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# TILL THE IRS DO US PART:
# (OPTIMAL) TAXATION OF HOUSEHOLDS

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**ABSTRACT**

This paper argues that a progressive tax system combined with individual taxation of married couples can generate more revenue than the current household-based U.S. system, especially when the extra revenues do not induce negative labor supply effects through increased government transfers. A progressive system that taxes individuals rather than couples jointly leads to larger labor force participation and higher average human capital, creates more “fiscal space”, Laffer curves shift up and social welfare potentially rises. In our model with one- and two-earner households, human capital and an extensive margin labor supply decision, the peak of the Laffer curve is 18 percentage points higher with an individual-based, progressive tax system than with the current U.S. tax system. The maximum revenue is attained with 100% more progressivity than the current system, and at an average tax rate of 42%. Progressive taxation, when imposed on individuals rather than households, lowers the average tax rate for individuals with modest potential income that are close to the participation margin. At the same time, it creates a positive income effect on the labor supply of these individuals by reducing the net income of their higher earning spouses and limiting their net earnings potential in the case of a high temporary labor productivity. Steady state social welfare is larger with individual taxation. The optimal progressivity is higher than the current U.S. status quo, and results in welfare gains of 0.8% in consumption-equivalent variation. Cohorts born during the transition also experience significant welfare gains from this reform.

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# 1 Introduction

How can it be that Scandinavian countries with their high labor income tax rates have employment rates and GDPs per capita that rank among the highest in the world? Following the work of Prescott (2004) and Rogerson (2006), who studied the impact of taxes on labor supply, one would expect labor supply and output to be low in these countries. We argue that a government can generate large tax revenue and facilitate high labor market participation, per capita output and incomes with a progressive tax code as long as the tax unit is the individual, as is generally the case in Scandinavia and many other countries, rather than the household.

In this paper we quantify the importance of the *interaction* between tax progressivity and the choice of the tax unit (an individual or a married couple) for tax revenue and welfare. We first empirically document that for *married* couples across countries and time, higher tax progressivity combined with joint taxation is associated with lower employment rates of both men and women. However, moving from joint to individual taxation reduces the negative impact of tax progressivity on employment, and can turn the relationship positive, especially for married women. To implement our empirical analysis, we construct a country panel with 19 years of data on taxes and employment rates for 17 developed economies, and we develop a novel index for the degree to which married couples are taxed jointly or individually. We then show empirically that there is a positive relationship between tax progressivity and the employment rates of *single* households.

Motivated by our empirical findings, and to study the quantitative importance of the progressivity and jointness of the tax system for tax revenues and welfare, we develop a life-cycle, overlapping generations economy with households that are composed of either singles or married couples. Individuals in our economy are subject to idiosyncratic wage risk, as well as exogenous marriage and divorce risk. Individuals and couples are heterogeneous with respect to innate ability, asset holdings and labor market experience, and they make decisions about whether or not to participate in the labor market (the extensive margin) and, conditional on participation, how many hours to work (the intensive margin). Individuals who work accumulate labor market experience which increases future wages. Couples make decisions cooperatively as we employ a unitary model of the household. The government taxes consumption, capital and labor income. The focus of our policy analysis is on the level, progressivity and jointness of the labor income tax code.

We find that an increase in the progressivity of labor income taxes, when combined with a shift to individual taxation of married couples, has the potential to generate more revenue and higher welfare. When married couples are taxed individually, a more progressive tax system leads to higher labor force participation and thus more labor market experience (higher human capital) in the economy. This occurs, first, because as tax progressivity increases, the average tax rate is lowered for low potential earners who are typically the ones on the margin between working and not working. In addition, progressive taxation can have a positive income effect on labor supply of couples when they are taxed as individuals. For married couples with one high-income earner and one low-income earner, the high earner brings home less net income as tax progressivity increases, creating an additional incentive to work for the low earner of the family (who at the same time is making a higher net income conditional on working due to lower average tax rates for this worker). Even for a single individual there may be a positive income effect on labor supply from progressive taxation. Such a worker takes home less pay in case of (temporarily) high productivity, but obtains more net pay in case of low productivity. The decision of working all the time thus becomes relatively more attractive compared to the strategy of working only when productivity is high for single households.

Let us contrast these results to a world when married couples are taxed jointly. Now the effect of higher tax progressivity on labor market participation tends to be negative. With joint taxation, spouses share the average and marginal tax rate. If one spouse, empirically still typically the male member of the household is a high earner, the additional benefit of the second spouse participating becomes smaller as taxes are made more progressive. Only in households where *both* spouses are low earners does more progressive taxes encourage participation for both.

In the traditional literature on optimal taxation, the question of optimal tax progressivity involves a clear trade-off between a loss of efficiency on the one hand and redistribution and insurance on the other hand, see e.g. Heathcote et al. (2017), Kindermann and Krueger (2021). In standard macroeconomic models focusing on the intensive margin of labor supply (see e.g. Guner et al. (2016)), higher tax progressivity leads to lower labor supply at a given average tax rate because the marginal tax rate is higher (this is also true for the labor supply choice along the intensive margin in our model). Progressive taxation thus distorts this decision and leads to lower revenue. The traditional upside is redistribution from high-earners to low-earners as well as insurance against idiosyncratic labor productivity risk.

However, with an operative extensive margin of the labor supply choice and human capital accumulation that works through labor market experience, this trade-off is no longer as clear-cut. A certain level of tax progressivity may now be beneficial for aggregate labor supply and output *especially if* married couples are taxed individually, because it encourages labor force participation and human capital accumulation of the secondary earner of a married couple. At the same time, the extent of redistribution between low- and high-income earners is not necessarily increasing in tax progressivity because now some low-earners enter the labor market, start paying taxes and stop receiving unemployment benefits (or other transfers that are conditional on not working or on low income).

As a consequence of this micro behavior the aggregate Laffer curve, which plots total revenue from labor income taxation against the level of the tax rate, shifts up with an individual-based, progressive tax system for labor income, relative to a proportional tax system or a progressive tax system in which the tax unit is the household. This is especially true if the additional tax revenue generated when raising the average tax rate is used for additional public *g*oods (we call this the "G"-Laffer curve) rather than returned back to households in the form of lump-sum transfers (which in turn negatively affect labor supply through a standard wealth effect). We also demonstrate that this positive impact of tax progressivity on revenue in the presence of individual taxation is quantitatively muted when the extra revenues are returned to households in the form of transfers, because the associated negative income effect on labor supply, and especially on participation partially offsets the impact of tax progressivity described above. (could be a bit confusing, since we first call it "standard wealth effect", and then "income effect" )

In the main paper we mostly focus on the G-Laffer curve since the need to raise extra tax revenue typically emerges in the context of increased government funding needs. The government can raise maximal revenue with an individual-based system that is approximately 100% more progressive than the current U.S. system (roughly the tax progressivity of Denmark) based on an index of progressivity that we define and measure empirically. This tax system has the potential to generate 18% more revenue than the current U.S. system, and the peak is attained at an average tax rate of approximately 42% of earnings.[1]

Welfare, measured in terms of steady state consumption-equivalent variation relative to the U.S. benchmark tax system, is also higher with an individual-based, progressive tax system. The optimal individual-based system has an average tax rate of 9.1% and is approximately 10% more progressive than the current U.S. system. The welfare gain in consumption equivalents is 0.8%, relative to the current U.S. status quo. Cohorts born during the transition also realize significant welfare gains from this reform. In contrast, with joint taxation of married couples, the optimal tax system is 50% less progressive than the current system, with an average rate of 11.5% and yields a small welfare gain of 0.1% relative to the benchmark.[2]

The remainder of this paper is organized as follows. In Section 1.1 we review the related literature. Section 2 develops simple empirical measures of tax progressivity and the degree to which married couples are taxed jointly. In Section 3 we conduct our empirical analysis exploring the relationship between tax progressivity, tax jointness and employment rates across countries and time. Section 4 develops a macroeconomic model of the labor market with single and married households, human capital and labor supply decisions along the intensive and extensive margins. Section 5 describes the calibration, and in Section 6 we present our results on the impact of individual-based, progressive taxation on the Laffer curve, including the key role labor supply adjustments along the extensive margin play for these findings. Section 7 contains the optimal policy analysis and Section 8 concludes; details of the model, its calibration and additional results are contained in Appendix A.

[1]This is lower than in some recent papers (see e.g. Guner et al. (2016), Holter et al. (2019)) and is explained by the fact that we, in contrast to those papers, model extensive margin of labor supply and human capital accumulation for *both* men and women.

[2]An optimal average tax rate of 9.1% may at first sound somewhat low. It should, however, be noted that the optimal tax experiment that we consider is a reform of the labor income tax. The social security tax is 15.3%, combining the taxes paid by the employee and the employer. Thus, the combined average tax rate on labor income is about 24%. In addition to labor income taxes our economy has taxes on capital and consumption that we hold constant during our labor income tax experiments.

