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# Tax Elasticity of Labor Earnings for Older Individuals

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# Tax Elasticity of Labor Earnings for Older Individuals


## Abstract

This paper studies the impact of income and payroll taxes on intensive and extensive labor supply decisions for workers ages 55-74 using the Health and Retirement Study. The literature provides little guidance about the responsiveness of this population to tax incentives, though the tax code is potentially an important mechanism that can alter retirement incentives. We model labor force participation decisions and labor earnings as functions of taxes, and we use the intensive margin to inform estimation of the extensive margin equation. Our method accounts for selection into labor force participation with a plausibly exogenous shock to employment. We use the results of our intensive labor supply estimation to predict the after-tax labor earnings of every person in our sample, including those that do not work. This method allows us to generate consistent estimates of the impact of taxes on employment and retirement. We find large compensated elasticities on the intensive margin. These results are imprecise, but they are statistically significant for women. On the extensive margin, we find significant effects on labor force participation and, for men, retirement decisions. Our estimates suggest that an age-targeted tax reform that eliminates payroll taxes for older workers would decrease the percentage of workers dropping out of the labor force by 1 percentage point, a 4% decrease.



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# 1 Introduction

Taxes impact individual labor supply decisions. A vast literature studies the ramifications of income taxes on hours worked, occupational choice, and labor force participation for the working age population. There is little work, however, on the tax responsiveness of labor supply decisions for the older population. In fact, in much of the labor supply literature on the effects of taxes, older people are specifically excluded from the analysis. Consequently, we have little evidence about the importance of income and payroll taxes on the labor supply of this population. However, this is a group that is potentially very responsive to the incentives generated by the tax schedule. This paper fills a major gap in the tax and labor supply literature by studying the effect that taxes have on both the intensive and extensive labor supply decisions of older workers.

The labor earnings of older workers are an important policy concern as they can supplement savings and Social Security benefits. Policymakers are frequently interested in mechanisms that can increase the labor earnings of older individuals in the United States by encouraging work or delaying retirement. There are many incentives to retire or work less at older ages due to Medicare, pensions, and Social Security. Income and payroll taxes have only rarely been considered as a means of incentivizing older workers to delay retirement or work more.

The United States tax code generally treats older and younger individuals in a similar manner, with a few small exceptions such as the age 65+ deduction and elimination of the EITC. However, the tax code could be more actively used to encourage older people to earn more and remain in the labor force. Age is an observable variable that likely proxies for different levels of productivity and attachment to the labor market. Age-specific taxes could target incentives to encourage work and labor force participation for older individuals (see Banks and Diamond [2010]). The payroll tax is an example of a tax that could easily be altered to exclude people eligible for Social Security. Social Security taxes can imperfectly be viewed as a forced savings mechanism for most of the population. However, Social Security recipients cannot increase their benefits through additional labor income, converting the payroll tax into a pure tax. Elimination of the payroll tax at certain ages or after Social Security receipt could drastically change the incentives for individuals to remain in the workforce or retire. Laitner and Silverman [2012] model the effects of a hypothetical reform that eliminates Social Security payroll taxes after the age of 54. The Laitner and Silverman [2012] paper uses structural estimation of a life-cycle model to conclude that this policy would delay retirement by, on average, one year. However, there is still only limited evidence of the possible impact of the tax code on retirement behavior. This paper takes a different approach than the structural modeling of Laitner and Silverman [2012] and provides some of the first "natural experiment" evidence of the impact of taxes on the labor supply decisions of older individuals.

There are many reasons to believe that estimates of the responsiveness of the working age population to tax incentives are not applicable to an older population. To understand the potential impact of tax policies on the labor supply decisions of older workers, we must understand whether this is a population that responds to tax incentives and to what extent they respond. Older individuals could differ on several dimensions compared to the working age population. Differences in health status could affect labor supply preferences. Older workers may have different productivity. Due to pensions and Social Security, this group is likely receiving a regular stream of unearned income and it may be more appropriate to model them as "secondary earners." Ultimately, the responsiveness of older workers to tax incentives is an empirical question, and this paper provides critical evidence on this understudied issue.

In this paper, we study both the intensive and extensive labor supply decisions of older individuals. We focus on labor earnings instead of total income as our metric of intensive labor supply for several reasons. First, labor income includes a host of choices that may respond to tax incentives such as hours worked, amenity preferences, and effort. The responsiveness of labor income summarizes the elasticity of all of these components. Second, we are specifically interested in the potential ramifications of policies that alter older individuals' incentives to work and the subsequent impact on earnings as a means of supplementing or replacing Social Security benefits. Third, we believe that labor income is a dimension in which older workers may be especially responsive to incentives in the tax code. Finally, the tax code can and does tax labor income differentially from other income. It is necessary to understand how labor income responds to taxes independent of other sources of income.

We model and estimate the labor supply decisions of older workers using the 2000-2008 Health and Retirement Study (HRS). Our empirical strategy uses legislative tax changes for identification. We build on a literature estimating the elasticity of taxable earnings that separately identifies the substitution and income effects associated with tax changes. We add to this literature by recognizing that tax-based incentives to work - for estimation of the extensive margin - are also separately identified and allow for estimation of the intensive and extensive margins. Our strategy suggests a powerful instrument for selection into labor force participation, which - to our knowledge - has not been used before as a shock to selection. This instrument should also be useful more broadly for questions involving an extensive margin dimension. We use both equations to provide information to aid consistent estimation of the other equation. We introduce a strategy that (1) accounts for selection in the intensive labor supply equation and (2) allows us to obtain consistent predictions of the variable of interest in the extensive equation. Both of these aspects of our empirical strategy make contributions to the tax and labor supply literatures.

Our results suggest that taxes have a statistically significant and economically meaningful impact on labor force participation and retirement decisions for older workers. We find evidence that individuals ages 55-74 respond on the intensive margin to the marginal net-of-tax rate, the amount that a worker keeps for an additional $1 in earnings. While our intensive labor supply estimates have large standard errors and it is difficult to rule out small elasticities, we do find statistically significant effects for women. On the extensive margin, we find statistically significant and economically meaningful effects. We find that tax-driven changes in after-tax labor earnings affect the decision to work. Our preferred estimates suggest that the elimination of the employee portion of payroll taxes for our population would decrease the percentage of workers dropping out of the labor force by 1 percentage point, a 4% decrease. The HRS also allows us to study retirement behavior. We find that taxes have a significant effect on the retirement decisions of men. Interestingly, we do not find similar retirement effects for women.

In the next section, we discuss how this paper is related to previous research in the tax and labor supply literatures. Section 3 describes the data and section 4 includes the model and empirical strategy. We present our results in section 5. Section 6 concludes.

# 2 Related Literature

This paper intersects the literatures on the elasticity of taxable income (ETI) and labor supply. Because we are especially interested in the extensive margin for the older population, we will highlight this paper's placement in the literature on the effects of tax incentives on working and labor force participation, particularly for secondary earners. First, we discuss the ETI literature.

