

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 four 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; the standard joint system with deductions for secondary earners. 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. Lastly, our results indicate that the standard joint system with secondary-earner deductions welfare dominates the individual system, as it approximates well the general joint system.

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1 Introduction

What is the effect of different income taxation systems – for instance individual versus joint – on decisions and welfare? What is the income taxation system that maximizes the total welfare of a country? The main objective of this paper is to answer these two questions when one accounts for the long term consequences of adopting a particular system. This is important because income tax revenues are the main source of government revenues for most developed countries (50% in the United States (U.S.)). These revenues play a significant role as, in addition to funding the provision of public goods, they enable governments to redistribute resources across households in ways that address inequality concerns and maximize total welfare. Moreover, governments can choose among several types of income taxation, each one with different effects on the welfare distribution and income inequality of the country. For example, Canada and Sweden adopt an individual system in which neither spousal earnings nor marital status determine the tax schedule of married individuals. By contrast, the U.S. and Germany use a joint system that consider only pooled earnings of a 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.

We answer the two questions in three steps. In the first part of the paper, we provide 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 suggest 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 market inputs 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 the tax reform imple-

mented in 2003 by the Bush Administration. We use the estimated model to determine the optimal income taxation system – the system that maximizes total welfare – and the corresponding tax rates. Our results indicate that different income taxation systems achieve welfare maximization through different mechanisms. The individual system achieves it by means of increases in labor supply and accumulation of human capital, especially for secondary earners, higher assortative matching, and corresponding increases in output produced. By contrast, the joint system currently adopted by the U.S. attains welfare maximization by increasing intra-household specialization, reducing human capital accumulations and wages for secondary earners, and increasing them for primary earners, and by reducing assortative matching. The adoption of an individual vs joint system have therefore different effects on income inequality: the individual systems has the tendency to increase it, whereas the joint systems have the opposite effect of reducing it at the cost of lower output.

Our findings also indicate that a more general form of joint system in which the tax rates of one individual are allowed to depend on the spouse’s income attains the highest level of welfare and lower levels of income inequality, with limited effects on output production and human capital accumulation. This system maximizes welfare by transferring a larger fraction of resources than any other system from high income to low income households. Using its greater flexibility, governments can take better advantage of differences in labor supply and household production time elasticities across gender, household composition, and stages of the lifecycle. Specifically, resources are redistributed from households with high earning potential to households lower in the distribution, without the adverse effects on individuals at the bottom of the distribution produced by the individual system.

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 couples 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 also over the lifecycle of different individuals and for the different generations that populate the economy at the time of the reform.

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 a 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 accounts 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. Rondina (2020) performs an exercise similar to Guner, Kaygusuz, and Ventura

(2012), with the difference that the calibrated model is a collective model without limited commitment, but without the general equilibrium aspect. 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 and the fit of the model. Section 8 assesses different taxation reforms and Section 9 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 losses. Figure 4a suggests that households with husbands earning below \$50,000 will generally experience welfare losses, 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 tax reform that took place in the U.S. in 2003, known as the Jobs and Growth Tax Relief Reconciliation Act of 2003 (the Bush tax cuts). In this section, we describe the variation in labor supply behavior generated by it and by the other two main tax reforms enacted in the U.S. in the last four decades: the Tax Reform Act of 1986 (the Reagan tax cuts) and the 1993 EITC expansion as part of Omnibus Budget Reconciliation Act (OBRA). This is 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:

$$y_{it} = \alpha_i + \beta_1 \cdot \hat{\tau}_i \cdot post_t + \beta_2 \cdot X_{it} + \gamma_t + \varepsilon_{it}$$

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, α_i is a household fixed effect, γ_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:

$$y_{it} = \sum_k \alpha_k inc_k + \sum_k \pi_k inc_k \cdot post_t + \beta_2 X_{it} + \gamma_t + \varepsilon_{it} \quad (1)$$

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 π_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 variables.

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 details.

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 θ . 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 β . In the estimation of the model, we assume that the utility function takes the following form for couples:

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

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 θ^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 σ_z . The first realization of θ at the time of marriage is drawn from a normal distribution with mean μ_θ and variance σ_θ .

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.

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

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

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:

$$\ln w^{g,j} = a^i + \beta_0^{g,j} + \beta_1^{g,j} (e_{FT}^i + \lambda e_{PT}^i + \delta e_{NT}^i) + \beta_2^{g,j} (e_{FT}^i + \lambda e_{PT}^i + \delta e_{NT}^i)^2 + \epsilon^{g,i},$$

or equivalently,

$$\begin{aligned} \ln w^{g,j} = & a^i + \beta_0^{g,j} + \beta_1^{g,j} e_{FT}^i + \psi_1^{g,j} e_{PT}^i + \psi_2^{g,j} e_{NT}^i + \beta_2^{g,j} (e_{FT}^i)^2 + \psi_3^{g,j} (e_{PT}^i)^2 + \psi_4^{g,j} (e_{NT}^i)^2 \\ & + \psi_5^{g,j} e_{FT}^i e_{PT}^i + \psi_6^{g,j} e_{FT}^i e_{NT}^i + \psi_7^{g,j} e_{PT}^i e_{NT}^i + \epsilon^{g,i}, \end{aligned} \quad (3)$$

where $\psi_1^{g,j} = \beta_1^{g,j} \lambda$, $\psi_2^{g,j} = \beta_1^{g,j} \delta$, $\psi_3^{g,j} = \beta_2^{g,j} \lambda^2$, $\psi_4^{g,j} = \beta_2^{g,j} \delta^2$, $\psi_5^{g,j} = 2\beta_2^{g,j} \lambda$, $\psi_6^{g,j} = 2\beta_2^{g,j} \delta$, and $\psi_7^{g,j} = 2\beta_2^{g,j} \lambda \delta$.

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

The functions τ^s and τ^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 $\tau^s(w_t h_t)$ and $\tau^m(w_t^1 h_t^1, w_t^2 h_t^2)$ 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 incorporate in the following constant elasticity of substitution (CES) production function:

$$Q = f(d^1, d^2, m) = (\eta^{g,n} \cdot (\alpha^1 \cdot (d^1)^v + \alpha^2 \cdot (d^2)^v)^{\frac{\tau}{v}} + (1 - \eta^{g,n}) \cdot m^\tau)^{\frac{1}{\tau}},$$

where α^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 η_g can take one of 6 values in the equation above. The parameter τ measures the degree of substitutability between time and market goods; η represents the share of time employed in the production of Q relative to market goods; and α^1 and α^2 capture differences in the productivity of time between women and men.

For singles, the production function becomes:

$$Q = f(d^1, m) = (\eta^{g,n} \cdot (\alpha_d^1 d^1)^\tau + (1 - \eta^{g,n}) \cdot m^\tau)^{\frac{1}{\tau}}.$$

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 ψ 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:

$$\begin{aligned}
 V_t^{ds}(b_t, e_t, n_t, a) &= \max_{h_t, d_t, m_t, c_t, b_{t+1}} u(c_t, l_t, Q_t) + \beta E_t [V_{t+1}^{es}(b_{t+1}, e_{t+1}, n_{t+1}, a)] \\
 \text{s.t.} \quad c_t + m_t &= w_t h_t - \tau^s(w_t h_t) + Rb_t - b_{t+1} - p_t^c n_t \\
 Q_t &= f(d_t, m_t), \quad h_t + d_t + l_t = T, \quad \text{and} \quad w_t = w(e_t, a),
 \end{aligned}$$

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_t^1 and M_t^2 the Pareto weights used to make efficient decisions in period t . We will discuss later in this section how they are computed. Also, let $V_t^{em,i}$ 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:

$$\begin{aligned} & \max_{\{h_t^i, d_t^i, m_t^i, c_t^i, b_{t+1}^i\}_{i=1}^2} \sum_{i=1}^2 M_t^i \{u^i(c_t^i, l_t^i, Q_t, \theta_t) + \beta E_t [V_{t+1}^{em,i}(b_{t+1}, e_{t+1}^1, e_{t+1}^2, n_{t+1}, a^1, a^2)]\} \\ & \text{s.t.} \quad c_t^1 + c_t^2 + m_t = w_t^1 h_t^1 + w_t^2 h_t^2 - \tau^m(w_t^1 h_t^1, w_t^2 h_t^2) + Rb_t - b_{t+1} - p_t^c n_t \\ & \quad Q_t = f(d_t^1, d_t^2, m_t), \quad h_t^i + d_t^i + l_t^i = T, \quad \text{and} \quad w_t^i = w^i(e_t^i, a^i), \quad i = 1, 2, \end{aligned}$$

where the change from having n_t children to n_{t+1} children is governed by the fertility probability. Denote by $h_t^{i*}, d_t^{i*}, m_t^{i*}, c_t^{i*}, b_{t+1}^*$, 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:

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

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.

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

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 $z^{**} = \{h_t^{i**}, d_t^{i**}, m_t^{i**}, c_t^{i**}, b_{t+1}^{i**}\}$ 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 utility for consumption σ_c and the discount factor β , we estimate all the model's parameters using the data described in Section 2. The parameter σ_c is set equal to 1.5 based on Blundell, Browning, and Meghir (1994) and Attanasio and Weber (1995), and the parameter β 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), σ_a^g , and of the error terms, σ_ϵ^g . The parameters governing the accumulation of human capital can then be identified by noting that $\lambda = \frac{\psi_2}{\psi_1}$ and $\delta = \frac{\psi_3}{\psi_1}$.

¹As we discuss in details in the next section, in the estimation we control for selection into the labor market.

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

The parameter η 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 τ 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 τ . 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 τ , $1 - \eta$ determines the fraction of resources used in household production that a single individual allocates to market inputs relative to time inputs. η 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 (α_1) from men's productivity (α_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 Frisch 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 γ_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, γ_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 μ_θ and σ_θ affect the probability of marriage for a couple with given education, as higher μ_θ and lower σ_θ 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 a declining function of the cost of divorce K_d . Thus, we can identify σ_z and K_d using the probability of divorce for couples with a given education. Lastly, the probability that an individual with education g marries a potential spouse with the same education $g_s = g$ increases with the probability that two individuals with such education meet π_g . Consequently, we can identify the parameters π_{HS} and π_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 $\rho_{g \neq g_s}$.

6 Estimation and Moment Selection.

Wage and Experience Parameters: $\beta_0^{g,i}, \beta_1^g, \beta_2^g, \sigma_\epsilon^g, \sigma_\epsilon^a, \lambda, \delta$. 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 τ by targeting changes $\frac{d}{m}$ in response to the Bush tax cuts. The substitution parameter for couple v 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 η 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 α_1 is estimated by targeting the difference between single men and women in the moment used to estimate η .

Preference Parameters: $\sigma_l, \gamma_l, \gamma_Q$. The parameter governing the response to tax rate changes, σ_l , 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 γ_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: $\mu_\theta, \sigma_\theta, \sigma_z, K_d, \pi_{HS}, \pi_C, \rho_{g=g_s}, \rho_{g \neq g_s}$. In the estimation, we normalize the standard deviations σ_θ and σ_z to 1. The other parameters are estimated following the discussion in the identification section. Specifically, the parameter μ_θ is estimated by targeting marriage probabilities the parameter K_{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 μ_θ and σ_θ 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 $\rho_{g \neq g_s}$ 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);²; (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 σ_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 there is substantial substitutability between time and market inputs in household 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

²Market input expenditure is composed of expenditure on children, housekeeping, meals, and additional daycare expenditure above the minimum required when both parents work.

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 earnings, 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 function 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 consider five tax systems: (i) the joint system with income splitting currently used in the U.S.; (ii) the individual tax system adopted for instance in the U.K. and Canada; (iii) a system with deductions for secondary earners; and (iv) a general joint system that allows for an arbitrary dependence between the tax rates of spouses. For each system, we derive the optimal tax rates – the tax rates that maximize welfare in the economy. We then compare their performance at the optimal rates in terms of welfare, output variables, and inequality. Lastly, we document the effect of dynamics and assortative matching on the derivation of the optimal tax rates for the general joint system.