### *1.1 Related Literature*

Our paper contributes to the broad literature on the impact and optimal design of progressive income taxes in dynamic quantitative macroeconomic models. Two recent papers that study the impact of tax progressivity on government tax revenues are Guner et al. (2016) and Holter et al. (2019). Both of these papers find that more tax progressivity leads to lower revenue for a given average tax rate. In Guner et al. (2016), who model single individuals and an intensive margin labor choice only, this happens because the marginal tax rate at a given average tax rate is higher with elevated tax progressivity. This distorts the first order condition for labor and the household optimally chooses to work less. Holter et al. (2019) include one- and two-person households and an extensive margin labor choice for women. However, their tax system is based on the current U.S. system, and therefore it features *joint* taxation of married couples. With this system they find that more progressive taxation leads to higher labor force participation for single women but lower labor force participation for married women. When it comes to the effect on tax revenue, these two opposite effects on female labor force participation nearly cancel out. Overall, more progressive taxes then reduce revenue due to a fall in labor supply along the intensive margin for both men and women.[3]

To our knowledge, the first paper in the quantitative literature in macroeconomics that explicitly considers the differences between individual-based and household-based taxation in a model with dual earners is Guner et al. (2012). They develop a model with one- and two-earner households where women have an extensive margin labor choice and consider two *separate* tax reforms: first, the shift to an individual-based tax system for married couples, but keeping tax progressivity at the current level in the U.S., and second, a reform towards a proportional tax system.[4] The paper shows that both these reforms lead to a substantial increase in the labor force participation of married women, as well as higher welfare.[5] Compared to Guner et al. (2012), our focus, first empirically and then quantitatively, is on the *interaction* between progressive taxation and the joint or individual taxation of couples, and how this interaction shapes the *optimal* design of the tax code. Our results suggest that progressive taxation can lead to significantly higher tax revenues compared to proportional taxes, but only when combined with individual-based taxation of couples. Our paper emphasizes the crucial importance of the extensive margin of labor supply

[3] Rondinel et al. (2025) present an analysis of Laffer curves for Australia, focusing on the taxation of singles.

[4] Eckstein et al. (2019) as well as Bronson et al. (2025) present structurally estimated empirical micro models of labor supply and/or education and marriage choices and also study the consequences of a tax policy reform from joint to individual taxation.

[5] Our paper demonstrates that when both men and women have an extensive margin of labor supply, they both also increase their labor force participation with the reform to an individual-based system. The response is strongest for married women because they are more often the secondary earners, but it is also present for men, which is important from an applied perspective since the gender wage gap is rapidly declining in many countries, and male and female employment rates are no longer so different, suggesting that it is important to also model the extensive margin of men. In our U.S. data from the CPS 2010-2019, the male employment rate, age 20-64, is 0.78 and the female employment rate is 0.68. Even if male employment remains higher, taking for granted that men always work is an increasingly strong assumption.

(especially for married women, but also for men) for this finding, an emphasis shared by Borella et al. (2023) and Holter et al. (2025), which in turn build on the idea of time averaging in labor supply choices pioneered by Ljungquist and Sargent (2006) and Ljungquist and Sargent (2011).

Kato (2022) and Garstenauer (2025) also investigate the optimal design of the income tax code (including the question whether it should be individual-based or household-based) of couples, but focus on the impact of endogenous marriage-, cohabitation and/or divorce decisions for the optimal structure of the tax code. These papers, ours included, extend the literature that has studied the impact of the choice of the tax unit (individuals versus the family or the household) on optimal tax progressivity in static models in the Mirrleesian tradition of optimal fiscal policy, see, e.g., da Costa and Lima (2020), Bierbrauer et al. (2023), Golosov and Krasikov (2023) and the references therein.

Finally, our paper contributes to the literature on the cross-country variation in taxation and work hours, see, e.g., Prescott (2004), Ljungquist and Sargent (2006), Rogerson (2006), Ohanian et al. (2008), Chakraborty et al. (2015), Bick and Fuchs-Schündeln (2017), Bick and Fuchs-Schündeln (2018). Whereas the first four papers consider the impact of average tax levels on labor supply across countries and time, Chakraborty et al. (2015), Lehmann et al. (2016) and Bick and Fuchs-Schündeln (2018) study the impact of the details of the tax system, including progressivity and the degree to which married couples are taxed jointly, on labor supply across countries. The focus of these papers is on explaining the cross-country variation in total work hours and unemployment. Our empirical study of the relationship between the extensive margin of labor supply (employment rates), and the interaction of tax progressivity and tax jointness across countries and time undertaken in Section 3 motivates the model-based quantitative analysis, but is also novel contribution to this empirical literature that might be of independent interest.

# 2 Measuring Tax Jointness in the Presence of Tax Progressivity

To operationalize tax jointness in an environment with progressive income taxation, our point of departure is a simple parametric, but commonly used tax function proposed by Benabou (2002). For single individuals, we assume that the tax function is defined by

$$y_{\text{net}} = \theta_0 y^{1-\theta_1} \tag{1}$$

where $y$ is pre-tax income, $y_{\text{net}}$ is after tax "net" income, the parameter $\theta_0$ controls the level of tax rate, and $\theta_1$ controls tax progressivity. This tax function was estimated by Heathcote et al. (2017) who argue that it fits the U.S. data well, and we use it in the model in Section 4. Under this tax function, the tax paid on income $y$ is $T(y) = y - y_{\text{net}}$, and we denote by $T'(y)$ the marginal tax rate and by $\tau(y) = 1 - \theta_0 y^{-\theta_1}$ the average tax rate for a tax unit with income $y$. To obtain tax functions that are comparable across countries and time, and not sensitive to model units of measurement, throughout this paper we normalize all incomes by Average Earnings (AE) in the economy when computing tax liabilities.

We now extend this function to the taxation of two-earner households in order to conceptualize and then measure empirically "tax jointness". If the labor income tax for married couples in a country is levied on the sum of the earnings of both spouses, we say they are subject to joint taxation or household-based taxation. If instead the tax unit is the individual, then we state that the tax system is separate or individual-based. We consider both options.

Empirically most countries do not have a completely joint or fully separate tax system, however, but somewhat of a mixed system. One reason for this is that there are various transfers, such as child support or housing support to low-income households that follow the household, whereas the income tax schedule itself is fully separate. Another complication is that there are several tax authorities, and local taxes could be separate while national taxes are joint. To empirically capture the fact that OECD countries vary greatly in the degree to which married couples are taxed individually or jointly, we modify the tax function in (1) by the following equation for net of tax income:

$$y_{\text{net}} = y_1 + y_2 - T(y_1, y_2) = \theta_0 \left( (y_1)^{1-\theta_1\varphi} + (y_2)^{1-\theta_1\varphi} \right)^{\frac{1-\theta_1}{1-\theta_1\varphi}} \tag{2}$$

which implies the tax function:

$$T(y_1, y_2) = y_1 + y_2 - \theta_0 \left( (y_1)^{1-\theta_1\varphi} + (y_2)^{1-\theta_1\varphi} \right)^{\frac{1-\theta_1}{1-\theta_1\varphi}} \tag{3}$$

The new parameter $\varphi$ governs the degree of tax jointness. We obtain fully joint taxation with $\varphi = 0$ and fully separate taxation with $\varphi = 1$. Note that if the tax system is proportional ($\theta_1 = 0$), then the tax unit parametrized by $\varphi$ is irrelevant and $y_{\text{net}} = \theta_0 (y_1 + y_2)$, independent of $\varphi$.

We do not impose the restriction that $\varphi \in [0, 1]$ and allow for "negative tax jointness". We say there is "positive tax jointness" if the marginal tax rate of one spouse depends positively on the income of the other spouse, that there is exact separate taxation if the marginal tax rate of one spouse is independent of the income of the other spouse, and there is "negative tax jointness" if the marginal tax rate of one spouse depends negatively on the income of the other spouse. Formally (and as shown straightforwardly in Appendix A.3),

$$\frac{\partial^2 T(y_1, y_2)}{\partial y_1 \partial y_2} = \theta_0 (1-\theta_1)(1-\varphi)\theta_1 \left( (y_1)^{1-\theta_1\varphi} + (y_2)^{1-\theta_1\varphi} \right)^{\frac{-(1-\varphi)\theta_1}{1-\theta_1\varphi} - 1} y_1^{-\theta_1\varphi} y_2^{-\theta_1\varphi}. \tag{4}$$

We observe that as long as $\theta_1 \in (0, 1)$ and the tax system is progressive, there is positive jointness if $\varphi \in (0, 1)$ and thus $\frac{\partial^2 T(y_1, y_2)}{\partial y_1 \partial y_2} > 0$ and negative jointness if $\varphi > 1$ and thus $\frac{\partial^2 T(y_1, y_2)}{\partial y_1 \partial y_2} < 0$. Of course, if $\theta_1 = 1$ (the tax system is confiscatory) or if $\theta_1 = 0$ and the tax system is fully proportional, the marginal tax rate of one spouse does not depend on the income of the other spouse.

