Taxation and Household Decisions: an Intertemporal Analysis∗

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Abstract

How do different income taxation systems – for instance individual vs. joint – affect people’s decisions and welfare? We provide an answer to this question in three steps. We document that taxing married households jointly, as in the U.S., generates substantial disincentives for secondary earners to supply labor, and that secondary earners respond to these disincentives. Next, we develop a lifecycle model in which single and married individuals make decisions about labor supply, household production, human capital accumulation, consumption, savings, marriage, and divorce. We estimate the model using variation from past tax reforms in the U.S., as well as auxiliary time use and expenditure data. Lastly, we use the model to evaluate the effect on individual decisions and welfare of three tax systems: the standard joint taxation system currently adopted by the U.S.; the individual taxation system; a more general form of the standard joint system that allows for flexible dependence of tax rates on the spouse’s earnings. We find that the optimal individual system welfare-dominates the optimal standard joint system because it allows for more progressivity. But we also find that the optimal general joint system generates higher welfare than the individual one, as it allows for a high degree of progressivity without the negative effects that the individual system has on low-income married households.

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1 Introduction

Income taxation differs significantly across countries, most prominently for individuals in married households. For example, countries with individual tax systems, like Canada and Sweden, consider neither spousal earnings nor marital status when determining an individual’s tax schedule. By contrast, joint tax systems, like those in the U.S. and Germany, consider only pooled earnings of the couple when determining married individuals’ tax rates and tax liability. Finally, a number of countries, like France and the U.K., have hybrid systems that borrow elements from both joint and individual schemes.

The choice of a tax system affects primary and secondary earners’ respective tax schedules, their contribution to after-tax household income, and correspondingly their incentives to work and save. Thus, it can produce potentially sizable short- and long-run effects on individual decisions, economic outcomes, and welfare (Bick and Fuchs-Schündeln (2017)). The objective of this paper is to estimate these effects, with emphasis on long-run consequences. The paper is divided into three parts. First, we provide evidence about households’ labor supply responses to the disincentives embedded in joint tax systems. Second, we develop and estimate a dynamic model of individual decisions that accounts for the fact that most households are composed of a primary and a secondary earner that make joint decisions. Lastly, we evaluate the performance of different taxation schemes using the estimated model.

The first part of the paper provides evidence about four main facts. First, secondary earners face higher marginal and average tax rates under a joint tax system than under an individual one. The opposite is true for primary earners. Second, in the U.S., a married woman’s average tax rate, as predicted by the earnings of her husband, is strongly correlated with her probability of employment. In Canada, however, which has an individual tax system, married women’s employment varies little with husband’s income. Third, under a joint tax system, married single-earner households enjoy larger take-home incomes than under the individual system, whereas the opposite is true for married couples with relatively equal earnings. These three facts suggests that joint taxation creates incentives for married couples to have one spouse specialize in labor market activities and one in household activities. Lastly, we document that changes in tax rates generated by past U.S. tax reforms produce significant changes in labor force
participation for one group of individuals: married women. We estimate that a 10 percentage-point decline in married women’s average tax rate, as predicted based on her husband’s earnings, is associated with percentage point increases in their labor force participation that are between 1.75 and 3 in the short run. The response is about twice as large for married women with young children.

In the second part, we use the evidence above to develop and estimate a dynamic model of household decisions. The facts indicate that, to credibly evaluate a tax reform, one should properly model primary and secondary earners, their interactions, and the possible selection in the way they match. Our evidence also makes clear that reduced-form methods are useful to document short-run effects of tax reforms. Assessing their long-run consequences requires a model that accounts for the dynamic aspects of tax reforms. To that end, we develop an intertemporal model with the following features. Individuals can be either single or married, where the marriage decision is endogenous. If married, two individuals make joint and efficient decisions, with the limitation that they cannot commit to future allocations of resources. Whether married or single, individuals choose labor supply on the extensive and intensive margins, consumption, savings, and the time and money they invest in the production of a home-produced good. The efficiency of decisions jointly with the existence of the home-produced good allows us to generate intra-household specialization, which is an important feature of the data. Changes in taxation systems have the potential to produce changes in number of marriages, selection into marriage, intra-household specialization, and number of divorces. We consider a model without commitment, because it allows for all types of divorces observed in the data – mutual consent and no fault – and for general changes in the degree of specialization. Individuals in the model accumulate human capital, and human capital depreciates when they do not work, allowing us to capture the long-run effects of changes in the tax system on individual decisions and outcomes. Since the model is estimated using U.S. data, we model in detail the U.S. taxation system by coding the year-on-year changes in tax brackets due to the tax code, to minor tax reforms, and to the three major tax reforms discussed above. Lastly, to account for the fact that the performance of a taxation system depends on the existing welfare system, we model in detail the main components of the U.S. safety net: Social Security Income (SSI) taxes and Medicare taxes, the EITC, the Child Tax Credit (CTC), the Child and Dependent Care Credit
(CDCC), and the Supplemental Nutrition Assistance Program (SNAP).

The model is estimated using as the main source of the variation three important tax reforms that took place in the U.S.: the 1986 Reagan tax reform, the 1993 Earned Income Tax Credit (EITC) expansion, and the 2003 Bush tax cut. We use the estimated model to determine the optimal income taxation system – the system that maximizes total welfare – and the corresponding tax rates. We start by considering the joint taxation system currently used in the United States (U.S.) – married couples are taxed on their pooled income – and derive the optimal tax rates. We find that the rates currently adopted by the U.S. are not far from the rates that, conditional on using the current joint system, maximize total U.S. welfare. But the optimal rates display more progressivity, with larger transfers from the top to the bottom of the income distribution. The current joint system is limited in the degree of progressivity it can attain because, in married households, an increase in rates at the top affects primary earners as well as secondary earners, who have high labor supply elasticities. We then analyze the most popular alternative to the current joint system: the individual taxation system, in which both single and married individuals are taxed based on their individual income. We find that, as tax rates are applied to individual income, this alternative system allows for more progressivity and, because of this, achieves higher welfare. The main shortcoming of the individual system is that it reduces welfare for married households at the bottom of the income distribution compared to the current joint system. Secondary earners in these households are less likely to work. They therefore do not benefit from a switch to individual taxation. But they are more likely to benefit from the marriage bonuses produced by the joint system and not present in the individual system. Lastly, we consider a more general form of the joint system. The current joint system applies the tax rates to the pooled income of a married couple. A more general system allows for different rates for primary and secondary earners and it also allows those rates to vary with the spouse’s income. This alternative approach addresses the shortcomings of the two most popular systems: it can generate more progressivity with smaller effects on secondary earners; and it does not reduce the welfare of low income married household if rates are properly chosen. Our results are consistent with this insight, as it produces the highest level of welfare. The general joint system appears therefore to be a superior alternative to the two more popular choices.
Our paper builds on two particularly insightful papers. Kleven, Kreiner, and Saez (2009) is one of the first papers to study theoretically an income taxation system in which tax rates can depend on the spouse’s earnings. Specifically, they analyze theoretically the non-linear optimal taxation of couples using a static unitary model in which the primary earner makes intensive margin labor supply decisions and the secondary earner makes extensive margin labor supply decisions. Using their framework they introduce the concept of jointness – the relationship between the taxes paid by a married couple and the spouses’ earnings. They derive conditions under which it is optimal to have negative jointness, i.e. a system in which, holding constant the earnings ability of the primary earner, the marginal tax rate of a married couple should decline with secondary earner’s earnings. Gayle and Shephard (2019) develop and estimate a static model of marriage and household decisions and use it to find the optimal tax structure for the U.S.. They find that a general tax system in which tax rates are allowed to depend on spouses’ earnings is optimal, as suggested by Kleven, Kreiner, and Saez (2009). We extend Gayle and Shephard (2019)’s paper by allowing for dynamics and assortative matching. The extension to an intertemporal framework is particularly important because it allows us to evaluate the long-run effects of different taxation systems. In our model, human capital accumulation, the evolution of intra-household specialization, marriage and divorce decisions enable us to evaluate the welfare effects of different tax schedules not only at one point in time, but over the lifecycle of different individuals.

Several other excellent papers have considered the effect of taxes on household decisions. Apps and Rees (1999b) show theoretically that, in a static collective model of the household, a joint taxation system can never be welfare improving over an individual taxation system, even when household production is taken into account. In as separate paper, Apps and Rees (1999a) argue theoretically, using a static collective model of the household, that tax reforms should be evaluated using a model of the households with multiple members. Guner, Kaygusuz, and Ventura (2012) develop a dynamic equilibrium model in which men and women make labor supply decisions and use it to evaluate the effect of a change from joint to individual taxation on labor force participation and hours of work. Our paper differs in several respects. First, we provide evidence that the individuals affected the most by tax changes are married women with children younger than 6. For this reason, our model account for the presence
of children of different ages and for household production. Second, we estimate the model using micro data. This is particularly important because the effect of tax reform depends on the estimated intensive and extensive margin elasticities. Third, we model marriage and divorce decisions, which may play an important role when a country switches from a joint to an individual taxation system. One limitation of our paper relative to Guner, Kaygusuz, and Ventura (2012) is that we do not consider general equilibrium effects, which are captured in their paper. Bick and Fuchs-Schündeln (2017) document that the cross-country correlation of average hours worked of working-age married men and married women is approximately zero. They then develop and simulate a static model of labor supply decisions for married men and women and provide evidence using the simulated data that differences in taxation systems across countries can explain the large differences in the labour supply behaviour of married men and married women across those countries. Alesina, Ichino, and Karabarbounis (2011) study the gender-based taxation of couples in a static collective model with linear and separable tax rates for the two spouses. Their main insight is that secondary earners should have lower marginal tax rates because they have lower labor supply elasticities. Our finding that individual taxation welfare-dominates the standard joint system in a dynamic model with taxation schedules that are non-linear and joint for couples is partially based on the same insight. Borella, De Nardi, and Yang (2019) estimate a lifecycle model of labor supply and saving decision of couples and study the effect of the dependence of taxes and social security benefits on marital status on the labor force participation decisions of women. They find that removing the dependence on marital status increases significantly the participation of women, which is consistent with our finding that the design of the taxation system has important effects on the choices of secondary earners.

The paper proceeds as follows. In Section 2, we briefly discuss the data used in the paper. Section 3 provides descriptive evidence of the effect of changes in tax rates on individual labor supply decisions. In Section 4, we document the effects that major tax reforms had on individual decisions. In Section 5, we develop the intertemporal model of the household. Section 6 describes the moments used in the estimation of the model. In Section 7, we report the estimation results, the fit of the model, and we discuss the effects of different taxation policies on household decisions. Section 8 concludes.
2 Data

We use five data sets. We provide descriptive evidence and estimate the response to prior tax cuts using the Panel Studies of Income Dynamic (PSID) (1980-2010), the 2000 Census, and the Current Population Survey (CPS) (2001-2015). These data sets provide information about labor force participation, hours of work, earnings, income, education, and demographic variables for primary and secondary earners. We rely on the PSID and the Current Population Survey (CPS) (1980-2016) for all variables used in the structural estimation, with two exceptions. We use the American Time Use Survey (ATUS) (2000-2011) to compute the time invested in the production of the home-produced good, and the Consumer Expenditure Survey (CEX) (1980-2010) to calculate private consumption and the financial resources invested in the production of the home-produced good.