8.1 Optimal Tax Rates

For each taxation system, the optimal tax rates are derived by maximizing a measure of welfare in the economy, conditional on the constraint that tax revenues generated by the system are greater than or equal to the tax revenues currently collected by the U.S. government. To be consistent with current practices, the government can condition the tax rates only on individual income, which is observed. As one of our goals is to compare the performance of four tax systems to the current system, the optimal tax rates are computed for the seven tax brackets adopted in the U.S. in 2012. Since in the U.S. the brackets for singles are approximately equal to the tax brackets for married households, we use the latter in our analysis and divided them by two to obtain the brackets for singles. Specifically, for single individuals, they are $\$0k - \$4.5k$, $\$4.5k - \$10.75k$, $\$10.75k - \$31k$, $\$31k - \$57.25k$, $\$57.25k - \$85.5k$, $\$85.5k - \$149k$, $> \$149k$. For couples, each endpoint is multiplied by 2.

Given the dynamic nature of our model, we can construct the welfare measure in different

ways depending on the weight we assign to different generations. One possibility is construct the welfare function as the sum of value functions of individuals that enter the economy at the time of the reform. 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 to compute the welfare function as the sum of the value functions of individuals that belong to young, middle-aged, and old generations in the economy. Since the latter method better approximates the objective function of a democratic government, we use the second approach with five generations: the generations of ages 20, 30, 40, 50, and 60 at the time of the reform. We restrict our attention to five generations because the addition of every single generation is computationally demanding.

Specifically, let $V^a(S, t_r)$ be the value function of an individual in generation $a = 20, 30, 40, 50, 60$, with state variables S , at the time of the reform t_r . Denote with $\bar{V}^a(t_r) = \int_S V^a(S, t_r) df(S)$, the integral of the individual value function over the distribution of state variables $f(S)$ for generation i at t_r . Then, conditional on a taxation system, the optimal tax rates $\tau = [\tau_1, \dots, \tau_n]$ that solve the following problem:³

$$\max_{\tau} \sum_{i=1}^5 \bar{V}^i(t_r).$$

The maximization problem can be solved using standard techniques for the first three taxation system. In those cases, we follow current practices in the U.S. and most other countries and allow for only one optimal marginal tax rate τ_j within each bracket.

The solution to the problem is more complicated for the general joint system, as for married couples it allows for a general dependence between the tax rate of one spouse and the income of the other. In this system, as defined in Kleven, Kreiner, and Saez (2009), the total taxes of a married couple depend freely on the individual incomes of the two spouses. We approximate this very general schedule following the approach used in Gayle and Shephard (2019). Specifically, we allow for different optimal rates for single and married households. For single households, we adopt the approach used for the other taxation systems and allow for one marginal tax

³It is straightforward to adopt a transformation of our linear welfare function to increase the degree of inequality aversion, following Mirrlees (1971), Blundell and Shephard (2012), and Gayle and Shephard (2019). This generalization would favor the general joint system, as it will be clear from our subsequent discussion.

rate for each bracket. For married couples, we assume that both spouses have the same tax brackets characterized by the end points n_1, \dots, n_N , which form the grid of $(N + 1) \times (N + 1)$ points illustrated in Figure 16. To each point of the grid we assign the marginal tax rate $\tau_{i,j}$ that applies to the part of the couple's income that belong to that bracket. We assume that the grid is symmetric, i.e $\tau_{i,j} = \tau_{j,i}$, and to be consistent with the other tax systems that along each side of the squares that compose the grid the marginal tax rate is constant.

Starting from the lowest bracket and moving up the grid, we can then compute the total taxes paid by a married couple with income that corresponds to each point of the grid. We can then approximate the entire tax schedule in a flexible way by dividing each square generated by the tax grid in an upper and lower triangle and by computing the total taxes paid a couple with income that corresponds to a given point of the triangle using the endpoints of the triangle and barycentric coordinates. The marginal tax rates at each point of the grid $\tau_{i,j}$ and the tax rates for singles are the decision variables in the maximization problem. To apply the approximation method that uses the barycentric coordinates, we need to have an upper bound for the individual income of the two spouses. We choose it to be equal to twice the starting point of the last bracket ($\$298k = \$149k$). With the seven brackets used in the U.S., we therefore have $7 \times (7 + 1)/2$ decision variable for couples and 7 decision variables for singles. We assume that individuals and couples with zero income pay zero taxes as marginal tax rates cannot be negative, which reduces the number of decision variable by 2. We therefore end up with $7 \times (7 + 1)/2 - 1 + 7 - 1 = 33$ decision variables.

8.2 Results

The current U.S. tax rates and the optimal tax rates for the four tax systems we consider are reported in Table 10.

Optimal Joint System with Income Splitting. The first and second columns consider the joint tax system with income splitting adopted by the U.S. and compares the current rates (first column) with the rates that maximize welfare (second column).⁴ The rates are quite similar

⁴The 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.

with the exception of the very bottom and top brackets. Our results indicate that total welfare in the economy would be improved with additional redistribution of resources from households at the very top to households at the bottom of the income distribution. The political hurdle of increasing tax rates for wealthy households may explain why the U.S. government does not impose a more progressive tax schedule. The rates differences are, however, small and this is reflected in a low willingness to pay by household for a reform that would switch to the optimal rates. We estimate that they are willing to give up 1.6% of their annual income.

To evaluate who gains and loses the most from this tax reform, in Figure 17 we reports the changes in welfare (red line) as a function of individual ability. We use ability as it represents a measure of individual earning potential that does not change across tax rates and systems. Later, we will discuss results by education and gender on top o ability, which are also constant across tax systems. Consistent with the low willingness to pay for the rate changes, the welfare differences are small except at the bottom of the ability distribution, where many individuals benefit of significantly lower rates. Figure 18 describes the same variable as a function of ability by gender and education, which are also constant across tax systems in our model. Women with low education and men with low education and ability are the ones that benefit the most from the change in tax rates, whereas women and men with a college degree and men with low education but high ability experience no gains or welfare losses. Under the new rates, many women with low education experience higher annual incomes when working. Moreover, if married, they can reduce their labor force participation and labor supply, as lower tax rates at the bottom of the income distribution for primary earners increase annual income for these households. Men with low education and ability also experience higher annual income and hence welfare due to the lower tax rates for low levels of earnings. All other households experience no change in welfare or losses as a result of the higher tax rates at the top of the income distribution.

One weakness of the joint system with income splitting is that only a limited degree of redistribution can be achieved, as higher rates for top brackets apply to both primary and secondary earners. Given that secondary earners tend to have high labor supply elasticities, if the increase in rates is large, they will respond by reducing their labor force participation and labor supply, which limits the increase in tax revenue and, thus, the redistribution generated

by the reform. We now provide evidence that the individual tax system is not as affected by this limitation.

Optimal Individual. Under the individual tax system, the optimal rates are significantly different from the corresponding rates for the joint system, with substantially more redistribution from the top of the earnings distribution (more than \$57.25k) to the bottom. Relative to the optimal joint system, brackets below \$57.25k benefit from low tax rates. The \$10.75k-\$31k bracket experience a decline of 5 percentage points and the \$31k-\$57.25k a reduction of 13 percentage points in the tax rate compared to the optimal joint system. These declines are funded by a steep rise in the tax rates for the top three brackets, which increase by 7, 13, and 8 percentage points.

Why can the individual system achieve higher levels of redistribution? Because, for married households, the tax rates of primary and secondary earners are decoupled. Thus, the government can increase the tax rates of high-earning primary earners without creating strong disincentives to work for secondary earners. The more extensive income redistribution produces a larger increase in welfare. Individuals are willing to pay on average 1.9% of their annual consumption to switch to the optimal individual tax system vs the 1.6% for the optimal joint.

It is surprising, nevertheless, that the substantial increase in redistribution generates a modest rise in annual equivalent consumption of 0.3%. The change in welfare by ability relative to the current joint system described by the blue line in Figure 17 help explain this result. The shift to individual taxation has no or limited welfare effects on the most vulnerable part of the population. The individuals that benefit the most are the ones in the middle, middle-high part of the ability distribution, with the earners at the very top losing the most from this type of reform, as expected. The inability of the individual system to improve the welfare of low ability and low earnings individuals becomes more apparent when the change in welfare over ability is reported by education and gender (Figure 18). All women with low ability and men with low education and low ability experience welfare declines. This finding can be explained by recalling that the individual tax system increases take-home income for low-middle earners through a reduction in their tax rates, but at the same time it reduces marriage bonuses. Thus,

individuals who do not work will not enjoy the benefits of a shift to individual taxation and, if married, will experience a drop in marriage bonuses. Figure 19 highlights that all low-ability women and men with low ability and low education have very low participation rates, which explain their welfare losses in case of a move to individual taxation.

Figure 18 also documents that college women with medium and high ability experience a drop in welfare, albeit small, even if they have high participation rates. Figures 20, 21, and 22, 23, 24, and 25 provide evidence on the reasons behind the decline. As expected, college women with middle or high ability respond to the tax reform by increasing their labor force participation and labor supply, which expands their resources and consumption. At the same time, it is optimal for them to reduce the time spent on household production, with a consequent decline in public consumption, which adversely impact their welfare. Moreover, the reduction in household production time is small relative to the increase in labor market hours, generating a decline in their leisure and, which has an additional negative effect on their welfare. Our results indicate that the increase in private consumption is not sufficiently large to offset the decline in public consumption and leisure, which explain the decline in welfare for this group of women.

The last result emphasizes the importance of accounting for the time spent on household production by family members when evaluating different taxation systems. The individual taxation system has the indisputable effect of increasing labor supply of individuals with sufficiently high ability and, thus, the amount of resources available to them. At the same time, it affects the allocation of time to different activities and the production of public goods in complicated ways. Without properly accounting for them, one could overestimate the positive effects of individual taxation.

Optimal General Joint. Columns 6-9 of Table 10 report the optimal tax rates for married individuals with spouses with low, medium-low, medium-high, and high income, and column 10 outlines the optimal rates for singles. This system is significantly more flexible than the standard joint and individual systems, as it can select tax rates that account for a larger set of labor supply elasticities and target the subpopulation with the lowest ones. By doing this, it can achieve high levels of redistribution without large adverse effects on individuals with low earning

potential. This is attained by adopting rates for married households with low or medium-low total income that are lower than in the current joint (highlighted in blue) and by offsetting the decline in tax revenues with sharp increases in rates for earners with medium and high income married to spouses with medium and high income, as these individuals have typically lower. With these rates, the economy reaches the highest level of welfare, as households are willing to pay on average 4.4% of their annual consumption for a shift to the general joint system.

In Figure 17, we describe how the welfare gains are allocated across the ability distribution. By reducing the rates for married individuals with low or medium earnings with a spouse with low income (below \$10.75k), this system can significantly increase the welfare of the subpopulation with low earning potential. An unexpected result is that welfare increases for everyone else in the ability distribution, including the people at the very top. In Figure 18, we report the changes in welfare by education and gender. All groups experience welfare increases except college men with very high ability.

There are several combined changes in the economy that explain this finding. First, as documented in Figure 20, labor force participation increased for all sub-populations, with changes that are very close to the ones generated by the individual taxation system. The rise in labor force participation is driven by marginal tax rates that are on average lower than for the current system for each ability level for women and identical except for high ability levels for men (Figure 29). This indicates that joint systems can provide incentives to work for both primary and secondary earners if they are designed in a way that is sufficiently flexible. The higher labor force participation rates increase the resources available to individuals and, hence, their welfare.

The change in labor force participation is associated with an expected decline in time spent on household production for most households (Figure 22). Despite this, public consumption increases for all individuals. This is explained by an increase in marriage rates (Figure 26) and by higher expenditure on market inputs (Figure 28). The marriage rates increase by about 2 percentage points, which is sufficient to produce higher public consumption as couples are more efficient in its production. Market inputs help married couples maintain a high level of public consumption, even though secondary earners increase increase work hours. With lower marginal tax rates, it is now optimal for secondary earners to supply more labor by substituting

time with market inputs in household production, using part of their higher earnings to pay for them. This result underscores the importance of market inputs when studying the effects of policies that have an impact on the labor supply decisions of secondary earners. A model without market inputs would have underestimated their labor supply responses and welfare increases.