# 3 Descriptive Evidence: Tax Progressivity, Tax Jointness and Employment Across Time and Space

In our structural model of Section 4, the key quantitative driver of our results is the extent to which participation (the extensive margin of labor supply) of single and married households responds to tax progressivity, and how this response differs by marital status and the degree of tax jointness. To motivate this analysis and also to measure the degree and dispersion of tax jointness across countries, we first estimate tax functions of the form 2 for a panel of countries and then use the parameter estimates to study the empirical association between tax progressivity and the employment rate of single men and women and the association between tax progressivity, the degree to which married couples are taxed jointly, and the employment rate of married men and women, across countries and time.

## *3.1 Data Description*

To estimate measures of tax progressivity and the degree to which married couples are taxed jointly, we use data from the OECD Tax-Benefit web calculator.[6] It allows us to generate data on the personal income taxes of single and married households, with and without children, in 17 countries over the 2001-2019 period, for individual incomes ranging from 0% to 200% of the *Average Earnings* per person. Since we are interested in the tax schedule for people who are working significantly more than zero hours, for our estimation, we use the data with individual incomes ranging from 20% to 200% of average earnings, in increments of 2%. Since the tax code typically differs by the number of children, we obtain the tax data for families with different number of children and we weight the observations by the share of each family type in U.S. data.

We obtain data on employment by gender and marital status in Western Europe and the U.S. from the EU Labor Force Survey and the CPS. This gives us 17 countries in our sample[7], with 19 observations per country (covering the period from 2001-2019). Appendix A.7 provides a more detailed description of the data.

## *3.2 Empirical Approach*

Using the data collected from the OECD Tax-Benefit web calculator, we estimate the parameters $(\theta_0, \theta_1, \varphi)$ of the tax functions for singles and married that best fit this data. We then use the estimated parameters to construct measures of the average tax level, tax progressivity and tax jointness. As our measure of the tax level, we use $1 - \theta_0$, which determines the tax rate at average earnings, $y = AE$. We use $\theta_1$ as our measure of tax progressivity. Table 10 displays the average values of the estimated tax function parameters by country. We find an estimate of $\varphi = 0.028$

[6] Available here: https://taxben.oecd.org/index.html

[7] Austria, Belgium, Switzerland, Germany, Denmark, Spain, Finland, France, Great Britain, Greece, Ireland, Iceland, Italy, Netherlands, Portugal, Sweden, the U.S.

for the U.S., confirming our prior that the U.S. effectively taxes earnings of couples jointly (as does Germany and Switzerland, which display estimates of $\varphi$ of zero). In contrast, estimates for the Nordic countries, and specifically Denmark, Sweden and Finland, suggest that the tax system treats spouses as effectively separate tax units in these countries.

Below, we show the results of regressing the employment rates of married men, married women, single men and single women on the tax measures. The main coefficient of interest in the regression for married is the interaction term between our measure of tax progressivity, $\theta_1$, and $\varphi$, the degree to which spouses are taxed individually. In the regression for singles, the main coefficient of interest is the one on tax progressivity.

### *3.3 Regression Results*

We consider 2 different groups of regressions: (1) fixed-effects estimates with country-fixed effects only, (2) fixed-effects estimates with both country- and year-fixed effects. Tables 1 and 2 display the main regression results when all tax measures are present in the regression for married women and men and single women and men.[8]

For all regression specifications we consider, the main variable of interest, $\varphi \times \theta_1$, the interaction term between tax progressivity and tax separateness, is positive and statistically significant at the 1%-level both in the regressions for married women and men. As we will see later, this finding matches the prediction from our model. The intuition is that for married couples, higher tax progressivity together with individual taxation of the two spouses means lower average tax rate for the secondary earner, which gives higher incentives to the secondary earner to enter the labor market. There is also an income effect. The primary earner will bring home less net income with separate progressive taxation, which increases the benefit of having two earners.

The coefficient on $\theta_1$, our measure of tax progressivity, is statistically significant and negative in three of our four regressions. This is as expected because progressive joint taxation would have the opposite effect of progressive separate taxation on employment. It encourages one earner in the family by increasing the tax rate on the secondary earner.

One can use our estimates to compute the effect of moving from joint $\varphi = 0$ to individual $\varphi = 1$ taxation, by using the country-specific value of tax progressivity, $\theta_1$. This effect is larger with more progressive taxation.[9] Notice that this effect disappears with proportional taxes (which corresponds to $\theta_1 = 0$), a result which our model replicates.

In line with economic intuition, the coefficient on the level of taxes, $(1 - \theta_0)$, is negative in three out of four regressions, but statistically significant only in the two regressions for men. This implies that higher average taxes lead to lower labor force participation.[10]

[8] Fixed effects panel regression estimates are obtained by first subtracting the appropriate group means (using the `linearmodels` library in `Python`).

[9] The average value of the tax progressivity parameter for married couples in our sample is $\bar{\theta}_{1,M} = 0.218$.

[10] See, e.g., Chakraborty et al. (2015), Bick and Fuchs-Schündeln (2018).

**Table 1:** Summary of Main Regression Results for Married Women and Men

| | FE (W) | FE+T (W) | FE (M) | FE+T (M) |
|---|---|---|---|---|
| $(1-\theta_0)$ | 0.014 | $-0.037$ | $-0.547^{***}$ | $-0.603^{***}$ |
| | (0.117) | (0.091) | (0.099) | (0.100) |
| $\theta_1$ | $-0.163$ | $-0.374^{***}$ | $-0.721^{***}$ | $-0.782^{***}$ |
| | (0.129) | (0.098) | (0.108) | (0.108) |
| $\varphi\times\theta_1$ | $0.289^{***}$ | $0.230^{***}$ | $0.413^{***}$ | $0.457^{***}$ |
| | (0.101) | (0.076) | (0.085) | (0.083) |
| Const | $0.637^{***}$ | $0.704^{***}$ | $1.053^{***}$ | $1.073^{***}$ |
| | (0.032) | (0.025) | (0.027) | (0.027) |
| $R^2$ (within) | 0.078 | 0.066 | 0.226 | 0.259 |
| $R^2$ | 0.931 | 0.965 | 0.810 | 0.837 |

The table displays the results from regressing the labor force participation rate of married women (W) and men (M) on our tax measures. In the columns labeled "FE" we include country fixed effects and in the columns labeled "FE+T" we include country and time fixed effects.

The regression results for single men and women are below. Our theory predicts that, controlling for the tax level, tax progressivity should have a positive effect on the labor force participation of singles, and in particular single women because they have lower average wages. In all four regressions for single women and men, the $\theta_1$ coefficients are positive. The coefficients on tax level, $(1-\theta_0)$, are negative as expected.

**Table 2:** Regression Results for Single Women and Men

| | FE (W) | FE+T (W) | FE (M) | FE+T (M) |
|---|---|---|---|---|
| $(1-\theta_0)$ | $-0.166^{**}$ | $-0.176^{**}$ | $-0.405^{***}$ | $-0.291^{***}$ |
| | (0.074) | (0.074) | (0.113) | (0.097) |
| $\theta_1$ | $0.095^{**}$ | $0.085^{*}$ | $0.127^{*}$ | 0.024 |
| | (0.047) | (0.046) | (0.072) | (0.061) |
| Const | $0.616^{***}$ | $0.622^{***}$ | $0.721^{***}$ | $0.715^{***}$ |
| | (0.02) | (0.02) | (0.031) | (0.026) |
| $R^2$ (within) | 0.025 | 0.028 | 0.049 | 0.039 |
| $R^2$ | 0.952 | 0.96 | 0.857 | 0.909 |

The table displays the results from regressing the labor force participation rate of single women (W) and men (M) on our tax measures. In the columns labeled "FE" we include country fixed effects and in the columns labeled "FE+T" we include country and time fixed effects.

# 4 A Life-Cycle Model of Family Labor Supply

To analyze the interplay between tax units and gender-specific labor supply, we utilize a life-cycle framework that explicitly accounts for household composition and human capital accumulation.

Conceptually, the framework builds on Chakraborty et al. (2015), Holter et al. (2019) and Holter et al. (2025). In particular, we extend the model framework in Holter et al. (2019) with an extensive margin of labor supply and human capital accumulation for men[11]. However, like Chakraborty et al. (2015), we assume a small open economy where the interest rate is given exogenously.

### *4.1 Demographic Structure*

Time is discrete and the population consists of $J$ overlapping cohorts. Household age is denoted by $j \in 1, \ldots, J$.[12] Because family structure is central for how the tax code applies in practice, we explicitly distinguish single-person households from couples in our demographic structure.[13] A household can be either a single adult or a married couple. Singles are indexed by gender $\iota \in m, w$, and we denote marital status by $X \in S, M$. Hence there are three household types in the model: single men, single women, and married couples. We assume that within a married household, the husband and the wife are of the same age. All households retire at the real-world age of 65 (which corresponds to $j = 46$ in the model).