A rich literature studies the effect of changes in marginal tax rates on taxable income.

Auten and Carroll [1999] take advantage of the differential effects that the Tax Reform Act of 1986 had on different households as an instrument for the marginal tax rate. Gruber and Saez [2002] employed a similar strategy but used these tax schedule changes to separately identify the substitution and income effects so that the effect of the marginal tax rate can be interpreted as a compensated elasticity. Singleton [2011] exploits a marriage penalty relief provision in the Economic Growth and Tax Relief Reconciliation Act of 2001. We utilize a specification similar in spirit to Gruber and Saez [2002] and Singleton [2011] and build on this specification by recognizing that tax changes can also separately identify a selection mechanism, which is especially useful for our purposes. The ETI literature typically excludes households with no taxable income, assuming that selection is random. Details concerning the ETI literature are further discussed below and are well-summarized in Auten et al. [2008] and Saez et al. [2012].

A related literature has studied the effects of taxes and wages on labor supply, typically measured as hours worked or labor force participation. This literature is summarized in Hausman [1985] and Blundell and Macurdy [1999] and typically finds that women are very responsive to taxes and wages, while working-aged men are not. In general, this literature does not study older workers and frequently even eliminates them from the analysis. It is unlikely that these estimates could be extrapolated to an older population.

There is also a small related literature studying the effects of the Social Security Earnings Test including Friedberg [2000], Gruber and Orszag [2003], Song and Manchester [2007], and Haider and Loughran [2008]. The literature finds mixed results with some evidence that Social Security recipients respond to reductions in benefits on the margin of labor earnings. However, the Earnings Test is not a pure tax since it actually returns the reduced benefits in an actuarially fair manner. Individuals' responsiveness to the earnings test may be different than in the case of a pure tax.

This project builds on the tax and labor supply literature that considers extensive margin questions, such as labor force participation, as a function of the economic return to work. For those who are not working, this literature imputes wages or total earnings as if they had worked. Typically, the literature predicts wages or earnings by assuming that workers and non-workers are the same conditional on covariates (see Meyer and Rosenbaum [2001] and Blau and Kahn [2007]). Eissa and Hoynes [2004] and Eissa et al. [2008] also use selection models to impute earnings for non-workers. The excluded variable identifying the selection equation is typically the number of preschool-aged children. We build on this framework, but improve on the identification of the selection equation using a new instrumental variable for older individuals. We believe that our strategy offers credibly exogenous variation in the selection mechanism. Furthermore, we test the robustness of our results by using methods that do not impose the strong distributional assumptions of conventional selection models.

Our empirical strategy models both the intensive and extensive margins of the labor supply decisions of older individuals. We use each equation to inform estimation of the other equation. This is helpful for two reasons. First, the extensive margin equation provides a useful exclusion restriction to identify the selection mechanism in the intensive margin equation. It is well-known that there are major difficulties finding appropriate instruments for selection. Shocks to selection need to impact labor force participation without separately affecting earnings. Our equations provide a natural and plausibly exogenous determinant of selection, which we find has a strong relationship with employment.

Second, we model the decision to work as a function of the economic benefits of working, which we define as after-tax labor income. This is the amount that the individual would make in labor earnings minus the additional taxes s/he would have to pay due to those additional earnings. This variable is not observed for the sample that does not actually work. There are many widely understood challenges to imputing labor income (and the related tax calculations) for individuals without labor income. Our intensive labor supply equation, however, provides consistent predictions of earnings for our sample. We can use this output to generate labor income for the entire sample and calculate the associated taxes. This predicted after-tax labor income allows for estimation of the extensive margin equation.

Our methodology allows for estimation of both intensive and extensive labor supply dimensions to fully understand the impact that taxes can have on the labor supply decisions of our population. This methodology should be useful more generally as it provides a credible means of accounting for selection and estimating the relationship between taxes and labor force participation.

# 3 Data

We use the Health and Retirement Study (HRS) as our primary data source. The HRS is a panel data set with a rich set of variables including demographics, income variables, and labor supply. The panel nature of the data is helpful for our empirical strategy. The detailed income variables are also crucial for generating tax variables. We use NBER's Taxsim program (Feenberg and Coutts [1993]) to derive tax rates, tax liability, and labor taxes. We use federal taxes plus one-half of FICA taxes in our calculations. We define "labor taxes" as the additional taxes paid due to the person's own labor earnings. The HRS income, asset, and demographic variables used as inputs to Taxsim are taken from RAND generated tax data files.[1]

The HRS provides data for each person every two years. We use the 2000-2008

[1] See RAND Contributions at http://hrsonline.isr.umich.edu/ for tax files for 2000.

samples in our analysis. Our sample includes everyone ages 55 to 74 who works at some time $t$ linked to their outcomes in period $t+1$. We use 2 year intervals in our specifications. Individuals appear multiple times in our data so we adjust all of our standard errors for clustering.

We define retirement in our data by two criteria: (1) no labor earnings in the year and (2) self-declared as "retired." It is well-known that labor supply decreases with age for this population. This pattern is evident in our data and illustrated by the trajectory of median labor earnings in Figure 1.

Identification of our tax variables requires legislative changes in the tax schedule. There were two key tax reforms during our study period: first, the Economic Growth and Tax Relief Reconciliation Act (EGTRRA) of 2001, which reduced tax rates for each bracket with especially large changes for those with relatively low incomes; second, the Jobs and Growth Tax Relief Reconciliation Act (JGTRRA) of 2003, which also reduced tax rates, primarily focusing on high income households. The tax reductions can be seen in our sample in Figure 2, which graphs the simulated marginal tax rate over time for ages 55-70, holding the sample constant across all years. These tax changes were previously studied in Auten et al. [2008].

These tax laws also included a marriage penalty relief provision that increased the taxable income threshold for married filers, pushing many households to a lower tax bracket. This provision was set to be gradually implemented by the EGTRRA but its enactment was hastened by the JGTRRA and the Working Family Tax Relief Act of 2004. Singleton [2011] extensively studies the impact of these provision changes on the earnings of married couples. Our identification strategy stems from the differential impact that these tax law changes had on single and married tax filers and for married tax filers with different levels of initial income.

We present summary statistics for our data in Table 1.

# 4 Model and Empirical Strategy

Our empirical strategy models and estimates the impact of taxes on both the intensive and extensive margins of labor earnings for older workers. We start with the intensive labor supply equation:

$$\ln L_{i,t+1} - \ln L_{it} = \alpha_t + X'_{it}\delta + \beta^I \left[\ln(1-\tau_{i,t+1}) - \ln(1-\tau_{it})\right] + \theta^I \Delta \ln y_{it} + (\epsilon_{i,t+1} - \epsilon_{it}) \quad (1)$$

where $L$ represents labor income, $\tau$ is the individual's marginal tax rate, and $\Delta \ln y$ is the change in the log of after-tax income and will be discussed in detail later. $X$ is a vector of covariates and measures of initial income. This specification models intensive labor supply decisions as a function of the marginal net-of-tax rate and shifts in the individual's budget constraint, the substitution and income effects.