The previous discussion calls attention to the complexity of the effects produced by a tax reform and to the importance of properly accounting for the allocation of time and market inputs to households production and for marriage and divorce decisions.

Optimal Joint with Income Splitting and Secondary Earners Deductions. The main concern with the general joint system is that it may be difficult to implement in practice because of its complexity. To address this issue, we have tried to approximate the flexibility of that system by adding a \$20k deductions for secondary earners. The corresponding optimal tax rates are reported in the fifth column of Table 10. We find that with the simple introduction of the secondary earner deduction, the system can attain higher levels of redistribution compared with the standard joint system. As secondary earners do not pay taxes up to \$20k, the system can increase tax rates at the top of the earning distribution ($> \$85k$) without being concerned with a large decline in labor force participation of secondary earners and, thus, tax revenue. Welfare improves by less than with the general joint system, as people are willing to pay on average 2.4% of their annual income vs the 4.4% with the general joint. But this welfare improvement is still they highest among all the other systems.

Similarly to the joint system, individuals with low ability experience significant welfare gains (Figure 18), indicating that the most vulnerable part of the population can be helped with the simple inclusion of a deduction. Almost everyone else experience similar welfare gains for the same reasons they enjoyed them with the general joint. Labor force participation, market inputs, public consumption, and marriage rates are higher on average for most men and women of all ability and education levels (Figure 20). These changes raise individual welfare despite of a decline in leisure and private consumption.

These results indicates that, if the general joint system is not an option for feasibility or political reasons, the inclusion of secondary earners deduction in the standard joint system is

the second best alternative.

Dynamics and the Optimal General Joint. The tax reforms considered up to this point highlight the importance of accounting for some aspects of individual decisions, such as household production and the time and market inputs employed in it, marriage and divorce decisions, differences in ability and education. But it is difficult to assess the role of two features that are specific to our analysis: dynamics and assortative matching.

To this end, we run a first experiment in which we diminish the effect of dynamics by reducing by 10% the coefficients on the experience variables in the wage processes. At the same time, to focus just on the change in the slope of human capital accumulation, we increase the constants in the wage processes by an amount that keeps average wages for each gender and education constant.⁵ We then re-derive the optimal tax rates for the tax system that produces the highest level of welfare: the general joint system.

The results are reported in Table 11. Before deriving the new optimal tax rates, the experiment reduces tax revenues by 1.4%, as individuals are redistributed from high to medium brackets, and from medium to low brackets. To adjust for this change, the general joint system reduces the gradient of the tax rates increase along the earning distribution. The top brackets experience declines in tax rates of 2-5 percentage points (marked in blue), while the tax rates for the medium earnings increase by 2-3 percentage points.

This simple experiment underlines the importance of accounting for human capital accumulation when assessing tax reforms. Without it, earnings inequality is underestimated, with resulting tax rates that are too low at the top and too high for medium earner, and inadequate redistribution of resources.

Assortative Matching and the Optimal General Joint. In the second experiment, we reduce the correlation between the ability draws of potential spouses by an amount that diminishes the correlation in ability between married individuals – assortative matching – by half. We then re-compute the optimal tax rates.

The results reported in Table 12 indicate that assortative matching and dynamics have

⁵We have experimented with larger declines in the experience coefficients. In those cases, the simulated moments are quite far from the actual moments, making the analysis less appealing.

similar effects on the optimal tax schedule. With less assortative matching, married couples are shifted from higher to lower brackets. The optimal response is a decline in tax rates for couples with high earners (marked in blue) and an increase for couples that earn incomes in the middle of the distribution. Without assortative matching, the tax schedule is therefore not sufficiently progressive.

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 four tax reforms: the adoption of tax rates that maximize welfare in the joint system with income splitting; a shift to an optimal individual taxation system; a switch to a joint system that allows for flexible dependence between the tax rates of an individual and the spouse's income; the introduction of secondary earners deductions in the current joint system. Our findings indicate that the general joint system generates the highest level of welfare, as it can achieve a significant redistribution of resources from the top to the bottom of the earnings distribution, without introducing significant disincentives to work for secondary earners. The standard joint system with secondary-earner deductions is second best, as it can approximate the effects of the general joint schedule.

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	Taxed As Individuals			Taxed Jointly As Married Couple		
	Pooled	Primary Earner	Secondary Earner	Pooled	Primary Earner	Secondary Earner
Pre-Tax Income	\$110k	\$80k	\$30k	\$110k	\$80k	\$30k
Marginal Tax Rate	-	0.40	0.10	0.40	0.40	0.40
After-Tax Income	\$86.5k	\$59.5k	\$27k	\$89k	\$71k [†]	\$18k [†]
Marriage Bonus	\$0			\$2.5k		
Average Tax Rate	0.21	0.26	0.10	0.19	0.11 [†]	0.40 [†]

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

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

	All Women		Women with Young Children		Women without Young Children	
	LFP	Hours	LFP	Hours	LFP	Hours
1986 Reform	-0.175*	-0.001	-0.278*	0.001	-0.121	-0.001
	[0.101]	[0.001]	[0.167]	[0.003]	[0.109]	[0.002]
1993 Reform	-0.197	0.001	-0.240	-0.008	-0.164	0.007
	[0.141]	[0.004]	[0.237]	[0.007]	[0.158]	[0.006]
2003 Reform	-0.313**	-0.001	-0.542**	-0.001	-0.227	-0.002
	[0.159]	[0.003]	[.303]	[0.004]	[0.175]	[0.003]

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

	Married Men	Single Men	Single Women
1986 Reform	0.044 [0.077]	-0.012 [0.237]	-0.220* [0.126]
1993 Reform	0.018 [0.191]	0.593 [0.417]	-1.187*** [0.483]
2003 Reform	0.022 [0.114]	0.505 [0.621]	0.213 [0.225]

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

	(1) All	(2) HS	(3) Col	(4) W/Child <6	(5) No Yng. Ch.	(6) Tax Change
Post x 45,000	0.00323 (0.00725)	0.00642 (0.00949)	-0.00308 (0.0111)	0.00685 (0.0141)	0.00302 (0.00842)	-0.0109
Post x 55,000	0.000893 (0.00882)	0.00415 (0.0122)	-0.00408 (0.0126)	-0.00146 (0.0179)	0.00111 (0.0101)	-3.693
Post x 65,000	0.0390*** (0.0107)	0.0300* (0.0157)	0.0438*** (0.0141)	0.0599*** (0.0212)	0.0315*** (0.0122)	-8.339
Post x 75,000	0.00723 (0.0136)	-0.0251 (0.0208)	0.0375** (0.0176)	0.00993 (0.0279)	0.00748 (0.0153)	-3.408
Post x 85,000	0.0186 (0.0131)	0.0311 (0.0205)	0.00281 (0.0167)	0.0140 (0.0256)	0.0192 (0.0151)	-1.768
Post x 95,000	-0.0176 (0.0212)	0.0130 (0.0353)	-0.0388 (0.0264)	-0.0740* (0.0418)	-0.00363 (0.0244)	-2.087
Observations	136296	94658	41638	40389	95907	136296
Adjusted R^2	0.736	0.704	0.795	0.683	0.757	

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

Parameter	Description:	Value
σ_c	Private consumption power parameter, fixed	1.50
σ_l	Leisure power parameter	2.85
Utility parameters, private consumption relative to		
	Leisure, γ_l	1.97
	Public consumption without kids present, γ_Q^i	4.43
	Public consumption if kids present (ages 6+ only), γ_Q^i	5.90
	Public consumption if kids under age 6 present, γ_Q^i	13.28
Home good production function parameters		
η	Time share parameter, no kids (high school)	0.33
η	Time share parameter, kids age 6+ (high school)	0.45
η	Time share parameter, kids under age 6 (high school)	0.24
η	Time share parameter, no kids (college)	0.47
η	Time share parameter, kids age 6+ (College)	0.57
η	Time share parameter, kids under age 6 (College)	0.42
τ	Substitution parameter, home hours vs. market Good	0.38
v	Substitution parameter, wife's vs husband's home hours	0.40
α^1	Productivity of home hours, women:	1.10
α^2	Productivity of home hours, men:	0.90

Table 5: Estimates I: Preference and Production Function Parameters

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

Table 6: Estimates II: Match Quality and Marriage Market Parameters

Description:	Women	Men
Constant:		
High School	2.085	2.229
College	2.340	2.539
Experience:		
High School	0.047	0.050
College	0.069	0.079
Experience Squared:		
High School	-0.0009	-0.0009
College	-0.0014	-0.0016
Part-time Experience Accumulation:		
High School	0.317	-0.098
College	0.630	0.433
No-time Experience Depreciation:		
High School	-0.937	-1.131
College	-1.585	-1.020
Standard Deviation of Wage Shocks:		
High School	0.370	0.373
College	0.387	0.433
Standard Deviation of Fixed Effects:		
High School	0.415	0.414
College	0.475	0.459

Table 7: Estimates III: Wage Process Parameters

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

Table 8: Summary Statistics, Data and Model Simulation

Employment Changes:	Model	Data
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)

Brackets	Curr. Joint	Joint*	Individual*	Deduction*	General Joint*				Singles
					Spouse's Earnings				
					<10.75	10.75-57.25	57.25-149	>149	
0-4.5k	0.0	0.0	0.0	0.0	0.04	0.14	0.35	0.42	0.0
4.5-10.75k	0.11	0.0	0.03	0.0	0.06	0.15	0.38	0.42	0.20
10.75-31k	0.19	0.23	0.18	0.24	0.07	0.24	0.39	0.44	0.20
31-57.25k	0.30	0.32	0.19	0.33	0.21	0.25	0.40	0.45	0.25
57.25-85.5k	0.33	0.34	0.41	0.34	0.33	0.36	0.44	0.46	0.43
85.5-149k	0.38	0.39	0.52	0.49	0.41	0.43	0.47	0.50	0.49
>149k	0.40	0.47	0.55	0.65	0.42	0.45	0.48	0.51	0.49
Ann. Cons. Equivalent	-	1.6%	1.9%	2.4%					4.4%

Table 10: Optimal Tax Rates in Different Taxation Systems

Brackets	General Joint* 10% Lower Human Capital Accumulation					Singles
	Spouse's Earnings					
	<10.75	10.75-57.25	57.25-149	>149		
0-4.5k	0.03	0.10	0.36	0.42	0.0	
4.5-10.75k	0.05	0.16	0.41	0.42	0.24	
10.75-31k	0.08	0.25	0.41	0.43	0.22	
31-57.25k	0.18	0.25	0.42	0.44	0.25	
57.25-85.5k	0.35	0.39	0.44	0.44	0.45	
85.5-149k	0.42	0.44	0.45	0.45	0.48	
>149k	0.42	0.43	0.45	0.46	0.48	
% Change in Tax Revenues before Re-optimization					-1.4%	
Brackets	General Joint*					Singles
	Spouse's Earnings					
	<10.75	10.75-57.25	57.25-149	>149		
0-4.5k	0.04	0.14	0.35	0.42	0.0	
4.5-10.75k	0.06	0.15	0.38	0.42	0.20	
10.75-31k	0.07	0.24	0.39	0.44	0.20	
31-57.25k	0.21	0.25	0.40	0.45	0.25	
57.25-85.5k	0.33	0.36	0.44	0.46	0.43	
85.5-149k	0.41	0.43	0.47	0.50	0.49	
>149k	0.42	0.45	0.48	0.51	0.49	

Table 11: Optimal General Joint with 10% Percent Lower Human Capital Accumulation with Constant Average Wages