A model period is one year. The probability of dying while working is zero; retired households, on the other hand, face an age-dependent probability of dying, $\pi(j)$, and die for certain at model age $J = 81$, corresponding to a real-world age of 100. By assumption, a husband and a wife both die at the same age. We assume that the size of the population is fixed and normalize the size of each newborn cohort to 1. Using $\omega(j) = 1 - \pi(j)$ to denote the age-dependent survival probability, by the law of large numbers the mass of retired agents of model age $j \geq 46$ still alive at any given period is equal to $\Omega_j = \prod_{q=46}^{q=j-1} \omega(q)$. There are no annuity markets, so that a fraction of households leave unintended bequests which are redistributed in a lump-sum manner between the households that are currently alive. We use $\Gamma_t$ to denote the per-household bequest.

In addition to age and marital status, households are heterogeneous with respect to asset holdings, $k$, exogenously determined permanent ability of its members, $a \sim N(0, \sigma_a^{\iota 2})$ drawn at birth, their years of labor market experience, $e$, and idiosyncratic productivity shocks $u$. We model both the extensive and intensive margins of labor supply. Individuals will either work or stay at home, and conditional on working they will choose how much to work. Married households jointly decide on how many hours to work, how much to consume, and how much to save. Individuals who participate in the labor market accumulate one year of labor market experience. Retired households make no labor supply decisions, but receive social security benefits $\Psi_t$.

Since, as we will show below, labor supply decisions will vary greatly by family type and age, it is important that the model has an empirically plausible distribution of family types by household age. The easiest way to achieve this is to introduce into the model marriage and

[11] These features are also present in Chakraborty et al. (2015) and Holter et al. (2025).

[12] Age $j = 1$ in the model corresponds to the real-world age of 20.

[13] In his survey of the literature, Keane (2011) stresses the importance of marital status for the response of labor supply to taxes.

divorce as exogenous shocks, as in Cubeddu and Rios-Rull (2003) and Chakraborty et al. (2015). Single households face an age-dependent probability, $M(j)$, of becoming married, whereas married households face an age-dependent probability, $D(j)$, of divorce. There is assortative matching in the marriage market, so that there is a greater chance of marrying someone with similar ability, a fact that singles rationally foresee. Specifically, a single man with ability $a^{\mathrm{m}}$ faces a probability $\phi^{\mathrm{w}}(a|a^{\mathrm{m}};\psi)$ of marrying a woman of type $a$, and symmetrically, a woman of type $a^{\mathrm{w}}$ marries a man of ability $a$ with probability $\phi^{\mathrm{m}}(a|a^{\mathrm{w}};\psi)$. The parameter $\psi$, calibrated in section 5, captures the degree of sorting in the marriage market, with $\psi = 0$ standing in for perfectly random marriage and $\psi = 1$ representing perfect sorting by permanent ability.[14]

## 4.2 Household Preferences

Preferences are defined at the household level. Married couples behave as a unitary decision maker that values both spouses symmetrically. Per-period utility for a married household with consumption $c$ and hours $(n_m, n_w)$ is given by:

$$U^M(c, n^{\mathrm{m}}, n^{\mathrm{w}}) = \log(c) - \frac{1}{2}\chi_M^{\mathrm{m}}\frac{(n^{\mathrm{m}})^{1+\eta^{\mathrm{m}}}}{1+\eta^{\mathrm{m}}} - \frac{1}{2}\chi_M^{\mathrm{w}}\frac{(n^{\mathrm{w}})^{1+\eta^{\mathrm{w}}}}{1+\eta^{\mathrm{w}}} - \frac{1}{2}F_M^{\mathrm{m}}\cdot\mathbb{1}_{[n^{\mathrm{m}}>0]} - \frac{1}{2}F_M^{\mathrm{w}}\cdot\mathbb{1}_{[n^{\mathrm{w}}>0]} \tag{5}$$

where $F_M^\iota$ is a fixed disutility from working positive hours. The indicator function, $\mathbb{1}_{[n>0]}$, is equal to 0 when $n = 0$ and equal to 1 when $n > 0$. The momentary utility function for singles is given by:

$$U^S(c, n, \iota) = \log(c) - \chi_S^\iota\frac{(n)^{1+\eta^\iota}}{1+\eta^\iota} - F_S^\iota\cdot\mathbb{1}_{[n>0]} \tag{6}$$

The disutility of work from hours and the fixed cost of work can differ by gender and marital status. For married and single men and women, we assume that it takes the following form: $F_X^\iota \sim N(\mu_{F_X^\iota}, \sigma^2_{F_X^\iota})$, $X \in \{M, S\}$. The participation cost of an individual is drawn only once, at the beginning of life, and thus is a fixed characteristic of an individual (but is allowed to differ when single and when married).[15]. To capture the fact that the participation cost of married women tends to vary substantially over the life-cycle due to child birth and caring for young children, we let their fixed cost of working be dependent of age. We assume that, similar to the other three demographic groups, the participation cost of married women contains a fixed constant term that is normally distributed. In addition, it has two other terms that are linear and quadratic in age:

$$F_M^{\mathrm{w}} = F_M^{\mathrm{w}0} + F_M^{\mathrm{w}1} \times j + F_M^{\mathrm{w}2} \times j^2, \tag{7}$$

[14] Conditional on gender, age and permanent ability, a single household rationally expects to draw a partner from the *conditional* stationary distribution along all other single household characteristics of the other gender. For example, a single man understands that if he were, by chance, to marry a high ability woman, she would carry higher than average assets into the marriage, since permanent ability and assets are positively correlated among single women.

[15] The state space for both cost distributions is discretized using Tauchen (1986)'s method, and an individual's position in the distribution of fixed costs remains the same throughout life.

where $F_M^{\mathrm{w}0} \sim N(\mu_{F_M^{\mathrm{w}0}}, \sigma^2_{F_M^{\mathrm{w}0}})$.

In a model without participation margin, King et al. (2002) show that the above preferences are consistent with balanced growth. Holter et al. (2019) demonstrate that this is also true in a model with a fixed utility cost from working positive hours, and thus an operative extensive margin.

### *4.3 Production*

The production side of the economy is represented by a competitive firm that combines aggregate capital and efficiency units of labor using a Cobb–Douglas technology. Output in period $t$ is

$$Y_t = K_t^{\alpha}, \big(Z_t L_t\big)^{1-\alpha},$$

where $K_t$ is the aggregate capital stock, $L_t$ is aggregate labor input measured in efficiency units, and $Z_t$ denotes labor-augmenting total factor productivity. Capital evolves according to

$$K_{t+1} = (1-\delta)K_t + I_t,$$

with $I_t$ denoting gross investment and $\delta$ the depreciation rate. We assume that long-run growth is driven by exogenous labor-augmenting technical progress. Productivity follows

$$Z_t = (1+\mu)^t, \quad Z_0 = 1,$$

so that output, consumption, investment, and capital all grow at rate $\mu$ along a balanced-growth path, whereas hours worked remain stationary. The firm takes factor prices as given and chooses $(K_t, L_t)$ to maximize static profits

$$\Pi_t = Y_t - w_t L_t - (r_t + \delta)K_t,$$

which implies the usual marginal-product conditions for the real wage and the rental rate of capital:

$$w_t = \frac{\partial Y_t}{\partial L_t} = (1-\alpha) Z_t^{1-\alpha} \left(\frac{K_t}{L_t}\right)^{\alpha}, \tag{8}$$

$$r_t = \frac{\partial Y_t}{\partial K_t} - \delta = \alpha Z_t^{1-\alpha} \left(\frac{L_t}{K_t}\right)^{1-\alpha} - \delta. \tag{9}$$

We focus on balanced-growth equilibria in which growth is entirely driven by exogenous labor-augmenting technical change $Z_t = (1+\mu)^t$). As in King et al. (2002) and Trabandt and Uhlig (2011), we normalize by $Z_t$ so that the transformed economy is stationary and can be analyzed in recursive form. Let

$$K \equiv \frac{K_t}{Z_t}, \quad w \equiv \frac{w_t}{Z_t},$$

and note that along a balanced-growth path both $K$ and the normalized prices $(w, r)$ are constant. Throughout the quantitative analysis we treat the economy as small and open in capital markets: the real interest rate $r$ is taken as exogenous, which pins down the stationary wage $w$ via the marginal-product relationships above.