We are also interested in understanding extensive margin decisions for both the decision to work and retirement:

$$P\left(\text{Work}_{i,t+1} = 1\right) = F\left(\phi_t + X'_{it}\gamma + \beta^E \ln\left(L - (T^w - T^{nw})\right)_{i,t+1} + \theta^E \Delta \ln y_{it} + \nu_{it}\right) \quad (2)$$

We study the decision to work (or retire) in period $t+1$ for all individuals working in period $t$. $T^w$ represents the tax liability if the individual works and earns labor income $L$. $T^{nw}$ is the individual's tax liability if the individual does not work. The implication of equation (2) is that we model the extensive margin as a function of the additional money that the individual receives if s/he works: $L$ minus the individual's additional tax liability $(T^w - T^{nw})$. We will refer to this variable as "after-tax labor income." A similar variable is referred to as "effective net-of-tax share" in Gelber and Mitchell [2011]. We also model the probability of retiring in the same manner as equation (2). Note that $L$ and, consequently, $(T^w - T^{nw})$ are not observed for non-workers.

Equations (1) and (2) pose a few identification challenges. First, OLS will not provide consistent estimates. Changes in tax rates and after-tax income are functions of changes in labor earnings. In equation (2), individuals with higher $L$ may be more likely to work for reasons unrelated to after-tax earnings. Second, we do not observe $L_{i,t+1}$ for individuals that do not work in period $t + 1$. Consequently, we can only estimate equation (1) for a selected sample of individuals. Similarly, we do not observe $L - (T^w - T^{nw})$ in equation (2).

To address the issue of endogeneity, we create a set of instruments that exploit plausibly exogenous shocks to the tax variables. These instruments are discussed in detail in Section 4.1 below. To adjust for selection, we follow standard methods in the labor supply literature with three important differences that improve the consistency of the estimates. First, we take advantage of the panel nature of the HRS data to incorporate previous income in our earnings predictions. The literature typically predicts earnings on the basis of only cross-sectional variables. Second, we use a new instrument for selection that plausibly satisfies the exclusion restriction. Conventional selection instruments used in the labor supply literature (such as number of children) have numerous identification concerns and are not relevant in the context of older workers. Third, we also consider semi-parametric alternatives to Heckman selection methods commonly employed in the literature so that we do not identify off of strong distributional assumptions.

In dealing with selection, we utilize equations for both the intensive and extensive margins and allow each equation to inform the other. Insights from the extensive margin equation can provide information on selection in the intensive equation by suggesting a natural excluded variable. Individuals who do not work are not making intensive labor decisions and are likely to not be responding to the marginal net-of-tax rate at the first dollar of labor earnings. These individuals are excluded from the estimation of the intensive labor supply equation, which may create issues related to a selected sample. The extensive labor supply equation allows us to address this selection concern and obtain consistent estimates. The extensive equation provides a necessary exclusion restriction to properly address selection. We expect selection to bias our estimates of $\beta^I$ downward. If the tax schedule becomes more generous, individuals with less proneness to labor supply (relative to their previous labor supply) will enter the labor force. These people will likely work less and, consequently, we will associate generous tax schedules (higher marginal net-of-tax rates) with lower intensive labor supply decisions. Accounting for selection, then, should increase our estimates of $\beta^I$. The same argument suggests that $\theta^I$ will be biased upward by selection.

## 4.1 Instruments

Our two equations of interest include three different tax-related variables: the marginal net-of-tax rate, after-tax income, and after-tax labor income. These are all potentially endogenous as taxes are a function of labor income. We implement an instrumental variables strategy with shocks to all three of these tax-related variables. The last instrument for after-tax labor income will also be used to identify the selection equation.

The tax schedule underwent two major reforms (EGTRRA and JGTRRA) during the study period, as shown previously. Furthermore, for a given level of labor earnings, it is possible that married individuals experienced different tax changes relative to single filers. We exploit this source of variation, because we can implicitly compare people with similar initial income who experience different tax shocks. Gruber and Saez [2002] show that their results are sensitive to controls for initial taxable income. We use a source of variation that is potentially orthogonal to issues of wage trends and mean reversion by adding an additional difference. Our variation originates from the interaction of tax schedule changes, initial income, and marital status. We will also control for initial income in a flexible manner to account for possible trends and mean reversion, but our method should be less sensitive to their inclusion than the existing ETI literature, which identifies purely off of legislative tax changes interacted with variation in initial income.

We implement this strategy by creating the Gruber and Saez [2002] instruments for the tax variables. We calculate tax liability, the marginal tax rate, and labor taxes for each individual in the initial year $t$. Holding everything constant in real terms, we also calculate their predicted tax rate in year $t+2$. We repeat these steps, but assuming that the individual is single (we include all spousal earnings as other income for tax purposes). These are the counterfactual tax variable changes. Finally, we take the Gruber-Saez instruments and subtract the counterfactual tax changes.

$$\underbrace{\Delta \ln \widehat{(1-\tau)}}_{\text{Gruber-Saez instrument}} \quad - \quad \underbrace{\Delta \ln \widehat{(1-\tilde{\tau})}}_{\text{counterfactual change}}$$

where $\tilde{\tau}$ is the marginal tax rate if the individual is a single filer. Note that for single filers, the tax variable will be 0. Identification, therefore, originates not just from the tax schedule changes, but the interaction of these legislative changes with initial marital status. We should highlight that we fix marital status so changes in marital status do not affect our instruments. Differential predicted tax changes are not simply a product of initial income and legislative tax schedule changes. We also control for 4 measures of initial income in our regression - own labor earnings, spousal labor earnings, total labor earnings, and total household income. We use a 5 piece spline for each variable and interact each with initial marital status.[2] The inclusion of controls for initial income makes our strategy similar

[2]We also include a variable for "no spousal labor earnings."

to the one found in Singleton [2011]. Our other instruments are constructed in a similar manner:

$$\Delta\ln(\widehat{z - T}(z)) - \Delta\ln(\widehat{z - \tilde{T}}(z))$$
$$\Delta\ln(L - \widehat{(T^w - T^{nw})}) - \Delta\ln(L - \widehat{(\tilde{T}^w - \tilde{T}^{nw})})$$

We should also highlight that all of our instruments use differences. Households that we predict will experience large tax changes (due to the interaction of marital status, initial income, and legislative tax changes) may be different from households that we predict will experience smaller tax changes. Using differences reduces concerns of bias. We believe that using differences for identification is important, and we emphasize that our instruments always use differences. In equation (2), we model the decision to work in period $t+1$ as a function of after-tax labor income in period $t+1$. Since we only want to use differences for identification though, we instrument this variable with the expected *change* in after-tax labor income.[3]

It is also important to note that our three separate shocks vary independently. A tax change may shift one person past a kink point in the tax schedule to a new tax bracket while not doing so for another person. Given different distances from the nearest kink point, the tax change will have different impacts on people's after-tax income. Finally, people with different non-labor income will experience differential changes in labor taxes.

