time due solely to this reform.

These results indicate that changes in effective income tax rates induce large labor income responses conditional on being employed.[2] However, in contrast with expectations, individuals appear more responsive to changes in the average tax rate (ATR) rather than the marginal tax rate (MTR), after controlling for changes in their total tax bills resulting from the reform. I show formally that this type of tax reform permits me to separately identify the effects of the ATR and total tax liability on labor income, which is not possible when the reform analyzed is a direct change in the tax schedule as in most of the related literature. This provides the first test of 'schmeduling' responses to income taxation—where the average price is used as a proxy for marginal price when nonlinear pricing schedules are complex and difficult to understand (Liebman and Zeckhauser, 2004)—in a quasi-experimental research design. The compensated elasticities of labor income with respect to the effective average net-of-tax share and marginal net-of-tax share are estimated to be 0.433 and −0.006, respectively, of which only the former is statistically significant.[3] The relevance of the ATR and tax progressivity together imply that older workers under-estimate the true cost of working and over-supply labor at the margin. In addition, large participation responses to changes in both individuals' own tax liabilities and to those of their spouses are observed.

In the second stage, I extend the analysis to consider how total taxable income responds to changes in tax rates and assess the extent to which couples coordinate effectively to reduce joint tax liabilities following the introduction of pension income splitting. Specifically, in an empirical density design (Saez, 2010), I estimate magnitudes of bunching in the distributions of individuals' taxable incomes at discontinuities in their effective MTRs created by federal and provincial/territorial government tax and transfer systems. A comparison of the magnitudes of pre- versus post-reform bunching credibly identifies the effect of income splitting from other real and avoidance responses. The results show that bunching is small in the pre-reform period as well as in the post-reform period among unmarried individuals and couples without a pensioner who are ineligible to use this avoidance technology by design. In contrast, bunching is substantial in the post-reform period among couples with a pensioner eligible to

[2] An effective tax rate refers to the rate individuals face taking into account the personal income tax schedule; the effects of allowances, credits and deductions; and indirect effects from transfer programs.

[3] The net-of-tax share is defined as 1 minus the tax rate.

split income. Such behavior occurs for two reasons: (i) high-income earners send income to their spouses up to the point where their MTRs fall into a lower bracket; and (ii) low-income earners receive income but only up to the point where their MTRs would otherwise enter a higher bracket. This is consistent with a strategy of minimizing the joint tax liabilities of couples under a piecewise-linear MTR schedule. Hence, pensioners are using this tax-planning tool not only to reduce their own tax liabilities, but also taking into account the taxes of their spouses. This offers credible evidence of intra-household tax avoidance that depends on the availability of deductions.

Taken together, these findings suggest that estimates of the excess burden of taxation are confounded by several factors. In an individual income tax system, cross-spouse responses create real effects that must be accounted for. In addition, consistent with a growing body of evidence, the availability of tax deductions biases estimates of the elasticity of taxable income (ETI) and, as shown here, this result continues to hold for deductions that require spousal coordination. Lastly, the evidence of schmeduling behavior indicates that estimates of the excess burden based on responses to the MTR rather than the ATR are biased downward given that a relevant margin of adjustment is omitted.

This paper proceeds as follows. The next section briefly reviews the related literature to provide context for this analysis. Then, Section 3 describe the institutional details of relevance to this study including key features of the tax reform analyzed. Section 4 describes the dataset and sample selection. Section 5 presents a stylized model from the taxable income literature augmented to include cross-spouse responses and tax avoidance, from which comparative statics of interest are derived to help guide the empirical analysis. Sections 6 and 7 assess the responses of labor and taxable income to changes in personal income tax, respectively. In Section 8, the analysis is briefly extended to test for heterogeneous responses to the tax reform. Lastly, Section 9 concludes.

2 Literature Review

This study contributes to several related literatures. Many studies estimate the ETI with respect to the marginal net-of-tax share, which have produced a range of findings owing to the diversity of reforms analyzed and methods used (Saez et al., 2012).[4] Of direct relevance

[4]Much of this research centers on tax reforms enacted in the United States, including the Economic Reform Tax Act of 1981, the Tax Reform Act of 1986, and the Omnibus Budget Reconciliation Acts of 1990 and 1993. Examples of such studies are Auerbach and Slemrod (1997), Carroll (1998), Moffitt and Wilhelm (1998), Gruber and Saez (2002), Giertz (2007), and Giertz (2010). Others investigate more recent reforms, including the Economic Growth and Tax Relief Reconciliation Act of 2001 and the Jobs and Growth Tax Relief Reconciliation Act of 2003, such as Heim (2009) and Singleton (2011). In addition, Gelber and Mitchell (2012) provide a comprehensive analysis of the combined effects of these reforms on the labor supply and

are studies that estimate the elasticity of taxable labor or wage income (Moffitt and Wilhelm, 1998; Saez, 2003; Blomquist and Selin, 2010; Bosch and van der Klaauw, 2012; Kleven and Schultz, 2014). This work tends to find lower elasticities than for taxable income, perhaps owing to inflexible labor contracts, search costs, or work preferences (Chetty et al., 2011). Another explanation is that individuals may use the ATR as a proxy for the MTR due to the complexity of nonlinear income tax schedules. This hypothesis has been tested in other contexts—Ito (2014) shows evidence of such behavior in electricity consumption—but this paper is the first to show that schmeduling occurs with income taxes in a quasi-experimental design.[5] These findings inform discourse on public finance problems of tax salience and financial literacy (Chetty et al., 2009; Finkelstein, 2009; Chetty and Saez, 2013; Taubinsky and Rees-Jones, 2015; Feldman et al., 2016).

Relatedly, while income tax reforms have been found to have small effects on real economic activity, they can induce large changes in taxable income due to avoidance (Saez et al., 2012). Channels through which individuals can avoid or delay paying income taxes include making tax-deductible charitable donations or contributing to retirement saving vehicles (Stiglitz, 1985; Auten et al., 2002; Bakija and Heim, 2008). Re-timing income payments or shifting income from the personal to the corporate tax base are relevant channels for business owners (Goolsbee, 2000; Gordon and Slemrod, 2000; Kreiner et al., 2016; Gorry et al., 2017). Further, Wolfson and Legree (2015) posit that income splitting occurs between business owners and their family members for tax evasion. The effect of pension income splitting on the magnitude of tax avoidance is consistent with prior evidence that the ETI—a measure once viewed as a sufficient statistic for the efficiency cost of taxation (Feldstein, 1995, 1999; Slemrod and Yitzhaki, 2002)—is manipulable by policy-makers (Kopczuk, 2005).

Lastly, this paper follows Gelber (2014) in assessing how individuals' labor supply decisions respond to changes in their own taxes relative to those of their spouses, offering new insights into the validity of unitary versus collective models of dual labor supply using a reduced-form approach. Prior research tends to implement these models (semi-)structurally (Blundell et al., 2007; Gustman and Steinmeier, 2004, 2009; Laitner and Silverman, 2012; Michaud and Vermeulen, 2011; van Soest and Vonkova, 2014).

home production of men and women. Examples of studies for other countries include Sillamaa and Veall (2001) for Canada, Blomquist and Selin (2010) and Gelber (2014) for Sweden, and Kleven and Schultz (2014) for Denmark.

[5] de Bartolome (1995) shows that there are as many individuals who use the ATR as if it was the MTR as there are individuals who correctly use the MTR in a controlled trial.

3 Institutional Details

This section gives an overview of Canada's personal income tax system, including details of the pension income splitting reform most relevant for the analysis.

3.1 Canada's Income Tax System: An Overview

Personal income taxation in Canada is based on a measure of taxable income minus permitted deductions, then credits are applied to determine the net amount payable. The unit of taxation in Canada is the individual; however, the system recognizes individuals may have reduced abilities to pay when they have dependent spouses or relatives, and may offer assistance in the form of additional credits or by permitting transfers of dependents' unused credits to the tax payers.

There are two levels of personal income tax: federal and provincial/territorial. Each level applies its own tax rates to a uniform measure of taxable income and offers its own credits to determine the net amount of income tax owed. In 2012, federal taxable income was divided into four brackets: the first \$42,707 of income; from \$42,708 to \$85,414; from \$85,415 to \$132,406; and \$132,407 or more. The marginal tax rates for these brackets were 15, 22, 26, and 29 percent, respectively. The federal basic exemption in 2012 was \$10,822, where the MTR applied to taxable income below this threshold was zero. At provincial/territorial levels, there is a lot of heterogeneity in income tax structures and rates.[6] Provinces/territories tend to set tax thresholds that fall in between federal tax brackets, a fact that I exploit in the analysis to identify bunching at these thresholds.

Two kinks in effective MTRs created by clawback provisions of tranfer programs are also assessed. The first is a public pension, which pays a demogrant benefit to individuals aged 65 and over who meet legal status and residence requirements (Baker et al., 2003).[7] The maximum annual public pension benefit was \$6,540 in 2012. If annual net world income exceeds a fixed amount, recipients must repay part or all of the pension benefit; the income threshold was \$69,562, and the recovery tax rate was 15 percent in 2012. Second, unemployment insurance in Canada offers temporary financial benefits to the unemployed,

[6] For example, in 2012: (i) Alberta imposed a flat tax rate of 10 percent on taxable income above a basic personal exemption of \$17,282; (ii) Newfoundland and Labrador, Prince Edward Island, Quebec, Ontario, Manitoba, and Saskatchewan had only two provincial tax brackets; (iii) New Brunswick, Northwest Territories, Yukon, and Nunavut had three provincial/territorial tax brackets; and (iv) Nova Scotia and British Columbia had four provincial tax brackets.

[7] This program is called Old Age Security (OAS). There is also a means-tested public pension called the Quebec Pension Plan (QPP) in the province of Quebec and the Canada Pension Plan (CPP) in all other provinces/territories. The CPP/QPP is not a focus of analysis in this study; henceforth, 'public pension' refers to the OAS.

including regular benefits for those who lose their jobs through no control of their own and sickness benefits for people unable to work. Among individuals who received regular benefits with net incomes exceeding a fixed threshold of $57,375 in 2012, they may be required to repay up to 30 percent of the lesser of net income in excess of the threshold and the total regular benefits paid in the past year.

3.2 Pension Income Splitting Reform

On October 31, 2006, the federal government of Canada announced that couples would be permitted to split private pension income with their spouses. Specifically, private pension recipients can now allocate up to 50 percent of eligible income to their spouses to reduce joint tax liabilities. The legislation implementing this tax reform was enacted in June, 2007, applicable to the 2007 and subsequent tax years (Woolley, 2007). The timing of this reform is ideal for this study because it was announced late, and thus not highly anticipated, but reliably implemented shortly thereafter and well before the end of the fiscal year.

There are several age-dependent restrictions on the sources of income that qualify for splitting. If a pensioner is aged 65 or over, eligible pension income includes lifetime annuity payments under EPPs, registered retirement savings plans (RRSPs), and registered retirement income fund payments.[8] However, if a pensioner is less than 65 years old, eligible income only includes lifetime annuity payments from EPPs and certain benefits received because of the death of a spouse.

4 Data and Sample Selection

This study is based on an analysis of the Longitudinal Administrative Databank (LAD) from Statistics Canada. The LAD is a 20 percent nationally representative panel dataset of personal income tax records for individuals and their census families based on files obtained from the Canadian central tax authority.[9] The LAD contains a wide set of variables about demographics, earnings, income, taxes, transfers, credits, allowances, and tax-deductible saving. The Canadian Tax and Credit Simulator (CTaCS) of Milligan (2016) is used to predict effective tax rates and liabilities using this wide breadth of information.

The initial sample consists of Canadian tax filers aged 53 to 69 in the reference year, from

[8] RRSPs are similar to, for example, individual retirement accounts (IRAs) in the United States. They are defined contribution plans that individuals set up and maintain through financial institutions.

[9] While individuals file tax returns independently in Canada, census families (both legal and common-law) were created in the tax data based on the spousal Social Insurance Number (SIN) listed on each individual's tax form or by matching based on name, address, age, sex, and marital status. Hence, the LAD provides data on both individuals and their spouses, which is needed to carry out this intra-household analysis.

2001 to 2012—a time interval centering on the pension income splitting reform. This age range was chosen for methodological reasons discussed in Section 6; intuitively, it ensures individuals are old enough to collect a pension and young enough to have a high incidence of employment. Additional restrictions are discussed in the IV analysis. Summary statistics for this sample are shown in Table 1. On average, individuals are 60.1 years old, of whom 51.5 percent are female and 72.8 percent are married (including common-law relationships). Many individuals have income from labor (59.9 percent), investments (41.2 percent), public pensions (22.1 percent), and private pensions (25.4 percent). In the restricted sample pertaining to the IV analysis, an even larger amount of households have income from at least one spouse from labor (77.4 percent) and private pensions (44.2 percent). This indicates the reform potentially affected taxes payable and labor decisions for many couples. The mean and median MTRs of individuals are 22.1 and 23.6 percent, respectively.

[Table 1 here]

5 Conceptual Framework

This section presents a stylized conceptual model from the taxable income literature to motivate the analysis and provide a framework for interpreting the results. Specifically, I extend the model of Gruber and Saez (2002) to include dual labor supply and a tax avoidance technology in the spirit of Chetty (2009), which couples may use to reduce their joint tax liabilities. In the next sections, to set up the empirical analyses I extend this model to derive predictions for how individuals respond to changes in their own and their spouses' tax rates and liabilities, which form the basis of the statistical models used.

5.1 Setup

In the unitary and collective models of dual labor supply, a single economic agent maximizes a weighted average of utilities for the individual and spouse, denoted i and s respectively. This is achieved by choosing consumption, c, and taxable labor incomes, z_i and z_s, conditional on personal traits given by the vectors d_i and d_s. As in Kleven and Schultz (2014), I assume z_i and z_s depend on such factors as hours worked or effort and that these are separable from consumption in utility. Personal traits can include individual factors, such as age and education, as well as factors that are common to both spouses, such as family composition and household size. The term $\lambda \in [0, 1]$ is a sharing rule (Pareto weight), which gives the influence of individual i on market outcomes. I also assume the individual and spouse receive pension incomes, $\bar{y}_j \geq 0$, which are exogenous and taxed equivalent to labor income, and there is a fixed cost (in utility terms) of supplying labor in the amount $k^j \geq 0$, for each $j \in \{i, s\}$. The utility maximization problem is:

$$\max_{\{z_i,z_s,x\}} U(c, z_i, z_s, x; d_i, d_s) \equiv \lambda u^i(c, z_i, z_s; d_i) + (1-\lambda)u^s(c, z_i, z_s; d_s) \\ - \mathbb{1}(z_i > 0)k^i - \mathbb{1}(z_s > 0)k^s - v(x) \quad (1)$$

subject to:

$$c = w_i + w_s \quad (2)$$

$$w_i = (z_i + \bar{y}_i - x)(1 - \tau^i) + R^i \quad (3)$$

$$w_s = (z_s + \bar{y}_s + x)(1 - \tau^s) + R^s \quad (4)$$

$$x \in [-\bar{y}_s, \bar{y}_i] \quad (5)$$

as well as $z_i, z_s \geq 0$. The variables w_i and w_s are the after-tax incomes (ATIs) of the individual and spouse, respectively, which takes into account the couple's use of the tax avoidance technology, x. The MTR is τ^j and the virtual income is R^j, for each $j \in \{i, s\}$. Note that $R^i = R^s = R$ in the unitary model. The function $\mathbb{1}(\cdot)$ is an indicator function.

The tax avoidance technology is a transfer of taxable income from the individual to the spouse, which is permissible by law and facilitates the reduction in joint tax liabilities. Only pension income is eligible for splitting given by the constraint in equation (5), which is consistent with the institutional setting. The term $v(x)$ is a 'resource' drain of splitting x measured in utility, which may reflect shared effort by the couple from coordination and measurement of tax rates and liabilities. I assume v is strictly convex, twice continuously differentiable, and satisfies $v(0) = 0$ and $v_x(0) = 0$; hence, the marginal cost increases with the amount split. This setup is consistent with recent evidence that individuals sometimes struggle to understand or respond to specific features of the tax code (Chetty et al., 2009; Jones, 2012; Chetty and Saez, 2013; Ito, 2014; Feldman et al., 2016).

Lastly, I follow Browning et al. (2006) in distinguishing between unitary and collective models by the way that the sharing rule is defined. This weight only depends on exogenous factors within the unitary model, $\lambda \equiv \lambda(d_i, d_s)$, whereas in the collective model it also depends on prices, $\lambda \equiv \lambda(1-\tau^i, 1-\tau^s; d_i, d_s)$. In the related literature, the variables d_i and d_s—called distribution factors, such as the sex ratio in the local population or the income ratio within the household—do not typically enter preferences (Browning et al., 1994, 2006). Distinguishing between personal traits and distribution factors would yield an excluded instrument for the sharing rule thereby providing the only testable restrictions for the collective model in the absence of price variation (Bourguignon et al., 2009), but such distinctions can be arbitrary in practice. Instead, I derive excluded instruments utilizing quasi-experimental variation in the variables of interest from the tax reform.

The setup assumes a static model is sufficient to capture all relevant decisions of older workers—including when to retire, which is an inherently dynamic process. This is made for simplicity given that modeling the collective framework in a dynamic setting is particularly challenging (Mazzocco, 2007; Blundell et al., 2016; Chiappori and Mazzocco, 2017). However, the model accounts for labor market participation decisions, which includes retirements, and comparative statics of the model are well-represented by this approach.