3 Joint vs Individual Taxation Systems

Existing joint tax systems, such as the one in the US or Germany, are predicted to disincentivize secondary earners’ labor supply. As we explain below, the reason for this is that under such systems the married secondary earner typically faces an income tax schedule with significantly higher rates than he or she would as an unmarried individual. However, reliably quantifying how much this feature affects labor supply – of both primary and secondary earners – is difficult for two reasons. While some countries, like the UK and Canada, switched from joint to individual taxation in recent decades, this type of policy change affects their whole population, making it difficult to study it using a quasi-experimental approach such as differences-in-differences or regression discontinuity. Moreover, changes in taxation systems have long-term effects through the accumulation of human capital and changes in the degree of intra-household specialization that are difficult to capture using quasi-experimental methods. An alternative is to use cross-country evidence, as Bick and Fuchs-Schündeln (2017) do. They find a strong correlation between the type of taxation system in a country and the aggregate labor supply of its men and women, driven by substantial negative effects of joint taxation on married women’s labor supply. While the evidence they present is convincing, it is nevertheless difficult to ascertain precisely how much of the difference in household behavior across countries is attributable directly to the
tax system, since differences in taxation across countries are likely to be correlated with other policies that affect labor supply. A third approach is to use a structural model to quantify effects on household behaviors, as we do in this paper. For this approach to provide credible result, it is important to have reliable estimates of the parameters that govern how people respond to tax rate changes and proper specification tests. In this section, we present descriptive and reduced-form evidence that will be used in the estimation of the model and specification tests.

First, we present a simple example that details the disincentives embedded in a joint system, relative to an individual one. Next, we provide evidence that aggregate labor supply patterns in the US are closely in line with what one would predict based on these described disincentives. Finally, we exploit past tax reforms in the U.S. that affected incentives especially for secondary earners to work, and provide evidence about how workers responded, in the short run. We conclude by discussing how these quantified short-run responses can be used as moments in the estimation and as validation of the dynamic structural model we develop.

### 3.1 Taxing Married Households: A Simple Example

We start with a simple example that illustrate the main differences between joint and individual tax systems. We will use them to provide evidence on the differential effects of these two taxation rules. The example uses a stylized tax schedule for a progressive, joint tax system, similar to the one adopted by the U.S. (Figure 1). According to the tax schedule, single individuals pay no taxes on the first $10,000; 15% on income between $10,000 and $40,000, and 40% on the remaining income. For married couples, these brackets double.

In Table 1 we consider a hypothetical couple, with $80,000 and $30,000 in pre-tax income. The first three columns of the table show tax rates and take-home pay for this couple when they are taxed individually – i.e., either prior to marrying in the joint tax system described above, or before and after marriage if the system were instead individual. The remaining three columns consider what happens to the couple when married under the joint system. As the first row of Table 1 shows, the primary earner has a marginal tax rate (MTR) of 40%, whether he or she is taxed as an individual with $80,000, or as part of a married household with $110,000 in earnings. By contrast, the secondary earner’s MTR increases from 15% to 40% after marrying. This increase in the secondary earner’s MTR is a well-understood consequence of joint taxation,
and commonly cited disincentive for secondary earner labor supply.

The remainder of Table 1 illustrates two additional effects of joint taxation. The first is a change in the couple’s take-home pay after marriage under the joint system, from $86,500 to $89,000. This $2,500 “marriage bonus” generates an additional potential disincentive to work in the form of an income effect. It is explained by the greater share of the couple’s pre-tax earnings that are taxed at the lower, 15% rate, after marriage.

The second effect relates to the total after-tax earnings of each individual household member and, relatedly, his or her average tax rate (ATR). For the couple that is taxed jointly in Table 1, we assume that the primary earner’s income is the first to be taxed, starting from the lower brackets, and the secondary earner’s income is taxed next at higher tax rates. This assumption reflects the decision process of many two-earner households, in which the primary earner works regularly and the secondary earner adjusts his or her labor supply depending on the economic conditions. Under this assumption, the primary earner’s after-tax income increases by $11,500 after marrying, to $71,000. By contrast, the secondary earner’s contribution to after-tax household income declines by $9,000, to $18,000. This implies an ATR of 40% on the secondary earner’s $30,000 of pre-tax income – 30 percentage points higher than it would be under the individual system.

We conclude with two observations. First, the above discussion of income effects, in the form of a marriage bonus, and price effects, in the form of changes in MTR and ATR, concerns work incentives in a joint vs. individual system. However, a change in tax rates even within a joint tax system will similarly alter the income and price effects influencing primary and secondary earner labor supply, as we will show shortly. Therefore, previous U.S. tax reforms can provide useful information about how individuals respond to the incentives and disincentives in the joint system. Second, it is important to distinguish between the two types of price effects for the reason that marginal tax rates are typically thought to influence labor supply on the intensive margin, while average tax rates may be more relevant for decisions about labor force participation, especially in the presence of fixed costs of work. We will refer back to this important issue in the discussion of our model results.
3.2 Descriptive Evidence on the Income and Price Effects

While taxation in the U.S. is more complex than the two tax-bracket system used in our example, in this subsection we document that the income and price effects discussed above are standard features of the U.S. joint tax system.

The joint system is known for the prevalence of marriage bonuses, defined as the difference between total after-tax earnings of a couple who is married and an identical couple who is not. In Figure 2, we plot the marriage bonus as a percent of total household after-tax income, for 2015. We consider three groups of U.S. married households: households with only one earner; households in which one spouse earns 80% of income; and households in which the two spouses earn the same amount of income. The Figure shows that all married U.S. households that are fully specialized and almost all married households that are partially specialized experience a marriage bonus. Additionally, the size of the marriage bonus, which can be as high as 9% of take-home income, increases with the degree of intra-household specialization. This second feature of the joint system has therefore also the potential of encouraging married couples to increase the degree of intra-household specialization.

A second feature of joint taxation is that married secondary earners face higher marginal and average tax rates than they would if they were taxed as an individual (Bick and Fuchs-Schündeln (2017)). The tax rate on the first dollar of an individually taxed worker in the U.S. is close to zero. If the same individual is a married secondary earner in the U.S., his or her effective tax rate on the first dollar of income is on average above 20% and can exceed 50%, depending on state of residence and spousal earnings. To document this fact and the potential disincentive effect on labor supply, we proxy primary and secondary earner status by gender, and plot in Figure 3a three series, all as a function of husband’s earnings: the predicted average tax rate (ATR) on a married woman’s first $15,000 of income; the share of married women not employed, both as a function of husband’s earnings; and the distribution of households. The graph is based on the idea that primary earners work mostly a fixed number of hours and that adjustments in labor force participation are mainly by secondary earners.

The graph shows a striking positive correlation between the fraction of married women not employed and the predicted ATR on their earnings. When the tax rate decreases, due to placement along the tax and EITC schedules, the fraction of married women not working
declines. When the ATR increases, the fraction rises. It is noteworthy that in the U.S. the percentage of women not working as a function of their husband’s earnings can be as low as 20% for low tax rates and as high as 55% for the highest tax rates. In Figure 3b, we analyze the same patterns for Canada, which has an individual tax system. Since under individual taxation the ATR on the first $15,000 is identical for all secondary earners, we omit that variable. There are two main differences between the U.S. and Canada. As predicted, the variation in women’s employment as a function of their husband’s earnings is much lower than for U.S. women, only varying from around 20% to around 30%. Second, in Canada, there is no particular relationship between the labor force participation of married women and the husband’s earnings. This evidence suggests that the joint tax system introduces disincentives for secondary earners to work.

The previous discussion indicate that a switch to individual taxation could have significant and positive welfare effects on secondary earners by reducing their marginal and average tax rates. Figures 4a and 4b indicate, however, that the gains from such a reform would be unequally distributed, with high-income households benefiting the most and low-income households potentially experiencing welfare loses. Figure 4a suggests that households with husbands earning below $50,000 will generally experience welfare loses, as the gain for secondary earners are offset by the losses of primary and the loss of marriage bonuses. Instead, households at the high end of the income distribution will generally experience large income gains, due to income increases for primary earners that can be as high as 35% and limited losses for secondary earners and from marriage bonuses. Figure 4b documents that the different effect of the policy is a consequence of the heterogeneity in earnings potential for primary and secondary earners along the income distribution, which is measured using the CENSUS occupational earning score. Households are assortatively matched on earnings potentials. They are therefore better off under joint taxation if they are at the low end of the distribution and under individual taxation if at the high end.

To conclude, the U.S. joint tax system generates substantial disincentives for secondary earners, in the form of both income and price effects. Moreover, aggregate labor force participation patterns of secondary earners in the U.S., as proxied by gender, are precisely in line with predicted disincentive effects. To obtain additional evidence, in the next section we consider
past tax reforms that altered the set of disincentives facing primary and secondary earners in the U.S., and corresponding behavioral responses.

4 Tax Reforms and Labor Supply Behavior

The evidence provided in the previous section indicates that the choice of a tax system has potentially large effects on individual and household behavior. To evaluate these effects, we will structurally estimate a model of household decisions and use it to evaluate through simulations the performance of different taxation systems. For the results of the model simulations to be credible, it is crucial to have reliable estimates of the parameters that govern the individual response to tax changes. The general consensus among economists is that the best source of variation to identify the responses of women and men to tax changes is represented by tax reforms (Keane (2011)). We will therefore structurally estimate those parameters using the main tax reforms that took place in the U.S. in the last four decades: the Tax Reform Act of 1986 (the Reagan tax cuts), the 1993 EITC expansion as part of Omnibus Budget Reconciliation Act (OBRA), and the Jobs and Growth Tax Relief Reconciliation Act of 2003 (the Bush tax cuts). In this section, we describe the variation in labor supply behaviors generated by the three tax reforms and, hence, the variation we will employ in the structural estimation to identify the model parameters related to the individual labor supply responses.

We start by providing evidence that the three tax reforms generated significant changes to the tax schedule. In Figure 6, we depict the tax schedule for a married couple without dependents before and after the Reagan tax cuts. It reveals that families with pooled income above $30,000 enjoyed significant reductions in marginal tax rates. Figure 7 reports the tax brackets for the same group of households before and after the Bush tax cuts. In this case, the reduction in tax rates was smaller, but still substantial, for most families. But some households, particularly the ones with total income between $57,000 and $70,000, experienced declines of the same order of magnitude as for the Reagan tax cuts. Lastly, in Figure 8 we describe the tax schedules before and after the EITC reform. This reform modified the tax brackets by changing the EITC program. It therefore affected only low-income households, as our Figure documents, with most of them experiencing a significant increase in their marginal tax rates.
We now document the responses to the tax reform using two datasets: the Panel Studies of Income Dynamics (PSID) and the Current Population Survey (CPS) March supplement. The PSID has the advantage of being a panel. This feature enables us to study the labor supply responses of married and single men and women using standard techniques. The main limitation of the PSID is that its sample size is small. It is therefore not possible to estimate the responses for different subgroups. Thus, we also estimate the responses using the CPS, which is not a panel, but has a significantly larger sample size. For reasons that will be clear later in the section, since the CPS is not a panel, using this data set we can only study the response of married women.

4.1 Labor Supply Responses to the Tax Reforms: The PSID

To quantify the effects of tax changes on labor supply decisions, we first use the panel structure of the PSID. We start by documenting the response of married women. We proceed in two steps. First, for each household, we construct the marginal tax rate before and after the tax reform. The change in tax rate reported in the PSID is composed of two parts: the change in rate introduced by the reform; and the movement along the tax schedule produced by the optimal labor supply decision made by a person after the reform. To isolate the first part, we compute the tax rate before and after the reform using in both cases the husband income before the reform took place. In the second step, we compute the labor supply response of married women, by regressing their labor force participation or labor supply on the marginal tax rate described above, household and time fixed effects and control variables.