Brackets	General Joint* 50% Lower Assortative Matching				Singles
	Spouse's Earnings				
	<10.75	10.75-57.25	57.25-149	>149	
0-4.5k	0.03	0.14	0.35	0.39	0.0
4.5-10.75k	0.05	0.15	0.37	0.39	0.23
10.75-31k	0.07	0.27	0.38	0.39	0.20
31-57.25k	0.23	0.27	0.40	0.40	0.25
57.25-85.5k	0.34	0.39	0.41	0.41	0.44
85.5-149k	0.38	0.39	0.41	0.44	0.47
>149k	0.39	0.40	0.42	0.45	0.47
% Change in Tax Revenues before Re-optimization					-0.5%
Brackets	General Joint*				Singles
	Spouse's Earnings				
	<10.75	10.75-57.25	57.25-149	>149	
0-4.5k	0.04	0.14	0.35	0.42	0.0
4.5-10.75k	0.06	0.15	0.38	0.42	0.20
10.75-31k	0.07	0.24	0.39	0.44	0.20
31-57.25k	0.21	0.25	0.40	0.45	0.25
57.25-85.5k	0.33	0.36	0.44	0.46	0.43
85.5-149k	0.41	0.43	0.47	0.50	0.49
>149k	0.42	0.45	0.48	0.51	0.49

Table 12: Optimal General Joint with 50% Lower Assortative Matching

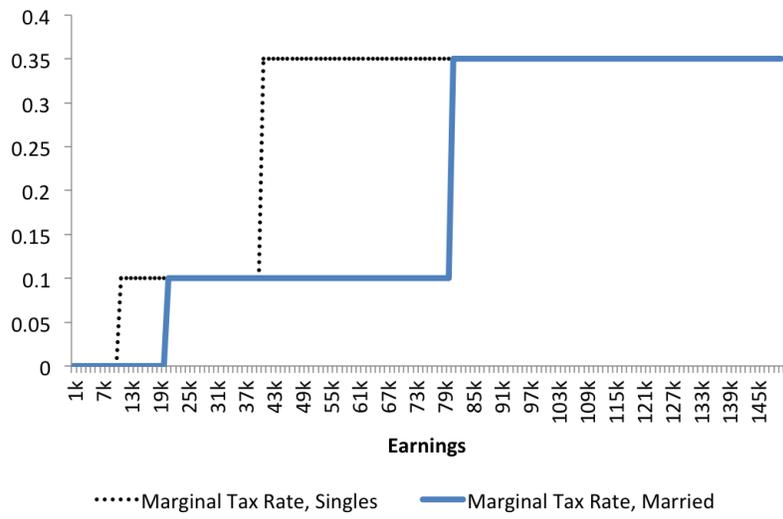


Figure 1: Tax Schedule: Marginal Tax Rate

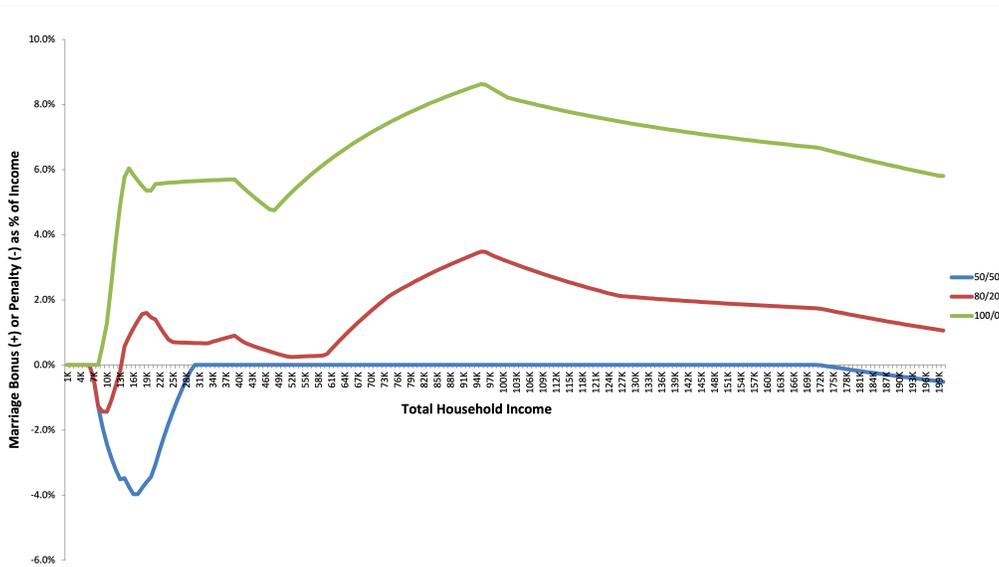
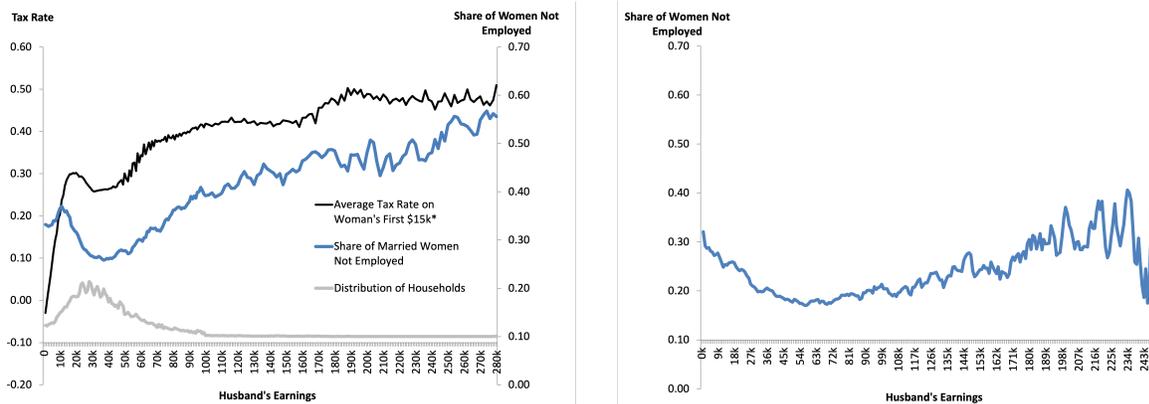


Figure 2: U.S. Tax Schedule: Marriage Bonuses and Penalties, 2015

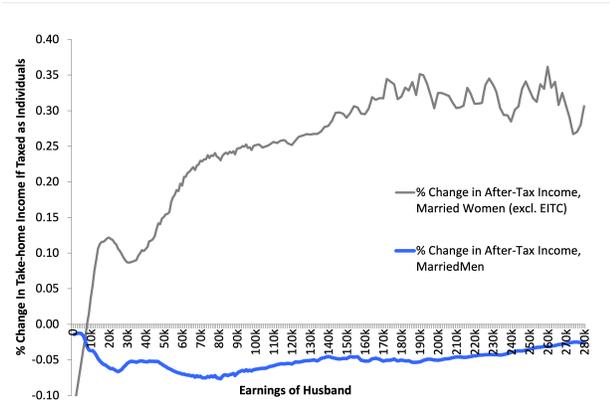


(a) Women's Non-Employment, US

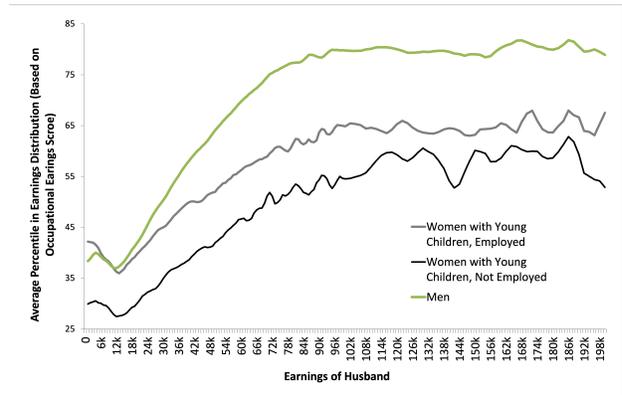
(b) Women's Non-Employment, Canada

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 step 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.