5.2 Equilibrium

I implicitly solve for the optimal labor income and pension income splitting decisions without further assumptions on preferences, such as functional form. Holding z_s and x constant and conditional on the individual being employed, optimal labor income $\tilde{z}_i$ is solved for by first-differencing equation (1) with respect to z_i:

$$\lambda\big(u_c^i(1-\tau^i)+u_{z_i}^i\big)+(1-\lambda)\big(u_c^s(1-\tau^i)+u_{z_i}^s\big)=0 \tag{6}$$

The optimum for the spouse's labor income conditional on being employed, $\tilde{z}_s$ is similarly obtained, for a given z_i and x; hence, $\{\tilde{z}_i(z_s,x),\tilde{z}_s(z_i,x)\}$ characterize the intensive margin labor solution. Then, the employment decision depends on the utility gain from working relative to the cost. The optimal labor income is:

$$\begin{aligned}\{z_i^*,z_s^*\}\in \arg\max_{\{z_i,z_s\}} U\big(&(z_i+\bar{y}_i-x)(1-\tau^i)+R^i\\ &+(z_s+\bar{y}_s+x)(1-\tau^s)+R^s,z_i,z_s,x;d_i;d_s\big)-\mathbb{1}(z_i>0)k^i-\mathbb{1}(z_s>0)k^s\end{aligned} \tag{7}$$

It follows that $z_j^*\in\{0,\tilde{z}_j\}$ for each $j\in\{i,s\}$. Such behavior only depends on the effect of ATI on consumption—an income effect (Alpert and Powell, 2014).

Denote by $\tilde{x}$ the desired pension income splitting conditional on the constraint in equation (5) being non-binding. As before, this amount is solved for by first-differencing equation (1) with respect to x:

$$\big(\lambda u_c^i+(1-\lambda)u_c^s\big)(\tau^i-\tau^s)-v_x(\tilde{x})=0 \tag{8}$$

Splitting occurs up to the point where the marginal benefit of consumption equals the marginal cost of using the technology. Income is transferred from the individual to the spouse ($\tilde{x}>0$) if $\tau^i>\tau^s$, and from the spouse to the individual ($\tilde{x}<0$) if $\tau^i<\tau^s$; no splitting occurs ($\tilde{x} = 0$) if $\tau^i = \tau^s$. The optimal splitting is:

$$x^* = \begin{cases} -\bar{y}_s, & \text{if } \big(\lambda u_c^i|_{x=-\bar{y}_s} + (1-\lambda)u_c^s|_{x=-\bar{y}_s}\big)(\tau^i - \tau^s) < v_x(-\bar{y}_s) \\ \bar{y}_i, & \text{if } \big(\lambda u_c^i|_{x=\bar{y}_i} + (1-\lambda)u_c^s|_{x=\bar{y}_i}\big)(\tau^i - \tau^s) > v_x(\bar{y}_i) \\ \tilde{x}, & \text{otherwise} \end{cases} \tag{9}$$

6 Effect of the Reform on Labor Income

I now consider individuals' labor income responses to changes in their own tax rates and liabilities and to those of their spouses resulting from the reform, using the approach of Gruber and Saez (2002) and the related literature. This section begins by describing the empirical method, including the statistical model and construction of the instruments. Then, I present the empirical results for the ETI with respect to the marginal net-of-tax share, test of schmeduling behavior, and several robustness checks.

6.1 Predicted Effect

The individual's predicted labor income responses to changes in their own marginal net-of-tax share and to that of their spouse are obtained by totally differentiating equation (6) with respect to $(1-\tau^i)$ and $(1-\tau^s)$, respectively, and evaluating at $\{\tilde{z}_i, z_s^*, x^*\}$:

$$\begin{aligned} \mathrm{d}\tilde{z}_i = \Gamma\big(\lambda u_c^i + (1-\lambda)u_c^s\big)\mathrm{d}(1-\tau^i) \\ - \Theta\big((\tilde{z}_i + \bar{y}_i - x^*)\mathrm{d}(1-\tau^i) + \mathrm{d}R^i\big) - \Lambda \mathrm{d}z_s^* - \Theta(\tau^i - \tau^s)\mathrm{d}x^* \\ + \Gamma\big((u_c^i(1-\tau^i) + u_{z_i}^i) - (u_c^s(1-\tau^i) + u_{z_i}^s)\big)\lambda_{1-\tau^i}\mathrm{d}(1-\tau^i) \end{aligned} \tag{10}$$

$$\begin{aligned} \mathrm{d}\tilde{z}_i = -\Theta\big((\tilde{z}_i + \bar{y}_i + x^*)\mathrm{d}(1-\tau^s) + \mathrm{d}R^s\big) - \Lambda \mathrm{d}z_s^* - \Theta(\tau^i - \tau^s)\mathrm{d}x^* \\ + \Gamma\big((u_c^i(1-\tau^i) + u_{z_i}^i) - (u_c^s(1-\tau^i) + u_{z_i}^s)\big)\lambda_{1-\tau^s}\mathrm{d}(1-\tau^s) \end{aligned} \tag{11}$$

where Γ, Θ, and Λ are constants that depend on model parameters and second-order partial derivatives of utility (see Online Mathematical Appendix). Denote by ω^j the share of those with positive labor income, $z_j^* > 0$. The total effect of a change in the marginal net-of-tax share is $\mathrm{d}z_j^*/\mathrm{d}(1-\tau^j) = \omega^j \mathrm{d}\tilde{z}_j/\mathrm{d}(1-\tau^j)$, for each $j \in \{i, s\}$.[10]

[10]More precisely, ω^j is a binary variable in this representative-agent model, $\omega^j = 1$ if j is employed and $\omega^j = 0$ otherwise, for each $j \in \{i, s\}$. This variable would fall on the $[0, 1]$ interval in a generalized model in which agents have heterogeneous preferences or labor supply costs, although the model's implications are the same in either case.

Equation (10) shows that the individual's response to a change in the own marginal net-of-tax share decomposes into: (i) a price effect, evaluated relative to the marginal utility of consumption weighted across both spouses; (ii) an income effect, expressed as the infra-marginal effect of the reform relative to $(\tilde{z}_i + \bar{y}_i - x^*)$ and the change in virtual income, $\mathrm{d}R^i$; (iii) a cross-spouse labor response, $\mathrm{d}\tilde{z}_s$; and (iv) the influence of a change in splitting, where the direction of this effect depends on whether the MTR is higher for the individual or spouse.[11] Equation (11) shows that the individual's response to a change in the spouse's marginal net-of-tax share has income, labor, and splitting effects. In this case, the cross-spouse income effect is expressed as the infra-marginal effect relative to $(\tilde{z}_s + \bar{y}_s + x^*)$ and the change in virtual income, $\mathrm{d}R^s$. The last term in each equation is the marginal change in bargaining power arising from the changes in prices, evaluated relative to the difference in each spouse's pre-reform bargaining positions. Given that $\mathrm{d}\lambda/\mathrm{d}(1-\tau^j) = 0$ for each $j \in \{i, s\}$ in the unitary model, this term is present only in the collective model. Gugl (2009) shows how this change in bargaining position can also exacerbate inequality within the household.

6.2 Empirical Model

This analysis is structured around the comparative statics of the conceptual model. The empirical approach accounts simultaneously for the effects predicted by equations (7), (10) and (11). Re-writing those equations in a general estimable form yields:

$$\begin{aligned}\Delta F(z_{it}) = \alpha + \beta\Delta\ln(1-\tau_{it}) + \gamma\Delta\ln(W_{it} - T_{it}) + \delta\Delta\ln(W_{st} - T_{st})\\ + \zeta\Delta F(z_{st}) + X_{it}'\theta^i + X_{st}'\theta^s + f[z_{it}] + f[z_{st}] + f[W_{it}] + f[W_{st}] + \eta_{it}\end{aligned} \quad (12)$$

where W_{jt} is taxable income, T_{jt} is the tax liability, $\tau_{jt} = \mathrm{d}T_{jt}/\mathrm{d}z_{jt}$ is the MTR (for small $\mathrm{d}z_{jt}$), and X_{jt} are observed covariates, for each $j \in \{i, s\}$.[12] The statistical residual is η_{it}. This model is estimated along two margins: (i) extensive, $F(z) = \mathbb{1}(z > 0)$; and (ii) intensive, $F(z) = \ln(z)$ subject to $z > 0$. Modelling the extensive margin is challenging because the decision is binary; first-differencing the dependent variable makes a linear probability model the preferred empirical approach. A wide set of covariates are included in the regressions to control for individual and household characteristics that vary across individuals and over time that may indirectly affect labor supply decisions. Specifically, the following variables are included: (i) demographics—age, spouse's age, female, family composition, indicator for having a child/children, immigrant status, and province of residence fixed effects; (ii)

[11] I formally derive $\mathrm{d}x^*$ in the Online Mathematical Appendix.

[12] More precisely, the MTR is calculated using CTaCS as $\tau_{jt} = \mathrm{d}T_{jt}/\mathrm{d}W_{jt}$ for a small change in taxable income, $\mathrm{d}W_{jt}$, induced by a change in labor income, $\mathrm{d}z_{jt}$.

income—capital gains, investments, RRSP withdrawals, unemployment insurance income, and social assistance income for the individual and spouse; (iii) savings—RRSP contributions for the individual and spouse; (iv) deductions—medical expenses and disability allowances for the individual and spouse. The intensive margin also controls for job-specific variables including union status, EPP coverage and industry of employment fixed effects of the individual, which partly addresses an implicit assumption of the model that hourly wages are uncorrelated with changes in taxes so that the full burden of the reform operates through time spent working (Gelber, 2014). I control flexibly for base period labor and taxable incomes, where f is a 10-piece spline, to account for mean reversion. Note that the extent to which results are robust to alternative methods of controlling for mean reversion is considered as a robustness check of the baseline findings. Tax liability is an implicit function of income and family characteristics, as well as a vector of tax parameters. Formally, $T_{jt} = T(\Psi_{jt}, \chi_{jt}; \Pi_t)$ subject to $\Psi_{jt} = \{W_{it}, W_{st}\}$ and $\chi_{jt} = \{X_{it}, X_{st}\}$, and where Π_t is the set of tax parameters at time t. Lastly, the model need not include $\mathrm{d}x^*$ explicitly because the introduction of pension income splitting is built into the instrumental variables.

Notice that the spouse's MTR does not enter into this baseline empirical model and that this specification is robust to whether the unitary or collective framework is used. This arises because the unit of taxation in Canada is the individual and so the spouse's tax rate is only levied on spousal income. A small change in the spouse's MTR does not affect the value of an extra $1 earned by the individual. However, the change in the spouse's MTR is still a relevant determinant of the individual's labor supply given that infra-marginal effects are expected to induce real responses, although this is captured by the variable for the spouse's ATI. Blundell et al. (2016) reach a similar conclusion in the context of a family model of labor supply responses to wage shocks. However, I also present results that include the spouse's MTR as robustness checks.

The compensated ETI with respect to the marginal net-of-tax share, controlling for income effects of the reform through the changes in the ATIs, is captured by β.[13] I obtain a simple measure of the uncompensated ETI by excluding the ATI variables from the estimating equation. This approach follows Gruber and Saez (2002), who use log-approximations to derive an equation containing the compensated elasticity and an income effect term.[14] The theory predicts $\beta = 0$ for the extensive margin, and $\beta > 0$ for the intensive margin as workers substitute from leisure to work following a decline in the cost of working. Further, in both

[13] Alpert and Powell (2014) control for selection of older workers in the labor market; however, their approach cannot be used here since the tax reform affected pension income rather than labor income. The authors show that controlling for selection has little effect on intensive margin elasticities.

[14] In contrast, Gelber (2014) estimates Marshallian supply functions and then uses the Slutsky relationship to obtain the compensated (Hicksian) elasticities.

the extensive and intensive margin analyses it is expected that $\gamma, \delta < 0$ as income effects of the reform permit individuals to purchase more leisure.

Throughout the analysis, I report test statistics for whether the income pooling prediction of the unitary model, $\gamma = \delta$, is supported by the data. This offers insight into the validity of unitary versus collective models of dual labor supply. However, it is important to keep in mind that the unitary model test is embedded in an identification strategy that relies on the efforts of both spouses to split income to reduce household tax burdens. As such, it is likely that this coordinated tax planning also induces coordinated real responses to a greater extent than if the tax shocks of both spouses were perfectly orthogonal. I partially address this issue by constructing the instrumental variables in a way that relies on cross-spouse coordination but takes the level of coordination to be exogenous based on policy parameters. More generally, this unitary model test can be interpreted as a measure of the extent to which couples choose to coordinate on labor supply conditional on there being some exogenous tax instrument that prompts them to reflect together on the matter of household tax liabilities. To the extent that the unitary model is better supported in this study compared with the related literature, it simply suggests that couples' labor supply decisions are sometimes consistent with the unitary model under the right conditions. As it will be shown, I reject the unitary model in some cases despite the type of identification strategy used.

6.3 Identification

The instruments are predicted variables for the changes in the effective marginal net-of-tax shares and ATIs of the individual and spouse resulting from the reform, holding everything else constant. Denote by π the parameter governing pension income splitting and $\tilde{\Pi}_t$ the vector of all other tax parameters at time t. The predicted ATI variable is:

$$\hat{W}_{jt} = W_{j,0} + \hat{x}_{jt} \tag{13}$$

for $t \in \{0, 1\}$ coinciding with the pre- and post-reform years, respectively. In turn, $\hat{x}_{jt}$ is a *predicted* amount of income received from the spouse (if $\hat{x}_{jt} > 0$) or sent to the spouse (if $\hat{x}_{jt} < 0$) through splitting, for each $j \in \{i, s\}$. Note that $\hat{x}_{j,0} = 0$ since pension income splitting was not permissible in the pre-reform period. It follows that $\Delta\hat{W}_{jt} = \hat{x}_{j,1}$, i.e., the predicted ATI changes over time due solely to the reform. Two assumptions are needed to calculate $\hat{x}_{jt}$. First, sources of pension income are inferred using the longitudinal component of the data. Workers observed with an EPP contribution at least once during normal working years prior to the tax reform are assumed to receive their private pension income from EPPs, while all others are treated as drawing the income from non-workplace accounts and are subject to the age restriction for splitting. This assumption is necessary because it is not possible to observe the source of private pension income (e.g., payments from employer-sponsored pensions, private annuities) in the tax records. Second, I assume that the high-income earner transfers to the low-income spouse up to a point where taxable incomes are equal or the amount split equals 50 percent of the sender's private pension income, whichever is less. This is consistent with joint tax minimization subject to the relevant tax regulations. Taken together, the instruments for the marginal net-of-tax share and ATI are:

$$\Delta \ln(\widehat{1-\tau_{jt}}) = \ln\left(1 - \frac{\mathrm{d}T(\hat{\Psi}_{j,t+1}, \chi_{jt}; \pi, \tilde{\Pi}_t)}{\mathrm{d}z_{jt}}\right) - \ln\left(1 - \frac{\mathrm{d}T(\Psi_{jt}, \chi_{jt}; \Pi_t)}{\mathrm{d}z_{jt}}\right) \tag{14}$$

$$\Delta \ln(\widehat{W_{jt} - T_{jt}}) = \ln\left(\hat{W}_{j,t+1} - T(\hat{\Psi}_{j,t+1}, \chi_{jt}; \pi, \tilde{\Pi}_t)\right) - \ln\left(W_{jt} - T(\Psi_{jt}, \chi_{jt}; \Pi_t)\right) \tag{15}$$

where $\hat{\Psi}_{jt} = \{\hat{W}_{it}, \hat{W}_{st}\}$ for each t. In equations (14) and (15), the only factor that changes within individuals over time is due to the reform.

The marginal net-of-tax share and ATI are separately identified by the nonlinear tax schedule; the variation across individuals (between couples) comes from differences in the predicted amounts to be split, age, and past EPP coverage; and the variation across individuals (within couples) comes from the different effects of splitting on high- versus low-income earners. Importantly, a transfer of income from one spouse to the other tends to have weakly inversely-related mechanical effects on tax rates and liabilities, which must be overcome to separately identify individual and cross-spouse effects of the reform; otherwise, for example, the estimated cross-spouse income effects will simply be approximately inverse of the individual income effects. In reality, this issue is not a concern because the percentage change in each spouse's income depends on both the amount of pension income split, which is common to both spouses, and the level of pre-reform income, which is unique to each spouse. Thus, the reform permits me to credibly estimate several labor supply parameters.

Figure 1 illustrates the variation in tax rates and liabilities induced by the reform relative to the actual changes realized from the pre- to the post-reform period. Specifically, it plots the share of individuals who experienced different magnitudes of change in their actual and predicted tax variables around this time. The analysis is carried out separately for pensioners who send income to their spouses and for those receiving the pension income from their spouses. Tax liability is non-increasing (non-decreasing) for senders (receivers), which occurs by design of the transfer process. Although the marginal net-of-tax share of senders (receivers) generally increases (decreases), as expected, this relationship is not perfect since the effective tax rate also takes into account the effects of federal and provincial/territorial tax and transfer programs. This analysis shows that changes in the instruments mirror actual changes over this time period quite well but there is still meaningful variation between the two. More individuals have no predicted changes in their tax rates and liabilities relative to those who actually experienced no changes. This is because a myriad of factors affect actual taxes but eligibility rules for splitting limit the number of individuals and spouses affected by the reform. For example, more than one third of senders had no predicted change in the marginal net-of-tax share for such reasons as the size of the transfer being too small to effect any change. However, there is also a large share of individuals with large changes in the predicted tax variables due to the reform in order for the effect of this variation on labor supply to be estimated with precision.

[Figure 1 here]

Throughout this analysis, I impose that individuals and spouses were at least 55 years old in 2008, the year following the tax reform, to focus on workers near the age of retirement since this is typically the earliest age for private pension benefit eligibility. In turn, individuals must have been 54 years old or less at some point between 1991 and 2006. This is imposed to assess whether EPP contributions are observed at least once during normal working years—hence, whether private pensions likely derive from EPPs and the age restriction on splitting binds to construct $\hat{x}_{it}$ and $\hat{x}_{st}$. EPP contributions are observed in the data from 1991 onward. These two conditions imply individuals and spouses were aged 53 to 69 in 2006, as described in Section 4. In addition, individuals must be observed throughout the period of analysis to estimate the model by first-differences, which is satisfied in 93.9 percent of cases. They must also have been married during this time in order to estimate cross-spouse responses. Lastly, this analysis centers on the tax years 2006 and 2007 to assess contemporaneous labor responses. Although these sample restrictions are imposed for methodological reasons, Table 1 shows that compositional changes are negligible.