### *4.4 Individual Wages*

Individual wages are the product of the aggregate wage per efficiency unit, $w$, and the worker's idiosyncratic efficiency units. These efficiency units depend on gender, $\iota$, permanent ability, $a$, accumulated labor market experience, $e$, and a transitory productivity shock, $u$, which follows an AR(1) process. Formally, we specify:

$$log(w(a, e, u, \iota)) = log(w) + a + \gamma_0^\iota + \gamma_1^\iota e + \gamma_2^\iota e^2 + \gamma_3^\iota e^3 + u \tag{10}$$

$$u' = \rho^\iota u + \epsilon, \quad \epsilon \sim N(0, \sigma_\epsilon^{\iota 2}) \tag{11}$$

The coefficients $\gamma^\iota$ capture gender-specific average productivity levels and returns to experience.

### *4.5 Taxation and the Government Budget*

The public sector operates a pay-as-you-go social security system: workers pay payroll taxes at rate, $\tau_{ss}$, and retirees receive benefits $\Psi_t$. We model the social security cap, $\overline{Y}_{ss}$, where $\tau_{ss}$ takes a higher value for $y < \overline{Y}_{ss}$ and a lower value for $y > \overline{Y}_{ss}$. The total amount of social security tax paid is given by:

$$T_{ss}(y) = \begin{cases} y\overline{\tau}_{ss}, & \text{if } y \leq \overline{Y}_{ss} \\ \overline{Y}_{ss}\overline{\tau}_{ss} + (y - \overline{Y}_{ss})\widetilde{\tau}_{ss}, & \text{if } y > \overline{Y}_{ss} \end{cases} \tag{12}$$

The government also taxes consumption, labor and capital income to finance the expenditures on pure public consumption goods (here assumed to be equivalent to wasteful spending), $G_t$, benefits to people that are not working, $\nu_t$, and lump-sum redistribution, $g_t$. Spending on public consumption is also assumed to be proportional to GDP, so that $G_Y = G_t/Y_t$ is constant. Consumption and capital income are taxed at flat rates $\tau_c$ and $\tau_k$. In reality, taxation of capital is of course more complicated than in the model. In the U.S. interest income is taxed together with labor income and the corporate tax code is also non-linear. We approximate the non-linear U.S. capital income tax code by a flat rate, as is standard in the quantitative macro literature. We assume that capital taxation is source based.[16]

To model the non-linear labor income tax for single households, we use the functional form proposed by Benabou (2002) and recently used in Heathcote et al. (2017), where the average tax

[16] Since ours is an open economy, the assumption is that if there is import of capital foreign investors pay tax to the U.S. If there is export of capital, U.S. investors pay tax abroad.

rate on labor income $y$ is given by: $\tau(y) = 1 - \theta_0 y^{-\theta_1}$, and where the parameters $\theta_0$ and $\theta_1$ govern the level and the progressivity of the tax system. For married couples, as discussed in Section 2, we modify the tax function by introducing an additional parameter, $\varphi$, which captures the degree of tax jointness. In our benchmark economy, we set $\varphi = 0$, which corresponds to fully joint taxation of married couples in the U.S.[17] In addition, the government collects social security contributions to finance the retirement benefits, using the social security tax function $\tau_{ss}$.

Along the BGP, tax revenues from labor, capital and consumption taxes $R_t$ and revenues from social security taxes $R_t^{ss}$ grow at the same rate as the total factor productivity $Z_t$.[18]

We will also assume that the government lump-sum transfers to all individuals $g_t$, the benefits to individuals that do not work $\nu_t$, the government consumption spending $G_t$ and the social security benefits $\Psi_t$ all grow at the same rate as $Z_t$. Therefore, the ratio of these variables with $Z_t$ remains constant (and also stays constant as a share of GDP):

$$R = R_t/Z_t, \quad R^{ss} = R_t^{ss}/Z_t, \quad g = g_t/Z_t, \quad \nu = \nu_t/Z_t, \quad G = G_t/Z_t, \quad \Psi = \Psi_t/Z_t$$

Denoting the fraction of workers that work 0 hours by $\zeta$, we can write the government budget constraints (normalized by the level of technology) along a BGP as follows:

$$\begin{aligned} g\left(45 + \sum_{j \geq 46} \Omega_j\right) + 45\nu\zeta + G = R, \\ \Psi\left(\sum_{j \geq 46} \Omega_j\right) = R^{ss}. \end{aligned}$$

The second equation assures budget balance in the social security system by equating per capita benefits times the number of retired individuals to total tax revenues from social security taxes. The first equation is the regular government budget constraint on a BGP. The government spends resources on per capita lump-sum transfers (times the number of individuals in the economy), per capita transfers to the unemployed (times the number of unemployed) and on government consumption, and has to finance these outlays through tax revenue.

[17] Both in our calibrated model and in the data, we use the individual labor income relative to the average labor income in the economy, $\widetilde{y}_i = y_i/AE$, as the argument of the tax function. As a result, changing only the tax progressivity parameter, $\theta_1$, will leave the after-tax labor income of the individual with the earnings equal to the average earnings in the economy unaffected.

[18] To have that along the BGP, the tax revenues from labor grow at the same rate as the total factor productivity, one need to appropriately adjust the 'tax level parameter', $\theta_0$. Since, as described in the previous footnote, we use individual labor income relative to the average labor income in the economy, this requires that along the BGP, we must have $\theta_{0,t} = \theta_0 Z_t$, where $\theta_0$ is constant in the 'normalized', or stationary economy.

### *4.6 Recursive Formulation of the Household Problem*

At any given time, a married household is characterized by its assets, $k$, the man's and the woman's experience levels, $e^{\mathrm{m}}, e^{\mathrm{w}}$, their transitory productivity shocks, $u^{\mathrm{m}}, u^{\mathrm{w}}$, and permanent ability levels, $a^{\mathrm{m}}, a^{\mathrm{w}}$, the fixed costs of working, $F_M^{\iota}$, as well as the households' age $j$. Thus the list of state variables of a married household is $\zeta_M = (k, e^{\mathrm{m}}, e^{\mathrm{w}}, u^{\mathrm{m}}, u^{\mathrm{w}}, a^{\mathrm{m}}, a^{\mathrm{w}}, F_M^{\mathrm{m}}, F_M^{\mathrm{w}}, j)$. The state space for a single household is $\zeta_S = (k, e, u, a, F_S^{\mathrm{w}}, \iota, j)$. To obtain a time-invariant recursive formulation, we normalize all individual variables that grow with productivity by $Z_t$. Let $c = c_t/Z_t$ and $k = k_t/Z_t$ denote normalized consumption and assets. Along a balanced-growth path, aggregate quantities relative to $Z_t$ are constant, and we assume the same for the cross-sectional distribution of normalized individual states.

To formulate the dynamic optimization problem of married couples recursively, we follow Cubeddu and Rios-Rull (2003), Borella et al. (2023) and Holter et al. (2025) and keep track of two value functions. We assume that when married, both partners follow the decision rules selected by a unitary household. In particular, they are the policy functions that attain the optimal value function which satisfies the following Bellman equation:

$$
\begin{aligned}
V^M(\zeta_M) = \max_{c,k',n^{\mathrm{m}},n^{\mathrm{w}}} \Big\{ & U^M\left(c, n^{\mathrm{m}}, n^{\mathrm{w}}\right) + \beta(1-D_j) E_{(u^{\mathrm{m}})',(u^{\mathrm{w}})'}\left[V^M(\zeta_M')\right] \\
& + \frac{1}{2}\beta D_j \left(E_{(u^{\mathrm{m}})'}\left[V^S(\zeta_{S,m}')\right] + E_{(u^{\mathrm{w}})'}\left[V^S(\zeta_{S,w}')\right]\right) \Big\}
\end{aligned}
$$

s.t.:

$$
\begin{aligned}
\zeta_M' &= (k', e^{\mathrm{m}} + \mathbb{1}_{[n^{\mathrm{m}}>0]}, e^{\mathrm{w}} + \mathbb{1}_{[n^{\mathrm{w}}>0]}, (u^{\mathrm{m}})', (u^{\mathrm{w}})', a^{\mathrm{m}}, a^{\mathrm{w}}, F_M^{\mathrm{m}}, F_M^{\mathrm{w}}, j+1), \\
\zeta_{S,\iota}' &= (k'/2, e^{\iota} + \mathbb{1}_{[n^{\iota}>0]}, u', a^{\iota}, F_S^{\iota}, j+1),\ \iota \in \{\mathrm{m}, \mathrm{w}\}, \\
& c(1+\tau_c) + k'(1+\mu) \\
&\quad = \begin{cases} (k+\Gamma)\left(1 + r(1-\tau_k)\right) + 2g + Y + \nu\left(\mathbb{1}_{[n^{\mathrm{m}}=0]} + \mathbb{1}_{[n^{\mathrm{w}}=0]}\right), & \text{if } j < 46 \\ (k+\Gamma)\left(1 + r(1-\tau_k)\right) + 2g + 2\Psi, & \text{if } j \geq 46 \end{cases} \\
Y &= Y^m + Y^{\mathrm{w}} - T^M\left(Y^{\mathrm{m}}, Y^{\mathrm{w}}\right) - T_{ss}(Y^{\mathrm{m}}) - T_{ss}(Y^{\mathrm{w}}) \\
Y^{\iota} &= n^{\iota} w^{\iota}\left(a^{\iota}, e^{\iota}, u^{\iota}\right),\ \iota = \mathrm{m}, \mathrm{w} \\
& n^{\mathrm{m}} \in [0,1], \quad n^{\mathrm{w}} \in [0,1], \quad k' \geq 0, \quad c > 0, \\
n^{\iota} &= 0 \quad \text{if } j \geq 46,\ \iota \in \{\mathrm{m}, \mathrm{w}\}.
\end{aligned}
\tag{13}
$$

$Y$ is here the household after-tax labor income, composed of labor income of the two spouses received during the working phase of their life. $\zeta_{S,\iota} = (k, e, u, a, F_S^{\iota}, j)$ is the state vector of a single household of gender $\iota$.