[3] The underlying experiment is to imagine Person A whose labor taxes are reduced (in our instruments) by $1000 between period $t$ and period $t+1$. Person B experiences no such predicted reduction. We expect, on average, Person A to have larger after-tax labor income and be more likely to work in period $t+1$. Identification does not originate from cross-sectional labor income or labor tax liability variation. Instead, all identification originates from predicted changes in labor taxes.

## 4.2 Selection

Both of our equations of interest are potentially affected by selection. Even with randomly-assigned tax schedules, selection could bias equation (1) since we do not observe $L_{i,t+1}$ for people who do not work in period $t+1$. Our primary concern is that these non-workers may have systematically different $\epsilon_{i,t+1}$, implying that $E\left[(\epsilon_{i,t+1} - \epsilon_{it})|\mathbf{z}_i\right] \neq 0$. Imagine if these non-workers were incentivized to work. We might guess that they would work less on average, given observable characteristics, than the population that actually does work. This in itself is not problematic if the decision to work or not work is independent of our shocks to $\ln(1-\tau)$ and $\Delta \ln y$. However, we may think that changes in incentives due to taxes influence the decision to earn labor income. While the tax variables explicitly included in equation (1) may not affect this decision, they are likely correlated with the variables that do. For example, an increase in taxes may lead to lower after-tax labor income and a higher marginal net-of-tax rate. The lower after-tax labor income will induce people to drop out of the labor market in period $t+1$, excluding them from the sample for estimation of equation (1). Since this is correlated with higher taxes and, specifically, higher marginal net-of-tax rates, we may have a selected sample.

Selection bias in equation (1) creates further problems for our empirical strategy since we use this equation to predict $L_{i,t+1}$ to use for equation (2). This procedure is similar in spirit to the methodology found throughout the labor supply literature studying extensive margin questions. Meyer and Rosenbaum [2001], Blau and Kahn [2007], Gelber and Mitchell [2011] impute earnings for non-workers based on covariates, assuming that workers and non-workers are the same after conditioning on observable characteristics. These studies predict earnings by estimating equations such as:

$$\ln(y_i) = \alpha + X_i\beta + \epsilon_i. \tag{3}$$

It is also common to account for selection bias in these equations using a Heckman [1979] correction term and adding the inverse Mills ratio to equation (3). This method is used in Eissa and Hoynes [2004]; Eissa et al. [2008]; and - as a robustness check - Gelber and Mitchell [2011]. These studies include an additional instrument for selection such as number of children or preschool-aged children.

We improve on this method in several ways for our context. First, we employ panel data, providing us with data on previous earnings. Instead of assuming that people who do not work have the same earning power and labor supply preferences as non-workers, we observe previous earnings in our sample. We can assign people the same earnings as the previous year, making adjustments to the new earnings based on observable characteristics. This method reduces concerns of selection issues by accounting for this individual fixed effect and not assuming that workers and non-workers are the same. Furthermore, note that equation (3) does not use information about taxes to predict earnings. If taxes (or, in other contexts, the policy variables of interest) affect earnings, then is potentially problematic to predict earnings without these policy variables. We model changes in earnings as a function of covariates and changes in the tax variables.

Second, we have a plausibly exogenous instrument for selection. Even panel data may not be adequate to impute earnings since people who stop working may have experienced different shocks to productivity or labor supply preferences than those who continue working. Our framework, however, provides a natural instrument for selection. The literature has used family characteristics such as the number of preschool-aged children as a cross-sectional shock to participation in the labor force. This instrument poses problems because the selection method requires an instrument that affects participation without separately affecting labor earnings. However, people with children are likely different than people without children on dimensions such as productivity. Furthermore, children may also change intensive labor supply preferences, affecting earnings independent of selection.

Our intensive and extensive labor supply equations offer a useful exclusion restriction. The extensive equation includes a variable (after-tax labor income) that is not included in the intensive equation, suggesting that the instrument for this variable is an appropriate instrument for selection into equation (1). Thus, we use changes in labor taxes as an exogenous shock to employment. To illustrate, take two people currently in the labor force. One person's labor taxes are predicted to decrease by \$1000, while another's are predicted to stay the same. We predict that the first person is more incentivized to remain in the labor force.

Of course, changes in labor taxes are correlated with changes in total taxes. Changes in taxes shift the budget constraint and could have important income effects, including impacts on intensive labor supply preferences. Consequently, our selection instrument is only orthogonal to the disturbance term in our intensive labor supply equation *conditional on changes in after-tax income*. It is important to highlight that these two terms - changes in labor taxes and changes in total taxes - are independently identified due to nonlinearities in the tax schedule. Thus, we use our shocks to labor taxes as an instrument for selection while conditioning on the change in total taxes. Since these are not collinear, this separates the selection shock from an income effect.

Our strategy depends on people responding to our selection instrument. Predicted changes in labor taxes must be correlated with employment probabilities. This is an empirical question and we will show that there is a relationship. A main insight of our empirical strategy is that, conditional on shocks to total taxes, shocks to labor taxes are a useful instrument for selection. This strategy should be useful in contexts beyond this paper. It is commonly argued that selection models are difficult to utilize because of the standards required for the selection mechanism. We suggest a credibly exogenous instrument for selection, which can be used for broader research questions.

Finally, we also account for selection using a method that does not rely on strong distributional assumptions found in the Heckman [1979] method. While we present results that condition on an inverse Mills ratio, we also report results using semi-parametric methods. Systematic selection into employment implies that

$$E\left[(\epsilon_{i,t+1} - \epsilon_{it})|\mathbf{z}_i\right] = \lambda(\mathbf{W}_i'\zeta) \tag{4}$$

where $W$ includes our instruments for the intensive labor supply equation, the selection instrument, and all exogenous variables in equation (1). We do not assume any functional form for $\lambda(\cdot)$ and instead use a series approximation, as suggested in Newey [2009]. We estimate the selection equation using a maximum rank approach introduced in Cavanagh and Sherman [1998], which requires no distributional assumptions to obtain consistent estimates.

## 4.3 Income Effect

Before discussing the practical implementation of our empirical strategy, we will address the $\Delta \ln y$ term in our two equations. Gruber and Saez [2002] discuss separate identification of the substitution and income effects, allowing for interpretation of the coefficient on the change in log of marginal net-of-tax rate variable as a compensated elasticity. This was an important innovation and important in our context. The Gruber-Saez after-tax income variable is $\ln(z_{i,t+1} - T_{t+1}(z_{i,t+1})) - \ln(z_{it} - T_t(z_{it}))$ and the paper models changes in taxable income as a function of this variable.