6.4 Primary Results

Table 2 begins by showing the first-stage results from equation (12), for both the extensive and intensive margins. As expected, the instruments are strong predictors of the actual variation in tax rates and liabilities around the the tax reform. I follow the recommendation of Sanderson and Windmeijer (2016) of considering the standard F-Statistic and the Cragg-Donaldson F-Statistic on the basis that each specification includes multiple endogenous variables, as well as the Kleibergen-Paap rk LM statistic, as described in the table's notes. In all cases, these standard tests indicate that the model is exactly and strongly identified. Overall, the predicted tax variables provide credible sources of exogenous variation in taxes with which to estimate the effects of interest. The standard errors throughout this analysis are clustered by individual.[15]

[Table 2 here]

The second-stage results are shown in Table 3 using both ordinary least squares (OLS) and IV estimators. The downward bias from OLS for the marginal net-of-tax share due to tax progressivity is apparent. There is also an upward bias in the OLS estimates for the ATIs, which arises because individuals with higher labor income are more likely to have higher total income. Along the extensive margin, the uncompensated IV regression suggests individuals respond meaningfully to increases in the marginal net-of-tax share by becoming more likely to work. However, this is absorbed in the compensated regression, which shows that individuals respond solely to income effects as expected. The statistic reported for the test of the unitary model is the p-value associated with the t-test of equality of the coefficients on the ATIs of the individual and spouse. In this case, individuals appear more responsive to changes in their own tax liabilities and the unitary model is statistically rejected, although significant and economically meaningful cross-spouse responses are observed. The results are similar along the intensive margin, where the marginal net-of-tax share is a weak determinant of labor income in contrast with expectations. Each 1 percent increase in the ATIs of the individual and spouse reduce labor income by 0.133 and 0.112 percent, respectively, which is this time consistent with the income-pooling prediction of the unitary model.

[Table 3 here]

The failed test of the unitary model for the extensive margin results is puzzling given that this test is embedded in an identification strategy that implies coordinated tax planning within spouses, as previously discussed. One possibility is that the result is driven by functional form assumptions. Equation (12) assumes that the log of the ATI is the correct variable for measuring labor income responses, which is an assumption derived from the literature but that could create problems for comparisons when initial incomes are different. The pension income splitting experiment is a transfer from the high-income spouse to the low-income spouse such that the transfer may increase the low-income earners' log ATIs by more than it decreases the high-income earners' log ATIs. In practice, however, the dataset used is a representative sample of Canadian tax filers within a system where the unit of taxation is

[15] Because the LAD is a 20 percent nationally representative sample of Canadian tax filers, individuals and spouses are not typically both observed as separate observations. Thus, it is not possible to cluster this analysis by household. The spousal information that is observed in the LAD is matched to the individual tax filer as the unit of observation.

the individual. This means each individual analyzed in the regression analysis is equally likely to be the high- or low-income earner within the couple. The average base-period labor incomes of the individual and spouse are approximately $25,550 and $26,650 and the average base-period total incomes of the individual and spouse are approximately $37,050 and $37,900, respectively. Hence, there are no underlying asymmetries that could skew these results.[16]

6.5 Extensions of the Baseline Model

I now consider the robustness of the baseline results. First, I employ an alternate model specification from Gelber (2014) that includes the tax rates of both spouses, which is performed for robustness. Second, I perform an encompassing test of the significances of average and marginal tax rates in the labor income equation, following the approach of Ito (2014). This test is motivated by the prediction of Liebman and Zeckhauser (2004) that individuals respond to the ATR as a proxy for the MTR given the complexity of the nonlinear income tax schedule. While empirical evidence of such behavior is scarce, this is a new and emerging area of research in behavioral public finance; notable examples include Feldman and Katuščák (2006), Ito (2014) who tests the hypothesis in a market for domestic electricity consumption, as well as de Bartolome (1995) and Rees-Jones and Taubinsky (2016) who test for schmeduling using controlled experiments. For each $j \in \{i, s\}$, the change in the log of the average net-of-tax share is $\Delta\ln(1-\tau^a_{jt}) = \ln(1 - T_{j,t+1}/W_{j,t+1}) - \ln(1 - T_{jt}/W_{jt})$, and the predicted variable for this endogenous regressor is:

$$\Delta\ln\widehat{(1-\tau^a_{jt})} = \ln\left(1 - \frac{T(\hat{\Psi}_{j,t+1}, \chi_{jt}; \pi, \tilde{\Pi}_t)}{\hat{W}_{j,t+1}}\right) - \ln\left(1 - \frac{T(\Psi_{jt}, \chi_{jt}; \Pi_t)}{W_{jt}}\right) \tag{16}$$

The predicted changes in the average net-of-tax share and ATI both vary exogenously and are separately identified (see Online Mathematical Appendix for the proof).

Figure 2 plots the empirically-observed relationships between the average net-of-tax share with the marginal net-of-tax share and ATI, for both the actual and predicted tax variables. This shows that predicted variables reasonably approximate the true relationships but that

[16] Another possibility is that not controlling directly for a change in the sharing rule (Pareto weight) leads to bias. This leads me to test whether controlling for observables commonly used as distribution factors—which affect the sharing rule but not labor supply directly—absorbs this effect. Table A1 repeats the primary analysis controlling for the income ratio of the individual to the couple and the sex ratio in the local population from the pre-reform period. The Forward Sortation Area (FSA) is used to construct local geographies, which identifies specific rural regions, entire medium-sized cities or sections of major metropolitan areas. The results show that the income ratio is a significant determinant of labor income and that the sex ratio matters for participation. The directions of these effects are consistent with expectations; however, the results for the variables of interest remain unchanged in this case. Other factors that could influence such behavior are divorce laws, education, pre-marriage wealth, or single-person benefits (Browning et al., 2006), although these are not observed in the dataset used.

there remains substantial variation between the predicted average net-of-tax share and ATI to separately identify their effects on labor income. Thus, I estimate a compensated ETI with respect to the average net-of-tax share, which is not possible when the tax reform is a change in the MTR schedule. The statistical model is:

$$
\begin{aligned}
\Delta F(z_{it}) = \tilde{\alpha} + \tilde{\beta}\Delta\ln(1-\tau_{it}) + \tilde{\beta}^a\Delta\ln(1-\tau^a_{it}) \\
+ \tilde{\gamma}\Delta\ln(W_{it}-T_{it}) + \tilde{\delta}\Delta\ln(W_{st}-T_{st}) + \tilde{\zeta}\Delta F(z_{st}) + X'_{it}\tilde{\theta}^i + X'_{st}\tilde{\theta}^s \\
+ f[z_{it}] + f[z_{st}] + f[W_{it}] + f[W_{st}] + \tilde{\eta}_{it} \quad (17)
\end{aligned}
$$

For the intensive margin, schmeduling implies $\tilde{\beta} = 0$ and $\tilde{\beta}^a > 0$. Milligan (2009) shows that effective MTRs in Canada are complex functions of province, demographics, income sources, and other factors. For this reason, individuals may struggle to know their MTRs and use their ATRs as a proxy. This is also a concern in other jurisdictions; for example, Kotlikoff and Rapson (2007) show that effective MTRs are complicated by federal and state personal, corporate and excise taxes, payroll taxes, Social Security, Medicare and Medicaid, Food Stamps, and welfare programs in the United States. I also carry out an extensive margin encompassing test as a 'placebo' check for whether individuals only respond to income effects as predicted by the theory, $\tilde{\beta} = \tilde{\beta}^a = 0$ and $\tilde{\gamma}, \tilde{\delta} < 0$, or if the average net-of-tax share indirectly picks up some of the income effect of the reform as evidenced by $\tilde{\beta}^a > 0$.

[Figure 2 here]

The findings from Table 4 are fourfold. First, using an alternate model specification from Gelber (2014) that permits labor income to depend on the marginal net-of-tax shares of both the individual and spouse, neither price effect appears significant along either margin. Second, individuals respond solely to changes in their own and their spouses' ATIs along the extensive margin, as expected. Third, along the intensive margin, own- and cross-spouse income effects are observed but the ATR is also significant: each 1 percent increase in the average net-of-tax share increases labor income by approximately 0.433 percent. Fourth, I test whether the individual's marginal net-of-tax share is a significant determinant of labor supply using the average net-of-tax share as the excluded instrument. This specification directly imposes that individuals use the ATR as a proxy for the MTR but that, in doing so, the MTR may still matter in some way for determining labor supply. The results show that the marginal net-of-tax share remains insignificant along the extensive margin but that this variable becomes statistically significant and economically meaningful for intensive margin labor decisions. Note that the individual's ATI is insignificant in this case but the point estimate is very imprecise and I fail to reject the unitary model test. Because the tax reform analyzed affects tax filers' taxable incomes and effective tax rates rather than being a direct change to the income tax schedule, this permits me to construct the average net-of-tax share and ATI instruments so that they are not perfectly correlated without relying on functional form assumptions (which is corroborated by the extensive margin placebo test). Overall, these findings are suggestive of schmeduling behavior.

[Table 4 here]

This analysis has so far used 10-piece splines of labor and total incomes as independent regressors to control for mean reversion in the dependent variable. The ability to account for mean reversion is increasingly debated in the related literature (Weber, 2014; Kawano et al., 2016). This is because the traditional method of estimating the ETI is to compare the responsiveness of higher- and lower-income tax payers to changes in the legislated income tax schedule based on a differences-in-differences approach; the identifying assumption is that lower-income earners are a reasonable control group for their higher-income counterparts. In this study, however, identification comes from variation in treatment both within and across couples based on numerous factors including the spread in income between high- and low-income spouses; whether at least one spouse is a pensioner; the age of the pensioner; and whether that pension income derives from EPPs. Put differently, estimating the responsiveness of tax payers to changes in their effective rather than legislated tax rates following the introduction of a tax avoidance technology with unique eligibility rules helps to at least partially relax this commonly-used identifying assumption.

Table 5 explores the sensitivity of the baseline results to alternative income controls. In this case, preferred specifications from Table 4 are used in which only the ATIs are included in the extensive margin analysis and the average and marginal net-of-tax shares are also included in the intensive margin analysis. The results show that not controlling flexibly for base-period income (first two columns) leads to significantly upward-biased estimates of the ATI and average net-of-tax share. The inclusion of flexible base-period income splines corrects this bias regardless of whether the previous year's income is also accounted for (third column). However, the degree of flexibility of the base-period income is not found to meaningfully impact the results (last three columns). The unitary model is consistently rejected along the extensive margin and the average net-of-tax share is a robust determinant of intensive-margin labor decisions. In this case, increasing the degree of flexibility of base-period income reduces the precision of the estimator but does not affect the magnitude of the predicted effects. The findings are consistent with the notion that mean reversion is a potential confounding factor but, once it is controlled for, sources of variation other than between individuals of different incomes help to identify the effects of interest.

[Table 5 here]

7 Effect of the Reform on Taxable Incomes

This section extends the previous analysis to consider how the total ATIs of individuals and spouses vary with the introduction of pension income splitting and the resulting implications for credibly estimating the ETI in the presence of an intra-household tax avoidance technology. As will be shown, this analysis corroborates the previous findings that real responses to changes in MTRs are small but that individuals respond meaningfully to changes in their total tax bills.

7.1 Predicted Effect

The ETI with respect to the marginal net-of-tax share, denoted ε, which is a focus of empirical analysis in this study and much of the related literature, is given by:

$$\varepsilon = \frac{1-\tau^i}{w_i^*}\frac{\mathrm{d}w_i^*}{\mathrm{d}(1-\tau^i)} = \frac{1-\tau^i}{z_i^* + \bar{y}_i - x^*}\left(\frac{\mathrm{d}z_i^*}{\mathrm{d}(1-\tau^i)} - \frac{\mathrm{d}x^*}{\mathrm{d}(1-\tau^i)}\right) \tag{18}$$

Equation (18) shows that the ETI depends equally on real and avoidance responses but only the former is a valid measure of the excess burden of taxation. The degree to which a tax avoidance technology is being used in a population to reduce tax burdens can be inferred by comparing observed ETIs from the post-reform period relative to the pre-reform period, $\varepsilon^{\text{post-reform}} - \varepsilon^{\text{pre-reform}}$, centered on the introduction of that technology.

7.2 Empirical Analysis

Holding everything else constant, equation (18) relates variation in the ETI to take-up of the tax avoidance technology. Saez (2010) shows that the ETI relates directly to the magnitude of bunching at convex kink points in the budget set created by federal and provincial/territorial government tax and transfer systems. Thus, I estimate bunching at the lower bounds of: the second, third, and fourth federal income tax brackets; the second and third provincial/territorial tax brackets; and the thresholds at which public pension and unemployment insurance benefits are clawed back through recovery taxes.[17,18] The estimates for the public pension and unemployment insurance thresholds are conditional on individuals aged 65 and over and on those receiving insurance benefits, respectively. I credibly identify the effect of pension income splitting by assessing how bunching changes across eligibility conditions and between the pre- and post-reform periods.

Figure 3a implements the pre-reform bunching analysis. Each panel shows the distribution of taxable income normalized to the relevant tax threshold, for those with income of $10,000 on either side. Each panel also shows the estimates of: (i) a counterfactual distribution in the absence of the MTR discontinuity; and (ii) the predicted amount of excess mass, defined as the fraction of tax filers who bunch at the kink normalized by the counterfactual density (Chetty et al., 2011).[19] The results show that, while bunching is detected, the magnitude is small. Several explanations for this finding are that employees have strict preferences for full-time employment or high search costs and that firms offer inflexible work arrangements (Chetty et al., 2011). The larger response at the public pension clawback may be due to the salience of this policy, greater control over pension income, tighter financial constraints, or higher financial and tax literacy among pensioners. In contrast, the post-reform bunching analysis in Figure 3b finds substantial responses to personal income taxation. This finding is consistent with the predictions from the theoretical model: because pension income splitting income is a tax planning tool with very low use cost, take-up is expected to be high provided that couples are able to coordinate effectively.

[Figure 3a and Figure 3b here]

Table 6 shows the bunching results disaggregated by year, from 2001 to 2012. In doing so, the analysis is similar in spirit to an event study design in which treatment is identified using the empirical density design annually spanning several years preceding and following the

[17] Figures A1a and A1b of the Online Appendix plot the effective MTRs as a function of *actual* taxable income (i.e., not the simulated income calculated by CTaCS) around the relevant tax thresholds for the pre- and post-reform period, respectively. I also estimate discontinuities in the rates after taking into account the plethora of allowances, credits, deductions, and transfers that may interact with the federal and provincial/territorial tax schedules using CTaCS. This analysis shows that there are sizeable discontinuities at the tax thresholds, as expected, and that they are relatively time-invariant. Importantly, the significances of these empirically-observed discontinuities in the MTRs indicate that CTaCS is an effective simulator of tax rates and liabilities.

[18] Responses to federal and provincial/territorial basic exemptions are not considered, as they are too close to one another for credible identification; each kink would influence the other's estimated counterfactual distributions. There are also other thresholds near the basic exemptions, such as the Working Income Tax Benefit clawback, which affect sorting at low incomes.

[19] The 'bunch_count' Stata .ado file is used (Olsen, 2011). The findings are robust to using different income bandwidths; $10,000 was chosen as a round number that is sufficiently large to distinguish bunching from random variation while ensuring income ranges do not overlap across tax thresholds.

reform year. As expected, the magnitude of bunching is small in each pre-reform year and increases in the post-reform period, which highlights the fact that most of the response of the ATI to the changes in the MTR arises from avoidance behavior. Further, Table 7 decomposes bunching observed in the post-reform period across several margins that are known to affect individuals' eligibility to split income due to the policy design of this program, namely marital status and private pension receipt. As expected, individuals who are either single or married but reside in households without a pensioner exhibit small responses, whereas bunching is large and statistically significant among those in households with at least one pensioner.[20] This is indicative of highly coordinated tax avoidance behavior among couples within an institutional setting of individual income taxation.

[Table 6 and Table 7 here]

To verify that the post-reform bunching is primarily driven by pension income splitting and not any other type of sorting response, Figure 4 plots the probabilities of sending or receiving pension income through splitting around each tax rate discontinuity, in the post-reform period. As expected, significant spikes in the probabilities are observed at each threshold. The fact that spikes are observed for senders and receivers suggests that individuals and their spouses are coordinating to reduce household tax liabilities: pensioners are sending income up to the point where either their tax rates fall into a lower bracket or the tax rates of their spouses would otherwise enter a higher bracket.

[Figure 4 here]

It is important to note that, even in the pre-reform period or among those who are ineligible to split income, bunching captures a weighted average of real responses and all other possible behaviors—including tax evasion. For example, prior research finds that bunching tends to be the most prevalent among the self-employed (Feldman and Slemrod, 2007; le Maire and Schjerning, 2013; Bastani and Selin, 2014), those with income tax balances owed (Rees-Jones, 2017), or affluent households with more sophisticated tax plans (Landier and Plantin, 2017). Pin-pointing the effect of a particular avoidance technology requires exogenous variation as is done here. Further, the estimated effect of this technology on the ETI is a weighted average of treatment on the treated—in this case, bunching among those who were initially eligible to split income—and various selection effects. For example, the pension

[20] Other margins of variation in treatment include age for the public pension clawback, since only individuals aged 65 or older can receive such income, and benefit receipt for the unemployment insurance clawback. I exploit these sources of variation in Table A2 of the Online Appendix, and find—as expected—that bunching is only prevalent among individuals affected by the clawback provisions.

income splitting reform may have changed couples' incentives to: (i) draw pension income; or (ii) get married, through an implicit marriage bonus (Kesselman, 2008).[21]

8 Heterogeneity

Whereas the analysis has so far considered population-level responses, there may be heterogeneity across groups. For example, men tend to have higher financial literacy than women even at older ages (Lusardi and Mitchell, 2014). The self-employed may have the most flexibility of income reporting, and workers in jobs requiring higher education may be the most tax savvy. Tables 8 and 9 present the analyses of labor and taxable incomes, respectively, by sex, self-employment status, and industry. First, Table 8 shows that the labor income of men is more responsive to the average net-of-tax share than of women but that women respond positively to the marginal net-of-tax share. Men also respond the most to changes in the ATIs notwithstanding large responses of employed women to the ATIs of their spouses. Changes in ATIs affect employment and labor income decisions the most among the self-employed, whereas the average net-of-tax share is a stronger predictor of labor income for those not self-employed. Participation responses are largest for white collar workers—perhaps because these individuals tend to earn more and can better afford to retire—but responses are similar across industries among employed workers.