Formally, we estimate the following fixed effect regression:

\[ y_{it} = \alpha_i + \beta_1 \cdot \hat{\tau}_{i,t} \cdot post_t + \beta_2 \cdot X_{it} + \gamma_t + \varepsilon_{it} \]

where \( y_{it} \) is either the logarithm of work hours in period \( t \) or an indicator for whether the married woman works in that period, \( \alpha_i \) is a household fixed effect, \( \gamma_t \) is a time fixed effect, \( \hat{\tau}_{i,t} \) is the predicted marginal tax rate on the wife’s first dollar of income computed using the method described above, \( post_t \) is an indicator for being in a post-reform year, and \( X_{it} \) is a set of time-varying controls that includes experience, the number of children, whether the households
have children younger than 6 at the time of the reform.

The results, reported in Table 2, indicate that married women responded to the Reagan and Bush tax cuts by significantly increasing their labor force participation. We find a 10 percentage points increase in the marginal tax rate is associated with an reduction in labor force participation of 1.75 percentage points in the Reagan reform and 3.13 percentage points in the Bush reform. The response to the EITC reform is larger than the response to the Reagan cuts but it is not statistically significant. When we divide the sample between women with and without young children, we find that women with young children responded the most, with an increase in labor force participation of 2.78 percentage points in the Reagan tax reform and of 5.42 in the Bush tax reform. The reforms had no impact on hours of work of married women.

To study the response of married men and single women and men, we estimate the same fixed-effect regression, except that the change in marginal tax rate is computed using household total income before the reform. Because of this, we can only consider individuals that worked before the response and, thus, only estimate their intensive margin response. Also, the meaning of the coefficient on the change in marginal taxes is less precise, since we can no longer interpret our measure of $\hat{\tau}_{it}$ as the tax rate on the individual’s first dollar of income. The estimated coefficients on $\hat{\tau}_{i,t}$ are described in Table 3. We find no statistically significant change in hours of work for married and single men, which should be expected as the majority works full time. But, we estimate significant negative responses to the EITC and Reagan reforms for single women, with a reduction of 11.9 and 2.2 percentage points as the tax rate increases by 10 percentage points.

4.2 Labor Supply Responses to the Tax Reforms: The CPS

Since the PSID has small sample size, the individual responses to tax cuts are not very precisely estimated and we cannot study the responses for different income and demographic groups. For married women, we can address this issues using the CPS. Since in the estimation of the model we only use the Bush tax cuts, we will only presents the results for that reform. The effect of the Reagan and EITC reforms are consistent with the ones documented using the PSID.

Because the CPS is not a panel, we cannot follow the same person over time and estimate directly the response to tax reforms. We can, however, determine the average response to tax
changes of individuals that are similar. For married women, we can achieve this by constructing income bins for the husband’s income and then estimate the average response to tax cuts, by comparing the labor supply decisions of wives whose husband had an income in a given bin before the reform with the decisions of wives with a husband whose income belonged to the same bin after the reform. By keeping the income bin constant, this approach enable us to isolate the changes in tax rates generated by the reform from the changes that are produced by the optimal labor supply response of women and men to the tax reform. The main limitation of this method is that we can only use it to study married women.

Formally, let $inc_k$ be a dummy variable equal to one if the husband’s income falls in quantile $k$ of the income distribution. We can then estimate the following regression:

$$y_{it} = \sum_k \alpha_k inc_k + \sum_k \pi_k inc_k \cdot post_t + \beta_2 X_{it} + \gamma_t + \varepsilon_{it}$$

where the $y_{it}$ is the logarithm of work hours in period $t$ or an indicator for whether the married woman works in that period, $post_t$ is a dummy equal to one if a person is observed after the tax reform, and $X_{it}$ is a set of time-varying controls that includes experience, the number of children, whether the households have children younger than 6 at the time of the reform. The parameter of interest is $\pi_k$.

Given the large sample size, we can first document graphically which married women were affected the most by the Bush tax cuts in Figure 5a. Only women with husbands earning between $55,000 and $85,000 experienced large declines in marginal tax rates. Correspondingly, Figure 5b provides evidence that exclusively women in that subgroup responded by significantly increasing their labor force participation.

The results obtained by estimating equation (1), which are described in Table 4, are consistent with the graphical evidence. In the last column, we report the change in marginal tax for different husband’s income quintiles and document that all income quintiles experience a large cut in marginal tax rates, with the cuts ranging from 1 percentage points for the income quintile $40 − 50K$ to 8.3 percentage points for the quintile $60 − 70K$. But only married women that experience the largest tax cuts responded by significantly changing their labor force participation, which an increase of 4 percentage points. We then divide the sample in
married women with and without college degree and find that both have significant responses, but married women with a college degree are more responsive to the tax cuts. We also divide the sample in women with and without young and document that married women with young children are affected the most by the cuts in marginal tax rates, with increases in labor force participation that, at 6 percentage points, are about twice as large as the changes for married women without children. We have also estimated the effect of the tax reform on hours of work of married women and, as with the PSID, we find no significant change in this variable.

5 Model

In this section, we develop a model that allows us to evaluate alternative taxation systems. Before describing the model in detail, we begin by outlining its general features. First, to account for the fact that individuals are generally taxed using different rules depending on their marital status, we model the decision about whom and whether to marry and divorce. Second, to allow for lasting effects of changes in tax regimes and to produce a realistic fraction of married and divorced individuals, we consider an intertemporal model in which married couples make efficient decisions with no commitment. Third, we model both labor supply and household production decisions, to account for changes in time allocated to market and home production in response to changes in tax regimes. Fourth, to capture heterogeneous responses to tax reforms by presence of children and education, the model includes fertility events and allows individuals to vary by education. Lastly, to capture long-term effects of tax changes, we allow for human capital accumulation and depreciation. We now describe the model in detail.

5.1 Timing

People enter adult life with or without a college degree. Their adult life is divided into a working and retirement stage. During their working stage, each person makes decisions about labor supply, time spent on household production, consumption, savings, marriage, and divorce. If a person enters a period in this stage as single, he or she meets a potential spouse and chooses whether to marry. If instead the person enters the period as married, she or he chooses whether to divorce. At the end of the working life, people enter the retirement stage, in which they only
choose consumption and savings.

5.2 Preferences and Technology

Preferences. Individual $i$ has preferences over private consumption $c_i$, leisure $l_i$, and a home-produced good $Q$. If $i$ is married, the preferences depend also on the quality of the marriage $\theta$. They can be characterized using the utility function $u^i(c_i, l_i, Q)$ if single and $u^i(c_i, l_i, Q, \theta)$ if married. Individuals discount the future at a factor $\beta$. In the estimation of the model, we assume that the utility function takes the following form for couples:

$$u(c^i, l^i, Q, \theta) = \left(\frac{c^i}{1-\sigma_c}\right)^{1-\sigma_c} + \frac{l^i}{1-\sigma_l} + \gamma Q \log Q + \theta,$$

where we allow the relative taste for public consumption to vary across households depending on whether they have children. Single individuals have the same utility function, except that $\theta^i$ is set to zero.

Match quality follows the random walk $\theta_t = \theta_{t-1} + z_t$, where $z_t$ is drawn from a normal distribution with mean 0 and variance $\sigma_z$. The first realization of $\theta$ at the time of marriage is drawn from a normal distribution with mean $\mu_\theta$ and variance $\sigma_\theta$.

Education and Savings. In the model, people differ depending on whether they enter the working stage of their life as college graduates. A college degree has three types of returns. It endows graduates with better wage processes; it makes the time invested in the home-good $Q$ more productive; and it increases the probability of matching with another college graduate in the marriage market. People can save using a risk-free asset with gross return $R$. We will denote by $b_t$ the amount saved.

Wage Processes and Experience. Conditional on education $g$ and gender $j$, individual $i$’s wage process takes a standard form that depends on a quadratic term in experience $e_{it}$, an idiosyncratic shock $\varepsilon_{i,t}$, and ability through an individual fixed effect $a_i$, i.e.

$$\ln w_{it} = a_i + \beta_0^{g,j} + \beta_1^{g,j} e_{it} + \beta_2^{g,j} e_{it}^2 + \varepsilon_{it},$$

(2)
where $\varepsilon_{it} \sim N(0, \sigma_{\varepsilon}^2)$, $g$ is high school or college, and $a_i \sim N(0, \sigma_{a_i}^2)$.

Human capital, in the form of labor market experience, evolves according to the following process. If a person works full time in a period, the individual’s experience increases by one. If the person works part-time, experience increases by a fraction $\lambda > 0$. If someone does not work in the period, the person’s experience declines by $0 \leq \delta \leq 1$, to capture the depreciation of human capital. Thus, the variable experience in the wage process (2) can therefore be characterized using the following equation:

$$e^i = e_{FT}^i + \lambda e_{PT}^i + \delta e_{NT}^i,$$

where $e_{FT}^i$ and $e_{PT}^i$ are years of experience accumulated in full-time and part-time jobs, and $e_{NT}^i$ are years spent outside the labor force. The wage process can then be written as follows:

$$\ln w_{g,j} = a^i + \beta_{g,j}^0 + \beta_{g,j}^1 (e_{FT}^i + \lambda e_{PT}^i + \delta e_{NT}^i) + \beta_{g,j}^2 (e_{FT}^i + \lambda e_{PT}^i + \delta e_{NT}^i)^2 + \epsilon_{g,i},$$

or equivalently,

$$\ln w_{g,j} = a^i + \beta_{g,j}^0 + \beta_{g,j}^1 e_{FT}^i + \psi_{g,j}^1 e_{PT}^i + \psi_{g,j}^2 e_{NT}^i + \beta_{g,j}^2 (e_{FT}^i)^2 + \psi_{g,j}^3 (e_{PT}^i)^2 + \psi_{g,j}^4 (e_{NT}^i)^2 + \psi_{g,j}^5 e_{FT}^i e_{PT}^i + \psi_{g,j}^6 e_{FT}^i e_{NT}^i + \psi_{g,j}^7 e_{PT}^i e_{NT}^i + \epsilon_{g,i},$$

(3)

where $\psi_{g,j}^1 = \beta_{g,j}^1 \lambda$, $\psi_{g,j}^2 = \beta_{g,j}^1 \delta$, $\psi_{g,j}^3 = \beta_{g,j}^2 \lambda^2$, $\psi_{g,j}^4 = \beta_{g,j}^2 \delta^2$, $\psi_{g,j}^5 = 2\beta_{g,j}^2 \lambda$, $\psi_{g,j}^6 = 2\beta_{g,j}^2 \delta$, and $\psi_{g,j}^7 = 2\beta_{g,j}^2 \lambda \delta$.

**Taxes.** The tax schedule is allowed to vary with the tax system and the marital status of an individual. We denote by $\tau^s(w_i h_i)$ the function that determines the income taxes that must be paid by a single individual with earnings equal to $w_i h_i$; and by $\tau^m(w_1^1 h_1^1, w_2^2 h_2^2)$ the taxes levied on a married couple, with the first spouse’s earnings equal to $w_1^1 h_1^1$ and the second spouse’s to $w_2^2 h_2^2$.