In addition to the value function of the married couples in (13), we also need to keep track of the value functions of each partner in the married couple. We need them to compute the values of getting married for single individuals. To define them, let $\widehat{c}(\zeta_M)$, $\widehat{k}'(\zeta_M)$, $\widehat{n}^{\mathrm{m}}(\zeta_M)$ and $\widehat{n}^{\mathrm{w}}(\zeta_M)$

be the optimal policy functions for consumption, savings, and hours worked that attain the value function in (13) for married couples at a given state vector $\zeta_M$. The value function of a partner of gender $\iota$ in a married couple is then given by:

$$
\begin{aligned}
\widetilde{V}_\iota^M(\zeta_M) &= U^M\left(\widehat{c}(\zeta_M), \widehat{n}^{\mathrm{m}}(\zeta_M), \widehat{n}^{\mathrm{w}}(\zeta_M)\right) + \beta(1-D_j)E_{(u^{\mathrm{m}})',(u^{\mathrm{w}})'}\left[\widetilde{V}_\iota^M(\zeta_M')\right] + \beta D_j E_{(u^\iota)'}\left[V_\iota^S(\zeta_{S,\iota}')\right] \\
&\text{s.t.:} \\
&\zeta_M' = (\widehat{k}'(\zeta_M), e^{\mathrm{m}} + \mathbb{1}_{[\widehat{n}^{\mathrm{m}}(\zeta_M)>0]}, e^{\mathrm{w}} + \mathbb{1}_{[\widehat{n}^{\mathrm{w}}(\zeta_M)>0]}, (u^{\mathrm{m}})', (u^{\mathrm{w}})', a^{\mathrm{m}}, a^{\mathrm{w}}, F_M^{\mathrm{m}}, F_M^{\mathrm{w}}, j+1) \\
&\zeta_{S,\iota}' = (\widehat{k}'(\zeta_M)/2, e^\iota + \mathbb{1}_{[\widehat{n}^\iota(\zeta_M)>0]}, u', a^\iota, F_S^\iota, j+1).
\end{aligned}
\tag{14}
$$

Notice that there is no optimization on the right side of Equation (14): we simply plug in the optimal decisions that attain the value function in (13) for couples.

A single person of gender $\iota$ with the characteristics summarized by the state vector $\zeta_{S,\iota} = (k, e, u, a, F_S^\iota, j)$ knows the probabilities of marrying someone of opposite gender $-\iota$ and characteristics summarized by the corresponding state vector $\zeta_{S,-\iota}'$. That person's dynamic problem can be written as follows[19]:

$$
\begin{aligned}
V_\iota^S(\zeta_{S,\iota}) &= \max_{c,k',n}\left[U^S(c,n,\iota) + \beta(1-M_j)E_{u'}\left[V_\iota^S(\zeta_{S,\iota}')\right] + \beta M_j E_{\zeta_{S,-\iota}',(u^\iota)'}\left[\widetilde{V}_\iota^M(\zeta_M')\right]\right] \\
&\text{s.t.:} \\
&\zeta_M' = k' + (k^{-\iota})', (e^{-\iota})', e + \mathbb{1}_{[n>0]}, (u^{\mathrm{m}})', (u^{\mathrm{w}})', a^{\mathrm{m}}, a^{\mathrm{w}}, F_M^{\mathrm{m}}, F_M^{\mathrm{w}}, j+1, \\
&\zeta_{S,\iota}' = (k', e + \mathbb{1}_{[n>0]}, u', a, F_S^\iota, j+1), \\
&c(1+\tau_c) + k'(1+\mu) = \begin{cases} (k+\Gamma)\left(1+r(1-\tau_k)\right) + g + Y + \nu\mathbb{1}_{[n^\iota=0]}, & \text{if } j < 46 \\ (k+\Gamma)\left(1+r(1-\tau_k)\right) + g + \Psi, & \text{if } j \geq 46 \end{cases} \\
&Y = Y^\iota - T^S(Y^\iota) - T_{ss}(Y^\iota) \\
&Y^\iota = n^\iota w^\iota(a^\iota, e^\iota, u^\iota), \ \iota = \mathrm{m}, \mathrm{w} \\
&n \in [0,1], \quad (k^z)' \geq 0, \quad c^z > 0, \\
&n = 0 \quad \text{if } j \geq 46.
\end{aligned}
\tag{15}
$$

$E_{\zeta_{S,-\iota}',(u^\iota)'}$ is here the expectation about the characteristics of a partner in the case of marriage in addition to the expectation about next period's labor productivity of the individual. The expectation is taken conditional on the individual's age and permanent ability, because there is perfect assortative matching with respect to age, and to some (calibrated) extent with respect to permanent ability.

[19] The order of two spouses' experiences in $\zeta_M'$ in this formulation corresponds to the case where $\iota = w$; for $\iota = m$, this order would need to be reversed.

### *4.7 Recursive Partial Competitive Equilibrium*

We refer to a stationary allocation of the normalized (growth-adjusted) economy that satisfies household optimality, firm optimality, and government budget balance, given the exogenous interest rate as a recursive partial competitive equilibrium. A formal definition is provided in Appendix A.1. All thought experiments to follow consider stationary partial equilibria, with the exception of Section 7.2 which explicitly considers the transitional dynamics induced by a specific tax reform (but still keeps factor prices constant and insists on period-by-period budget balance of the government).

# 5 Calibration

We now describe how we discipline the parameters of the model using U.S. data for the period 2010–2019. A subset of parameters is pinned down directly from external sources; see Table 3. The remaining parameters are estimated by simulated method of moments so as to reproduce key moments of the U.S. cross-section. They can be found in Table 4.

### *5.1 Demographic Structure and Transition Between Family Types*

The demographic structure of the model is completely determined by the unit mass of newborn households and the death probabilities of retirees. We obtain the latter from the National Center for Health Statistics.

We distinguish three family types in the calibration: single men, single women, and married couples. Age-specific marriage and divorce hazards $M(j)$ and $D(j)$ are inferred from CPS data for 2010–2019 by matching the empirical age profiles of marriage and divorce rates under the assumption of stationarity across cohorts. That is, although we permit the probabilities of transitioning between the family types to depend on an individual's age, we rule out dependence on her birth cohort. Denoting the shares of married and divorced individuals at age $1 \leq j \leq 46$ by $\bar{M}(j)$ and $\bar{D}(j)$, we compute the probability of getting married at age $1 \leq j \leq 46$, $M(j)$, and the probability of getting divorced, $D(j)$, from the following transition equations[20]:

$$\bar{M}(j+1) = (1 - \bar{M}(j))M(j) + \bar{M}(j)(1 - D(j)),$$
$$\bar{D}(j+1) = \bar{D}(j)(1 - M(j)) + \bar{M}(j)D(j).$$

Upon marriage, the exogenous degree of spousal sorting by ability is governed by the parameter $\psi$, which is estimated within the SMM procedure so that the model matches the empirical correlation

[20] We assume that there is no marriage or divorce after retirement. This allows us to reduce the number of state variables that we need to keep track of in the post-retirement period. In particular, we do not need to keep track of the individual's permanent ability type, $a$, which affects the types of likely marriage partners through assortative matching, as explained below.

of hourly wages of 0.287 in the CPS (2010-2019) for married couples.[21]

### *5.2 Household Preferences*

Given the functional forms in (5) and (6), we determine the preference parameters—namely the discount factor $\beta$, the means and variances of the fixed participation costs, and the hour-disutility coefficients $\chi$—by simulated method of moments. The main targets are the capital-output ratio, employment rates by gender and marital status, average hours worked, and transition rates into and out of employment.