[Table 8 here]

Second, among workers ineligible for splitting, bunching is most prevalent among men, the self-employed (as expected), and agricultural or blue collar workers, as shown in Table 9. The latter finding may be due to men being disproportionately employed in these industries. For individuals with at least one pensioner in the household, in contrast, bunching is much larger and uniform across groups. This suggests the low-cost avoidance technology is being used by households to minimize tax liabilities *ex post*, net of any real responses that may or may not be occurring. This raises the question of whether the optimization occurs strategically or automatically through the use of tax software or tax-planning professionals. How tax returns were filed is not observed in the dataset used, so this issue is left for future research. Overall, there is significant heterogeneity in real responses but the avoidance technology is used consistently to minimize taxes payable, consistent with minimization of joint tax liabilities at tax season.

[Table 9 here]

[21] In Figures A2 and A3 of the Online Appendix, I show that lower-income households may have to some extent responded to these incentives. However, much of these effects are likely due to changes in sample compositions around the tax thresholds resulting from the changes in bunching.

9 Conclusion

This paper assesses the real and avoidance responses of labor and taxable income to changes in personal income taxation among older Canadian workers, with a focus on intra-household allocations. The analysis exploits both variation in tax rates at convex kink points in the budget set created by tax and transfer systems and resulting from the introduction of a new tax avoidance technology using several quasi-experimental research designs.

The results indicate that couples coordinate effectively to lower joint tax liabilities with the availability of a low-cost intra-household tax avoidance technology even in a system of individual income taxation. Further, workers respond meaningfully to changes in their own tax rates and liabilities and to those of their spouses, where the unitary model is only partially rejected. There is a growing literature on the capacity of workers to remain in the labor force at older ages. In the Canadian context, for example, Milligan and Schirle (2016) find that men and women employed in 2012 could work an additional 5 years and 2 years, respectively, if they worked at the same rate per unit of mortality risk as their 1976 counterparts. The tax code appears to be a viable instrument, alongside changes in retirement ages and active labor market policies, to influence labor supply and retirement decisions to keep these individuals working longer. However, in contrast with standard predictions from economic theory, workers respond to compensated changes in their average rather than marginal tax rates. This is consistent with the schmeduling hypothesis of Liebman and Zeckhauser (2004), whereby individuals use the average price of labor as a proxy for the marginal price given the complexity of nonlinear marginal pricing schedules.

Interestingly, while much of policy is centered on keeping older workers in the workforce, the fact that labor responds at the margin to the ATR suggests there is over-employment along the intensive margin (Ito, 2014). These findings offer new insights into the black box of intra-household labor supply and have wider implications for tax salience and financial literacy. They also imply that estimates of the excess burden of taxation based on standard individual-level responses to the MTR miss important margins of adjustment. Notably, the fact that individuals' labor decisions respond to changes in their ATRs and to the tax liabilities of their spouses must both be accounted for.

The unitary model appears to be well-supported in this study compared with the related literature. Several possible explanations are that older workers are more financially responsible, tax literate, or forward-looking than their younger and middle-aged counterparts who are often the focus of analysis. Another expanation is that this analysis centers on the introduction of a tax-planning tool that to some extent requires a collaborative effort from both spouses to be successful and, hence, cross-spouse responses are expected to be large. This suggests that tests of the validity of the unitary versus collective model must take into consideration both standard identifying assumptions and the study's underlying context or environment. More broadly, the optimal unit of taxation is a central issue in public economics (Boskin and Sheshinski, 1983; Piggott and Whalley, 1996; Apps and Rees, 1999). Income splitting is a hybrid arrangement between individual and joint (full sharing) taxation that endogenizes the mix within couples. This paper contends that the efficiency of such an arrangement to some extent depends on how intra-household allocations are determined, and finds that distortions from joint taxation are likely small among older couples notwithstanding a possible barrier to labor market participation as evidenced by the failed unitary model test along the extensive margin. This finding is consistent with Philipps (2010), who suggests that provisions for income splitting should include measures that reduce the costs to second earners of entering paid labor on the basis of gender equality. There is likely a trade-off between the additional household-level consumption benefit of income splitting and the cost of shifting lower-income spouses from paid labor to domestic production.

References

Alpert, A. and D. Powell (2014). Estimating intensive and extensive tax responsiveness: Do older workers respond to income taxes? RAND Labor & Population Working Paper WR-987-1, Santa Monica: RAND Corporation.

Apps, P. F. and R. Rees (1999). Individual versus joint taxation in models with household production. *Journal of Political Economy 107*(2), 393–403.

Auerbach, A. J. and J. Slemrod (1997). The economic effect of the Tax Reform Act of 1986. *Journal of Economic Literature 35*(2), 589–632.

Auten, G. and R. Carroll (1999). The effect of income taxes on household income. *Review of Economics and Statistics 81*(4), 681–693.

Auten, G. E., H. Sieg, and C. T. Clotfelter (2002). Charitable giving, income, and taxes: An analysis of panel data. *American Economic Review 92*(1), 371–382.

Baker, M. and D. Benjamin (1999). Early retirement provisions and the labor force behavior of older men: Evidence from Canada. *Journal of Labor Economics 17*(4), 724–756.

Baker, M., J. Gruber, and K. Milligan (2003). The retirement incentive effects of Canada's income security programs. *Canadian Journal of Economics 36*(2), 261–290.

Bakija, J. M. and B. T. Heim (2008). How does charitable giving respond to incentives and income? Dynamic panel estimates accounting for predictable changes in taxation. NBER Working Paper 14237, Cambridge: National Bureau of Economic Research.

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

Blomquist, S. and H. Selin (2010). Hourly wage rate and taxable labor income responsiveness to changes in marginal tax rates. *Journal of Public Economics 94*(11-12), 878–889.

Blundell, R., P.-A. Chiappori, T. Magnac, and C. Meghir (2007). Collective labour supply: Heterogeneity and non-participation. *Review of Economic Studies 74*(2), 417–445.

Blundell, R., L. Pistaferri, and I. Saporta-Eksten (2016). Consumption inequality and family labor supply. *American Economic Review 106*(2), 387–435.

Bosch, N. and B. van der Klaauw (2012). Analyzing female labor supply—evidence from a Dutch tax reform. *Labour Economics 19*(3), 271–280.

Boskin, M. J. and E. Sheshinski (1983). Optimal tax treatment of the family: Married couples. *Journal of Public Economics 20*, 281–297.

Bourguignon, F., M. Browning, and P.-A. Chiappori (2009). Efficient intra-household allocations and distribution factors: Implications and identification. *Review of Economic Studies 76*(2), 503–528.

Browning, M., F. Bourguignon, P.-A. Chiappori, and V. Lechene (1994). Incomes and outcomes: A structural model of intrahousehold allocation. *Journal of Political Economy 102*(6), 1067–1096.

Browning, M., P.-A. Chiappori, and V. Lechene (2006). Collective and unitary models: A clarification. *Review of Economics of the Household 4*(1), 5–14.

Carroll, R. (1998). Do taxpayers really respond to changes in tax rates? Evidence from the 1993 Tax Act. OTA Working Paper 79, Washington, DC: Office of Tax Analysis, US Department of the Treasury.

Chetty, R. (2009). Is the taxable income elasticity sufficient to calculate deadweight loss? The implications of evasion and avoidance. *American Economic Journal: Economic Policy 1*(2), 31–52.

Chetty, R., J. N. Friedman, T. Olsen, and L. Pistaferri (2011). Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from Danish tax records. *Quarterly Journal of Economics 126*(2), 749–804.

Chetty, R., A. Looney, and K. Kroft (2009). Salience and taxation: Theory and evidence. *American Economic Review 99*(4), 1145–1177.

Chetty, R. and E. Saez (2013). Teaching the tax code: Earnings responses to an experiment with EITC recipients. *American Economic Journal: Applied Economics 5*(1), 1–31.

Chiappori, P.-A. and M. Mazzocco (2017). Static and intertemporal household decisions. *Journal of Economic Literature 55*(3), 985–1045.

de Bartolome, C. A. M. (1995). Which tax rate do people use: Average or marginal? *Journal of Public Economics 56*(1), 79–96.

Feldman, N. E. and P. Katuščák (2006). Should the average tax rate be marginalized? CERGE-EI Working Paper 304, Prague: Charles University Center for Economic Research and Graduate Education-Economic Institute.

Feldman, N. E., P. Katuščák, and L. Kawano (2016). Taxpayer confusion: Evidence from the Child Tax Credit. *American Economic Review 106*(3), 807–835.

Feldman, N. E. and J. Slemrod (2007). Estimating tax noncompliance with evidence from unaudited tax returns. *Economic Journal 117*(518), 327–352.

Feldstein, M. (1995). The effect of marginal tax rates on taxable income: A panel study of the 1986 Tax Reform Act. *Journal of Political Economy 103*(3), 551–572.

Feldstein, M. (1999). Tax avoidance and the deadweight loss of the income tax. *Review of Economics and Statistics 81*(4), 674–680.

Feldstein, M. and J. B. Liebman (2002). Social security. In A. J. Auerbach and M. Feldstein (Eds.), *Handbook of Public Economics*, Volume 4, Chapter 32, pp. 1173–1249. Amsterdam: Elsevier B.V.

Finkelstein, A. (2009). E-ZTax: Tax salience and tax rates. *Quarterly Journal of Economics 124*(3), 969–1010.

French, E. and J. B. Jones (2012). Public pensions and labor supply over the life cycle. *International Tax and Public Finance 19*(2), 268–287.

Gelber, A. M. (2014). Taxation and the earnings of husbands and wives: Evidence from Sweden. *Review of Economics and Statistics 96*(2), 287–305.

Gelber, A. M. and J. W. Mitchell (2012). Taxes and time allocation: Evidence from single women and men. *Review of Economic Studies 79*(3), 863–897.

Giertz, S. H. (2007). The elasticity of taxable income over the 1980s and 1990s. *National Tax Journal 60*(4), 743–768.

Giertz, S. H. (2010). The elasticity of taxable income during the 1990s: New estimates and sensitivity analyses. *Southern Economic Journal 77*(2), 406–433.

Goolsbee, A. (2000). What happens when you tax the rich? Evidence from executive compensation. *Journal of Political Economy 108*(2), 352–378.

Gordon, R. and J. Slemrod (2000). Are "real" responses to taxes simply income shifting between corporate and personal tax bases? In J. Slemrod (Ed.), *Does Atlas Shrug? The Economic Consequences of Taxing the Rich*, pp. 240–280. New York: Russell Sage Foundation; Cambridge: Harvard University Press.

Gorry, A., K. A. Hassett, R. G. Hubbard, and A. Mathur (2017). The response of deferred executive compensation to changes in tax rates. *Journal of Public Economics 151*, 28–40.

Gruber, J. and E. Saez (2002). The elasticity of taxable income: Evidence and implications. *Journal of Public Economics 84*(1), 1–32.

Gugl, E. (2009). Income splitting, specialization, and intra-family distribution. *Canadian Journal of Economics 42*(3), 1050–1071.

Gustman, A. L. and T. L. Steinmeier (2004). Social security, pensions and retirement behaviour within the family. *Journal of Applied Econometrics 19*(6), 723–737.

Gustman, A. L. and T. L. Steinmeier (2009). Integrating retirement models. NBER Working Paper 15607, Cambridge: National Bureau of Economic Research.

Heim, B. T. (2009). The effect of recent tax changes on taxable income: Evidence from a new panel of tax returns. *Journal of Policy Analysis and Management 28*(1), 147–163.

Ito, K. (2014). Do consumers respond to marginal or average price? Evidence from nonlinear electricity pricing. *American Economic Review 104*(2), 537–563.

Jones, D. (2012). Inertia and overwithholding: Explaining the prevalence of income tax refunds. *American Economic Journal: Economic Policy 4*(1), 158–185.

Kawano, L., C. E. Weber, and A. Whitten (2016). Estimating the elasticity of broad income for high-income taxpayers. Unpublished Manuscript.

Kesselman, J. R. (2008). Income splitting and joint taxation of couples: What's fair? *IRPP Choices 14*(1).

Kleven, H. J. and E. A. Schultz (2014). Estimating taxable income responses using Danish tax reforms. *American Economic Journal: Economic Policy 6*(4), 271–301.

Kopczuk, W. (2005). Tax bases, tax rates and the elasticity of reported income. *Journal of Public Economics 89*(11-12), 2093–2119.

Kotlikoff, L. J. and D. Rapson (2007). Does it pay, at the margin, to work and save? Measuring effective marginal taxes on Americans' labor supply and saving. In J. M. Poterba (Ed.), *Tax Policy and the Economy, Volume 21*, NBER Book Series Tax Policy and the Economy, Chapter 4, pp. 83–143. Cambridge: MIT Press.

Kreiner, C. T., S. Leth-Petersen, and P. E. Skov (2016). Tax reforms and intertemporal shifting of wage income: Evidence from Danish monthly payroll records. *American Economic Journal: Economic Policy 7*(4), 243–278.

Laitner, J. and D. Silverman (2012). Consumption, retirement and social security: Evaluating the efficiency of reform that encourages longer careers. *Journal of Public Economics 96*(7-8), 615–634.

Landier, A. and G. Plantin (2017). Taxing the rich. *Review of Economic Studies 84*(3), 1186–1209.

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

Liebman, J. B. and R. J. Zeckhauser (2004). Schmeduling. Unpublished Manuscript.

Lusardi, A. and O. S. Mitchell (2014). The economic importance of financial literacy: Theory and evidence. *Journal of Economic Literature 52*(1), 5–44.

Mazzocco, M. (2007). Household intertemporal behaviour: A collective characterization and a test of commitment. *Review of Economic Studies 74*(3), 857–895.

Michaud, P.-C. and F. Vermeulen (2011). A collective labor supply model with complementarities in leisure: Identification and estimation by means of panel data. *Labour Economics 18*(2), 159–167.

Milligan, K. (2009). Time for a tune up: Personal income taxation in western Canada. GOING FOR GOLD Project Working Paper Series, Calgary: Canada West Foundation.

Milligan, K. (2016). Canadian tax and credit simulator (CTaCS). `http://faculty.arts.ubc.ca/kmilligan/ctacs`. Version 2016-2.01.

Milligan, K. and T. Schirle (2016). The health and capacity to work of older men and women in canada. (2016-03).

Moffitt, R. A. and M. Wilhelm (1998). Taxation and the labor supply decisions of the affluent. NBER Working Paper 6621, Cambridge: National Bureau of Economic Research.

OECD (2011). *Taxation and Employment*. OECD Tax Policy Studies. Paris: Organisation for Economic Co-Operation and Development.

OECD (2012). *OECD Pensions Outlook 2012*. Paris: Organisation for Economic Co-operation and Development.

OECD (2014). *OECD Pensions Outlook 2014*. Paris: Organisation for Economic Co-operation and Development.

Olsen, T. (2011). Bunch count. `http://www.rajchetty.com/chettyfiles/bunch_count.zip`.

Philipps, L. (2010). Income splitting and gender equality: The case for incentivizing intra-household wealth transfers. Research Report 4/2010, Toronto: Osgoode Hall Law School of York University.

Piggott, J. and J. Whalley (1996). The tax unit and household production. *Journal of Political Economy 104*(2), 398–418.

Rees-Jones, A. (2017). Quantifying loss-averse tax manipulation. *Review of Economic Studies*. https://doi.org/10.1093/restud/rdx038.

Rees-Jones, A. and D. Taubinsky (2016). Measuring 'schmeduling'. NBER Working Paper 22884, Cambridge: National Bureau of Economic Research.

Saez, E. (2003). The effect of marginal tax rates on income: A panel study of 'bracket creep'. *Journal of Public Economics 87*(5-6), 1231–1258.

Saez, E. (2010). Do taxpayers bunch at kink points? *American Economic Journal: Economic Policy 2*(3), 180–212.

Saez, E., J. Slemrod, and S. H. Giertz (2012). The elasticity of taxable income with respect to marginal tax rates: A critical review. *Journal of Economic Literature 50*(1), 3–50.

Sanderson, E. and F. Windmeijer (2016). A weak instrument f-test in linear iv models with multiple endogenous variables. *Journal of Econometrics 190*(2), 212–221.

Schmidt, L. G. and P. H. Sevak (2009). Taxes, wages, and the labor supply of older Americans. *Research on Aging 31*(2), 207–232.

Sillamaa, M.-A. and M. R. Veall (2001). The effect of marginal tax rates on taxable income: A panel study of the 1988 tax flattening in Canada. *Journal of Public Economics 80*(3), 341–356.

Singleton, P. (2011). The effect of taxes on taxable earnings: Evidence from the 2001 and related US federal tax acts. *National Tax Journal 64*(2), 323–352.

Slemrod, J. and S. Yitzhaki (2002). Tax avoidance, evasion, and administration. In A. J. Auerbach and M. Feldstein (Eds.), *Handbook of Public Economics*, Volume 3, Chapter 22, pp. 1423–1470. Amsterdam: Elsevier B.V.

Stiglitz, J. E. (1985). The general theory of tax avoidance. *National Tax Journal 38*(3), 325–337.