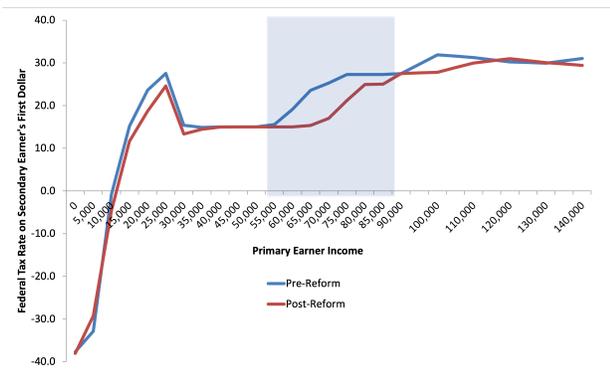


(a) Percent Change in After-tax Income

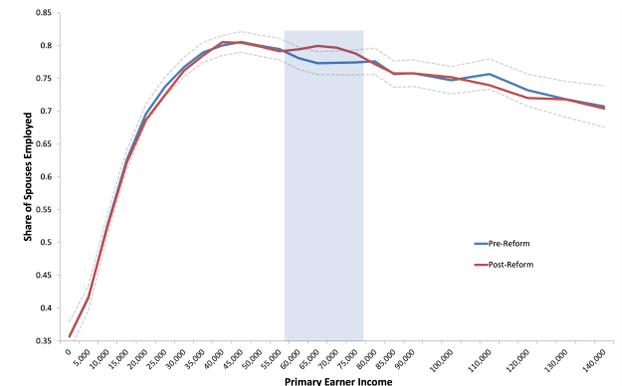


(b) Earnings Potential of Women and Men

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

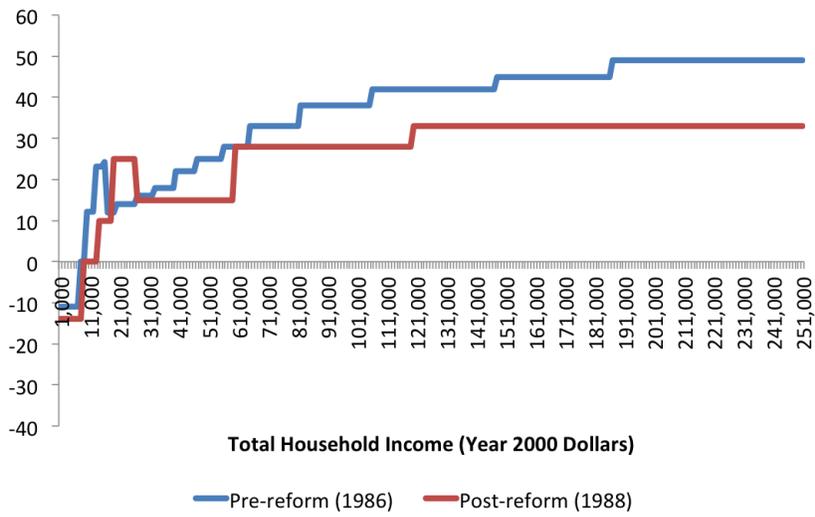


Figure 6: 1986 Reagan Tax Reform

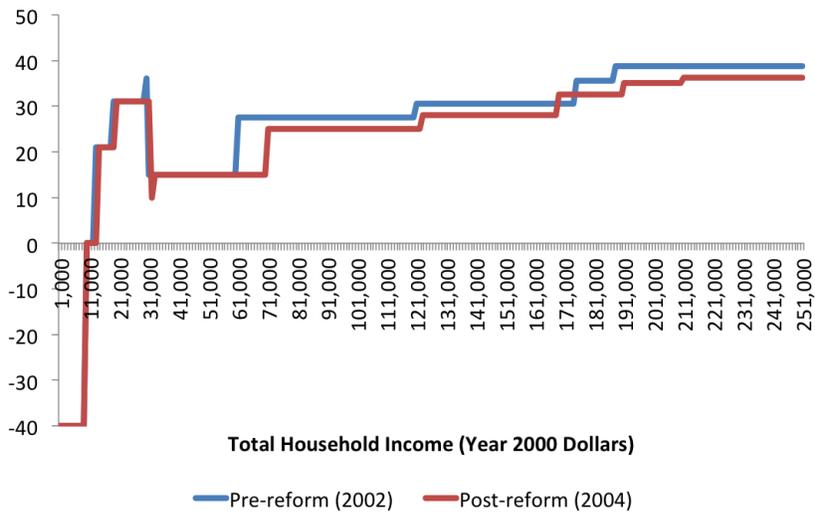


Figure 7: 2003 Bush Tax Reform

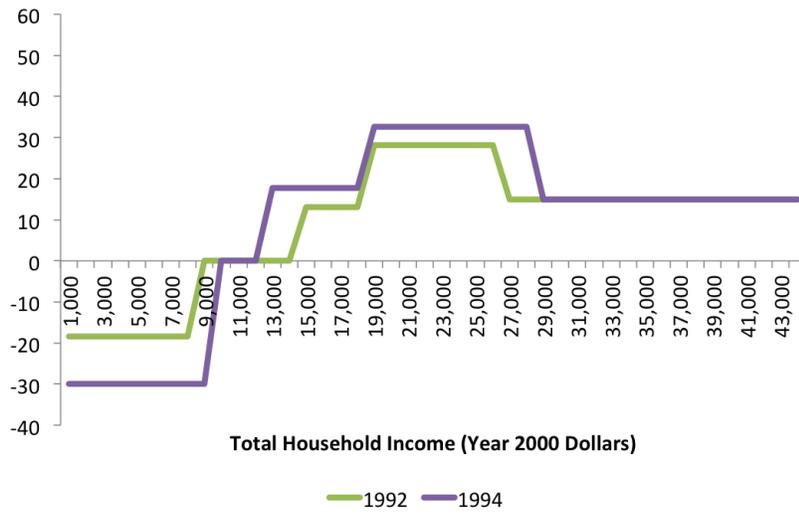


Figure 8: 1993 EITC Reform

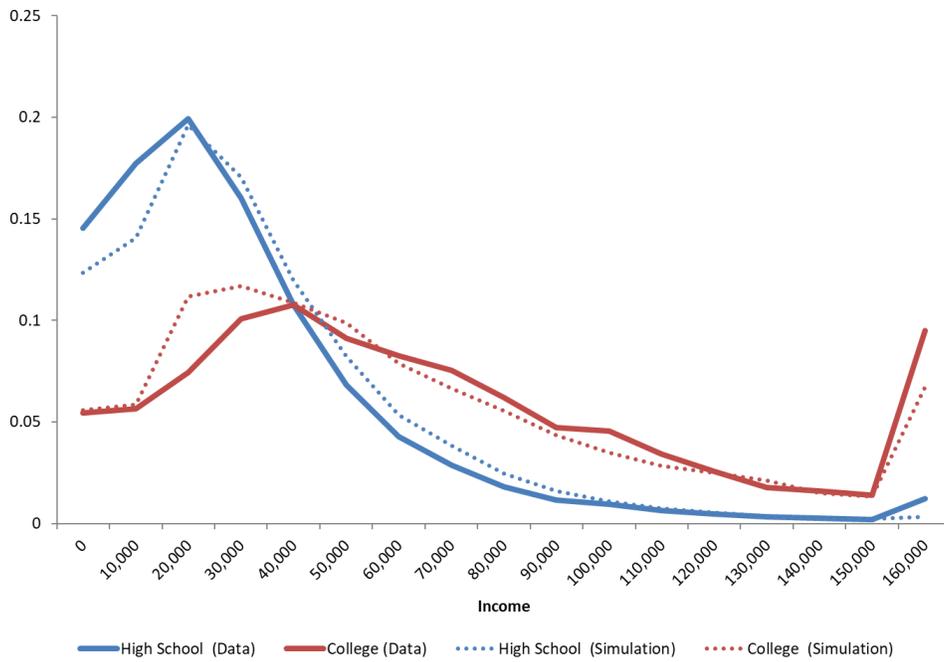


Figure 9: Income Distribution of Men By Education (Ages 25-54)

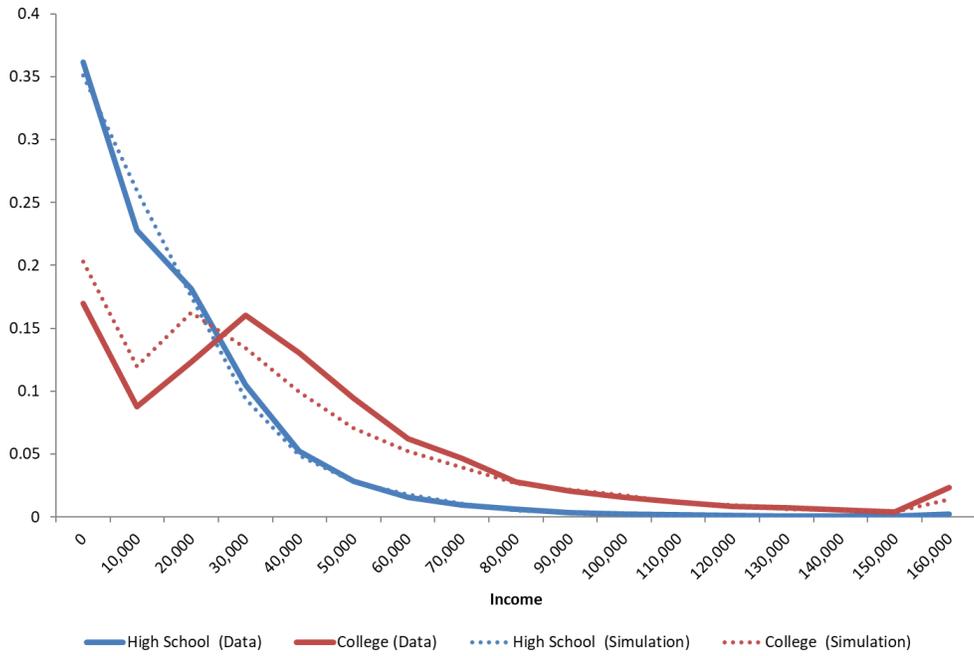


Figure 10: Income Distribution of Women (Ages 25-54)

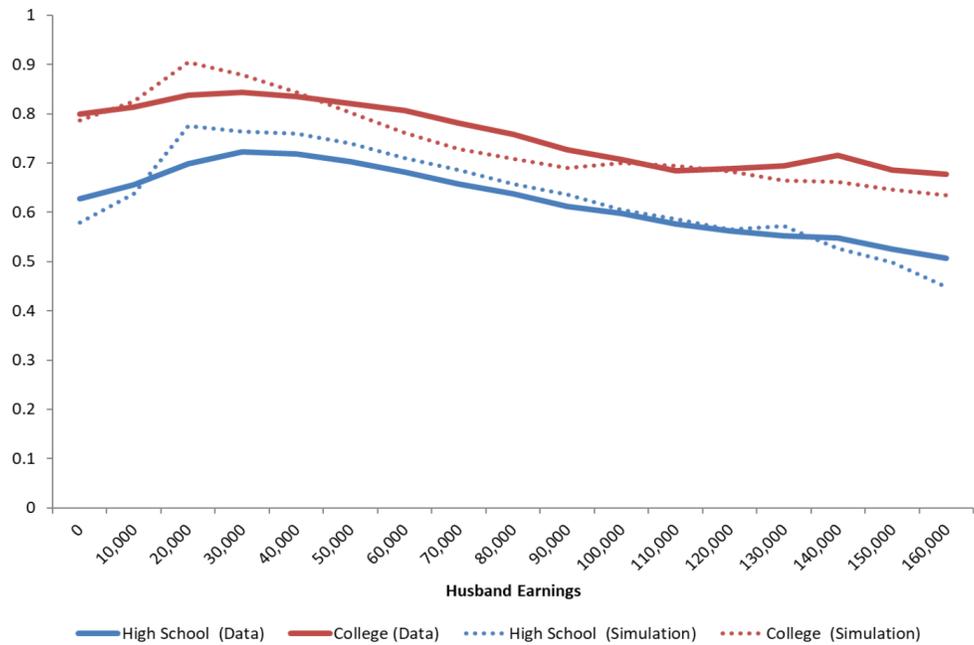


Figure 11: Share of Women Employed By Husband's Earnings and Education

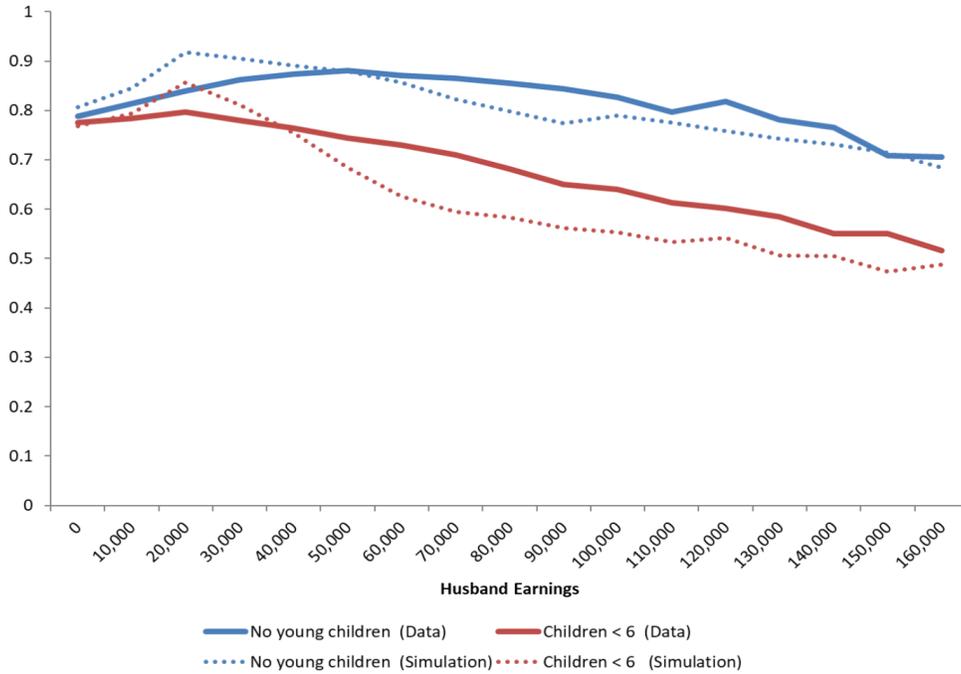


Figure 12: Share of College Women Employed By Husband's Earnings and Young Children

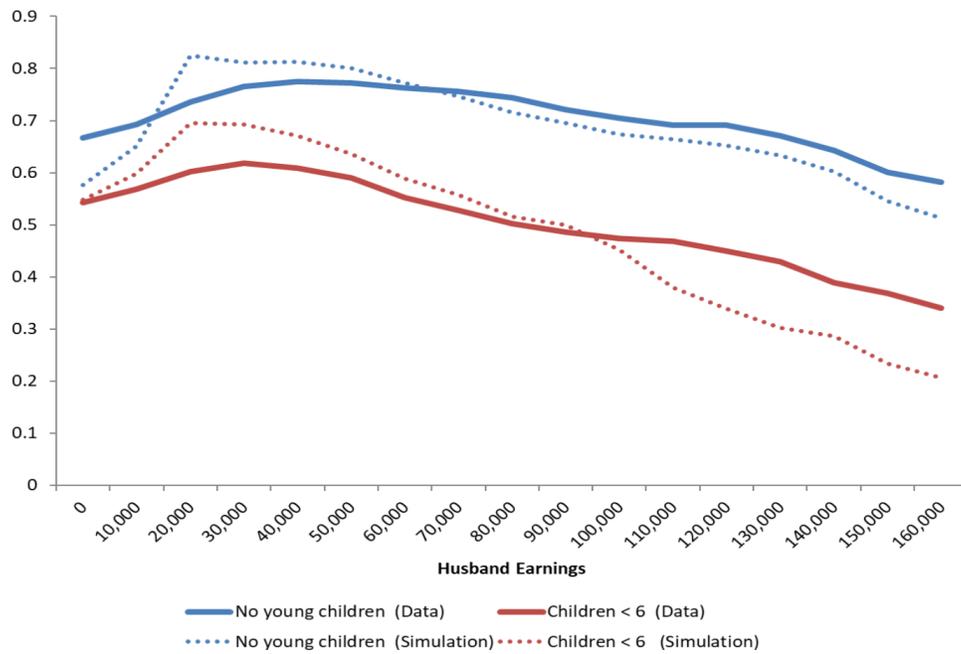


Figure 13: Share of High School Women Employed By Husband's Earnings and Young Children