The functions $\tau^s$ and $\tau^m$ are constructed accounting for the year-on-year changes in tax brackets that are codified in the tax law, other year-on-year changes produced by minor tax reforms, and changes introduced by the Reagan tax cuts, the EITC expansion, and the Bush tax
cuts. To solve the model, we have to make assumptions on the beliefs people have on future tax changes. We assume that people anticipate the year-on-year changes in tax brackets generated by the tax code and by minor tax reforms. With regard to the major tax reforms, to keep the model tractable, we can make one of the following assumptions: people have perfect foresight; or people believe that there will be no major reform. We adopt the second assumption, even if it introduces complexity in the model, because it is more realistic.

Changes to the income tax schedule have different effects depending on the social security system adopted by a country. For instance, an increase in marginal tax rates for low-income families should have smaller effects on individual choices and welfare in places with a well-developed food-stamp program. Moreover, economists have argued that the kinks and non-convexities created by the social security system have substantial effects on individual decisions and, hence, on the impact of tax reforms (Saez (2010)). To account for the interactions between the social security and taxation schemes, we model the U.S. social security system by allowing the tax schedules $\tau^s(w_th_t)$ and $\tau^m(w^1_th^1_t, w^2_th^2_t)$ to depend on (i) Social Security Income taxes (SSI) and Medicare taxes, (ii) the Earned Income Tax Credit, (iii) the Child Tax Credit, (iv) the Child and Dependent Care Credit, and (v) the Supplemental Nutrition Assistance Program (SNAP), also known as food stamp program.

**Household Production Function.** The home-produced good $Q$ enters the model to account for the significant amount of time that people allocate to home production and childcare: on average 25 and 12 hours per week, by women and men, respectively. The good $Q$ is produced using as inputs the time spent by each household member in household production, $d^i$, and market goods, $m$. The corresponding production function is allowed to vary with the number of children in the household, $n$.

We assume that the production function has three main characteristics. It allows for substitutability between time and market goods. This feature is essential to match the following two related observed patterns. Women with a college degree have higher labor force participation and hours of work than women with less education. Men with higher earnings potential are more likely to marry women with a college degree. A model with a production function without market good $m$ or without a significant degree of substitutability between time and
goods would not be able to simultaneously generate both patterns. As a second characteristic, to account for the evidence provided in Guryan, Hurst, and Kearney (2008), in our production function, the productivity of time depends on the number of the children, on whether they are of pre-school age (age < 6), and on whether the parents have a college degree. Lastly, for couples, we allow the productivity of time to vary between women and men.

For couples, the three characteristics are incorporated in the following constant elasticity of substitution (CES) production function:

\[
Q = f(d_1, d_2, m) = (\eta^{g,n} \cdot (\alpha_1 \cdot (d_1)^{v} + \alpha_2 \cdot (d_2)^{v})^{\frac{\tau}{v}} + (1 - \eta^{g,n}) \cdot m^{\frac{1}{\tau}}),
\]

where \(\alpha^i\) varies only by gender; \(\eta^{g,n}\) varies both by education (col vs. hs) and by child status: (i) no children, (ii) have children < 6, and (iii) have only older children age 6+. Therefore \(\eta_g\) can take one of 6 values in the equation above. The parameter \(\tau\) measures the degree of substitutability between time and market goods; \(\eta\) represents the share of time employed in the production of \(Q\) relative to market goods; and \(\alpha^1\) and \(\alpha^2\) capture differences in the productivity of time between women and men.

For singles, the production function becomes:

\[
Q = f(d_1, m) = (\eta^{g,n} \cdot (\alpha_1 d_1)^{\tau} + (1 - \eta^{g,n}) \cdot m^{\frac{1}{\tau}}).
\]

The sum of the time devoted to household production, labor, and leisure must add up to the total time available to an individual, which we denote by \(T\).

**Fertility and Child Care.** Married and single women give birth according to a probability function that depends on their marital status, education, age, and current number of children. Individuals can therefore affect the number of children they have, albeit in a simple way, by delaying marriage.

Children younger than 6 require child care if their parents work. A married couple has to purchase a number of child-care hours that is equal to the minimum between the labor hours supplied by the husband and the wife. A single parent must pay for a number of child-hours that corresponds to the number of hours supplied to the market. The price paid for one hour
of child care is independent of marital status and denoted by $p^c$.

**The Marriage Market.** We model the marriage market using a matching framework with search frictions. Specifically, with some probability, single individuals meet a potential spouse with a given education and ability. The probability depends on own education and ability and declines linearly with age to account for the fact that the number of single individuals decreases as people become older. Single individuals who are divorced and have children incur a re-marriage penalty $\psi$ to account for the observation that they have lower marriage rates.

### 5.3 Decisions

**Single’s Decisions.** If individual $i$ enters period $t$ as single and decides to remain single, this person chooses labor supply, the time and goods used in household production, private consumption, and savings that solve a standard single-agent problem. Let $V_t^{es}$ be the value function of an individual who enters period $t$ as single and $V_t^{ds}$ the value function of a person who decides to be single in the period. The single-agent problem can then be written as follows:

$$
V_t^{ds}(b_t, e_t, n_t, a) = \max_{h_t, d_t, m_t, c_t, b_{t+1}} u(c_t, l_t, Q_t) + \beta E_t \left[V_{t+1}^{es}(b_{t+1}, e_{t+1}, n_{t+1}, a)\right]
$$

s.t. $c_t + m_t = w_t h_t - \tau^s(w_t h_t) + R b_t - b_{t+1} - p_t n_t$

$Q_t = f(d_t, m_t), \quad h_t + d_t + l_t = T, \quad$ and $\quad w_t = w(e_t, a),$

where the transition from $n_t$ children to $n_{t+1}$ children is governed by the fertility probability.

**Couples’ Decisions.** If two individuals enter period $t$ as married and decide to stay married, they make efficient decisions with limited commitment. Efficient decisions means that they solve a Pareto problem. But, since they cannot commit to future allocations, the Pareto weights used to make decisions in period $t$ may differ from the Pareto weights with which the two spouses entered the period. Denote with $M^1_t$ and $M^2_t$ the Pareto weights used to make efficient decisions in period $t$. We will discuss later in this section how they are computed. Also, let $V_t^{rem,i}$ be individual $i$’s value function if this person enters period $t$ as married and $V_t^{dm,i}$ the value function if he or she decides to stay married in the period. Then, the couple chooses
labor supply, household production time and goods, private consumption, and savings as the solution to the following problem:

\[
\max \left\{ h_{i t}, d_{i t}, m_{i t}, c_{i t}, b_{i t + 1} \right\} \sum_{i = 1}^{2} M_i \{ u^i (c_{i t}, l_{i t}, Q_t, \theta_t) + \beta E_t [V_{t+1}^{em, i} (b_{t+1, i+1}, e_{t+1, i+1}, n_{t+1}, a^1, a^2)] \}
\]

\[
s.t. \quad c_{i t}^1 + c_{i t}^2 + m_t = w_{1 t}^1 h_{i t}^1 + w_{2 t}^2 h_{i t}^2 - r_m (w_{1 t}^1 h_{i t}^1, w_{2 t}^2 h_{i t}^2) + R b_t - b_{i t + 1} - p_i n_t
\]
\[
Q_t = f (d_{1 t}, d_{2 t}, m_t), \quad h_{i t}^i + d_{i t}^i + l_t^i = T, \quad \text{and} \quad w_{i t}^i = w^i (e_{i t}^i, a^i), \quad i = 1, 2,
\]

where the change from having \( n_t \) children to \( n_{t+1} \) children is governed by the fertility probability.

Denote by \( h_{i t}^*, d_{i t}^*, m_{i t}^*, c_{i t}^*, b_{i t + 1}^* \), for \( i = 1, 2 \), the solution of the couple’s problem. Then, person’s \( i \) value function if this individual decides to stay married takes the following form:

\[
V_{t}^{dm, i} (b_{t+1, i+1}, e_{t+1, i+1}, n_{t+1}, a^1, a^2) = u^i (c_{i t}^*, l_{i t}^*, Q_t^*, f_t^i, \theta_t) + \beta E_t [V_{t+1}^{em, i} (b_{t+1, i+1}, e_{t+1, i+1}, n_{t+1}, a^1, a^2)].
\]

**Marriage, Divorce, and Renegotiation Decisions.** Given the optimal choices and value functions of people who have decided to stay single and people who have selected to remain married, we can determine the optimal marriage decision. An individual who enters period \( t \) as single and the potential spouse choose to marry if the value of being married is larger than the value of staying single for both of them, i.e.

\[
V_{t}^{dm, i} (b_{t+1, i+1}, e_{t+1, i+1}, n_{t+1}, a^1, a^2) \geq V_{t}^{ds, i} (b_{t+1, i+1}, e_{t+1, i+1}, n_{t+1}, a^i), \quad i = 1, 2.
\]

These inequalities are also known as participation constraints (Kocherlakota (1996), Mazzocco (2007), Marcet and Marimon (2011), Bronson (2015), and Chiappori and Mazzocco (2017)).

The participation constraints determine also whether it is optimal for a married couple to divorce, remain married maintaining the current allocation of resources, or renegotiate the current allocation by changing the Pareto weights used to solve their problem. Consider two individuals who enter period \( t \) as married with Pareto weights \( M_{t-1}^1 \) and \( M_{t-1}^2 \). Denote by \( z^{**} = \{ h_{t}^{i**}, d_{t}^{i**}, m_{t}^{i**}, c_{t}^{i**}, b_{t+1}^{**} \} \) the solution of the couple’s problem computed using the initial Pareto weights. If at the solution \( z^{**} \) the participation constraints are satisfied for both spouses, it is optimal for them to remain married at the current optimal allocation of resources. If the
participation constraints of both spouses are violated, the marriage produces no surplus that can be shared. It is therefore optimal to divorce. The most interesting case is represented by a situation in which the participation constraint of one spouse is satisfied, but the participation constraint of the other is violated. In this case, there may exist a different allocation of household resources, at which both participation constraints are satisfied and, hence, at which both spouses are better off staying married. If such allocation exists, it can be achieved by increasing the Pareto weight of the constrained individual and, consequently, the share of resources allocated to this spouse. From an ex-ante perspective, the most efficient new allocation is the one that corresponds to a new set of Pareto weights $M_t^1$ and $M_t^2$ that make the constrained individual indifferent between staying married or being single (Kocherlakota (1996)). If such new allocation does not exist, the household does not generate surplus and it is optimal for the spouses to divorce.

5.4 Heuristic Argument for Identification and Moments Selection

In this section, we provide heuristic arguments describing the variation in the data that enables us to identify the parameters of the model. With the exception of the curvature of the subutility for consumption $\sigma_c$ and the discount factor $\beta$, we estimate all the model’s parameters using the data described in Section 2. The parameter $\sigma_c$ is set equal to 1.5 based on Blundell, Browning, and Meghir (1994) and Attanasio and Weber (1995), and the parameter $\beta$ is set equal to 0.98 following Attanasio, Low, and Sánchez-Marcos (2008).

**Wage and Experience Parameters:** $\beta_0^{g,i}$, $\beta_1^g$, $\beta_2^g$, $\sigma_{\epsilon}^g$, $\sigma_a^g$, $\lambda$, $\delta$

Given the model assumptions, the fixed-effects, the parameters $\beta_0^{g,i} - \beta_2^g$, and the parameters $\psi_1 - \psi_7$ of the wage processes (3) can be consistently estimated using ordinary least squared (OLS) if years in full-time and part-time jobs and years without a job are observed. They are therefore identified.$^1$ Using the fixed-effects and $\psi_0 - \psi_7$, we can also consistently estimate and, hence, identify the standard deviation of the distribution of ability (the fixed effect), $\sigma_a^g$, and of the error terms, $\sigma_{\epsilon}^g$. The parameters governing the accumulation of human capital can then

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$^1$As we discuss in details in the next section, in the estimation we control for selection into the labor market.
be identified by noting that $\lambda = \frac{\psi_2}{\psi_1}$ and $\delta = \frac{\psi_3}{\psi_1}$.