We note that this structural relationship may be problematic. Households respond to shifts in their budget constraints, but this variable assumes that they are responding to their final after-tax income, which includes the response to this budget constraint shift and changes in the marginal tax rate. This point is discussed briefly in Powell and Shan [2012]. An example can help make this point clearer. Imagine an individual with income $\tilde{z}$ in period 1 and no tax liability. The tax code changes such that this person is given a lump sum equal to $\tilde{z}$ in period 2. In response, the person changes behavior and earns income equal to 0. This is a strong income effect resulting from the outward budget constraint shift. However, the Gruber-Saez specification models the change in earnings $(-\tilde{z})$ as a function of the final change in after-tax income, which is 0. This is because using actual after-tax income changes includes the response to the tax change as well. The variable capturing the income effect should not include this endogenous response.

We include a $\Delta \ln y$ term because our shocks to the marginal net-of-tax rate also shock the individual's budget constraint. We want to instrument the marginal net-of-tax rate with an instrument that is exogenous to changes in the budget constraint so we explicitly include this term. Our $\Delta \ln y$ term is the expected change in after-tax income given the shocks in our identification strategy. We hold everything constant and estimate the budget constraint shift due only to the shock that we use for identification. This separates the substitution and income effects as before, and we interpret our estimates as compensated elasticities.

In practice, we create a variable equal to

$$\ln(z_{it} - T_{i,t+1}(z_{it})) - \ln(z_{it} - T_{it}(z_{it}))$$

where $z_{it}$ is total pre-tax income in period $t$. Note that this variable looks very much like an instrument for the income shift. The important consideration is that our other instruments are orthogonal to income effect considerations conditional on this variable or, alternatively, the instrument for after-tax income. We instrument the above variable with our predicted change in log of after-tax income due to legislative tax changes and initial marital status.

Note that while it is important to control for this variable to interpret the coefficients on the other tax variables, the construction of this variable makes it difficult to interpret its own coefficient. We treat this coefficient as a necessary parameter but do not interpret its magnitude. We expect the coefficient to be negative, however.

## 4.4 Implementation

We implement our empirical strategy in three steps. Given that the labor supply literature has consistently found that men and women respond to labor market incentives in different ways, we perform all estimations separately by gender. We also include several covariates in our estimation. We create cells based on age and education of individual $i$ and the age and education of individual $i$'s spouse. There are 4 education categories (less than high school, high school graduate, some college, college graduate) and 6 age group categories (55-60, 61-62, 63-64, 65-67, 68-69, 70+) for a total of 24 cells. We allow each group to have a differential effect based on initial marital status. We include an indicator variable for each cell. We also include indicator variables based on spouse's age (under 55,[4] 55-60, 61-62, 63-64, 65-67, 68-69, 70+) and education. There is an additional dummy variable for "no spouse." $X$ also includes functions of initial labor income ($L_{it}$), spousal labor income, total household labor income, and total household income. In practice, we use a 5-piece spline in each of these income variables. Each spline is also interacted with a dummy variable for "married at time $t$" so that the initial income measures can have different effects for single and married filers.

[4]While our sample includes people 55+, a respondent's spouse may be younger.

### 4.4.1 Step 1:

In the first step, we model the selection mechanism. When we report estimates that do not account for selection, this step is skipped. It is only appropriate to include exogenous variables in the selection equation so we estimate a reduced form version of equation (2). Furthermore, we must include all of the instruments used in the intensive labor supply equation. In the end, we estimate

$$\begin{aligned}P\left(\text{Work}_{i,t+1}=1\right)=F\Big(&\phi_t+X_{it}'\gamma+\beta_1\left[\Delta\ln\widehat{(1-\tau)}-\Delta\ln\widehat{(1-\tilde{\tau})}\right]_{it}\\&+\beta_2\left[\Delta\ln(\widehat{z-T}(z))-\Delta\ln(\widehat{z-\tilde{T}}(z))\right]_{it}\\&+\beta_3\left[\Delta\ln(L-\widehat{(T^w-}T^{nw}))-\Delta\ln(L-\widehat{(\tilde{T}^w-}\tilde{T}^{nw}))\right]_{it}+\eta_{it}\Big)\end{aligned}\quad(5)$$

The predictions provided by equation (5) are used as selection adjustments for the intensive equation. We do this in two different ways. First, we assume that $F(\cdot)=\Phi(\cdot)$, estimate equation (5) using a probit regression, and form an inverse Mills ratio as discussed in Heckman [1979]. This method is frequently used in the literature.

Second, we use a maximum rank estimator introduced in Cavanagh and Sherman [1998]. This estimator does not estimate $F(\cdot)$ but provides $\sqrt{n}$-consistent estimates up to scale of the coefficients in the argument of the function. We then predict the index function, which we denote as $W_{it}'\hat{\zeta}$. The selection correction term is a function of this index and we follow the method of Newey [2009] by approximating this term with a power series of $W_{it}'\hat{\zeta}$. The advantage of this approach is that the maximum rank estimator requires no distributional assumptions to obtain consistent $\hat{\zeta}$. We will refer to this as the semi-parametric selection correction.

We coded the maximum rank estimator, generated initial values through a probit regression, and maximized the objective function using a Nelder-Mead optimization algorithm. Standard errors are generated using a clustered bootstrap.[5]

#### 4.4.2 Step 2:

The second step estimates the intensive labor supply equation. Because of selection, we estimate the following in practice:

$$\ln L_{i,t+1} - \ln L_{it} = \alpha_t + X_{it}'\delta + \beta^I \left[\ln(1-\tau_{i,t+1}) - \ln(1-\tau_{it})\right] + \theta^I \Delta \ln y_{it} + \lambda(W_{it}'\hat{\zeta}) + (\mu_{i,t+1} - \mu_{it}) \tag{6}$$

In practice, we use an inverse Mills ratio or a fifth degree polynomial in $W_{it}'\hat{\zeta}$. We use $\left[\Delta \ln \widehat{(1-\tau)} - \Delta \ln \widehat{(1-\tilde{\tau})}\right]_{it}$ and $\left[\Delta \ln (\widehat{z - T}(z)) - \Delta \ln (\widehat{z - \tilde{T}}(z))\right]_{it}$ as instruments.

Because of estimation of the selection terms, we bootstrap Steps 1 and 2 to account for the inclusion of an estimated term in equation (6). Since each individual may be included multiple times in our data, we use a clustered bootstrap.

We should highlight that 2SLS includes the selection adjustment terms in the first stage as well. This has practical importance in our strategy. Notice that for individuals not working, we do not observe the change in their marginal net-of-tax rate if they had actually worked.[6] We predict this variable from the first-stage regression in the same way that we will predict labor earnings for period $t+1$.

We use 2SLS to obtain consistent estimates. Once we have consistent estimates for equation (6), we can predict $\ln L_{i,t+1} - \ln L_{it}$ for our entire sample. This includes people who did not work in period $t+1$. However, it is important to note that when using the Newey [2009] method, the constant term is not separately identified from the selection correction

[5]Subbotin [2007] discusses properties of bootstrapping rank regression estimates.

[6]Since our endogenous after-tax income measure is the shift in the budget constraint, we do observe this variable.

term. A method to estimate the constant term was introduced in Heckman [1990]. Schafgans and Zinde-Walsh [2002] proved that this estimator was consistent and asymptotically normal. We implement this estimator to derive the constant term.