The empirical moment that mainly identifies the time discount factor $\beta$ is the capital-output ratio $K/Y$, taken from the BEA. The mean participation costs, $\mu_{F^{\iota}_M}$, $\mu_{F^{\iota}_S}$, are identified by the employment rates of married and single men and women aged 20-64, taken from the CPS. To resemble that the disutility from participating in the labor market varies over the life-cycle due to the presence of children we also add an age-dependent term (a 2nd order polynomial in age) to the fixed cost of working for married women[22]: $F^{\mathrm{w}}_M = F^{\mathrm{w}0}_M + F^{\mathrm{w}1}_M \times j + F^{\mathrm{w}2}_M \times j^2$, where $F^{\mathrm{w}0}_M \sim N(\mu_{F^{\mathrm{w}0}_M}, \sigma^2_{F^{\mathrm{w}0}_M})$. The moments used to determine the age polynomial are the employment rates of married women aged 25-34 and 55-64.

To pin down the cross-sectional variance of the participation costs, $\sigma^2_{F^{\iota}_M}$ and $\sigma^2_{F^{\iota}_S}$, we use the *probability* of changing employment status for married and single men and women (again aged 20-64), taken from the CPS 1980-2024. If the cross-sectional dispersion of the participation cost is high, some individuals will work all the time, and some individuals will always be out of the labor force. The probability of changing employment status will thus be low. We estimate the probability of changing using a logistic regression both with data from the CPS and with model generated data. The switching probabilities obtained from the data are used as moments when estimating the model. The parameters governing the disutility of working more hours, $\chi^{\mathrm{m}}_M$, $\chi^{\mathrm{w}}_M$, $\chi^{\mathrm{m}}_S$ and $\chi^{\mathrm{w}}_S$, are identified by hours worked per person aged 20-64 by marital status and gender, again taken from the CPS.

There is considerable debate in the economic literature about the Frisch elasticity of labor supply, see Keane (2011) for a thorough survey. However, there seems to be consensus that female

[21]Specifically, we order single individuals of both genders according to an index that combines a purely random 'marriage quality' component, $\varsigma \sim U[0,1]$ and the individual's permanent ability type:

$$M_i = (1-\psi)\varsigma_i + \psi a_i.$$

and use this ordering to match the single individuals of the opposite genders with each other. If $\psi = 0$, marriage is random, and as $\psi \to 1$, marriages become perfectly sorted by spousal ability $a$. Appendix A.6 contains the details of this construction, which, conditional on own ability $a$, induces a distribution over spousal abilities (and associated distribution over the other payoff-relevant state variables of future partners) that permits singles to rationally form expectations.

[22]The work decisions of all four demographic groups may be affected by the presence of children in the household or other age-related factors, but for the purpose of keeping the number of parameters down we add the age-dependent utility cost only for married women.

labor supply is much more elastic than male labor supply.[23] We set $1/\eta^{\mathrm{m}} = 0.3$, in line with the contemporary literature in quantitative macroeconomics, see for instance Guner et al. (2012). $1/\eta^{\mathrm{w}}$ we set to 0.6. Note that $1/\eta^{\mathrm{w}}$ is here to be interpreted as the intensive margin Frisch elasticity of female labor supply, while $1/\eta^{\mathrm{m}}$ is the intensive margin Frisch elasticity of male labor supply. The $1/\eta$ parameter cannot be interpreted as the *macro elasticity* of labor supply with respect to tax rates, see Keane and Rogerson (2012) for a detailed discussion.

### *5.3 Production Technology*

The capital share in production is fixed at $\alpha = 1/3$. The depreciation rate $\delta$ is chosen so that the steady-state investment-to-capital ratio in the model equals 9.88 percent, consistent with U.S. national accounts.

### *5.4 Individual Wages*

The parameters governing returns to experience, the persistence and variance of idiosyncratic shocks, and the dispersion of permanent ability are estimated from PSID data (1968–1997) using the two-step, Heckman (1976) and Heckman (1979), selection correction procedure described in Appendix A.5. The strategy closely follows Holter et al. (2019); here we re-estimate the process for women and obtain new estimates for men, using the same specification. We then apply them to our updated macro environment.

After estimating the returns to experience for men and women, we use the residuals from the regressions and the panel data structure of the PSID to estimate the parameters for the productivity shock processes, $\rho^{\iota}$ and $\sigma_{\epsilon}^{\iota}$, and the variance of individual ability, $\sigma_{a}^{\iota}$. We estimate the mean wage parameters $\gamma_0^w$ and $\gamma_0^m$ internally in the model. The targeted data moments are the ratio between male and female earnings and the average wage of working individuals, which we normalize to 1 in the model.

### *5.5 Mapping the U.S. Tax and Social Security Systems*

To resemble the U.S. labor tax code in our model, we adopt the parametric schedule of Benabou (2002) (see also Section 4.5). To create a mapping between the tax and income data and our model, we normalize labor income by the average earnings in the economy (AE), both when we estimate our tax functions and in our model. Given gross labor income, $y/AE$, the after-tax income is denoted as $y_{net}/AE$, and it is given by: $y_{net}/AE = \theta_0(y/AE)^{1-\theta_1}$, with $\theta_0 < 1$, $\theta_1 < 1$. We adjust $AE$ when computing equilibrium so that the tax rate for a person with average income in the model continues to equal the tax rate of a person with average income in the data. Since the OECD tax and Benefit calculator only provides the taxes for incomes up to 200% of Average Earnings we use tax data from the NBER TaxSim to estimate our tax functions for married and

[23] Kimmel and Kniesner (1998) do for example estimate the intensive margin labor supply of men and women to be 0.39 and 0.66 respectively.

**Table 3:** Parameters Calibrated Outside of the Model

| Parameter | Value | Description | Target |
|---|---|---|---|
| $1/\eta^{\mathrm{m}}, 1/\eta^{\mathrm{w}}$ | 0.3, 0.6 | $U^M(c, n^{\mathrm{m}}, n^{\mathrm{w}}) = \log(c) - \frac{1}{2}\chi_M^{\mathrm{m}}\frac{(n^{\mathrm{m}})^{1+\eta^{\mathrm{m}}}}{1+\eta^{\mathrm{m}}} - \frac{1}{2}\chi_M^{\mathrm{w}}\frac{(n^{\mathrm{w}})^{1+\eta^{\mathrm{w}}}}{1+\eta^{\mathrm{w}}} - \frac{1}{2}F_M^{\mathrm{m}} \cdot \mathbb{1}_{[n^{\mathrm{m}}>0]} - \frac{1}{2}F_M^{\mathrm{w}} \cdot \mathbb{1}_{[n^{\mathrm{w}}>0]}$ | Literature |
| $\gamma_1^{\mathrm{m}}, \gamma_2^{\mathrm{m}}, \gamma_3^{\mathrm{m}}$ | 0.0605, $1.06 \times 10^{-3}$, $9.30 \times 10^{-6}$ | $w_t(a_i, e_i, u_i) = w_t e^{a_i + \gamma_0^{\mathrm{m}} + \gamma_1^{\mathrm{m}} e_i + \gamma_2^{\mathrm{m}} e_i^2 + \gamma_3^{\mathrm{m}} e_i^3 + u_i}$ | PSID (1968-1997) |
| $\gamma_1^{\mathrm{w}}, \gamma_2^{\mathrm{w}}, \gamma_3^{\mathrm{w}}$ | 0.0784, $2.56 \times 10^{-3}$, $2.56 \times 10^{-5}$ | $w_t(a_i, e_i, u_i) = w_t e^{a_i + \gamma_0^{\mathrm{w}} + \gamma_1^{\mathrm{w}} e_i + \gamma_2^{\mathrm{w}} e_i^2 + \gamma_3^{\mathrm{w}} e_i^3 + u_i}$ | |
| $\sigma_\epsilon^{\mathrm{m}}, \sigma_\epsilon^{\mathrm{w}},$ | 0.322, 0.310 | $\epsilon \sim N(0, \sigma_\epsilon^{\iota 2})$ | |
| $\rho^{\mathrm{m}}, \rho^{\mathrm{w}}$ | 0.396, 0.339 | $u' = \rho^\iota u + \epsilon$ | |
| $\sigma_a^{\mathrm{m}}, \sigma_a^{\mathrm{w}}$ | 0.315, 0.385 | $a^\iota \sim N(0, \sigma_a^{\iota 2})$ | |
| $\theta_0^S, \theta_1^S, \theta_0^M, \theta_1^M$ | 0.895, 0.140, 0.975, 0.149 | $ya = \theta_0 y^{1-\theta_1}$ | NBER TaxSim tax data |
| $\tau_k$ | 0.36 | Capital tax | Trabandt and Uhlig (2011) |
| $\overline{Y}_{ss}$ | 2.33×AE | Social Security cap | SSA (2010-2019) |
| $\overline{\tau}_{\mathrm{ss}}$ | 0.142 (for $y \leq \overline{Y}_{ss}$) | Social Security tax | SSA (2010-2019) |
| $\widetilde{\tau}_{\mathrm{ss}}$ | 0.029 (for $y > \overline{Y}_{ss}$) | Social Security tax | SSA (2010-2019) |
| $\tau_c$ | 0.05 | Consumption tax | Trabandt and Uhlig (2011) |
| $\nu$ | 0.202×AE | Income if not working | CEX 2001-2007 |
| $G/Y$ | 0.0778 | Pure public consumption goods | 2X military spending (World Bank) |
| $\omega(j)$ | Varies | Survival probabilities | NCHS |
| $M(j)$, $D(j)$ | Varies | Marriage and divorce probabilities | CPS |
| $\mu$ | 0.02 | Output growth rate | Trabandt and Uhlig (2011) |
| $\delta$ | 0.079 | Depreciation rate | $I/K - \mu$ (BEA) |
| $\alpha$ | 1/3 | $Y_t(K_t, L_t) = K_t^\alpha \left[Z_t L_t\right]^{1-\alpha}$ | Historical capital share |

single households. Like in Section 3 we obtain the tax data for families with 0-3 children and weight the observations by the shares of these family types in the population. We set the capital tax rate, $\tau_k = 36\%$, and the consumption tax rate, $\tau_c = 5\%$, following Trabandt and Uhlig (2011).