Taubinsky, D. and A. Rees-Jones (2015). Attention variation and welfare: Theory and evidence from a tax salience experiment. Unpublished Manuscript.

van Soest, A. and H. Vonkova (2014). How sensitive are retirement decisions to financial incentives? A stated preference analysis. *Journal of Applied Econometrics 29*(2), 246–264.

Weber, C. E. (2014). Toward obtaining a consistent estimate of the elasticity of taxable income using difference-in-differences. *Journal of Public Economics 117*, 90–103.

Wolfson, M. and S. Legree (2015). Policy forum: Private companies, professionals, and income splitting—recent Canadian experience. *Canadian Tax Journal 63*(3), 1–19.

Woolley, F. (2007). Policy forum: Liability without control—the curious case of pension income splitting. *Canadian Tax Journal 55*(3), 603–625.

Table 1: Summary Statistics

	Primary Sample		Restricted Sample	
	Mean	Median	Mean	Median
Demographics				
Age (Years)	60.1	60.0	60.3	60.0
Female (Percent)	51.5		50.0	
Married (Percent)	72.8		100.0	
Has Income (Percent)				
Labor	59.9		62.7	
Labor in Household	69.3		77.4	
Capital Gains	11.8		19.2	
Investments	41.2		48.3	
Unemployment Insurance	7.7		6.9	
Public Pension	22.1		19.8	
Private Pension	25.4		28.2	
Private Pension in Household	37.0		44.2	
Conditional Income (2006 Dollars)				
Labor	44,200	31,250	40,750	30,450
Capital Gains	8,450	600	9,100	950
Investments	2,800	550	2,750	550
Unemployment Insurance	5,650	4,500	5,200	4,150
Public Pension	5,100	5,800	5,050	5,850
Private Pension	20,650	17,200	22,300	19,450
After-Tax	40,700	29,700	43,750	31,000
Personal Income Tax Rates (Percent)				
Marginal	24.9	28.9	24.3	26.7
Average	14.5	16.9	16.5	18.5

Notes: The primary sample is based on 12,662,341 observations for 1,994,119 individuals pooled from 2001 to 2012. The bunching analyses draw from this sample those individuals who are localized around the relevant tax thresholds. The restricted sample consists of 476,004 individuals who meet the age and marital status requirements discussed in text to be included in the IV analysis, based on observations from the 2006 cross-section. The household statistics report the probability of the individual or spouse having such income in the reference year; these incidences are lower in the primary sample, as only the restricted sample is conditional on individuals who are married or in common-law relationships. The income statistics are conditional on those values being strictly positive, expressed in 2006 constant dollars and rounded to the nearest $50.

Table 2: First-Stage Effects, 2006 to 2007—Instrumental Variables

	Extensive Margin			Intensive Margin		
	Marginal Net-of-Tax Share of Individual	ATI of Individual	ATI of Spouse	Marginal Net-of-Tax Share of Individual	ATI of Individual	ATI of Spouse
Panel A: Uncompensated Effects						
Predicted Marginal Net-of-Tax Share of Individual	0.575***			0.572***		
	(0.004)			(0.007)		
R^2	0.201			0.149		
Panel B: Compensated Effects						
Predicted Marginal Net-of-Tax Share of Individual	0.538***	−0.406***	−0.137***	0.506***	−0.201***	−0.107**
	(0.005)	(0.030)	(0.027)	(0.008)	(0.036)	(0.041)
Predicted ATI of Individual	−0.015***	0.460***	0.013***	−0.035***	0.428***	0.064***
	(0.001)	(0.010)	(0.004)	(0.002)	(0.019)	(0.009)
Predicted ATI of Spouse	0.003***	0.009*	0.696***	0.001	−0.016***	0.773***
	(0.001)	(0.005)	(0.009)	(0.001)	(0.004)	(0.015)
R^2	0.203	0.227	0.254	0.151	0.165	0.239
Panel C: Income Effects Only						
Predicted ATI of Individual		0.474***	0.018***		0.449***	0.075***
		(0.010)	(0.004)		(0.017)	(0.009)
Predicted ATI of Spouse		−0.005	0.692***		−0.020***	0.771***
		(0.006)	(0.009)		(0.005)	(0.014)
R^2		0.226	0.254		0.165	0.239

Notes: In each panel, every row is a first-stage regression of the actual tax rate or liability shown on the predicted tax rates and liabilities. The number of observations is 476,004 for the extensive margin and 272,071 for the intensive margin. The R^2 for each regression estimated by OLS is also reported. The Cragg-Donaldson and Kleibergen-Paap F-Statistic and the Kleibergen-Paap rk LM statistic indicate that the model is exactly and strongly identified ($p < 0.01$ in all cases). The control variables included in every regression are listed in text. Standard errors are in parentheses, clustered by individual. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 3: Labor Income Responses to Changes in the Marginal Net-of-Tax Share and ATI, 2006 to 2007—Instrumental Variables

	Extensive Margin			Intensive Margin		
	Ordinary	Instrumental Variables		Ordinary	Instrumental Variables	
	Least Squares	Reduced-Form	Two-Stage Least Squares	Least Squares	Reduced-Form	Two-Stage Least Squares
Panel A: Uncompensated Effects						
Marginal Net-of-Tax Share	−0.851***	0.048***	0.083***	−2.628***	0.042	0.074
of Individual	(0.005)	(0.010)	(0.017)	(0.023)	(0.047)	(0.082)
R^2	0.267	0.148		0.219	0.092	
Panel B: Compensated Effects						
Marginal Net-of-Tax Share	−0.831***	0.023**	0.013	−1.928***	0.036	−0.006
of Individual	(0.005)	(0.010)	(0.021)	(0.026)	(0.056)	(0.125)
ATI of Individual	0.011***	−0.017***	−0.036***	0.481***	−0.064***	−0.133***
	(0.001)	(0.001)	(0.003)	(0.010)	(0.018)	(0.048)
ATI of Spouse	−0.001	−0.009***	−0.012***	−0.021***	−0.085***	−0.112***
	(0.001)	(0.002)	(0.003)	(0.002)	(0.010)	(0.013)
R^2	0.267	0.148		0.291	0.093	
Test of Unitary Model	[0.000]	[0.000]	[0.000]	[0.000]	[0.236]	[0.654]
Panel C: Income Effects Only						
ATI of Individual	0.044***	−0.018***	−0.037***	0.626***	−0.067***	−0.131***
	(0.001)	(0.001)	(0.003)	(0.012)	(0.016)	(0.034)
ATI of Spouse	−0.003***	−0.008***	−0.012***	−0.026***	−0.084***	−0.112***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.010)	(0.013)
R^2	0.162	0.148		0.231	0.093	
Test of Unitary Model	[0.000]	[0.000]	[0.000]	[0.000]	[0.279]	[0.544]

Notes: Standard errors are in parentheses, clustered by individual. The p-values for the tests of the unitary model are in square brackets, where the unitary model is rejected for low p-values. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 4: Encompassing Tests of Labor Income Responses to Changes in the Average versus Marginal Net-of-Tax Share, 2006 to 2007—Instrumental Variables

	Extensive Margin				Intensive Margin			
	Marginal, Alternate	Average	Average and Marginal	Average, as a Proxy for Marginal	Marginal, Alternate	Average	Average and Marginal	Average, as a Proxy for Marginal
Marginal Net-of-Tax Share of Individual	0.011		0.001	0.075	−0.121		−0.113	0.898**
	(0.021)		(0.023)	(0.051)	(0.180)		(0.125)	(0.446)
Marginal Net-of-Tax Share of Spouse	−0.012				0.133			
	(0.021)				(0.191)			
Average Net-of-Tax Share of Individual		0.026	0.026			0.433**	0.488**	
		(0.018)	(0.020)			(0.211)	(0.215)	
ATI of Individual	−0.036***	−0.037***	−0.037***	−0.032***	−0.211***	−0.087*	−0.104**	0.047
	(0.003)	(0.003)	(0.003)	(0.005)	(0.064)	(0.047)	(0.053)	(0.108)
ATI of Spouse	−0.013***	−0.012***	−0.012***	−0.014***	−0.203***	−0.116***	−0.115***	−0.121***
	(0.003)	(0.002)	(0.002)	(0.003)	(0.056)	(0.013)	(0.013)	(0.014)
Test of Unitary Model	[0.000]	[0.000]	[0.000]	[0.009]	[0.924]	[0.531]	[0.825]	[0.126]

Notes: The model is exactly and strongly identified in the first-stage regressions ($p < 0.01$ in all cases). The predicted average net-of-tax share of the individual is used as the instrument for the marginal net-of-tax share of the individual in the two tests of whether the average tax rate is used as a proxy for the marginal tax rate. Standard errors are in parentheses, clustered by individual. See the notes in Tables 2 and 3 for more information. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 5: Labor Income Responses to Changes in the Marginal Net-of-Tax Share, Average Net-of-Tax Share, and ATI using Controls of 1-Year Lagged and Base Period Incomes, 2006 to 2007—Instrumental Variables

	Controls for total incomes of individual and spouse			Controls for labor and total incomes of individual and spouse		
	Base, Linear	Lagged, 10-Piece Spline	Base and Lagged 10-Piece Spline	Base, 5-Piece Splines	Base, 15-Piece Splines	Base, 30-Piece Splines
Panel A: Extensive Margin						
ATI of Individual	0.007***	−0.003	−0.012***	−0.036***	−0.036***	−0.035***
	(0.002)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
ATI of Spouse	−0.011***	−0.011***	−0.013***	−0.012***	−0.011***	−0.011***
	(0.002)	(0.003)	(0.004)	(0.002)	(0.002)	(0.003)
Test of Unitary Model	[0.000]	[0.016]	[0.869]	[0.000]	[0.000]	[0.000]
Panel B: Intensive Margin						
Marginal Net-of-Tax Share	0.053	−0.090	−0.101	−0.054	−0.088	−0.119
of Individual	(0.110)	(0.159)	(0.179)	(0.114)	(0.125)	(0.128)
Average Net-of-Tax Share	1.411***	1.315***	0.590*	0.487**	0.452**	0.424*
of Individual	(0.184)	(0.281)	(0.344)	(0.203)	(0.219)	(0.220)
ATI of Individual	0.294***	0.174***	−0.114	−0.045	−0.119**	−0.144**
	(0.035)	(0.050)	(0.072)	(0.044)	(0.054)	(0.057)
ATI of Spouse	−0.054***	−0.065***	−0.120***	−0.125***	−0.116***	−0.117***
	(0.010)	(0.015)	(0.022)	(0.013)	(0.013)	(0.013)
Test of Unitary Model	[0.000]	[0.000]	[0.919]	[0.066]	[0.957]	[0.635]

Notes: Standard errors are in parentheses, clustered by individual. The column headings indicate whether 1-year lags of income or base-period income, or both, is used as controls. Recall the baseline specification uses 10-piece splines of labor and total incomes of both the individual and spouse. See the notes in Tables 2, 3, and 9 for more information. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 6: Bunching at the MTR Discontinuities by Year, 2001 to 2012—Empirical Density Design

	2nd Federal	2nd Provincial/ Territorial	3rd Federal	3rd Provincial/ Territorial	4th Federal	Public Pension	Unemployment Insurance
2001	0.465***	0.467***	0.210***	0.131	0.606**	0.689***	0.452
	(0.052)	(0.044)	(0.081)	(0.084)	(0.242)	(0.183)	(0.301)
2002	0.293***	0.183***	0.189**	−0.091	−0.021	0.043	0.071
	(0.065)	(0.055)	(0.084)	(0.076)	(0.237)	(0.201)	(0.302)
2003	0.349***	0.238***	0.072	0.096	0.216	0.442**	0.237
	(0.051)	(0.052)	(0.101)	(0.083)	(0.253)	(0.188)	(0.273)
2004	0.157***	−0.005	0.410***	−0.045	−0.087	0.818***	0.477**
	(0.051)	(0.052)	(0.101)	(0.098)	(0.243)	(0.219)	(0.241)
2005	0.421***	0.008	0.306***	−0.164*	0.319	0.740***	0.147
	(0.059)	(0.056)	(0.097)	(0.093)	(0.231)	(0.190)	(0.205)
2006	0.246***	0.073	0.183**	−0.140*	0.458*	0.729***	0.274
	(0.054)	(0.049)	(0.078)	(0.080)	(0.244)	(0.205)	(0.242)
2007	1.519***	0.647***	0.341***	0.314**	0.828***	3.624***	0.583***
	(0.150)	(0.225)	(0.115)	(0.127)	(0.228)	(0.200)	(0.216)
2008	2.189***	1.988***	0.960***	1.040***	0.437**	5.028***	0.750***
	(0.337)	(0.248)	(0.249)	(0.172)	(0.174)	(0.363)	(0.225)
2009	3.198***	1.071***	1.008***	−0.006	0.602**	4.506***	0.949***
	(0.329)	(0.398)	(0.200)	(0.239)	(0.237)	(0.318)	(0.191)
2010	3.606***	0.287	1.382***	0.362	0.363*	4.219***	1.285***
	(0.422)	(0.438)	(0.183)	(0.256)	(0.195)	(0.250)	(0.286)
2011	3.727***	0.009	1.088***	0.583*	0.581***	4.759***	1.121***
	(0.416)	(0.462)	(0.107)	(0.301)	(0.175)	(0.330)	(0.228)
2012	3.494***	0.034	1.155***	0.650*	0.709***	4.279***	0.946***
	(0.362)	(0.550)	(0.138)	(0.359)	(0.204)	(0.262)	(0.265)

Notes: The bunching analysis of Figures 3a and 3b is carried out by year; see the notes in those figures for more information. Standard errors are in parentheses, clustered by individual. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 7: Bunching at the MTR Discontinuities by Marital Status and Private Pension Receipt, 2007 to 2012 (Post-Reform)—Empirical Density Design

	Single		Married			
	No Private Pension Income	Has Private Pension Income	No Private Pension Income	Has Private Pension Income		
				Individual	Spouse	Either
2nd Federal	0.072	0.007	0.311***	7.342***	8.146***	7.072***
	(0.051)	(0.068)	(0.039)	(0.541)	(0.525)	(0.454)
2nd Provincial/Territorial	0.090**	0.024	0.133***	1.529***	1.247**	1.359**
	(0.044)	(0.069)	(0.032)	(0.568)	(0.521)	(0.533)
3rd Federal	0.001	0.255	0.154***	3.925***	3.960***	3.465***
	(0.089	(0.170)	(0.052)	(0.294)	(0.306)	(0.231)
3rd Provincial/Territorial	0.139	0.101	−0.016	1.890***	1.890***	1.694***
	(0.085)	(0.136)	(0.047)	(0.512)	(0.570)	(0.416)
4th Federal	0.223	0.101	0.010	2.357***	2.771***	2.315***
	(0.201)	(0.473)	(0.097)	(0.215)	(0.240)	(0.190)
Public Pension	0.848***	0.331	1.086***	7.195***	8.661***	7.056***
	(0.254)	(0.206)	(0.180)	(0.271)	(0.402)	(0.268)
Unemployment Insurance	0.530***	0.745**	−0.014	2.563***	4.050***	3.018***
	(0.202)	(0.363)	(0.123)	(0.245)	(0.431)	(0.265)

Notes: The public pension tax analysis is restricted to individuals 65 years of age or older, and the unemployment insurance tax analysis is restricted to benefit recipients. Standard errors are in parentheses. See the notes in Figure 3a for more information. *** and ** denote significance at the 1% and 5% levels, respectively.

Table 8: Labor Income Responses to Changes in the Marginal Net-of-Tax Share, Average Net-of-Tax Share, and ATI by Observed Characteristics, 2006 to 2007—Instrumental Variables

	By Sex		By Self-Employment Status		By Industry	
	Male	Female	Yes	No	Agricultural, Blue Collar	White Collar
Panel A: Extensive Margin						
ATI of Individual	−0.064***	−0.006	−0.070***	−0.018***	−0.014***	−0.084***
	(0.012)	(0.004)	(0.017)	(0.003)	(0.003)	(0.012)
ATI of Spouse	−0.020***	−0.009	−0.067***	−0.016***	0.008***	−0.096***
	(0.003)	(0.012)	(0.011)	(0.002)	(0.003)	(0.006)
Test of Unitary Model	[0.000]	[0.778]	[0.877]	[0.563]	[0.000]	[0.193]
Panel B: Intensive Margin						
Marginal Net-of-Tax Share	−0.293	0.440***	0.324	0.061	0.089	0.026
of Individual	(0.214)	(0.167)	(0.305)	(0.142)	(0.191)	(0.175)
Average Net-of-Tax Share	1.746**	0.404	0.100	0.459*	0.497	0.597
of Individual	(0.859)	(0.249)	(0.471)	(0.267)	(0.307)	(0.371)
ATI of Individual	−0.205	−0.010	−0.085	−0.108*	−0.052	−0.059
	(0.215)	(0.061)	(0.088)	(0.064)	(0.073)	(0.085)
ATI of Spouse	−0.109***	−0.402***	−0.058*	−0.137***	−0.089***	−0.134***
	(0.028)	(0.082)	(0.035)	(0.016)	(0.021)	(0.020)
Test of Unitary Model	[0.619]	[0.000]	[0.754]	[0.634]	[0.586]	[0.343]

Notes: Standard errors are in parentheses, clustered by individual. See the notes in Tables 2, 3, and 9 for more information. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 9: Bunching at Selected MTR Discontinuities by Marital Status and Observed Characteristics, 2007 to 2012 (Post-Reform)—Empirical Density Design

	Single, or Married with No Private Pension Income in the Household			Married with Private Pension Income from Either Spouse		
	2nd Federal	3rd Federal	4th Federal	2nd Federal	3rd Federal	4th Federal
Panel A: By Sex						
Male	0.249***	0.150**	0.115	6.553***	3.123***	1.687***
	(0.035)	(0.060)	(0.091)	(0.488)	(0.182)	(0.195)
Female	0.168***	0.088	−0.135	7.591***	3.883***	3.528***
	(0.033)	(0.071)	(0.200)	(0.383)	(0.357)	(0.331)
Panel B: By Self-Employment Status						
Self-Employed	1.016***	0.289**	0.587**	6.166***	3.301***	2.913***
	(0.117)	(0.136)	(0.262)	(0.361)	(0.296)	(0.660)
Not Self-Employed	0.140***	0.114**	−0.020	7.122***	3.482***	2.230***
	(0.028)	(0.053)	(0.084)	(0.452)	(0.238)	(0.205)
Panel C: By Industry						
Agricultural, Blue Collar	0.256***	0.207***	0.125	7.236***	3.570***	2.030***
	(0.033)	(0.072)	(0.135)	(0.555)	(0.326)	(0.265)
White Collar	0.152***	0.063	−0.028	6.549***	3.374***	2.582***
	(0.037)	(0.057)	(0.116)	(0.267)	(0.197)	(0.261)

Notes: Individuals are classified herein as self-employed if $2,000 or more is earned as self-employment income. Agriculture or blue collar industries are set as those with 2-digit North American Industrial Classification System (NAICS) codes 11-49, and white collar industries are set as NAICS codes 51-91. The sample sizes across the two industry groups are approximately equal. Standard errors are in parentheses. See the notes in Figure 3a for more information. *** and ** denote significance at the 1% and 5% levels, respectively.