We predict the change in earnings for the entire sample using the estimated coefficients in equation (6), the estimated constant term, and the imputed change in $\ln(1-\tau_{i,t+1})-\ln(1-\tau_{it})$. In other words, we have consistent predictions of the tax variables and the coefficients to predict $\ln L_{i,t+1}-\ln L_{it}$ for everyone in our sample. We use this to predict Ł$_{i,t+1}$ using

$$\widehat{L}_{i,t+1}=\exp(\ln L_{it}+\overbrace{\ln L_{i,t+1}-\ln L_{it}}^{\text{Predicted}}). \tag{7}$$

#### 4.4.3 Step 3:

Once we have $\widehat{L}_{i,t+1}$, we can calculate $\widehat{T^w_{i,t+1}-T^{nw}_{i,t+1}}$ using NBER's Taxsim program. Then, we estimate

$$P\left(\text{Work}_{i,t+1}=1\right)=F\left(\phi_t+X'_{it}\gamma+\beta^E\ln\left(\widehat{L}-(\widehat{T^w-T^{nw}})\right)_{i,t+1}+\theta^E\Delta\ln y_{it}+\nu_{i,t+1}\right). \tag{8}$$

We estimate this equation using 2SLS with instruments

$$\left[\Delta\text{ln}(L-\widehat{(T^w-T^{nw})})-\Delta\text{ln}(L-\widehat{(\tilde{T}^w-\tilde{T}^{nw})})\right]_{it}$$
$$\text{and}\left[\Delta\text{ln}(\widehat{z-T}(z))-\Delta\text{ln}(\widehat{z-\tilde{T}}(z))\right]_{it}.$$

We adjust all standard errors for clustering at the individual level. We use a clustered bootstrap for all 3 steps to generate all standard errors in this paper.

# 5 Results

## 5.1 Estimates

Our empirical strategy requires three different steps. First, we estimate the selection mechanism and examine the impact of our labor taxes instrument on employment. This equation is the reduced form equivalent of the extensive labor supply equation. Second, we estimate the intensive labor supply equation to measure the effect of the marginal tax rate on labor earnings. Finally, we estimate the extensive labor supply dimension to obtain the structural estimates of the impact of after-tax labor earnings on labor force participation. For these last two steps, we include estimates with (1) no selection adjustment; (2) a Heckman [1979] adjustment method; (3) a semi-parametric adjustment method. These adjustments are marked in the tables. We should highlight that no selection term is actually included in the extensive margin estimation. Instead, the different selection adjustments refer to the method used to generate the earnings (and the corresponding tax variables) used in the extensive equation.

In Table 2, we present results for the reduced form selection mechanism. Note that all exogenous variables are included in these regressions. Adjusting for selection in the intensive labor supply equation requires an excluded variable that is correlated with selection (i.e., participation in the labor force). Technically, it is possible to identify purely off of distributional assumptions using Heckman [1979] and a probit regression. Even with an excluded variable, some of the identification will originate from distributional assumptions. The semi-parametric method that we employ, however, does require an excluded variable that predicts labor force participation. All identification of the selection term originates from our selection instrument.

Columns (1) and (3) present the results from probit regressions and show that there is a statistically significant relationship between our selection instrument and employment for women and men. Columns (2) and (4) are the results of a maximum rank estimator introduced in Cavanagh and Sherman [1998]. It is important to note that the coefficients between the probit and maximum rank estimators are not comparable. The maximum rank estimator coefficients are only identified up to scale. We present the results of this estimation only to show their significance. It appears that our selection equation is well-identified. The results also suggest that labor taxes impact the probability of working. Estimating the intensive labor supply equation and generating the endogenous "after-tax labor income" is necessary for parameterization of this relationship, but we can surmise from Table 2 that there is likely a positive relationship.

Table 3 presents the first stage results for the intensive labor supply equation. We present Partial F-statistics, which measure the strength of the instruments on each endogenous variables independent of the other endogenous variables. We find strong relationships for all variables in all samples and specifications.

Table 4 includes the results from IV estimation of the intensive labor supply equations. We can interpret the coefficients on the marginal net-of-tax rate as compensated elasticities. The standard errors in this table are rather large, likely due to the relatively high variance of labor earnings for this population. Interestingly, we find evidence that selection does bias the results. Our preferred semi-parametric method increases the coefficients of the marginal net-of-tax rate variable by a large amount. We do find a significant relationship between the marginal net-of-tax rate and labor earnings for women, suggesting that a 10% increase in the marginal net-of-tax rate would increase labor earnings for those who are working by 30%. However, given the imprecision of the results, we cannot rule out much smaller elasticities. We find large point estimates for men, but these are not significantly different from zero.

Finally, we use the results found in Table 4 to generate predicted labor earnings. As detailed earlier, we then calculate the additional taxes that the individual would pay had s/he earned this income. We use this variable in our extensive margin equation and estimate with instrumental variables.

Table 5 shows significant effects on the extensive margin dimension. When we do not account for selection, we find that a 10% increase in after-tax labor income increases employment by 0.8 percentage points for both men and women. Our results are not sensitive to the selection method used to generate the intensive labor supply predictions. When we focus on retirement in Table 6, we find similar but opposite effects for men, suggesting that an increase in after-tax labor income delays retirement. Note that over 80% of the drop in labor force participation for men can be attributed to retirement. We do not find similar effects for women. The evidence on retirement in Table 6 suggests possibly that taxes can induce men to retire, while women may simply drop out of the labor force in a less permanent manner.

## 5.2 Discussion

We find evidence that older workers may be very responsive on the intensive margin. The point estimates, after accounting for selection using our preferred method, are relatively large. However, due to the imprecision of the estimates we cannot rule out less elastic relationships either.

The key finding in our analysis is the level of responsiveness of older workers to the additional taxes that they would have to pay if they worked. The parameter estimated in Table 5 is hard to interpret, however, so we considered the following policy experiment, inspired by Laitner and Silverman [2012]. We study how extensive margin work decisions would respond to the elimination of the employee portion of the FICA taxes for our sample. We assume that an equivalent lump sum tax is levied on each person in a way that that does not distort labor decisions. In our sample, 25% of working women and 26.2% of working men will not earn positive wages 2 years later. Elimination of the employee FICA taxes will reduce each of these by 1 percentage point, or approximately 4% for both men and women. The retirement rate for working men is 16.6% and this would decrease by 0.8 percentage points, or 5%.

While we find a significant relationship between retirement and taxes for men, we do not find this relationship for women. There are many possible explanations for this difference. For example, women may be less attached to the labor market in general and not definitively "retiring" due to tax incentives. However, it would be difficult for us to isolate an exact mechanism with our data.

The retirement changes for men are especially interesting because they suggest that tax incentives can have dynamic effects on labor supply by causing men to drop out of the labor force in a more permanent manner. Understanding the permanence of these behavioral responses will be studied in future research.