**Production Function Parameters: $\tau$, $v$, $\eta$, $\alpha_1$, $\alpha_2$**

The parameter $\eta$ takes six different values depending on education (high school or college) and child status (no children, children younger than 6, children of age 6 or older). We only discuss the identification of one of the six parameters by conditioning on one particular level of education and child status. The argument for the identification of the other five parameters follows directly.

For singles, the parameter $\tau$ determines the degree of substitutability between time and market inputs in the household production function in response to wage changes, where the degree is an increasing function of $\tau$. This parameter can therefore be identified by the elasticity of the ratio of the two inputs with respect to changes in the individual wage. For couples, the parameter $v$ characterizes the substitutability between the primary and secondary earners’ time in household production when their relative wages change. Thus, it can be identified by the elasticity of the ratio of the two time inputs to the relative wages of primary and secondary earners.

Given the substitution parameter $\tau$, $1 - \eta$ determines the fraction of resources used in household production that a single individual allocates to market inputs relative to time inputs. $\eta$ can therefore be identified by the ratio of the market inputs used in household production by singles divided by the sum of market inputs and time inputs valued at the individual’s wage. We allow women’s time inputs to have a different productivity ($\alpha_1$) from men’s productivity ($\alpha_2$). Given our production function, we can normalize one of the two parameters without loss of generality. We can identify the other productivity parameters by the difference between single men and women in the ratio of market inputs to the sum of the value of market and time inputs.

**Preference Parameters: $\sigma_l$, $\gamma_l$, $\gamma_Q$**

In our model, the Frish leisure elasticity of single individuals is equal to $-\frac{1}{\sigma_l}$. The power parameters on leisure can therefore be identified by the changes in leisure by singles in response
to expected changes in their wages or, equivalently, changes that keep the marginal utility of
wealth constant. The parameters $\gamma_l$ measures the the taste for leisure relative for the taste for
consumption. It can therefore be identified by the average ratio of leisure to consumption for
single individuals. Analogously, $\gamma_Q$ captures the relative taste for public consumption relative
to leisure. Thus, we can identify this parameters by the average ratio of consumption to the
value of inputs used on household production.

**Fertility Process**

In our model, the probability of a birth is a function of discrete variables. If births and the
 corresponding discrete variables are observed, then there is only one conditional probability
function for births that is consistent with the data. The fertility process is therefore identified.

**Marriage, Divorce, and Meeting Parameters:** $\mu_\theta, \sigma_\theta, \sigma_z, K_d, \pi_{HS}, \pi_C, \rho_{g=g_s}, \rho_{g\neq g_s}$

The parameters of the initial match quality $\mu_\theta$ and $\sigma_\theta$ affect the probability of marriage for a
couple with given education, as higher $\mu_\theta$ and lower $\sigma_\theta$ increase it. We can therefore identify
these two parameters by means of the probability of marriage conditional on the couple’s
education. Given the couple’s education, the probability of divorce is an increasing function of
the standard deviation of the subsequent match quality shocks $c$ and and a declining function
of the cost of divorce $K_d$. Thus, we can identify $\sigma_z$ and $K_d$ using the probability of divorce
for couples with a given education. Lastly, the probability that an individual with education $g$
arries a potential spouse with the same education $g_s = g$ increases with the probability that
two individuals with such education meet $\pi_g$. Consequently, we can identify the parameters
$\pi_{HS}$ and $\pi_C$ using the probabilities that a person with high school (college) education married
a person with the same education. The correlation between the ability of two spouses with
the same education is an increasing function of $\rho_{g=g_s}$, the correlation between the ability of a
person and the ability of a potential spouse with the same education. These two parameters are
not identical because of selection into marriage. Using data on wages for married individuals
we can identify the first correlation and then use it to identify the parameter $\rho_{g=g_s}$. The same
argument applies to $\rho_{g\neq a}$.

6 Estimation and Moment Selection.

Wage and Experience Parameters: $\beta^{g,i}_0$, $\beta^{g}_1$, $\beta^{g}_2$, $\sigma^g$, $\sigma^a$, $\lambda$, $\delta$. The parameters of the wage processes and the parameters determining the accumulation of experience are estimated separately from the other parameters using the PSID. We employ a two-stage procedure that controls for selection into working, which is applied separately to each gender-education group. The selection equation is estimated using a Probit specification that includes the following variables: non-labor income, dummies for whether someone is married, never married, widowed, separated, or divorced, a dummy for whether the household includes a child younger than 6, dummies for number of children, a dummy for black head of households, year-fixed effects, and the expected average tax rate on own income. For married women, we also include the marginal tax rate based on the husband’s income. The excluded variables are the dummy for children younger than 6 and the tax variables.

Fertility Process. The probability of a birth conditional on marital status, education, age, and presence of children is estimated non-parametrically using PSID data and a bin estimator.

Household Production Parameters: $\tau$, $v$, $\eta$, $\alpha_1$, $\alpha_2$. For singles, the elasticity of the ratio of time to market goods invested in household production with respect to the wage rate is equal to $\frac{1}{\tau-1}$. This implies that larger values of $\tau \leq 1$ generate larger substitutions away from $d$ and toward $m$ when after-tax wages increase. We can therefore estimate $\tau$ by targeting changes $\frac{d}{m}$ in response to the Bush tax cuts. The substitution parameter for couple $\nu$ is estimated by targeting changes in $\frac{d_1}{d_2}$ in response to changes in relative wages $\frac{w_1}{w_2}$. The share parameter $\eta$ is estimated by targeting the average expenditure on market goods $m$ divided by the same average plus the average time spend on household production evaluated at the individual’s wage, for singles with different education and child status. The parameter $\alpha_1$ is estimated by targeting the difference between single men and women in the moment used to estimate $\eta$. 
**Preference Parameters:** $\sigma_\ell$, $\gamma_\ell$, $\gamma_Q$. The parameter governing the response to tax rate changes, $\sigma_\ell$, is estimated using the variation in labor force participation generated by the Bush tax reform discussed earlier. Specifically, we match the average labor force participation change of married women with and without children before and after the Bush tax cuts, as measured in the CPS. The parameter measuring the preferences for leisure relative to private consumption is identified using the average ratio of private consumption to leisure as observed in the PSID. The parameter on the public good $\gamma_Q$ is identified using the ratio between average private consumption and average expenditure on market good inputs in the production function.

**Marriage, Divorce, and Meeting Parameters:** $\mu_\theta$, $\sigma_\theta$, $\sigma_z$, $K_{\text{div}}$, $\pi_{\text{HS}}$, $\pi_C$, $\rho_{g=g_s}$, $\rho_{g\neq g_s}$. In the estimation, we normalize the standard deviations $\sigma_\theta$ and $\sigma_z$ to 1. The other parameters are estimated following the discussion in the identification section. Specifically, the parameter $\mu_\theta$ is estimated by targeting marriage probabilities the parameter $K_{\text{div}}$ is estimated by matching divorce probabilities.

The probability of drawing a spouse is normalized to be equal to 1 at any age since it cannot be separately identified from the parameters $\mu_\theta$ and $\sigma_\theta$ without data on meetings before marriage. Conditional on meeting, we estimate the probability of meeting someone with the same education by matching the shares of married couples with spouses that have the same education. We estimate the correlation between the partners’ abilities conditional on having the same education, $\rho_{g=g_s}$, by matching the correlation between the individual fixed effects estimated for the wage process for married couples with identical education. Analogously, we estimate $\rho_{g=g_s}$ by matching the correlation between fixed effects for married couples with different education. Allowing single individuals to match based on their ability measured by the fixed effect, enables us to better capture the degree of assortative matching in the marriage market.

**Full Set of Moments Used in Simulated Method of Moments.** All model parameters, except the ones characterizing the wage and fertility processes, are estimated using the Simulated Method of Moments. Following the discussion above, we match the following moments: (i) changes in labor force participation of married women generated by the Bush tax cut by quantile the husband’s income; (ii) the same moments for married women with children younger
than 6; (iii) married women’s labor force participation and hours worked by education (high school and college), child status (no children, with children younger than 6, without children younger than 6), and quartile of husband’s income; married men’s labor force participation and hours worked by education (high school and college) and child status (no children, with children younger than 6, without children younger than 6); (iv) single individuals labor force participation and hours worked by gender, education, and child status; (iv) labor force participation by age group (20-25, 26-54, 56-64), gender, and education; (v) hours invested in household production by gender, education, marital status, and child status (no children, with children younger than 6, without children younger than 6); for married women we also condition on work status (no work, part-time, full-time); (vi) expenditure on market inputs used in household production by marital status, child status (no children, with children younger than 6, without children younger than 6), and work status (no work, part-time, full-time); (vii) share married and share divorced by age group (22-26, 27-36, 37-50, above 50) and education; (viii) share of individuals with high school or college education married to individual with the education.

7 Results

7.1 Parameter Estimates

The parameter estimates are reported in Tables 5-7. The estimated value of $\sigma_l$ implies a Frish leisure elasticity of 0.35 for both men and women. Since, on average, men have a leisure to labor hours ratio around 1, the upper bound for the implied Frish labor elasticity – obtained by setting the elasticity for the time allocated to household production to zero – is equal to 0.35, which is consistent with the low estimates obtained in the labor literature (Keane (2011)). Women’s ratio leisure to hours of work is on average larger at around 1.5, which implies a labor supply Frish elasticity of 0.53. The estimated production function parameters indicates that the productivity of the time spent on the public good is higher for women. They also indicate that the there is substantial substitutability between time and market inputs in household

\footnote{Market input expenditure is composed of expenditure on children, housekeeping, meals, and additional daycare expenditure above the minimum required when both parents work.}

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production ($\tau = 0.38$), but that they are far from being perfect substitutes which would require $\tau = 1$. We obtain similar estimates for the degree of substitutability between the wife’s and husband’s time input to household production: significant substitutability, but far from being perfect substitutes. Lastly, we find that time inputs represent a larger share of total resources invested in household production for individuals with college degree than without. The wage parameters have the expected sign and size. Experience increases wages at a declining rate and its effect is smaller for workers without a college degree.

7.2 Model Fit

With the estimated parameters we match well the most relevant moments, which are reported in Table 8. The share married and divorced generated by the model (0.61 and 0.12) is very close to the shares observed in the data (0.65 and 0.11). Analogously, the share of married households with young children in our simulations (0.34) is only slightly lower than the share in the data (0.38). For the share employed, we match well the ranking and level by education and gender. The share employed for men with high school degree is 0.74 in our simulations and 0.79 in the data, whereas for men with college degree it is 0.91 in the model and 0.94 in the data. For women, we have similarly good results, with the share employed being equal to 0.64 for women with a high school degree in the simulations and 0.66 in the data. Women with a college degree work slightly more both in the model (0.79) and data (0.83).

We fit the production function moments reasonable well, but not as well as the previous moments. We slightly underestimate the hours spent by men in household production (12.3 in the simulations versus 14.1 in the data) and slightly overestimate the hours devoted by women to the production of the public good (25.2 in the model versus 21.2 in the data). We also do a relatively good job matching the share of households in which the wife is the higher earner conditional on the husband’s education. This share is 29.3 in our model (33.7 in the data) for families with a husband without a college degree, and 26.2 (31.2 in the data) for households in which the husband has a college degree.