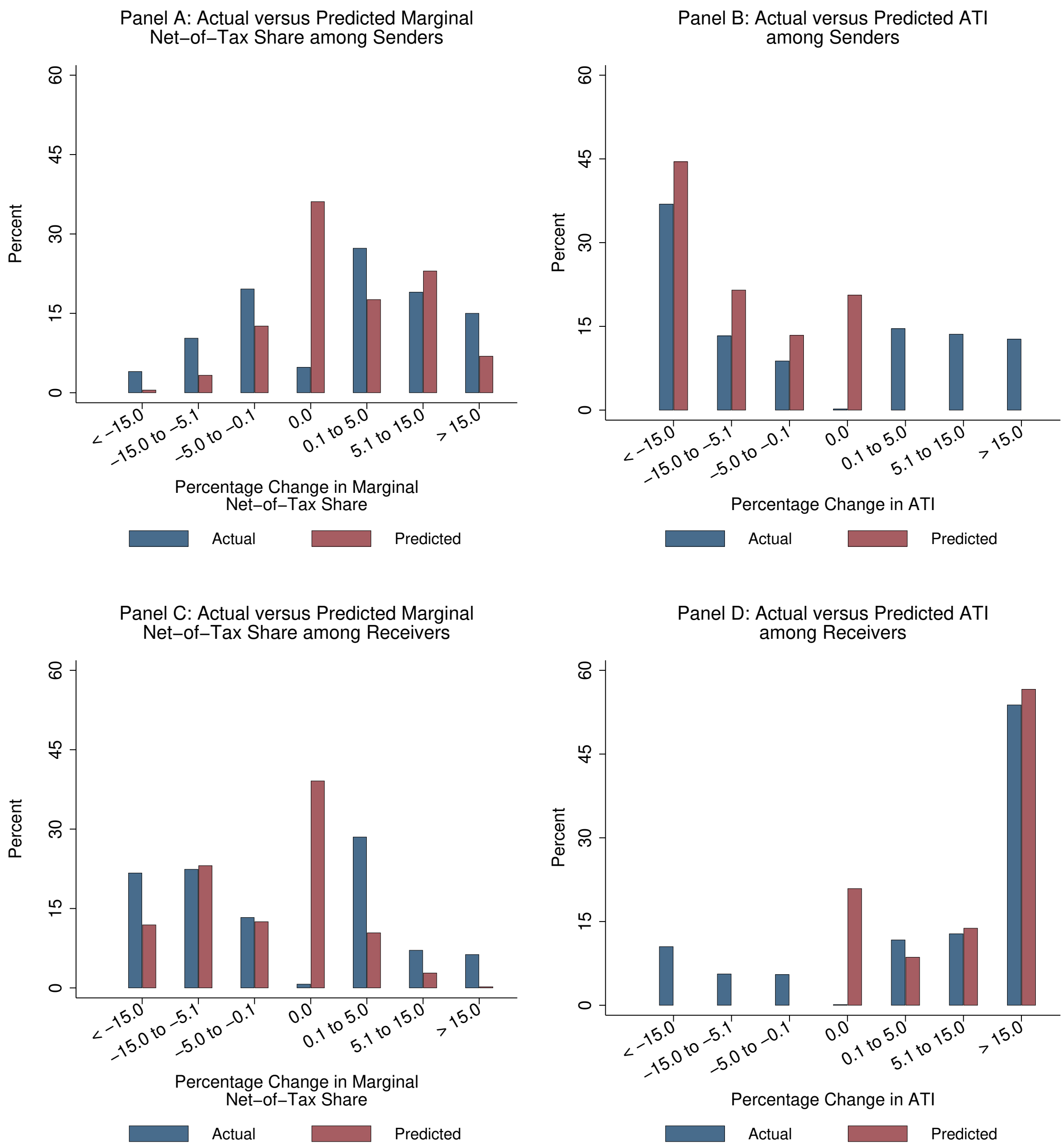

Figure 1: Variation in the Actual and Predicted Tax Variables among Individuals Belonging to a Household with At Least One Pensioner, 2006 to 2007

Notes: The share of individuals who experienced different sizes of percentage changes in the marginal net-of-tax share and ATI are shown, for individuals who belong to a household with at least one pensioner and who would be most likely to either send (Panels A and B) or receive (Panels C and D) income through splitting.

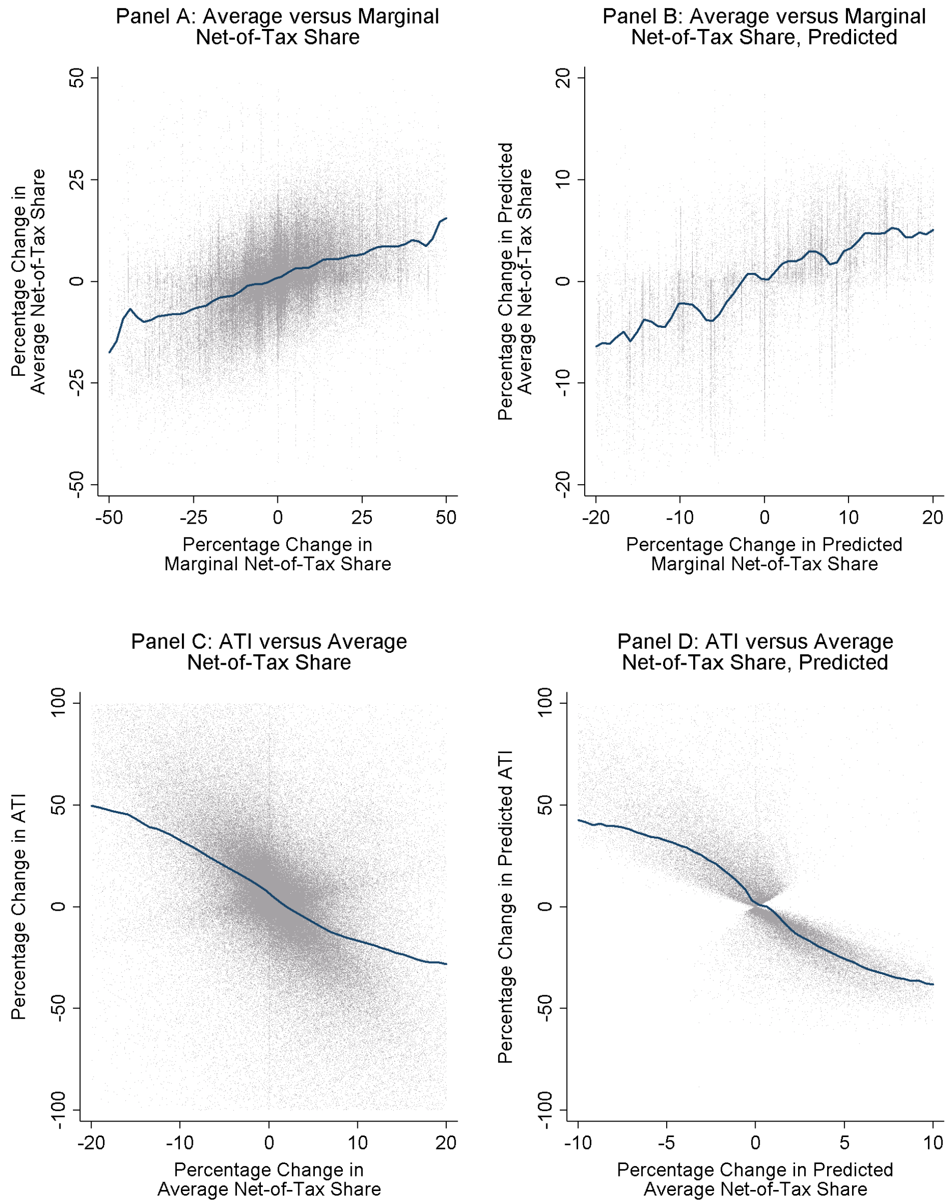

Figure 2: Relationships between Actual and Predicted Changes in Tax Rates and Liabilities, 2006 to 2007

Notes: The correlations between the marginal net-of-tax share, average net-of-tax share, and ATI are shown, for both the actual and predicted variables. Each dot corresponds to a unique observation. Kernel-weighted local polynomial functions are also plotted for these relationships.

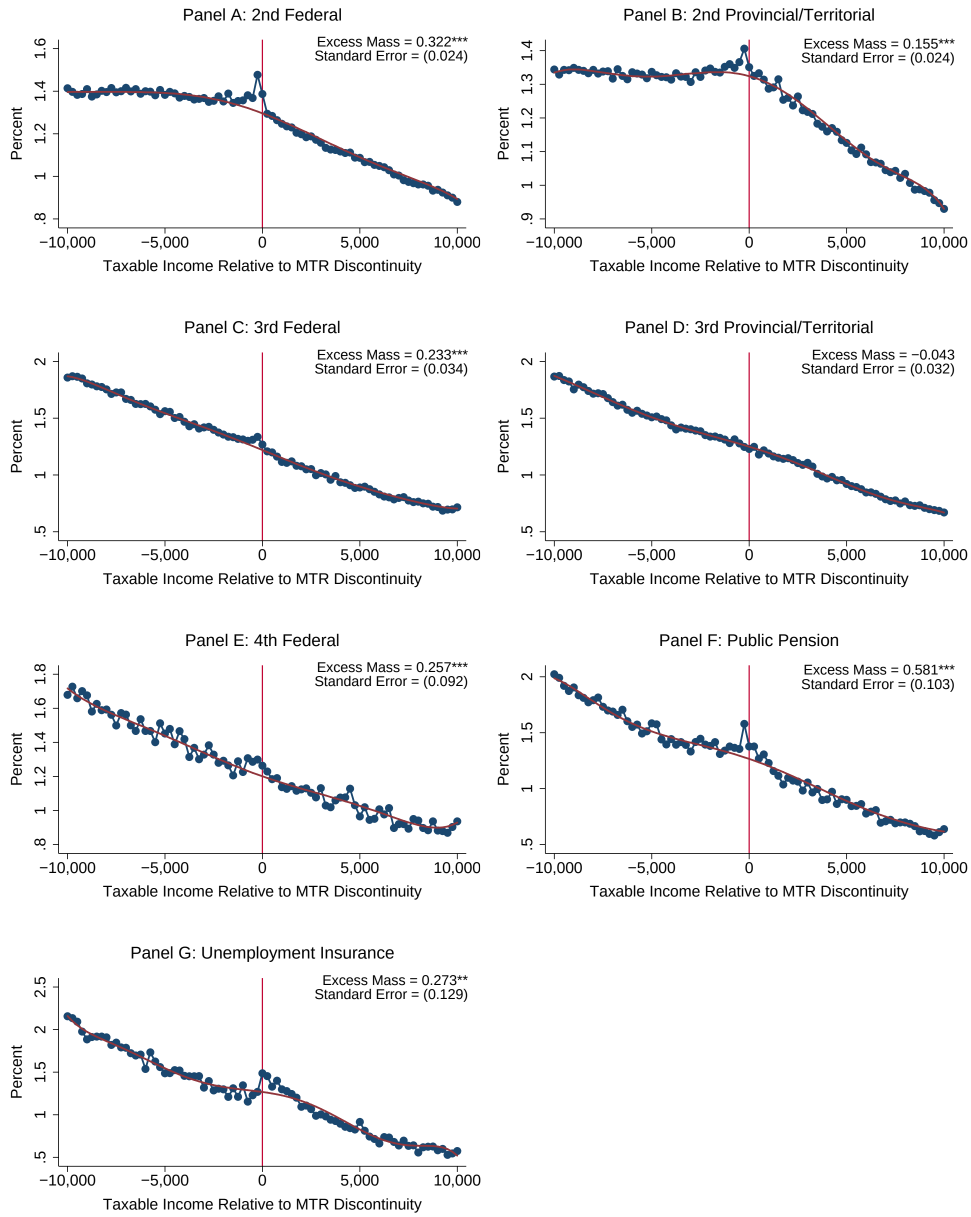

Figure 3a: Bunching at the MTR Discontinuities, 2001 to 2006 (Pre-Reform)

Notes: The distribution of taxable income within \$10,000 of either side of the relevant tax threshold is shown, based on pooled data from the pre-reform period. The values are grouped into bins of width \$250. The predicted distributions and excess mass estimates use the procedure of Chetty et al. (2011) and Stata module by Olsen (2011). *** and ** denote significance at the 1% and 5% levels, respectively.

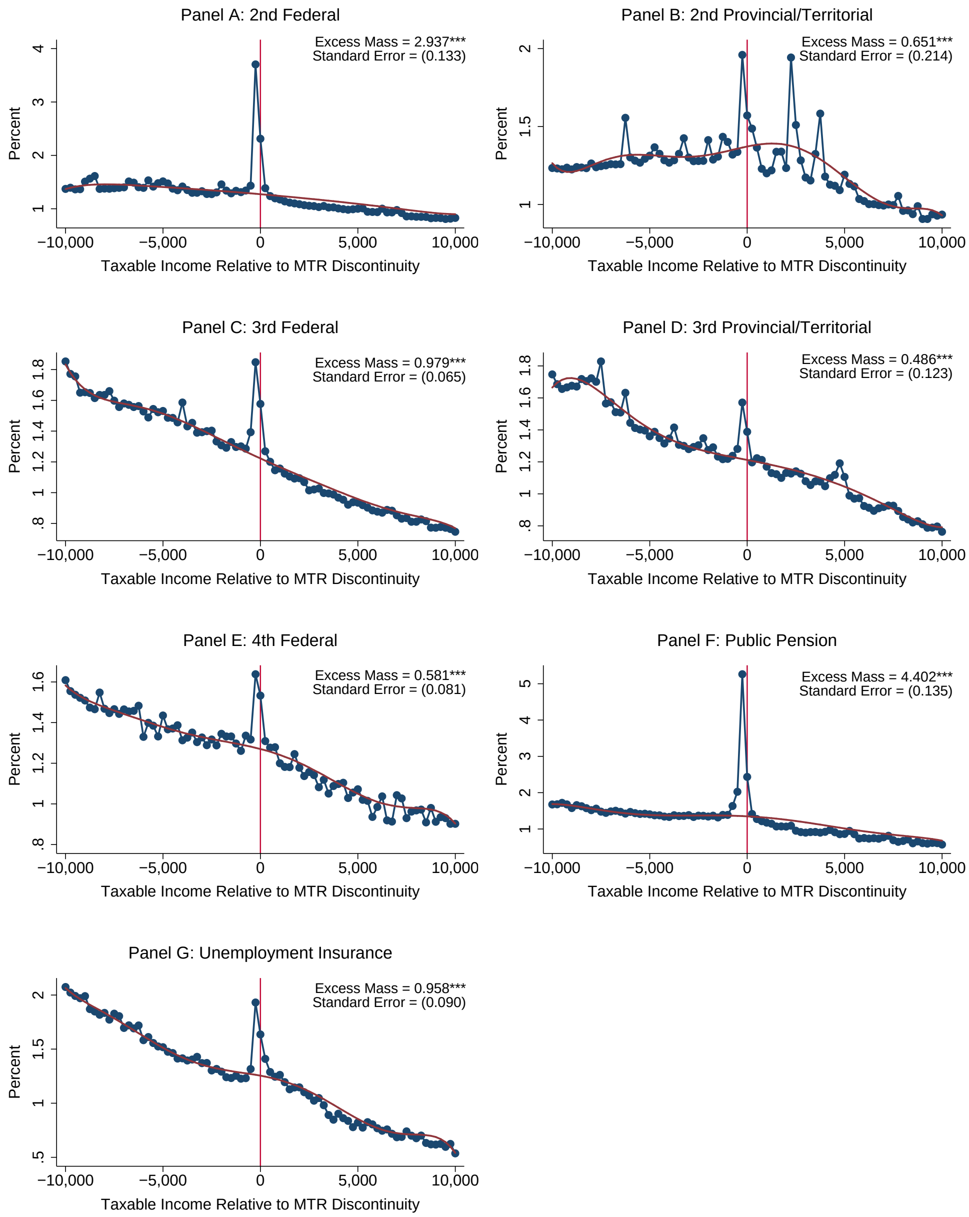

Figure 3b: Bunching at the MTR Discontinuities, 2007 to 2012 (Post-Reform)

Notes: The distribution of taxable income within \$10,000 of either side of the relevant tax threshold is shown, based on pooled data from the post-reform period. See the notes in Figure 3a for more information. *** denotes significance at the 1% level.