The magnitudes of these effects are large. The Song and Manchester [2007] study finds little evidence of any effect of the elimination of the Earnings Test in 2000 for ages 65-69 on labor force participation. Our estimates are equivalent to their largest estimates on labor force participation.

# 6 Conclusion

This paper models both the intensive and extensive margins of labor supply, using each dimension to provide more accurate and consistent estimation of the other. We model the intensive labor supply as a function of the marginal net-of-tax rate and shifts in the budget constraint. Extensive labor supply is a function of the monetary benefit of working as measured by after-tax labor earnings. Both of these equations are difficult to estimate even with proper instrumental variables. The extensive labor supply equation, however, provides a natural exclusion restriction to account for selection in the intensive labor supply. This instrument is, to our knowledge, new to the labor supply literature, which has consistently suggested that selection instruments meeting the required conditions are difficult to find. The intensive labor supply equation provides a crucial variable to the extensive equation, allowing us to generate consistent estimates for that equation as well.

We find statistically significant and economically meaningful effects of taxes on the labor force participation behavior of older workers. We find evidence that men retire in response to high taxes. The labor supply and tax literatures rarely study the older segment of the population, frequently excluding them from the analysis. This paper fills a large gap in these literatures and provides important estimates about the incentivizing potential of the tax code. Age-specific tax reductions could cause this population to stay in the labor force and delay retirement.

# Figures

Figure 1: Median Labor Earnings by Age

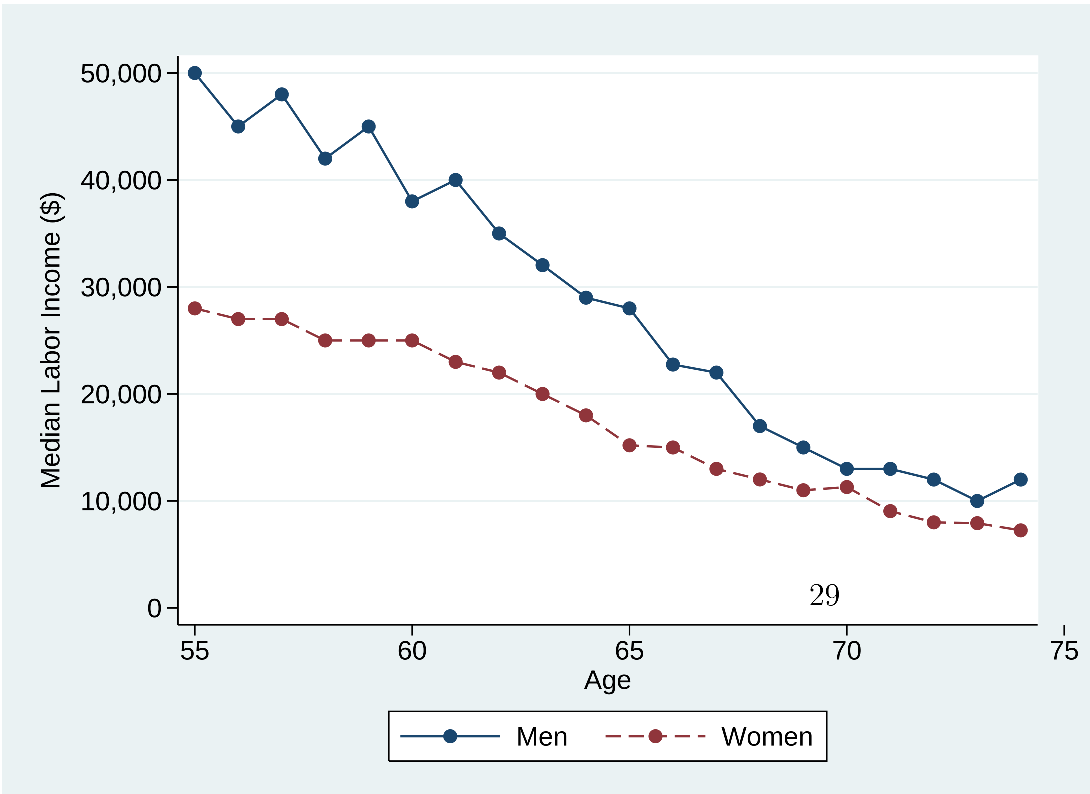
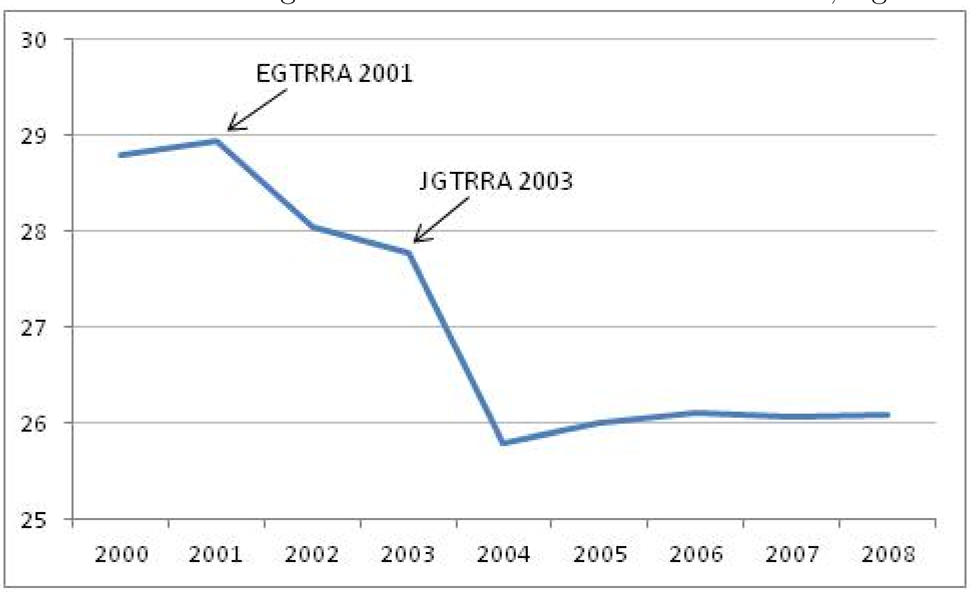


Figure 2: Simulated Federal MTR in HRS, Ages 55-70



# Tables

Table 1: Descriptive Statistics

| Sample: | Overall Sample |
|---|---|
| **Demographics** | |
| Age | 62.1 |
| Less than HS | 0.145 |
| HS Grad | 0.359 |
| Some College | 0.236 |
| College Grad | 0.260 |
| Male | 0.475 |
| **Labor Outcomes** | |
| Labor Earnings | 35,213.59 |
| Spouse's Labor Earnings | 14,960.93 |
| Total Income | 81,979.61 |
| Employed in Next Period | 0.744 |
| Wages in Next Period (if Employed) | 36,809.07 |
| Retired in Next Period | 0.152 |
| **Tax Variables** | |
| Marginal Tax Rate | 27.3 |
| Tax Liability | 17186.16 |
| Change in MTR ($t$ and $t+2$) | -3.3 |
| Change in Tax Liability ($t$ and $t+2$) | -2,835.23 |
| **Observations** | 16,443 |