In Figure 9, we report the actual and simulated income distribution of men by education. It documents that we match well the full distribution of this variable in the data for both high school and college graduates. Figure 10 reports the same variable for women by education. The
model fit is reasonably good, with higher densities at low income levels for women with a high-
school degree or less than for women with a college degree, but lower densities at larger income
levels. It is critical for us to match well the observed income distribution for three reasons.
First, men’s income has first-order effects on married women’s labor supply through the taxes
they have to pay on their earning, since higher husband’s earnings imply that higher tax rates
will be levied on their earnings. Second, the husband’s earnings have income effects on the
wife’s choices. These first two effects determine the household’s choice of whether to allocate
an additional hour of the secondary earner to the labor market or to household production.
Lastly, matching this distribution correctly is important for our policy analysis. With one
exception, all the policies we evaluate are revenue neutral, but they change the distribution of
the tax burden in the population. Since the changes in individual tax burdens generated by a
tax policy depend on the underlying income distribution, our policy exercises require that the
model approximates well the income distribution observed in the data.

In Figure 11, we report the share of women employed as a function of husband’s earnings
in the simulations and data, separately for women with and without a college degree. We fit
well the decline in the share employed when the husband’s earning increases, for both groups
of women. In Figures 12 and 13, we describe the same variables, but we also condition on the
presence of children younger than 6. Our model can account for the fact that women work less
when young children are present in the household for both college and no-college women.

Figure 14 illustrates that we fit well the share of women with a college degree as a func-
tion of the husband’s earnings observed in the data. Since education is a strong predictor
of earnings potential, the figure documents that our model can account for marital sorting
based on potential earnings of the spouse. This is important for our policy analysis, since high
earnings-potential women are more likely to respond to changes in tax policies, all else equal.

In Figure 15, we document the ability of our model to replicate the labor supply decisions
over the life-cycle of women and men with and without college. For women, we match well the
three main patterns observed in the data. First, women without a college degree supply fewer
hours than women with a degree throughout their working life. Second, both groups of women
experience a decline in hours work in the middle of their working life due to fertility events,
but women without a college degree experience the decrease earlier due to the fact that they
have children at younger ages. Third, the dip in labor supply generated by fertility is larger for women with a college degree. For men, we match the main pattern observed in the data, which is that men with a college degree work longer hours for most of their working life.

Lastly, in Table 9, we test whether our model can generate the labor force participation responses to the Bush tax cuts observed in the CPS. We can replicate well the responses of women both by child status and education, which suggests that our model is able to approximate well the most important patterns observed in the data.

8 Policy Evaluation

In this section, using the estimated model, we answer the following question: Which income tax system should a government adopt? We do this in two steps. In the first step, we consider four different taxation systems and, for each one, we determine the optimal marginal tax rates. In the second step, we compare their performance.

The optimal tax rates are determined by the government by maximizing the sum of individual lifetime welfare in the economy at the time the system is evaluated. The government only observes individual annual earnings. The tax rates can therefore only depends on them. To compare the different taxation systems among themselves and with the current U.S. system we fix two features across taxation systems: (i) all systems must use the tax brackets currently adopted by the U.S; (ii) all systems must generate total tax revenues that are greater than or equal to the revenues generated by the current U.S. system.

We evaluate the following four systems: (i) the joint system with income splitting; (ii) the individual system; (iii) the unrestricted system; (iv) the individual system with tax deductions for secondary earners. We start with the joint system with income splitting and the individual system because they are the two systems typically used by governments. These two systems restrict the way the tax rates for the primary earner can depend on the secondary earners’ income, the degree of jointness. At one extreme, the joint system with income splitting only allows for a strong form of positive jointness, as the same marginal tax rate is applied to both earners based on their joint income. At the other extreme, the individual system rules out any form of jointness, since the tax rates of one earner are independent of the other earner’s income.
The third system we evaluate, the unrestricted system, allows for a general form of jointness, as the primary earner’s tax rates can depend in a general way on the secondary earner’s income. The unrestricted system may be politically difficult to implement. To address this issue, we also consider as a last alternative a system that is politically easier to implement – the individual system with secondary earners’ deductions – which through the deductions, introduce some degree of jointness. We then evaluate how close its performance is to the unrestricted system.

8.1 Optimal Tax Rates

The derivation of the optimal tax rates is straightforward for three of the four tax systems we consider: the joint taxation system with income splitting and the individual taxation systems without and with secondary deductions. In these cases, the same brackets and marginal tax rates apply to both single and married individuals and primary and secondary earners. For married individuals, in the joint system with income splitting the brackets and rates apply to average household income, whereas in the individual systems they apply to individual income. Then, as within a bracket the marginal tax rate is constant, if the system is characterized by \( N \) brackets, we need to find the \( N \) marginal tax rates that maximize the sum of individual welfare in the economy subject to the constraint that total revenues generated by the system are greater than or equal to the ones produced by the current U.S. tax system.

The derivation is more complex for the unrestricted joint system. The main appeal of this system is that, for married couples, it allows for a general dependence of an individual’s tax rates on the spouse’s income. Formally, it allows for jointness of varying degree that can be positive – marginal tax rates increase with the spouse’s income – or negative – the marginal tax rates decline with the spouse’s income. To allow for this generality, the tax system must have two features: separate brackets for the primary earner’s and secondary earner’s income; the total taxes paid by married couples vary freely across combinations of primary earner’s and secondary earner’s brackets. Given these two features it is complicated to derive the optimal unrestricted system.

In this paper we develop a method that enable us to deal with this complexity and, at the same time, generates a parameters that measures the degree of jointness in the system. This last feature is useful to evaluate whether and how the unrestricted system can be approximated.
by an alternative system that is politically easier to implement, such as the individual system with secondary earner’s deductions. Our method is partially based on the insightful analysis in Gayle and Shephard (2019) for an unrestricted system in a static model.

Consider some secondary earner’s income $y^2$. To make the unrestricted system comparable with the other ones, we consider a tax schedule with the following three features: (i) given the secondary earner’s income $y^2$, marginal tax rates applied to total household income are constant within brackets for the primary earner’s income $y^1$; (ii) the system is symmetric in the sense that the brackets and marginal tax rates for the primary earner given $y^2$ are equal to the brackets and marginal tax rates for the secondary earner given $y^1$, if the two conditioning incomes are equation, i.e. $y^1 = y^2$; (iii) the system is progressive. Given $y^2$, condition (i) implies that the tax schedule is piece-wise linear over primary earner’s income, whereas condition (iii) implies that the tax schedule is convex. We introduce jointness in this system, by allowing the marginal tax rates of this tax schedule to increase (positive jointness) or decrease (negative jointness) with the secondary earner’s income. To have one parameters that capture the degree of jointness of the system and make the computations feasible, we restrict the way jointness affects the tax schedule.

Specifically, for singles we use a piece-wise linear and progressive tax schedule with marginal tax rates $m^s_j$, for $j = 1, \ldots, N$. For married couples, let $y^i_j$ be the lower bound of the tax bracket $j$ for earner $i$, with $j = 1, \ldots, N$. We then determine one possible unrestricted tax schedule by starting with the secondary earner’s income that corresponds to the lower bound of the first bracket, $y^2_1$. Given $y^2_1$, there is a total amount of taxes $T \left( y^1_1 + y^2_1 \right)$ paid by a household with total income equal to the sum of lower bounds of the first bracket, and are marginal tax rates $m^1_j$, for $j = 1, \ldots, N$, one for each primary earner’s bracket that characterizes the the tax schedule of households with a secondary earner with income $y^1_1$. Given symmetry, this schedule also determines the total taxes paid by households with total income $y^1_1 + y^2_j$, for $j = 1, \ldots, N$. Consider now the secondary earner’s income that corresponds to the lower bound of the second bracket, $y^2_j$. By symmetry, we know total taxes paid by a households with total income $y^1_1 + y^2_j$. We then determine the marginal tax rates of the tax schedule for households with secondary earner’s income $y^2_j$, by multiplying the marginal tax rates $m^1_j$, $j = 1, \ldots, N$, described above by $1 + z_m$, where $z_m \in \mathbb{R}$. By symmetry, the second tax schedule give us also total taxes paid by
households with total income between $y_1^1 + y_2^j$ and $y_1^j + y_2^j$, for $j = 1, \ldots, N$. We repeat these steps for the secondary earner’s incomes that correspond to the lower bound of the remaining brackets, by changing the marginal tax rates of the last schedule by the same percent $z_m \in \mathbb{R}$. Lastly, we compute the tax schedules that corresponds to households whose secondary earner’s income is between the upper and lower bound of a bracket by simply interpolation of the two corresponding tax schedules. The percent $z_m \in \mathbb{R}$ measures whether marginal tax rates increase with earnings.

We compute the optimal unrestricted tax system by finding the following $2N+3$ variables that maximize the sum of individual welfare in the economy: (i) the total taxes $T(y_1^1)$ paid by a single individual with income equal to the lower bound of the first tax bracket; (ii) the $N$ marginal tax rates for singles $m^s_j$, for $j = 1, \ldots, N$; (iii) the total amount of taxes $T(y_1^1 + y_2^1)$ paid by a married couple with total income equal to the sum of the lower bounds of the first tax brackets; (iv) the $N$ marginal tax rates $m^1_j$, for $j = 1, \ldots, N$, that characterize the tax schedule of a married couple with secondary earner’s income equal to the lower bound of the first bracket; (v) the jointness parameter $z_m$. With the six brackets currently used in the U.S. states, we have to maximize total welfare over 15 variables. Given that our dynamic model is computationally demanding, the maximization problem is extremely time consuming, but still feasible using FORTRAN, Message Passing Interface (MPI) and a large cluster.

The dynamic nature of our analysis implies that there are several ways the welfare function can be constructed depending on the weight we assign to different generations. One possibility is construct the welfare function as the sum of value functions of individuals at the time they enter the economy. This measures the effect of different tax reforms on a generation if the reforms take place at the beginning of their lifetime. This approach would not account for the effect of the policies on older generations. An alternative is compute the welfare function as the sum the value functions of individuals that belong to different generations and weight them based on the percentage of people in the U.S. population that belong to a generation. This method takes into account the effect of future generations but it is less forward looking. Because of this, we have decided to use the first approach even if they are computationally equivalent. In all cases, we keep fixed at the current level the tax brackets and welfare system.
8.2 Current Joint System vs Optimal Joint System with Income Splitting

The current joint system in the U.S. closely approximate a joint system with income splitting as the brackets for married couples are about twice the brackets for singles and the marginal tax rates are about the same, except at the very top of the income distribution. A natural question is therefore: How close is the current system to the optimal joint system with income splitting?

We answer this question in Table 10. We find that the current system is close to the optimal joint with income splitting, except that it has a lower degree of progressivity. We find that total welfare can be improved by increasing the redistribution from the top of the income distribution (above 85.5K of individual or average household income) to the bottom (below 11K). This is achieve in the optimal system by increasing the marginal tax rates for the last two tax brackets from 38% and 40% in the current system to 47% and by significantly reducing the marginal tax rates for the second bracket from 11% to 3%. Figure 16 clarifies why it is optimal for the social planner to increase redistribution. We plot individual lifetime welfare as a deviation from the average in the economy as a function of individual ability. We use ability as a proxy of permanent income as, in a model with endogenous marriage, divorce, and intra-household specialization, individual income is not a good predictors of a person’s earning power, particularly for secondary earners. The Figures documents that the welfare distribution displays a high degree of concavity at the bottom of the ability distribution and convexity a the top. The social planner can increase total welfare in the economy by redistribution resources to the bottom of the distribution while taking advantage of the convexity at the top. Figure 17 documents that all individuals below the 70th percentile of the ability distribution gain from the adoption of the optimal tax rates. But the gains are limited, particularly for the most vulnerable individuals at the very bottom of the ability distribution.