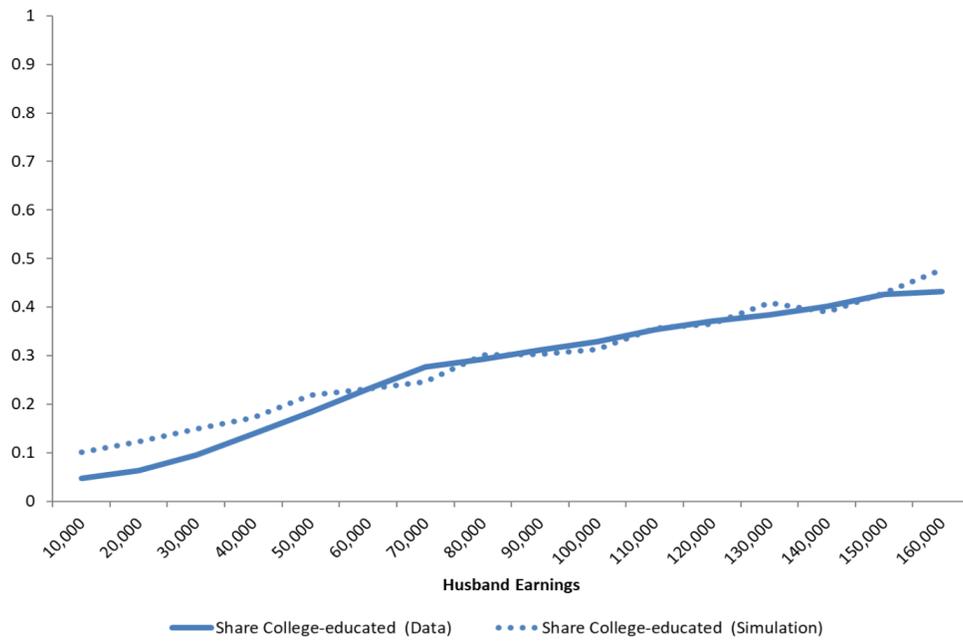


Figure 14: Share of Women With College Education, By Husband's Earnings

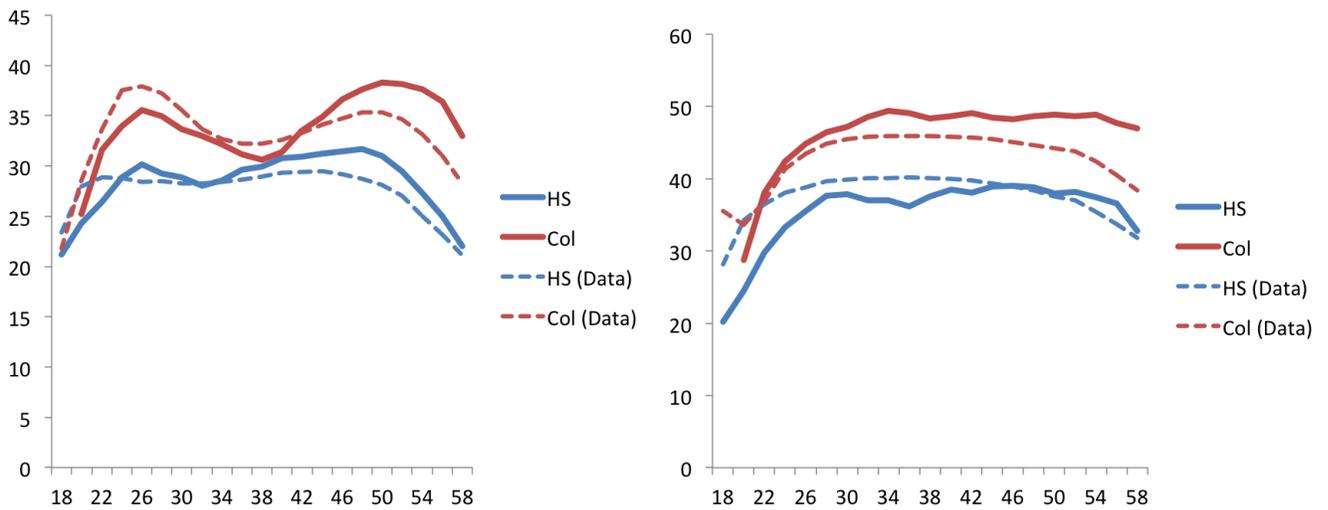


Figure 15: Weekly Hours Worked, Model and Data

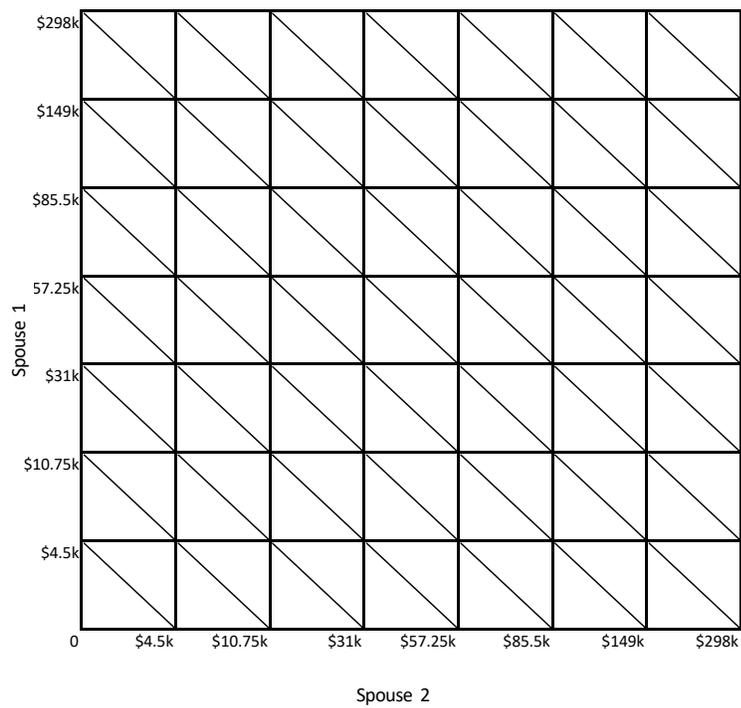
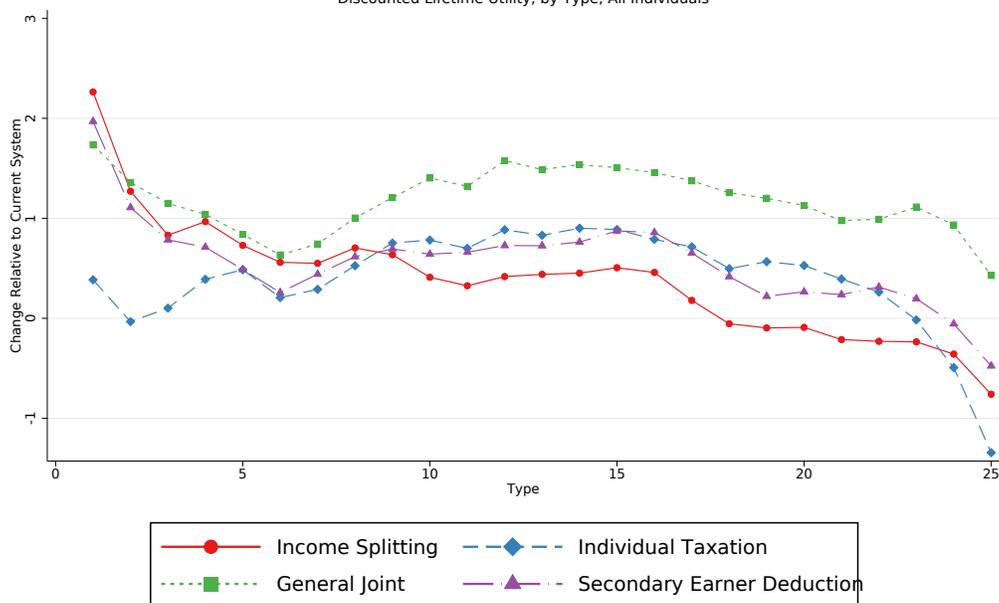


Figure 16: Grid for the General Joint System

Welfare, by Tax System

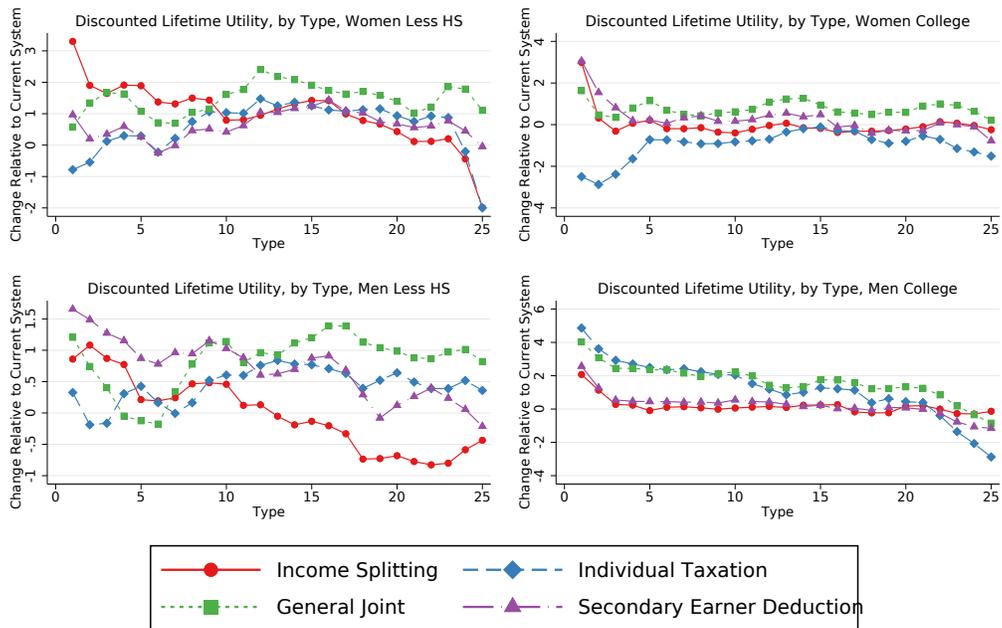
Discounted Lifetime Utility, by Type, All Individuals



Notes: Moving averages.
Welfare measures are discounted lifetime utilities.