Table 2: Selection Equation, Reduced Form

| Dependent Variable: | I(Employed) | | | |
|---|---|---|---|---|
| | Women | | Men | |
| | (1) | (2) | (3) | (4) |
| Predicted Δ in ln(After-Tax Labor Income) | 0.779*** | 0.059*** | 0.896*** | 0.102*** |
| | (0.244) | (0.024) | (0.273) | (0.035) |
| Probit | X | | X | |
| Maximum Rank | | X | | X |
| Observations | 8,635 | 8,635 | 7,808 | 7,808 |

Significance levels: * 10%, ** 5%, *** 1%. Other variables included: predicted change in log of marginal net-of-tax rate; predicted change in log of after-tax income; year dummies; interactions for age group × education × initial marital status; interactions based on spousal age group × spousal education. Initial income controls include 5-piece splines in initial labor income, spousal labor income, household labor income, and total income by marital status. Standard errors in parentheses adjusted for clustering at individual level. Maximum Rank standard errors generated from bootstrap.

Table 3: Intensive Labor Supply Equation, First Stage

| Dependent Variable: | Δ ln(1-MTR) | | | Δ ln(After-Tax Income) | | |
|---|---|---|---|---|---|---|
| Selection Adjustment: | None | Heckman | Semi-Parametric | None | Heckman | Semi-Parametric |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Women** (N=6,489) | | | | | | |
| Predicted Δ ln(1-MTR) | 0.320*** | 0.316*** | 0.301*** | 0.006* | 0.003 | 0.000 |
| | (0.057) | (0.058) | (0.060) | 0.003 | (0.003) | (0.004) |
| Predicted ΔAfter-Tax Income | 0.718* | 0.037 | 1.328** | 0.718*** | 0.805*** | 0.827*** |
| | (0.405) | (0.025) | (0.639) | (0.059) | 0.055 | (0.070) |
| Partial F-Statistic | 29.57 | 29.08 | 25.02 | 144.73 | 203.16 | 129.40 |
| **Men** (N=5,780) | | | | | | |
| Predicted Δ ln(1-MTR) | 0.375*** | 0.380*** | 0.388*** | 0.011*** | 0.005 | 0.004 |
| | (0.047) | (0.047) | (0.049) | (0.003) | (0.003) | (0.003) |
| Predicted ΔAfter-Tax Income | 0.420 | 0.348 | 0.145 | 0.535*** | 0.620*** | 0.643*** |
| | (0.400) | (0.407) | (0.486) | (0.072) | (0.066) | (0.077) |
| Partial F-Statistic | 58.79 | 62.70 | 60.29 | 53.32 | 87.65 | 70.35 |

Significance levels: * 10%, ** 5%, *** 1%. Other variables included: year dummies; interactions for age group × education × initial marital status; interactions based on spousal age group × spousal education. Initial income controls include 5-piece splines in initial labor income, spousal labor income, household labor income, and total income by marital status. Standard errors in parentheses adjusted for clustering at individual level. Heckman (1979) and Semi-Parametric standard errors generated from bootstrap.

## Table 4: Intensive Labor Supply Equation, 2SLS

| Dependent Variable: | ln(Labor Income) | | | | | |
|---|---|---|---|---|---|---|
| | **Women** | | | **Men** | | |
| Selection Adjustment: | None | Heckman | Semi-Parametric | None | Heckman | Semi-Parametric |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $\Delta$ ln(1-MTR) | -0.249 | 1.046 | 3.043** | -0.108 | 0.720 | 0.942 |
| | (0.799) | (0.680) | (1.541) | (0.649) | (0.637) | (0.796) |
| $\Delta$ ln(After-Tax Income) | 7.504 | -13.102** | -24.652** | 12.204* | 6.618 | -4.278 |
| | (5.323) | (5.930) | (12.438) | (6.669) | (6.784) | (8.471) |
| Observations | 6,489 | 6,489 | 6,489 | 5,780 | 5,780 | 5,780 |

Significance levels: * 10%, ** 5%, *** 1%. Other variables included: year dummies; interactions for age group × education × initial marital status; interactions based on spousal age group × spousal education; Initial income controls include 5-piece splines in initial labor income, spousal labor income, household labor income, and total income by marital status. Standard errors in parentheses adjusted for clustering at individual level. Heckman (1979) and Semi-Parametric standard errors generated from bootstrap.

## Table 5: Extensive Labor Supply Equation (Employment), 2SLS

| Dependent Variable: | I(Employed) | | | | | |
|---|---|---|---|---|---|---|
| | **Women** | | | **Men** | | |
| Selection Adjustment: | None | Heckman | Semi-Parametric | None | Heckman | Semi-Parametric |
| ln(After-Tax Labor Income) | 0.086*** | 0.085*** | 0.084*** | 0.079*** | 0.078*** | 0.079*** |
| | (0.028) | (0.027) | (0.027) | (0.022) | (0.022) | (0.022) |
| ln(After-Tax Income) | -4.637* | -3.110 | -2.572 | 0.012 | 0.376 | 0.216 |
| | (2.684) | (2.739) | (2.810) | (2.341) | (2.342) | (2.305 ) |
| Observations | 8,438 | 8,438 | 8,438 | 7,583 | 7,583 | 7,583 |

Significance levels: * 10%, ** 5%, *** 1%. Other variables included: predicted change in after-tax income; year dummies; interactions for age group × education; interactions based on spousal age group × spousal education; 5-piece splines in initial labor income, spousal labor income, household labor income, and total income. Standard errors in parentheses adjusted for clustering at individual level. Selection Adjustment refers to method used to predict labor earnings.

## Table 6: Extensive Labor Supply Equation (Retirement), 2SLS

| Dependent Variable: | I(Employed) | | | | | |
|---|---|---|---|---|---|---|
| | **Women** | | | **Men** | | |
| Selection Adjustment: | None | Heckman | Semi-Parametric | None | Heckman | Semi-Parametric |
| ln(After-Tax Labor Income) | -0.032 | -0.032 | -0.031 | -0.066*** | -0.065*** | -0.066*** |
| | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) |
| ln(After-Tax Income) | 3.493 | 2.922 | 2.540 | -1.401 | -1.709 | 2.721 |
| | (2.170) | (2.203) | (2.241) | (2.006) | (2.010) | (1.980) |
| Observations | 8,438 | 8,438 | 8,438 | 7,583 | 7,583 | 7,583 |

Significance levels: * 10%, ** 5%, *** 1%. Other variables included: predicted change in after-tax income; year dummies; interactions for age group × education; interactions based on spousal age group × spousal education; 5-piece splines in initial labor income, spousal labor income, household labor income, and total income. Standard errors in parentheses adjusted for clustering at individual level. Selection Adjustment refers to method used to predict labor earnings.

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