This result highlights the main weakness of a joint system with income splitting. It is difficult to achieve high rates of redistribution because higher rates at the top of the distribution apply to both primary and secondary earners. Given the high secondary earner’s labor supply elasticity, they will respond by reducing their labor force participation limiting the increase in
tax revenue and, thus, redistribution generated by the reform. We provide evidence of this in Figure 18. Even with the limited increase in tax rates for the two top brackets, the labor force participation of secondary earners declines significantly at the top of the ability distribution. Any additional increase would reduce their labor force participation to levels that would be detrimental to the collection of tax revenues.

8.3 Optimal Joint System with Income Splitting vs Optimal Individual System

This individual system addresses the main limitation of the joint system with income splitting. Since the marginal tax rates apply to individual income and not to average household income, it can achieve higher degrees of redistribution. In Table 11, we report the optimal marginal tax rate for individual system and compare them with the optimal rates for the joint system with income splitting. The individual system can generate the same amount of tax revenues while attaining a significantly higher degree of redistribution than the joint system with income splitting. The two bottom brackets have now zero marginal tax rates, and the marginal tax rates for the third and fourth brackets decline by 1 and 6 percentage points. Total revenues are kept constant by significantly increasing the tax rates for the last two brackets from 47% to 54%.

The rates for the top brackets can be higher under the individual system without adversely affecting tax revenue collection, because most secondary earners are in the bottom four tax brackets. We can see this in Figure 19. Under the individual system, the labor force participation of secondary earners increases to around 90% levels for all except the secondary earners with primary earners with no income, labor force participation levels that are similar to primary earners’.

The higher degree of redistribution and increased secondary earners’ labor force participation comes at the cost of increasing inequality. In Figure 20, we report the changes in individual welfare produced by the switch to the individual system. All percentiles of earning potential gain on average except the most vulnerable individuals at the bottom of the distribution, who experience substantial losses. To understand this outcome, it helps to remember the main dif-
ferences between the individual and joint system illustrated by the example presented at the beginning of the paper. Individual taxation has lower marginal and average tax rates, whereas the joint system has larger marital bonuses. Individuals with low earning potential, particularly secondary earners, are less likely to take advantage of the lower tax rates, as they have lower labor force participation. But they are more likely to be adversely affected by the loss of marriage bonuses, as they marry and specialize in household production more frequently. The result is an increase in inequality.

8.4 Optimal Individual System vs Optimal Joint with Flexible Jointness

The joint system with flexible jointness has the potential to achieve at the same time higher degrees of redistribution and lower inequality. As tax rates of the primary earners are allowed to depend in a flexible way on the secondary earner’s income, policy makers can increase them at the top of the income distribution while controlling their effects on secondary earners’ labor supply decisions. With flexible jointness, governments can also increase or shrink marital bonuses as required by the maximization of total welfare.

Table 12 describes the main features of the joint system with flexible jointness and compares them with the individual system’s. We find that the optimal general joint system marginal tax rates that increase with earnings as $z_m = 0.21$. With this $z_m$, marginal tax rates are lower than the individual system’s for couples with spouses with low income, but they increase rapidly with the spouse’s earnings.

These rates enable a government to achieve simultaneously substantial redistribution without adversely affecting the most vulnerable part of the population. We document this in Figure 21, where we report the changes in individual welfare produced by the flexible joint system as a function of earning potential. All individuals in the economy experience large welfare gains from the new rates, except the ones in the top percentiles of the earning potential distribution. Inequality therefore declines in the economy. A partial explanation for this result is that the added flexibility of the system enables the government to increase tax rates for high earners without deterring secondary earners to participate in the labor market. Figure 22 indicates
that the labor force participation of the secondary earners is significantly higher than under the current and the joint system with income splitting. It is also comparable to the labor force participation of secondary earners in the individual system for couples with primary earner’s income below 70k, which represent the majority of married couples in the U.S.

9 Conclusions

The objective of the paper is to evaluate the effect of different taxation systems on choices and welfare. We do this by providing descriptive evidence that distinct taxation systems produce different incentives for primary and secondary earners and that these incentives influence individual choices. We then develop and estimate using U.S. data an intertemporal model in which single and married individuals make decisions on labor supply, household production, human capital accumulation, consumption, savings, marriage and divorce. Moreover, the model accounts for the main features of the U.S. taxation and welfare systems. Lastly, using the estimated model we evaluate three popular tax policies: a shift from a joint to an individual taxation system; the introduction of a secondary earner deduction in a joint taxation system; and the addition of child care subsidies to a joint and to an individual taxation system. Our results indicate that all three policies have important effects on choices and welfare, with secondary earners that increase their labor force participation and labor supply, at the cost of lower hours spent on household production, accumulate more human capital, increase their intra-household decision power, and their welfare.
References


Table 1: Effects on Outcomes: Joint vs. Individual Taxation

<table>
<thead>
<tr>
<th></th>
<th>Taxed As Individuals</th>
<th></th>
<th>Taxed Jointly As Married Couple</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pooled</td>
<td>Primary Earner</td>
<td>Secondary Earner</td>
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<tr>
<td>Pre-Tax Income</td>
<td>$110k</td>
<td>$80k</td>
<td>$30k</td>
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<tr>
<td>Marginal Tax Rate</td>
<td>-</td>
<td>0.40</td>
<td>0.10</td>
</tr>
<tr>
<td>After-Tax Income</td>
<td>$86.5k</td>
<td>$59.5k</td>
<td>$27k</td>
</tr>
<tr>
<td>Marriage Bonus</td>
<td>$0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Tax Rate</td>
<td>0.21</td>
<td>0.26</td>
<td>0.10</td>
</tr>
</tbody>
</table>

† Calculation supposes that primary earner always works, while secondary earner supplements primary earner income.

Table 2: Labor Supply Responses to Changes in Tax Rates on First Dollar of Earnings, Based on Husband’s Income

<table>
<thead>
<tr>
<th></th>
<th>All Women</th>
<th>Women with Young Children</th>
<th>Women without Young Children</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LFP</td>
<td>Hours</td>
<td>LFP</td>
</tr>
<tr>
<td>1986 Reform</td>
<td>-0.175*</td>
<td>-0.001</td>
<td>-0.278*</td>
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<tr>
<td></td>
<td>[0.101]</td>
<td>[0.001]</td>
<td>[0.167]</td>
</tr>
<tr>
<td>1993 Reform</td>
<td>-0.197</td>
<td>0.001</td>
<td>-0.240</td>
</tr>
<tr>
<td></td>
<td>[0.141]</td>
<td>[0.004]</td>
<td>[0.237]</td>
</tr>
<tr>
<td>2003 Reform</td>
<td>-0.313**</td>
<td>-0.001</td>
<td>-0.542**</td>
</tr>
<tr>
<td></td>
<td>[0.159]</td>
<td>[0.003]</td>
<td>[.303]</td>
</tr>
</tbody>
</table>

Notes: P-values in brackets. Coefficients presented are from the interaction between the change in marginal tax rate due to the tax reform, based on an individual’s pre-reform income, and an indicator for the post-reform period.
<table>
<thead>
<tr>
<th></th>
<th>Married Men</th>
<th>Single Men</th>
<th>Single Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986 Reform</td>
<td>0.044</td>
<td>-0.012</td>
<td>-0.220*</td>
</tr>
<tr>
<td></td>
<td>[0.077]</td>
<td>[0.237]</td>
<td>[0.126]</td>
</tr>
<tr>
<td>1993 Reform</td>
<td>0.018</td>
<td>0.593</td>
<td>-1.187***</td>
</tr>
<tr>
<td></td>
<td>[0.191]</td>
<td>[0.417]</td>
<td>[0.483]</td>
</tr>
<tr>
<td>2003 Reform</td>
<td>0.022</td>
<td>0.505</td>
<td>0.213</td>
</tr>
<tr>
<td></td>
<td>[0.114]</td>
<td>[0.621]</td>
<td>[0.225]</td>
</tr>
</tbody>
</table>

Notes: P-values in brackets. Coefficients presented are from the interaction between the change in marginal tax rate due to the tax reform, based on an individual’s pre-reform income, and an indicator for the post-reform period.

Table 3: Response of Weekly Hours to Change in Marginal Tax Rate

<table>
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<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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<tbody>
<tr>
<td></td>
<td>All HS Col</td>
<td>W/Child &lt;6</td>
<td>No Yng. Ch.</td>
<td>Tax Change</td>
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<tr>
<td>Post x 45,000</td>
<td>0.00323</td>
<td>0.00642</td>
<td>-0.00308</td>
<td>0.00685</td>
<td>0.00302</td>
<td>-0.0109</td>
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<tr>
<td></td>
<td>(0.00725)</td>
<td>(0.00949)</td>
<td>(0.0111)</td>
<td>(0.0141)</td>
<td>(0.00842)</td>
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<td>Post x 55,000</td>
<td>0.000893</td>
<td>0.00415</td>
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<td>-0.00146</td>
<td>0.00111</td>
<td>-3.693</td>
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<td></td>
<td>(0.00882)</td>
<td>(0.0122)</td>
<td>(0.0126)</td>
<td>(0.0179)</td>
<td>(0.0101)</td>
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<td>Post x 65,000</td>
<td>0.0390***</td>
<td>0.0300*</td>
<td>0.0438***</td>
<td>0.0599***</td>
<td>0.0315***</td>
<td>-8.339</td>
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<td>(0.0107)</td>
<td>(0.0157)</td>
<td>(0.0141)</td>
<td>(0.0212)</td>
<td>(0.0122)</td>
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<tr>
<td>Post x 75,000</td>
<td>0.00723</td>
<td>-0.0251</td>
<td>0.0375**</td>
<td>0.00993</td>
<td>0.00748</td>
<td>-3.408</td>
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<td></td>
<td>(0.0136)</td>
<td>(0.0208)</td>
<td>(0.0176)</td>
<td>(0.0279)</td>
<td>(0.0153)</td>
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<td>Post x 85,000</td>
<td>0.0186</td>
<td>0.0311</td>
<td>0.00281</td>
<td>0.0140</td>
<td>0.0192</td>
<td>-1.768</td>
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<tr>
<td></td>
<td>(0.0131)</td>
<td>(0.0205)</td>
<td>(0.0167)</td>
<td>(0.0256)</td>
<td>(0.0151)</td>
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<tr>
<td>Post x 95,000</td>
<td>-0.0176</td>
<td>0.0130</td>
<td>-0.0388</td>
<td>-0.0740*</td>
<td>-0.00363</td>
<td>-2.087</td>
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<tr>
<td></td>
<td>(0.0212)</td>
<td>(0.0353)</td>
<td>(0.0264)</td>
<td>(0.0418)</td>
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<tr>
<td>Observations</td>
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<td>94658</td>
<td>41638</td>
<td>40389</td>
<td>95907</td>
<td>136296</td>
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<tr>
<td>Adjusted $R^2$</td>
<td>0.736</td>
<td>0.704</td>
<td>0.795</td>
<td>0.683</td>
<td>0.757</td>
<td></td>
</tr>
</tbody>
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Standard errors in parentheses
Source: CPS
*p < 0.10, ** p < 0.05, *** p < 0.01