Figure 17: Changes in Welfare over Ability by Tax System

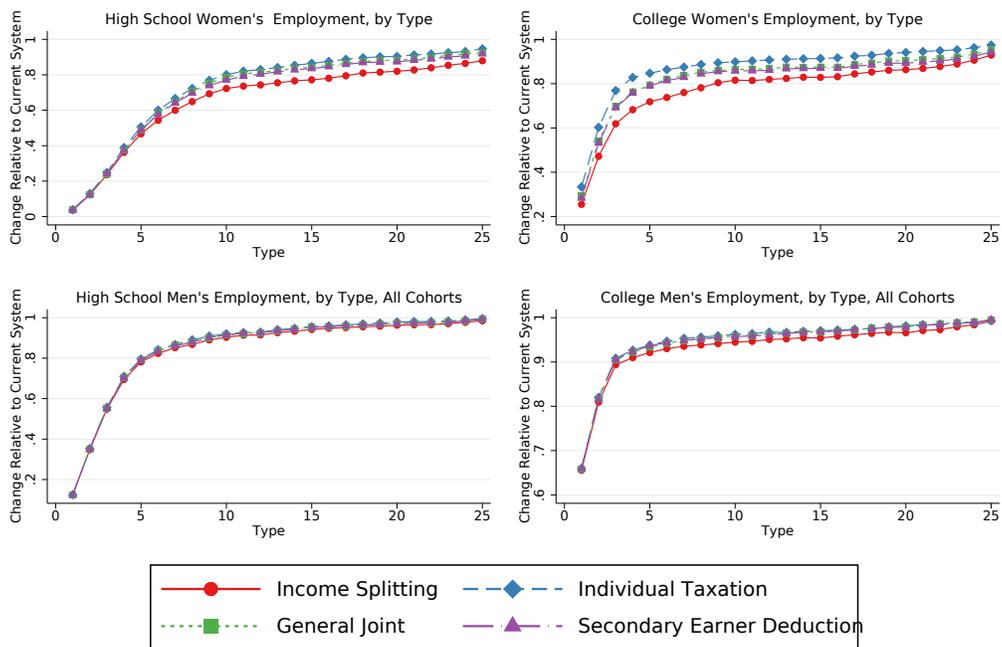
Welfare, by Gender, Education, and Tax System



Notes: Moving averages.
Welfare measures are discounted lifetime utilities.

Figure 18: Changes in Welfare over Ability by Education, Gender, and Tax System

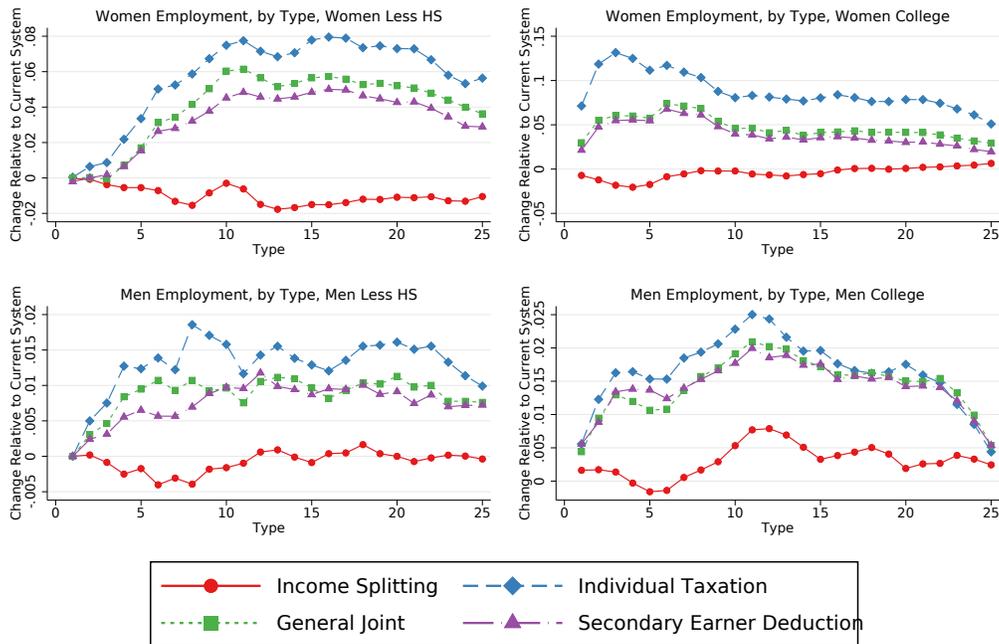
Labor Force Participation by Gender, Education and Tax System, Levels



Notes: Moving averages.

Figure 19: Labor Force Participation over Ability by Education, Gender, and Tax System

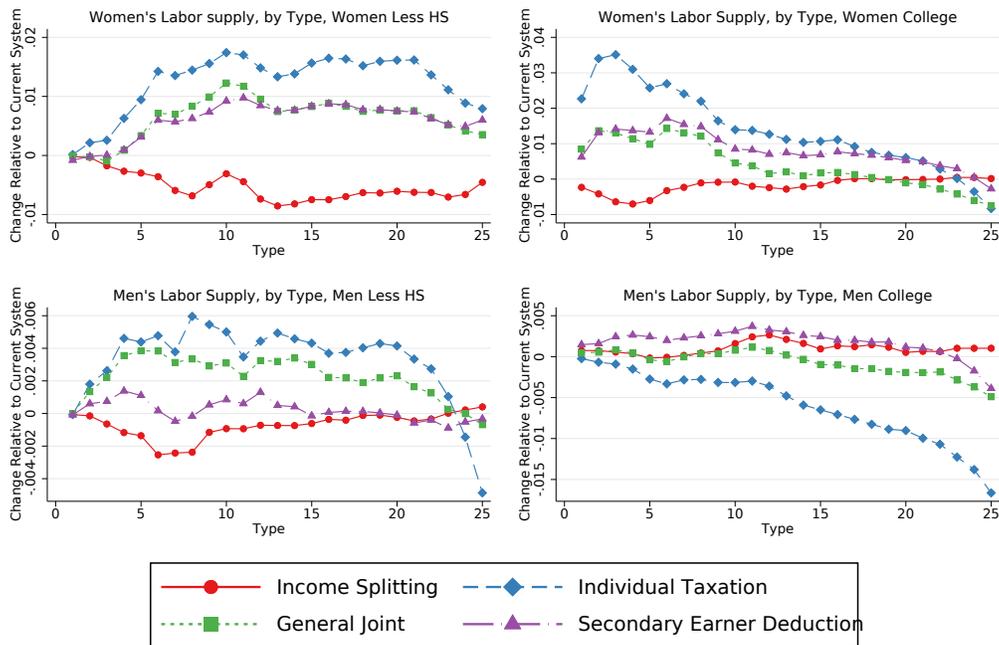
Labor Force Participation by Gender, Education, and Tax System



Notes: Moving averages.

Figure 20: Changes in Labor Force Participation over Ability by Education, Gender, and Tax System

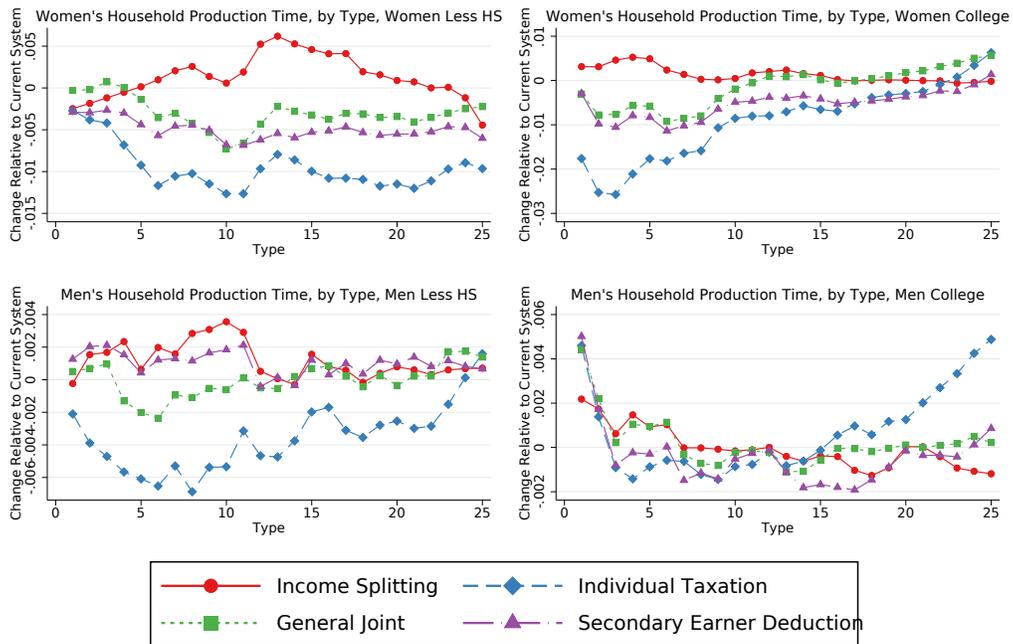
Labor Supply by Gender, Education, and Tax System



Notes: Moving averages.

Figure 21: Changes in Labor Supply over Ability by Education, Gender, and Tax System

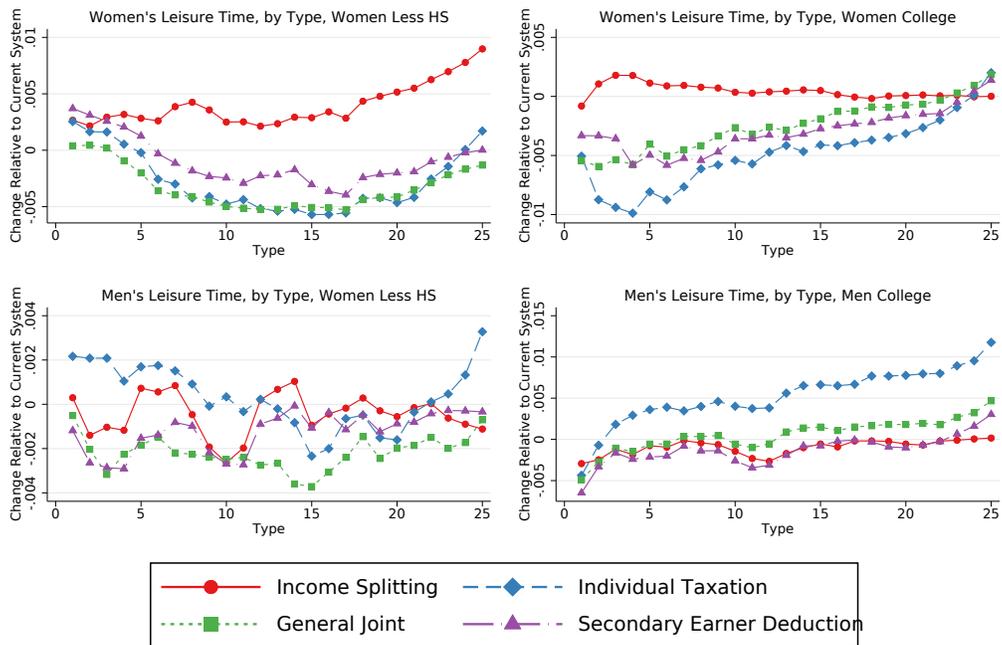
Household Production Time by Gender, Education, and Tax System



Notes: Moving averages.

Figure 22: Changes in Household Production Time over Ability by Education, Gender, and Tax System

Leisure Time by Gender, Education, and Tax System



Notes: Moving averages.