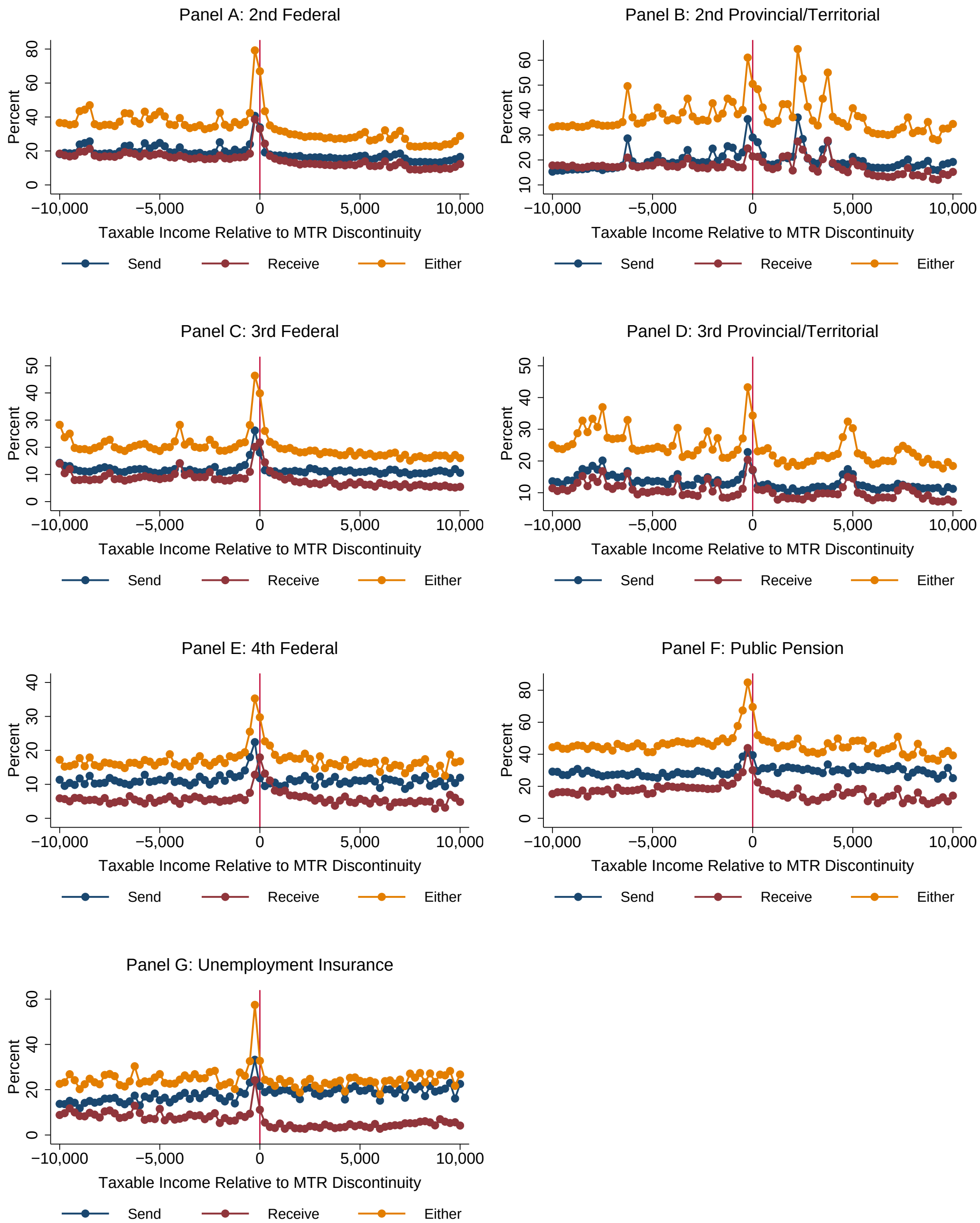

Figure 4: Splitting Incentives—Probabilities of Sending and Receiving Pension Income among Married Individuals at the MTR Discontinuities, 2007 to 2012 (Post-Reform)

Notes: The probability of splitting pension income as a function of taxable income relative to the relevant tax threshold is shown, for income within \$10,000 on either side of the kink point, based on pooled data from the post-reform period. The values are grouped into bins of width \$250.

Online Appendix

Table A1: Robustness Checks of Labor Income Responses to Changes in the Marginal Net-of-Tax Share and ATI with Distribution Factors, 2006 to 2007—Instrumental Variables

	Extensive Margin			Intensive Margin		
	Income Ratio	Sex Ratio	Income and Sex Ratios with Interactions	Income Ratio	Sex Ratio	Income and Sex Ratios with Interactions
Marginal Net-of-Tax Share	0.018	0.012	0.017	0.010	−0.006	0.008
of Individual	(0.021)	(0.021)	(0.021)	(0.125)	(0.125)	(0.125)
ATI of Individual	−0.036***	−0.036***	−0.035***	−0.136***	−0.133***	−0.134***
	(0.003)	(0.003)	(0.003)	(0.048)	(0.048)	(0.048)
ATI of Spouse	−0.012***	−0.012***	−0.012***	−0.116***	−0.112***	−0.114***
	(0.003)	(0.003)	(0.003)	(0.013)	(0.013)	(0.013)
Income Ratio	−0.051***		−0.139***	−0.193***		−0.475***
	(0.010)		(0.037)	(0.044)		(0.157)
Sex Ratio		−0.053**	−0.141***		0.055	−0.250
		(0.021)	(0.043)		(0.079)	(0.185)
Income × Sex Ratios			0.177**			0.561*
			(0.072)			(0.295)
Test of Unitary Model	[0.000]	[0.000]	[0.000]	[0.664]	[0.645]	[0.674]

Notes: The model is exactly and strongly identified in the first-stage regressions ($p < 0.01$ in all cases). The sex and income ratios are defined as the percent of individuals in the local population who are the same sex as the individual, and the percent of the individual's income in total income of the couple, respectively. Standard errors are in parentheses, clustered by individual. See the notes in Tables 2 and 3 for more information. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table A2: Bunching at the Public Pension and Unemployment Insurance MTR Discontinuities by Age and Benefit Receipt, 2007 to 2012 (Post-Reform)—Empirical Density Design

	Unmarried		Married	
	No Private Pension Income	Has Private Pension Income	No Private Pension Income	Has Private Pension Income
Panel A: Public Pension				
60 Years Old	0.312	−0.135	0.078	0.891***
	(0.338)	(0.425)	(0.185)	(0.293)
61 Years Old	−0.047	−0.436	−0.259	0.410
	(0.288)	(0.400)	(0.203)	(0.263)
62 Years Old	0.273	−0.437	0.261	0.249
	(0.307)	(0.459)	(0.229)	(0.305)
63 Years Old	0.189	−0.076	0.051	0.476
	(0.421)	(0.324)	(0.253)	(0.321)
64 Years Old	0.095	−0.117	−0.260	0.488
	(0.419)	(0.417)	(0.284)	(0.356)
65 Years Old	−0.525	0.684	1.138***	5.456***
	(0.393)	(0.460)	(0.317)	(0.293)
66 Years Old	0.709	−0.099	1.048***	6.916***
	(0.513)	(0.370)	(0.303)	(0.375)
67 Years Old	1.279*	0.553	0.966***	6.930***
	(0.775)	(0.401)	(0.330)	(0.388)
68 Years Old	2.398***	0.602	1.197***	8.033***
	(0.850)	(0.396)	(0.394)	(0.526)
69 Years Old	3.099***	−0.153	1.095**	8.314***
	(0.921)	(0.390)	(0.486)	(0.432)
Panel B: Unemployment Insurance				
No Receipt	0.024	0.036	−0.103**	−0.010
	(0.065)	(0.077)	(0.044)	(0.222)
Receipt	0.530***	0.745	−0.014	3.018***
	(0.188)	(0.371)	(0.126)	(0.292)

Notes: Individuals under the age of 65 or without unemployment insurance benefits are comparison groups to check, in a non-experimental approach, whether individuals the most responsive to each tax threshold are those who are the most likely affected by it. As expected, bunching is most prevalent among individuals eligible for the public pension or receiving unemployment insurance and who are able to split income. In this analysis, married individuals have private pension income if the income comes from either themselves or their spouses. The analysis is restricted to the post-reform period. Standard errors are in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

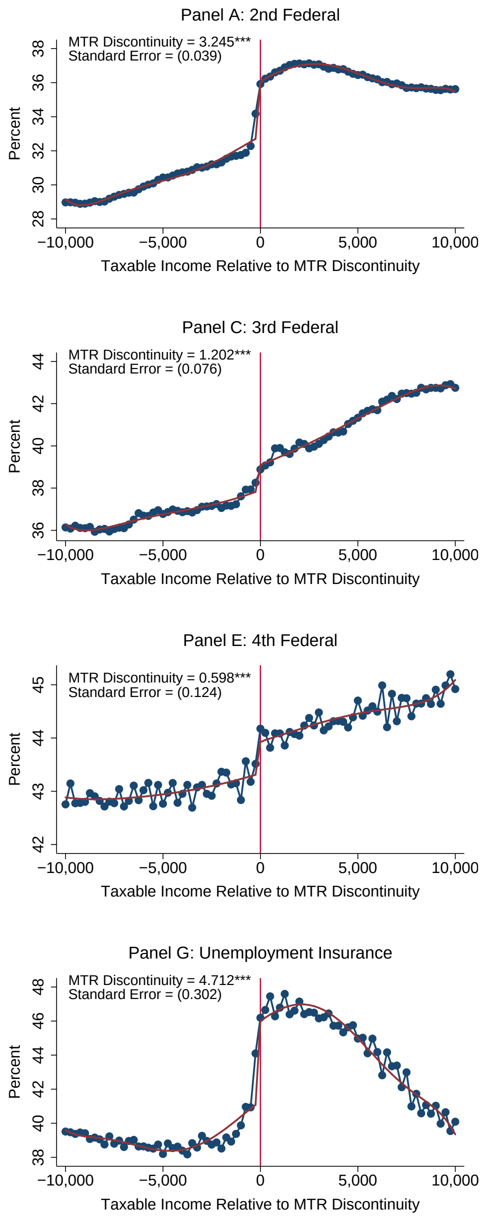

Figure A1a: Discontinuities in MTRs at the Tax Thresholds, 2001 to 2006 (Pre-Reform)

Notes: The MTR as a function of taxable income relative to the relevant tax threshold is shown, for income within $10,000 on either side of the kink point, based on pooled data from the pre-reform period. The values are grouped into bins of width $250. The predicted values of the MTR are based on sextic polynomial regressions of the MTR on taxable income with an indicator variable for income exceeding the tax threshold. Standard errors are in parentheses, clustered by individual. *** denotes significance at the 1% level.

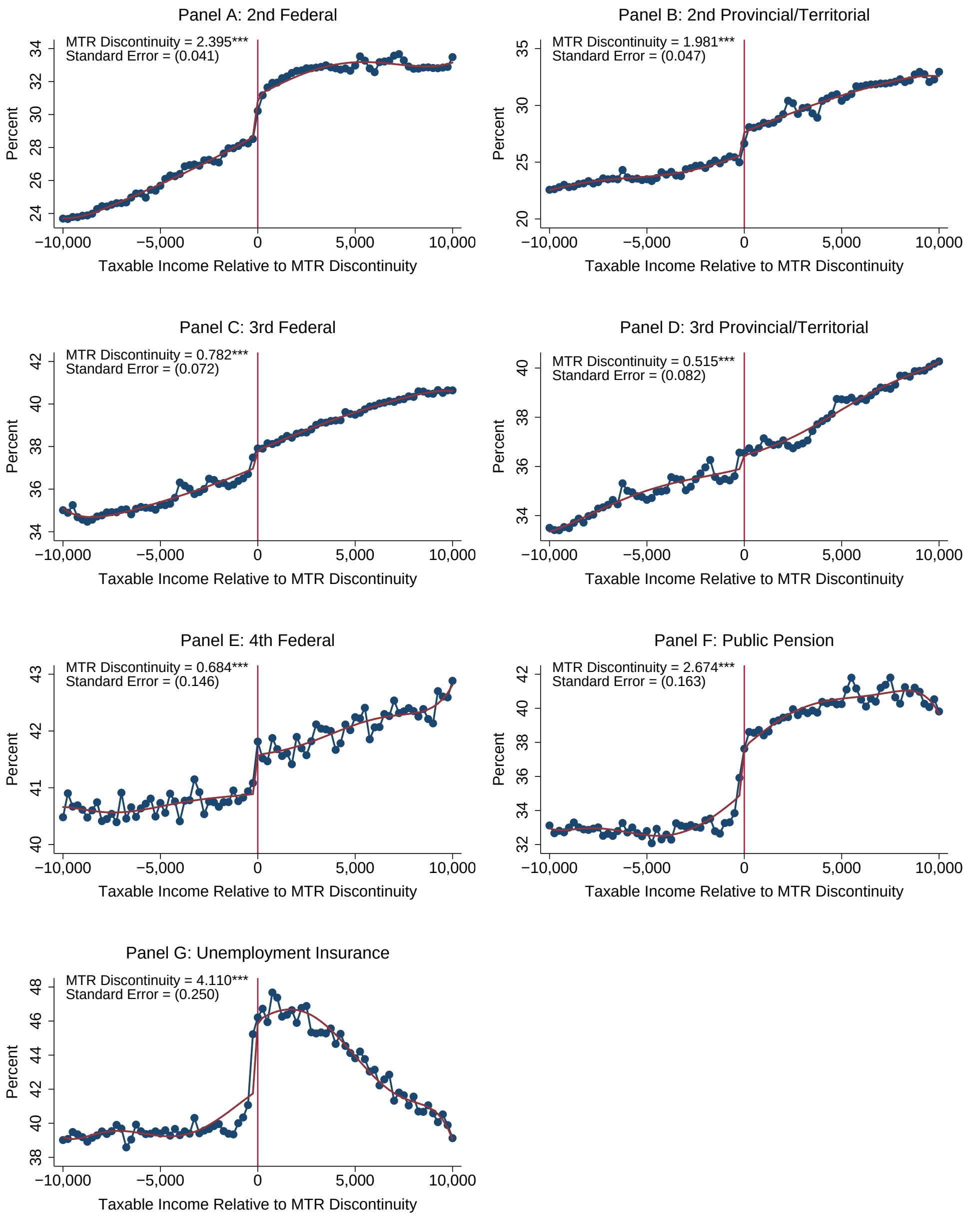

Figure A1b: Discontinuities in MTRs at the Tax Thresholds, 2007 to 2012 (Post-Reform)

Notes: The MTR as a function of taxable income relative to the relevant tax threshold is shown, for income within $10,000 on either side of the kink point, based on pooled data from the post-reform period. See the notes in Figure A1a for more information. *** denotes significance at the 1% level.

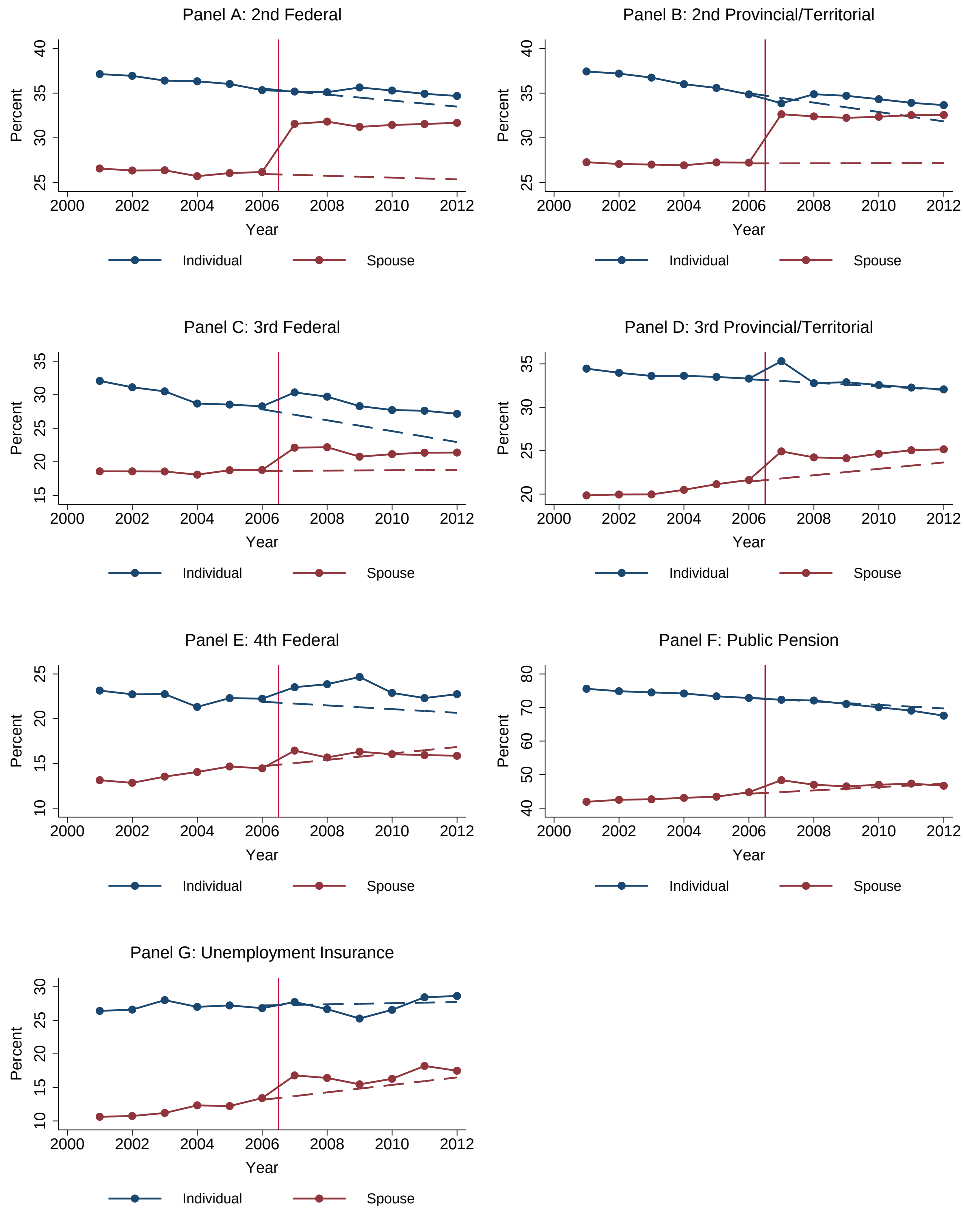

Figure A2: Pension Receipt Incentives—Probability of Collecting Private Pension Income at the MTR Discontinuities among Married Couples, 2001 to 2012

Notes: The probability of private pension income receipt is shown, by marital status and year. The analysis is restricted to individuals with taxable income within \$10,000 on either side of the relevant tax threshold in the reference year. The dashed lines are linear extrapolations of trends prior to the reform into the post-reform period. The results indicate that some households may have become more likely to have a pensioner. This result is also driven, at least in part, by the fact that pensioners are the most likely to sort around each tax threshold.