Table 4: Secondary Earner Employment After Reform, by Decile of Primary Earner Income

Table 42
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description:</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma_c$</td>
<td>Private consumption power parameter, fixed</td>
<td>1.50</td>
</tr>
<tr>
<td>$\sigma_l$</td>
<td>Leisure power parameter</td>
<td>2.85</td>
</tr>
<tr>
<td>Utility parameters, private consumption relative to Leisure, $\gamma_l$</td>
<td>1.97</td>
<td></td>
</tr>
<tr>
<td>Public consumption without kids present, $\gamma^i_Q$</td>
<td>4.43</td>
<td></td>
</tr>
<tr>
<td>Public consumption if kids present (ages 6+ only), $\gamma^i_Q$</td>
<td>5.90</td>
<td></td>
</tr>
<tr>
<td>Public consumption if kids under age 6 present, $\gamma^i_Q$</td>
<td>13.28</td>
<td></td>
</tr>
<tr>
<td>Home good production function parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\eta$</td>
<td>Time share parameter, no kids (high school)</td>
<td>0.33</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Time share parameter, kids age 6+ (high school)</td>
<td>0.45</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Time share parameter, kids under age 6 (high school)</td>
<td>0.24</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Time share parameter, no kids (college)</td>
<td>0.47</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Time share parameter, kids age 6+ (College)</td>
<td>0.57</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Time share parameter, kids under age 6 (College)</td>
<td>0.42</td>
</tr>
<tr>
<td>$\tau$</td>
<td>Substitution parameter, home hours vs. market Good</td>
<td>0.38</td>
</tr>
<tr>
<td>$v$</td>
<td>Substitution parameter, wife’s vs husband’s home hours</td>
<td>0.40</td>
</tr>
<tr>
<td>$\alpha^1$</td>
<td>Productivity of home hours, women:</td>
<td>1.10</td>
</tr>
<tr>
<td>$\alpha^2$</td>
<td>Productivity of home hours, men:</td>
<td>0.90</td>
</tr>
</tbody>
</table>

Table 5: Estimates I: Preference and Production Function Parameters

<table>
<thead>
<tr>
<th>Description:</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of divorce, high school</td>
<td>5.49</td>
</tr>
<tr>
<td>Cost of divorce, college</td>
<td>11.52</td>
</tr>
<tr>
<td>Mean Initial Match Quality</td>
<td>-0.40</td>
</tr>
<tr>
<td>Variance Initial Match Quality</td>
<td>1.0</td>
</tr>
<tr>
<td>Variance Match Quality</td>
<td>1.0</td>
</tr>
<tr>
<td>Decline in mean of initial match quality with age:</td>
<td>0.14</td>
</tr>
<tr>
<td>Probability of drawing a potential match, Normalized</td>
<td>1</td>
</tr>
<tr>
<td>Probability of drawing a partner with the same education</td>
<td>0.75</td>
</tr>
<tr>
<td>Correlation between the individual-fixed effects of potential partners, if same education</td>
<td>0.46</td>
</tr>
<tr>
<td>Correlation between the individual-fixed effects of potential partners, if different education</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Table 6: Estimates II: Match Quality and Marriage Market Parameters
<table>
<thead>
<tr>
<th>Description</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constant:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>2.085</td>
<td>2.229</td>
</tr>
<tr>
<td>College</td>
<td>2.340</td>
<td>2.539</td>
</tr>
<tr>
<td><strong>Experience:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>0.047</td>
<td>0.050</td>
</tr>
<tr>
<td>College</td>
<td>0.069</td>
<td>0.079</td>
</tr>
<tr>
<td><strong>Experience Squared:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>-0.0009</td>
<td>-0.0009</td>
</tr>
<tr>
<td>College</td>
<td>-0.0014</td>
<td>-0.0016</td>
</tr>
<tr>
<td><strong>Part-time Experience Accumulation:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>0.317</td>
<td>-0.098</td>
</tr>
<tr>
<td>College</td>
<td>0.630</td>
<td>0.433</td>
</tr>
<tr>
<td><strong>No-time Experience Depreciation:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>-0.937</td>
<td>-1.131</td>
</tr>
<tr>
<td>College</td>
<td>-1.585</td>
<td>-1.020</td>
</tr>
<tr>
<td><strong>Standard Deviation of Wage Shocks:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>0.370</td>
<td>0.373</td>
</tr>
<tr>
<td>College</td>
<td>0.387</td>
<td>0.433</td>
</tr>
<tr>
<td><strong>Standard Deviation of Fixed Effects:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>0.415</td>
<td>0.414</td>
</tr>
<tr>
<td>College</td>
<td>0.475</td>
<td>0.459</td>
</tr>
</tbody>
</table>

Table 7: Estimates III: Wage Process Parameters

<table>
<thead>
<tr>
<th>Moment</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share Married, Ages 22 to 60</td>
<td>0.61</td>
<td>0.65</td>
</tr>
<tr>
<td>Share Divorced, Ages 22 to 60</td>
<td>0.12</td>
<td>0.11</td>
</tr>
<tr>
<td>Share w/Child &lt; 6, Ages 22 to 38</td>
<td>0.34</td>
<td>0.38</td>
</tr>
<tr>
<td>Share Employed:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men, HS</td>
<td>0.74</td>
<td>0.79</td>
</tr>
<tr>
<td>Men, College</td>
<td>0.91</td>
<td>0.94</td>
</tr>
<tr>
<td>Women, HS</td>
<td>0.64</td>
<td>0.66</td>
</tr>
<tr>
<td>Women, College</td>
<td>0.79</td>
<td>0.83</td>
</tr>
<tr>
<td>Weekly Hours Spent in Home Production:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>12.3</td>
<td>14.1</td>
</tr>
<tr>
<td>Women</td>
<td>25.2</td>
<td>21.2</td>
</tr>
<tr>
<td>Share of Households in which Woman is Higher Earner:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When Husband is High School Graduate</td>
<td>29.3</td>
<td>33.7</td>
</tr>
<tr>
<td>When husband is College Graduate</td>
<td>26.2</td>
<td>31.2</td>
</tr>
</tbody>
</table>

Table 8: Summary Statistics, Data and Model Simulation
Employment Changes:

**By Child Status:**
- Women with children under age 6: 0.0547 0.0599
- Women without children under age 6: 0.0297 0.0315

**By Education:**
- College-educated women: 0.0461 0.0438
- High school or less: 0.0269 0.0300
- HS+Low-type (model), HS drop-out (data): -0.0051 -0.0075

Table 9: Bush Tax Cut and Women’s Employment (Husbands’ Earning $60-70k)

<table>
<thead>
<tr>
<th>Bracket for Individual or Average Income</th>
<th>Current Joint Income Splitting</th>
<th>Optimal Joint Income Splitting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4.5k</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>4.5-11k</td>
<td>0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>11-31k</td>
<td>0.19</td>
<td>0.21</td>
</tr>
<tr>
<td>31-57.5k</td>
<td>0.30</td>
<td>0.29</td>
</tr>
<tr>
<td>57.5-85.5k</td>
<td>0.33</td>
<td>0.36</td>
</tr>
<tr>
<td>85.5-149k</td>
<td>0.38</td>
<td>0.47</td>
</tr>
<tr>
<td>&gt;149k</td>
<td>0.40</td>
<td>0.47</td>
</tr>
<tr>
<td>$T(y^1 = 0, y^2 = 0)$</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Table 10: Current vs Optimal Joint with Income Splitting

<table>
<thead>
<tr>
<th>Bracket for Individual or Average Income</th>
<th>Current Joint Income Splitting</th>
<th>Optimal Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4.5k</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>4.5-11k</td>
<td>0.03</td>
<td>0.0</td>
</tr>
<tr>
<td>11-31k</td>
<td>0.21</td>
<td>0.20</td>
</tr>
<tr>
<td>31-57.5k</td>
<td>0.29</td>
<td>0.23</td>
</tr>
<tr>
<td>57.5-85.5k</td>
<td>0.36</td>
<td>0.37</td>
</tr>
<tr>
<td>85.5-149k</td>
<td>0.47</td>
<td>0.54</td>
</tr>
<tr>
<td>&gt;149k</td>
<td>0.47</td>
<td>0.54</td>
</tr>
<tr>
<td>$T(y^1 = 0, y^2 = 0)$</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Table 11: Optimal Joint with Income Splitting vs Optimal Individual
<table>
<thead>
<tr>
<th>Brackets</th>
<th>Optimal Individual</th>
<th>Optimal Joint with Flexible Jointness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Degree of Jointness</td>
<td>$z_m = 0.21$</td>
</tr>
<tr>
<td></td>
<td>Spouse’s Earnings</td>
<td>0k</td>
</tr>
<tr>
<td>0-4.5k</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>4.5-11k</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>11-31k</td>
<td>0.20</td>
<td>0.15</td>
</tr>
<tr>
<td>31-57.5k</td>
<td>0.23</td>
<td>0.15</td>
</tr>
<tr>
<td>57.5-85.5k</td>
<td>0.37</td>
<td>0.31</td>
</tr>
<tr>
<td>85.5-149k</td>
<td>0.54</td>
<td>0.53</td>
</tr>
<tr>
<td>&gt;149k</td>
<td>0.54</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Table 12: Optimal Individual vs Optimal General Joint
Figure 1: Tax Schedule: Marginal Tax Rate
Figure 2: U.S. Tax Schedule: Marriage Bonuses and Penalties, 2015

(a) Women’s Non-Employment, US

(b) Women’s Non-Employment, Canada

Figure 3: Women’s Non-employment and Tax Rates, Comparison Between US and Canada

Notes: In the computation of the average tax rate, we include federal income taxes, FICA, state taxes weighted by population, the Earned Income Tax Credit and the Child Tax Credit. The EITC helps explain the steep increase in the average tax rate at very low levels of income and the subsequent decline for households with income between $20,000 and $40,000.
(a) Percent Change in After-tax Income  
(b) Earnings Potential of Women and Men

Figure 4: After-tax Income Changes and Earnings Potential

(a) Marginal Tax Rate for Married Women  
(b) Labor Force Participation Married Women

Figure 5: Effect of Bush Tax Cuts on Married Women

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Figure 6: 1986 Reagan Tax Reform

Figure 7: 2003 Bush Tax Reform
Figure 8: 1993 EITC Reform

Figure 9: Income Distribution of Men By Education (Ages 25-54)
Figure 10: Income Distribution of Women (Ages 25-54)

Figure 11: Share of Women Employed By Husband’s Earnings and Education
Figure 12: Share of College Women Employed By Husband’s Earnings and Young Children

Figure 13: Share of High School Women Employed By Husband’s Earnings and Young Children
Figure 14: Share of Women With College Education, By Husband’s Earnings

Figure 15: Weekly Hours Worked, Model and Data
Figure 16: Distribution of Welfare over Ability

Figure 17: Changes in Welfare Generated by The Optimal Joint with Income Splitting
Figure 18: Labor Force Participation, Current vs Optimal Joint with Income Splitting

Figure 19: Labor Force Participation, Individual System
Figure 20: Change in Welfare Generated by the Individual System

Figure 21: Change in Welfare Generated by the General Joint System
Figure 22: Labor Force Participation, General Joint System