Figure 23: Changes in Leisure over Ability by Education, Gender, and Tax System

Public Consumption by Gender, Education, and Tax System

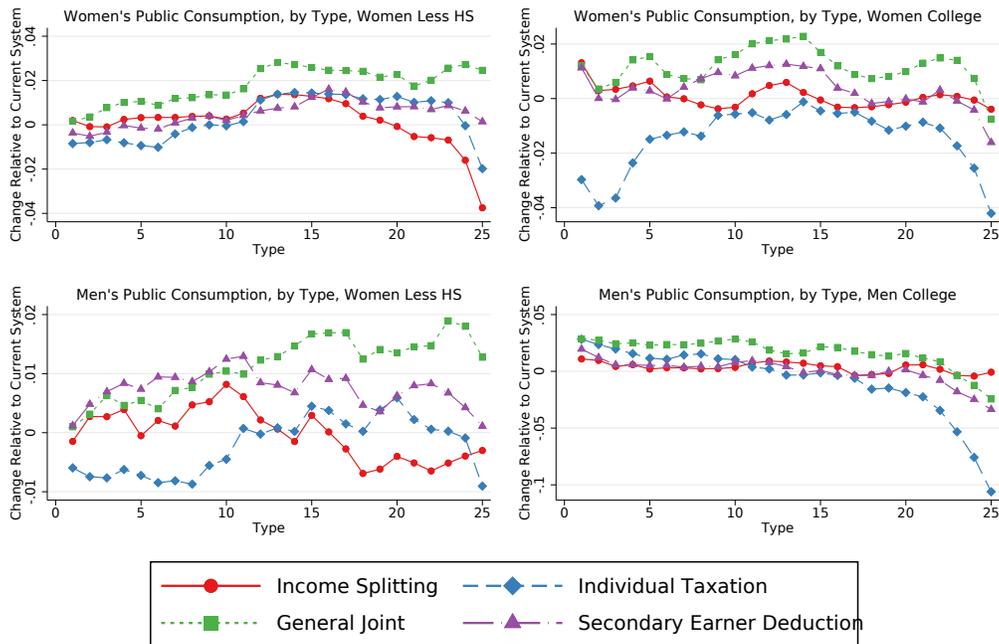
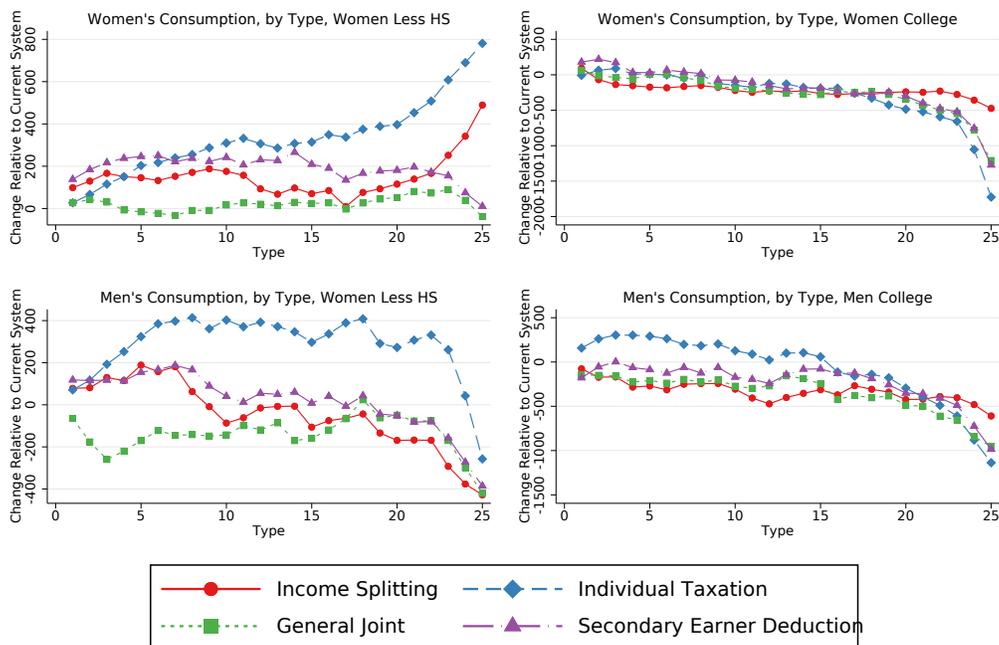


Figure 24: Changes in Public Consumption over Ability by Education, Gender, and Tax System

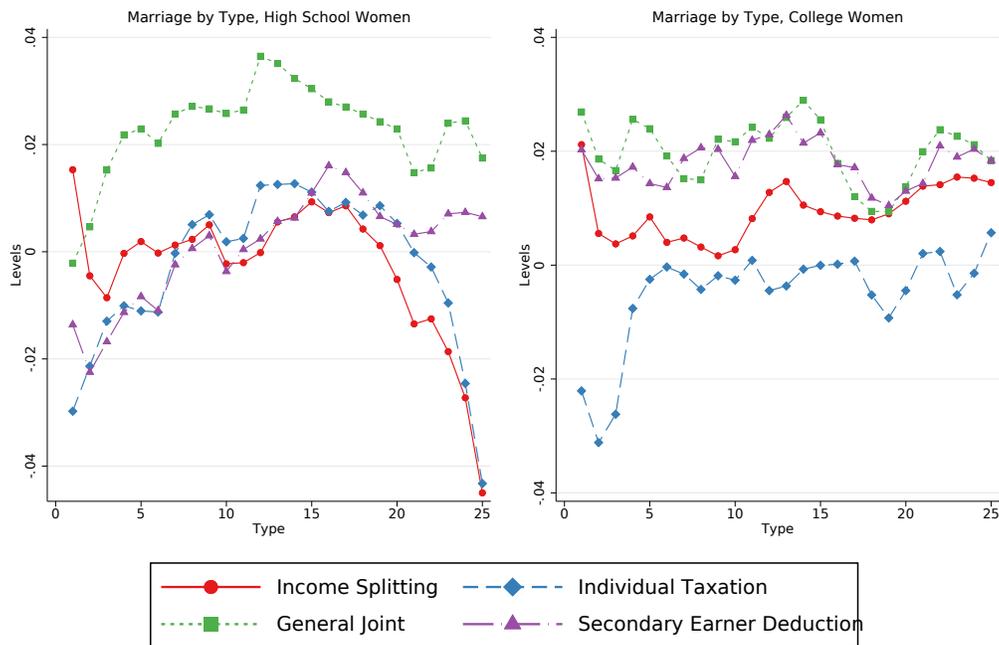
Consumption by Gender, Education, and Tax System



Notes: Moving averages.

Figure 25: Changes in Consumption over Ability by Education, Gender, and Tax System

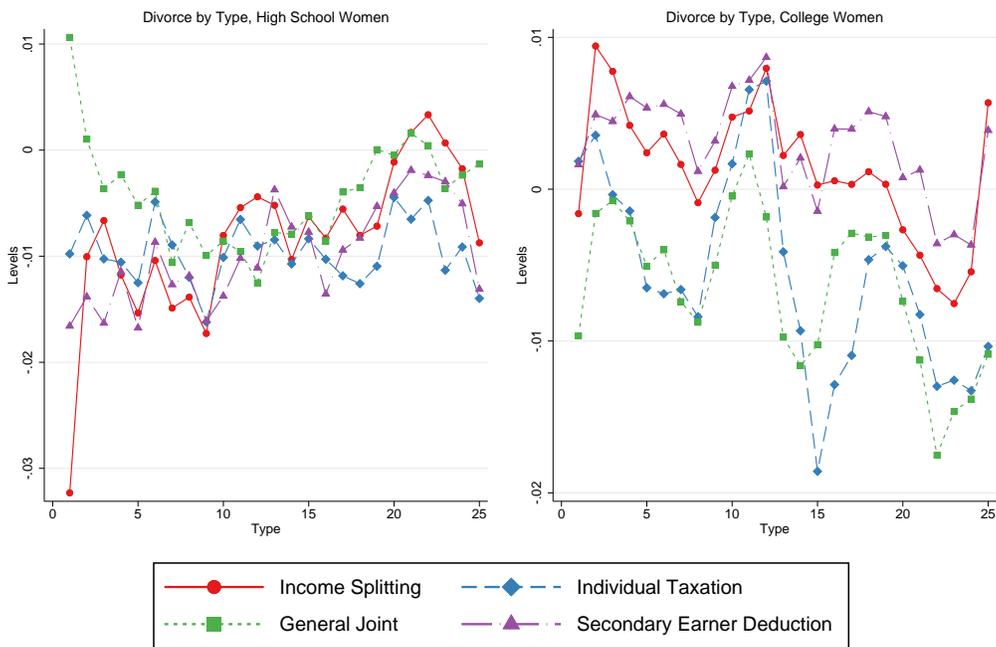
Marriage, by Education and Tax System, Changes



Notes: Moving averages.

Figure 26: Changes in Marriage Rates by Tax System

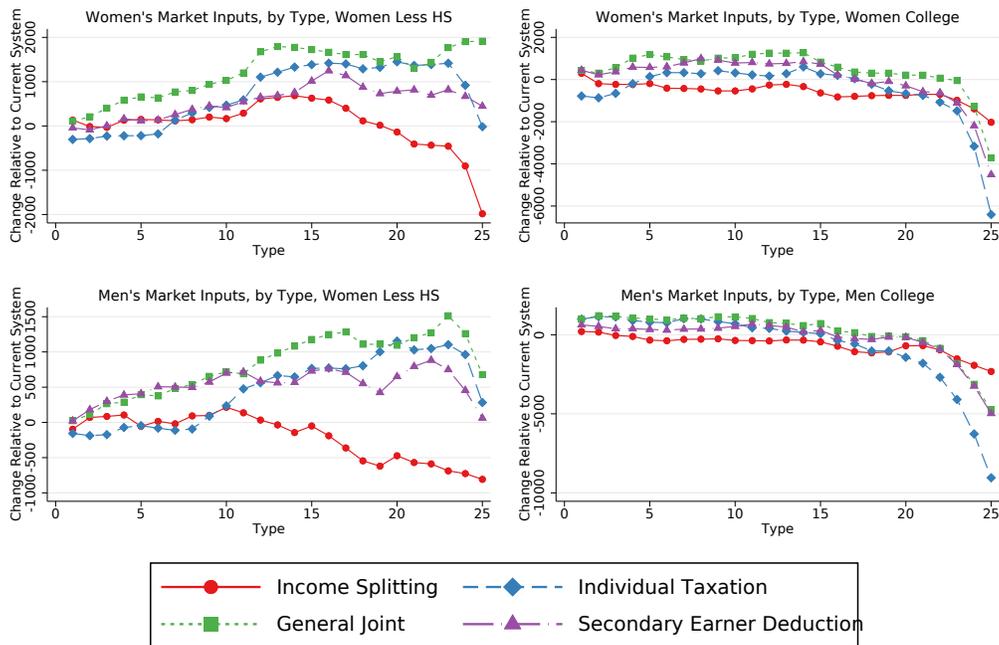
Divorce, by Education and Tax System, Changes



Notes: Moving averages.

Figure 27: Changes in Divorce Rates by Tax System

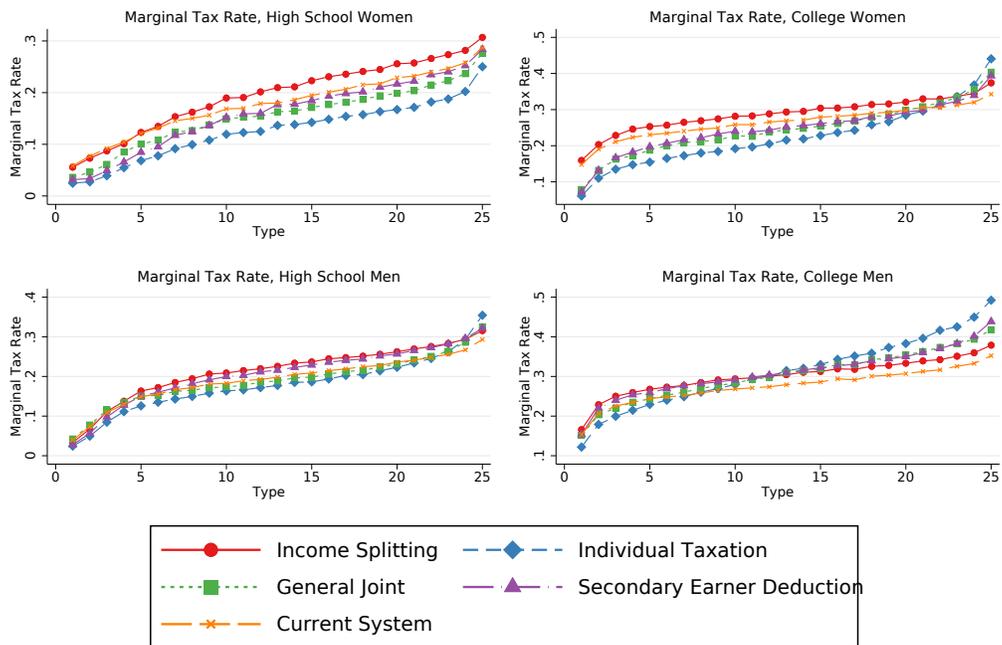
Market Inputs by Gender, Education, and Tax System



Notes: Moving averages.

Figure 28: Changes in Market Inputs by Tax System

Marginal Tax Rates, by Gender, Education, and Tax System



Notes: All households.

Figure 29: Marginal Tax Rates by Gender, Education and Tax System