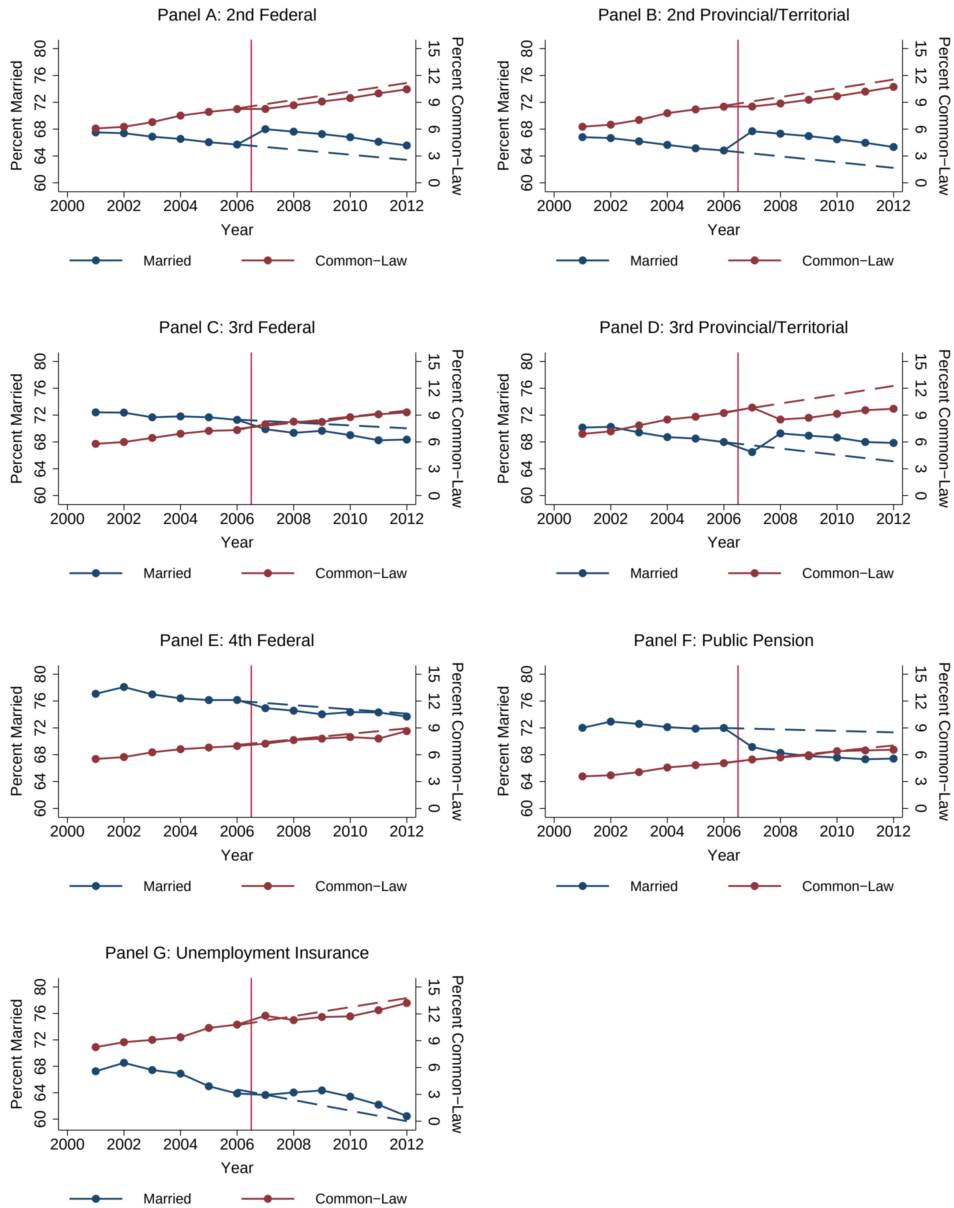

Figure A3: Marriage Bonus—Probabilities of being Married and in a Common-Law Relationship at the MTR Discontinuities, 2001 to 2012

Notes: The probabilities of being legally married and in a common-law relationship are shown, by year. The results indicate that some couples may have become more likely to be married. This result is also driven, at least in part, by the fact that pensioners are the most likely to sort around each tax threshold. The downward effect for public pensions may be driven by public and private pensions being correlated. See the notes in Figure A2 for more information.

Online Mathematical Appendix

Derivations of $\mathbf{d}\tilde{z}_i/\mathbf{d}(1-\tau^i)$ and $\mathbf{d}\tilde{z}_i/\mathbf{d}(1-\tau^s)$

To solve for $\mathrm{d}\tilde{z}_i/\mathrm{d}(1-\tau^i)$, totally differentiate equation (6) with respect to $(1-\tau^i)$ and evaluate at $\{\tilde{z}_i, z_s^*, x^*\}$:

$$\begin{aligned}\lambda\Bigg\{u_c^i + (1-\tau^i)\Bigg(u_{cc}^i\frac{\mathrm{d}c}{\mathrm{d}(1-\tau^i)} + u_{cz_i}^i\frac{\mathrm{d}\tilde{z}_i}{\mathrm{d}(1-\tau^i)} + u_{cz_s}^i\frac{dz_s^*}{\mathrm{d}(1-\tau^i)}\Bigg) \\ + u_{z_ic}^i\frac{\mathrm{d}c}{\mathrm{d}(1-\tau^i)} + u_{z_iz_i}^i\frac{\mathrm{d}\tilde{z}_i}{\mathrm{d}(1-\tau^i)} + u_{z_iz_s}^i\frac{\mathrm{d}z_s^*}{\mathrm{d}(1-\tau^i)}\Bigg\} \\ + (1-\lambda)\Bigg\{u_c^s + (1-\tau^i)\Bigg(u_{cc}^s\frac{\mathrm{d}c}{\mathrm{d}(1-\tau^i)} + u_{cz_i}^s\frac{\mathrm{d}\tilde{z}_i}{\mathrm{d}(1-\tau^i)} + u_{cz_s}^s\frac{dz_s^*}{\mathrm{d}(1-\tau^i)}\Bigg) \\ + u_{z_ic}^s\frac{\mathrm{d}c}{\mathrm{d}(1-\tau^i)} + u_{z_iz_i}^s\frac{\mathrm{d}\tilde{z}_i}{\mathrm{d}(1-\tau^i)} + u_{z_iz_s}^s\frac{\mathrm{d}z_s^*}{\mathrm{d}(1-\tau^i)}\Bigg\} \\ + \big((u_c^i(1-\tau^i) + u_{z_i}^i) - (u_c^s(1-\tau^i) + u_{z_i}^s)\big)\lambda_{1-\tau^i} = 0 \end{aligned} \tag{19}$$

where:

$$\begin{aligned}\frac{\mathrm{d}c}{\mathrm{d}(1-\tau^i)} = \tilde{z}_i + \bar{y}_i - x^* + (1-\tau^i)\frac{\mathrm{d}\tilde{z}_i}{\mathrm{d}(1-\tau^i)} + (1-\tau^s)\frac{\mathrm{d}z_s^*}{\mathrm{d}(1-\tau^i)} \\ + \frac{\mathrm{d}R^i}{\mathrm{d}(1-\tau^i)} + (\tau^i - \tau^s)\frac{\mathrm{d}x^*}{\mathrm{d}(1-\tau^i)}\end{aligned} \tag{20}$$

which follows from the budget constraint given by equations (2), (3), and (4). This imposes $\mathrm{d}R^i/\mathrm{d}(1-\tau^s) = 0$, which is consistent with how virtual income is defined in Gruber and Saez (2002) and the related literature.

The next step is to rearrange equation (19), solving for $\mathrm{d}\tilde{z}_i/\mathrm{d}(1-\tau^i)$ by collecting like terms. For ease of notation, let:

$$u_{ab} = \lambda u_{ab}^i + (1-\lambda)u_{ab}^s \tag{21}$$

for each $a, b \in \{c, z_i, z_s\}$. Equation (21) simplifies the expression for the weighted average of the second-order cross-partial derivatives of utility across the individual and spouse. It follows that the solution can be written:

$$\begin{aligned}\frac{\mathrm{d}\tilde{z}_i}{\mathrm{d}(1-\tau^i)} = \Gamma\big(\lambda u_c^i + (1-\lambda)u_c^s\big) - \Theta\Bigg(\tilde{z}_i + \bar{y}_i + \frac{\mathrm{d}R^i}{\mathrm{d}(1-\tau^i)}\Bigg) - \Lambda\frac{\mathrm{d}z_s^*}{\mathrm{d}(1-\tau^i)} \\ - \Theta(\tau^i - \tau^s)\frac{\mathrm{d}x^*}{\mathrm{d}(1-\tau^i)} + \Gamma\big((u_c^i(1-\tau^i) + u_{z_i}^i) - (u_c^s(1-\tau^i) + u_{z_i}^s)\big)\lambda_{1-\tau^i}\end{aligned} \tag{22}$$

where:

$$\Gamma = -\Big((u_{cc}(1-\tau^i) + u_{z_i c})(1-\tau^i) + (u_{cz_i}(1-\tau^i) + u_{z_i z_i})\Big)^{-1} \tag{23}$$

$$\Theta = -\Gamma(u_{cc}(1-\tau^i) + u_{z_i c}) \tag{24}$$

$$\Lambda = -\Gamma\Big((u_{cc}(1-\tau^i) + u_{z_i c})(1-\tau^s) + (u_{cz_s}(1-\tau^i) + u_{z_i z_s})\Big) \tag{25}$$

Dividing both sides of equation (22) by $\mathrm{d}(1-\tau^i)$ expresses the solution identical to equation (10). The process of deriving $\mathrm{d}\tilde{z}_i/\mathrm{d}(1-\tau^s)$ is analogous to the one shown here, where equation (8) is totally differentiated with respect to $(1-\tau^s)$ and then solved for accordingly. $\square$

Derivations of $\mathbf{d}\tilde{x}/\mathbf{d}(1-\tau^i)$ and $\mathbf{d}\tilde{x}/\mathbf{d}(1-\tau^s)$

To solve for $\mathrm{d}\tilde{x}/\mathrm{d}(1-\tau^i)$, totally differentiate equation (8) with respect to $(1-\tau^i)$ and evaluate at $\{z_i^*, z_s^*, \tilde{x}\}$:

$$\begin{aligned}
&-(\lambda u_c^i + (1-\lambda)u_c^s) \\
&\qquad + (\tau^i - \tau^s)\Bigg\{\lambda\left(u_{cc}^i \frac{\mathrm{d}c}{\mathrm{d}(1-\tau^i)} + u_{cz_i}^i \frac{\mathrm{d}z_i^*}{\mathrm{d}(1-\tau^i)} + u_{cz_s}^i \frac{\mathrm{d}z_s^*}{\mathrm{d}(1-\tau^i)}\right) \\
&\qquad + (1-\lambda)\left(u_{cc}^s \frac{\mathrm{d}c}{\mathrm{d}(1-\tau^i)} + u_{cz_i}^s \frac{\mathrm{d}z_i^*}{\mathrm{d}(1-\tau^i)} + u_{cz_s}^s \frac{\mathrm{d}z_s^*}{\mathrm{d}(1-\tau^i)}\right) + (u_c^i - u_c^s)\lambda_{1-\tau^i}\Bigg\} \\
&\qquad - v_{xx}(\tilde{x})\frac{\mathrm{d}\tilde{x}}{\mathrm{d}(1-\tau^i)} = 0 \qquad (26)
\end{aligned}$$

where $\mathrm{d}c/\mathrm{d}(1-\tau^i)$ is defined in equation (20). Then, simplifying equation (26) by collecting like terms:

$$\begin{aligned}
\frac{\mathrm{d}\tilde{x}}{\mathrm{d}(1-\tau^i)} &= -\Xi(\lambda u_c^i + (1-\lambda)u_c^s) + \Sigma(\tau^i - \tau^s)\left(z_i^* + \bar{y}_i + \tilde{x} + \frac{\mathrm{d}R^i}{\mathrm{d}(1-\tau^i)}\right) \\
&\quad + \Upsilon(\tau^i - \tau^s)\frac{\mathrm{d}z_i^*}{\mathrm{d}(1-\tau^i)} + \Phi(\tau^i - \tau^s)\frac{\mathrm{d}z_s^*}{\mathrm{d}(1-\tau^i)} - (u_c^i - u_c^s)(\tau^i - \tau^s)\lambda_{1-\tau^i} \qquad (27)
\end{aligned}$$

where:

$$\Xi = -\big((\lambda u_{cc}^i + (1-\lambda)u_{cc}^s)(\tau^i - \tau^s)^2 - v_{xx}(\tilde{x})\big)^{-1} \qquad (28)$$

$$\Sigma = -\Xi u_{cc} \qquad (29)$$

$$\Upsilon = -\Xi(u_{cc}(1-\tau^i) + u_{cz_i}) \qquad (30)$$

$$\Phi = -\Xi(u_{cc}(1-\tau^s) + u_{cz_s}) \qquad (31)$$

Dividing both sides of equation (27) by $\mathrm{d}(1-\tau^i)$ gives the result, and $\mathrm{d}\tilde{x}/\mathrm{d}(1-\tau^s)$ is derived analogously. □

Equation (27) shows that the direction of the splitting response depends on whether the individual's MTR is above, equal to, or below the MTR of the spouse, as the optimal direction of transfer depends on who is the primary income-earner. Because the change in splitting is a function of the marginal change in the sharing rule, bargaining implies couples do not fully internalize the benefits of increases in joint disposable income from avoidance. This leads to a resource loss not reflected by the ETI (Chetty, 2009) and to sub-optimal use of the avoidance technology. Within the unitary model, in contrast, use of the technology is efficient because there is no bargaining loss, $\lambda_{1-\tau^i} = \lambda_{1-\tau^s} = 0$.

Identification of $\Delta\ln\big(1-\tau_{jt}\big)$, $\Delta\ln\big(1-\tau^a_{jt}\big)$ and $\Delta\ln\big(W_{jt}-T_{jt}\big)$

The predicted marginal net-of-tax share variable is separately identified from the other two predicted tax variables due to the convexity of the tax schedule. The percentage change in the predicted ATI variable rewrites as:

$$\%\Delta(\widehat{W_{jt}-T_{jt}}) = \frac{\big(\hat{W}_{j,t+1} - T(\hat{\Psi}_{j,t+1},\chi_{jt};\pi,\tilde{\Pi}_t)\big) - \big(W_{jt} - T(\Psi_{jt},\chi_{jt};\Pi_t)\big)}{\big(W_{jt} - T(\Psi_{jt},\chi_{jt};\Pi_t)\big)} \tag{32}$$

$$= \frac{\left(\frac{\hat{W}_{j,t+1}}{W_{jt}} - \frac{T(\hat{\Psi}_{j,t+1},\chi_{jt};\pi,\tilde{\Pi}_t)}{W_{jt}}\right) - \left(\frac{W_{jt}}{W_{jt}} - \frac{T(\Psi_{jt},\chi_{jt};\Pi_t)}{W_{jt}}\right)}{\left(\frac{W_{jt}}{W_{jt}} - \frac{T(\Psi_{jt},\chi_{jt};\Pi_t)}{W_{jt}}\right)}$$

$$= \frac{\left(\frac{\hat{W}_{j,t+1}}{W_{jt}} - \frac{T(\hat{\Psi}_{j,t+1},\chi_{jt};\pi,\tilde{\Pi}_t)}{W_{jt}}\right) - \left(1 - \frac{T(\Psi_{jt},\chi_{jt};\Pi_t)}{W_{jt}}\right)}{\left(1 - \frac{T(\Psi_{jt},\chi_{jt};\Pi_t)}{W_{jt}}\right)}$$

In contrast, the percentage change in the predicted average net-of-tax share variable is:

$$\%\Delta(\widehat{1-\tau^a_{jt}}) = \frac{\left(1 - \frac{T(\hat{\Psi}_{j,t+1},\chi_{jt};\pi,\tilde{\Pi}_t)}{\hat{W}_{j,t+1}}\right) - \left(1 - \frac{T(\Psi_{jt},\chi_{jt};\Pi_t)}{W_{jt}}\right)}{\left(1 - \frac{T(\Psi_{jt},\chi_{jt};\Pi_t)}{W_{jt}}\right)} \tag{33}$$

Hence, $\%\Delta(\widehat{W_{jt}-T_{jt}}) \neq \%\Delta(\widehat{1-\tau^a_{jt}})$. $\square$

This proof is based on a linear approximation of the log difference is the percentage change, $\ln(x_1) - \ln(x_0) \approx x_1/x_0 - 1$, given that the empirical analysis uses log differences in tax rates and liabilities. On average, $\hat{W}_{j,t+1} \neq W_{jt}$ due to the predicted variable for splitting, $\hat{x}_{j,t+1}$, which is set exogenously based on couples' rational incentives for splitting and regulations governing this tax-planning tool.