The social security system is calibrated to reproduce the statutory payroll tax rates and earnings cap observed in 2010–2019. We capture that the payroll tax paid by the employee, $T_{ss}$, is a piece-wise linear tax. It has a higher rate up to an earnings cap, $\overline{Y}_{ss}$, and a lower rate above this cap. In practice, in the U.S., payroll taxes (which include contributions to social security and Medicare) are paid by both the employee and employer, at a flat rate equal to 7.65% for both, below the social security cap, and a flat rate of 1.45% for both, above the social security cap[24]. We set $\tau_{ss}$ such that $1 - \tau_{ss} = \frac{1-\tau_{ss}^{\text{Employee}}}{1+\tau_{ss}^{\text{Employer}}}$, with $\overline{\tau}_{\text{ss}}^{\text{Employee}} = \overline{\tau}_{\text{ss}}^{\text{Employer}} = 0.0765$, for $y \leq \overline{Y}_{ss}$, and with $\widetilde{\tau}_{\text{ss}}^{\text{Employee}} = \widetilde{\tau}_{\text{ss}}^{\text{Employer}} = 0.0145$, for $y > \overline{Y}_{ss}$. We set $\overline{Y}_{ss}$ by calculating the average ratio of the cap to average earnings in the data during the 2010-2019 period.

## 5.6 Public Consumption and Transfers

There is an ongoing debate on what share of government spending that resembles transfers to households. Here we take the view that a significant share of government spending resembles transfers, in line with Prescott (2004), Oh and Reis (2012). In the calibrated equilibrium we follow Prescott (2004) and assume that two times military spending (obtained from the World Bank) is spent on a pure public consumption good, $G$. There is no utility from G in the model, it just has to be paid for. People who do not work often have other sources of public income such as unemployment benefits, social aid, disability insurance etc. To approximate the income when not working, $\nu$, we take the average value of non-housing consumption of households with income less than \$5000 per year from the Consumer Expenditure Survey.

## 5.7 Estimation

The vector of SMM parameters $\Theta$ is chosen to minimize the unweighted sum of squared percentage deviations between model-implied and empirical moments, as detailed in Table 4. Let $\Theta = \{\gamma_0^{\text{m}}, \gamma_0^{\text{w}}, \beta, \mu_{F_M^{\text{w0}}}, \sigma_{F_M^{\text{w0}}}, F_M^{\text{w1}}, F_M^{\text{w2}}, \chi_M^{\text{w}}, \mu_{F_M^{\text{m}}}, \sigma_{F_M^{\text{m}}}, \chi_M^{\text{m}}, \mu_{F_S^{\text{w}}}, \sigma_{F_S^{\text{w}}}, \chi_S^{\text{w}}, \mu_{F_S^{\text{m}}}, \sigma_{F_S^{\text{m}}}, \chi_S^{\text{m}}, \psi\}$, and let $V(\Theta) = (V_1(\Theta), \ldots, V_{18}(\Theta))'$ with $V_i(\Theta) = (\bar{m}_i - \hat{m}_i(\Theta))/\bar{m}_i$ measuring the percentage difference between empirical and simulated moments. Then $\Theta$ is chosen to minimize $V(\Theta)'V(\Theta)$. Table 4 summarizes the estimated parameter values and the data moments. We get close to matching all the moments. We assume a closed economy when calibrating our model, and we get the implied real interest rate equal to 4.54%. We keep this interest rate fixed in our experiments in sections 6, 6.3 and 7.2, where we instead assume a small open economy.

[24] Above the cap one only pays contributions to Medicare.

Table 4: Parameters Calibrated Endogenously

| Parameter | Value | Description | Moment | Data | Model |
|---|---|---|---|---|---|
| $\gamma_0^{\mathrm{m}}$ | -0.107 | $w_t(a_i, e_i, u_i) = w_t e^{a_i+\gamma_0^\iota+\gamma_1^\iota e_i+\gamma_2^\iota e_i^2+\gamma_3^\iota e_i^3+u_i}$ | Gender earnings ratio | 1.432 | 1.432 |
| $\gamma_0^{\mathrm{w}}$ | -0.145 | | Average Earnings (AE) | 1.000 | 1.000 |
| $\beta$ | 1.002 | Discount factor | K/Y | 2.683 | 2.683 |
| $\mu_{F_M^{\mathrm{w0}}}$ | 0.240 | $F_M^{\mathrm{w0}} \sim N(\mu_{F_M^{\mathrm{w0}}}, \sigma^2_{F_M^{\mathrm{w0}}})$ | Married fem employment | 0.668 | 0.668 |
| $\sigma_{F_M^{\mathrm{w0}}}$ | 0.171 | | M. fem P(switch emp. stat.) | 0.117 | 0.117 |
| $F_M^{\mathrm{w1}}$ | -0.023 | $F_M^{\mathrm{w}} = F_M^{\mathrm{w0}} + F_M^{\mathrm{w1}} \cdot j + F_M^{\mathrm{w2}} \cdot j^2$ | Married fem employment, 25-34 | 0.661 | 0.661 |
| $F_M^{\mathrm{w2}}$ | 0.0004 | | Married fem employment. 55-64 | 0.597 | 0.599 |
| $\chi_M^{\mathrm{w}}$ | 7.42 | $\chi_M^{\mathrm{w}} \frac{(n^w)^{1+\eta^{\mathrm{w}}}}{1+\eta^{\mathrm{w}}} - F_M^{\mathrm{w}} \cdot \mathbb{1}_{[n^{\mathrm{w}}>0]}$ | Married female hours | 0.224 (1225 h/year) | 0.224 |
| $\mu_{F_M^{\mathrm{m}}}$ | 0.201 | | Married male employment | 0.871 | 0.871 |
| $\sigma_{F_M^{\mathrm{m}}}$ | 0.030 | | M. male P(switch emp. stat.) | 0.046 | 0.046 |
| $\chi_M^{\mathrm{m}}$ | 31.40 | $\chi_M^{\mathrm{m}} \frac{(n^{\mathrm{m}})^{1+\eta^{\mathrm{m}}}}{1+\eta^{\mathrm{m}}} - F_M^{\mathrm{m}} \cdot \mathbb{1}_{[n^{\mathrm{m}}>0]}$ | Married male hours | 0.349 (1905 h/year) | 0.349 |
| $\mu_{F_S^{\mathrm{w}}}$ | 0.011 | $F_S^\iota \sim N(\mu_{F_S^\iota}, \sigma^2_{S_M^\iota})$ | Single fem. employment | 0.694 | 0.694 |
| $\sigma_{F_S^{\mathrm{w}}}$ | 0.559 | | S. fem P(switch emp. stat.) | 0.101 | 0.101 |
| $\chi_S^{\mathrm{w}}$ | 14.77 | $\chi_S^\iota \frac{(n^\iota)^{1+\eta^\iota}}{1+\eta^\iota} - F_S^\iota \cdot \mathbb{1}_{[n^\iota>0]}$ | Single female hours | 0.236 (1288 h/year) | 0.236 |
| $\mu_{F_S^{\mathrm{m}}}$ | 0.557 | | Single male employment | 0.727 | 0.727 |
| $\sigma_{F_S^{\mathrm{m}}}$ | 0.412 | | S. male P(switch emp. stat.) | 0.096 | 0.096 |
| $\chi_S^{\mathrm{m}}$ | 75.50 | | Single male hours | 0.260 (1420 h/year) | 0.260 |
| $\psi$ | 0.091 | $M_n = (1-\psi)\varsigma + \psi a$ | $corr(\log(w^{\mathrm{m}}), \log(w^{\mathrm{w}}))$ | 0.287 | 0.287 |

## 5.8 *Model Performance: Employment Rates and Labor Supply Elasticities*

The extensive margin of labor supply and the elasticity of labor supply, in particular along the extensive margin, is quantitatively important for impact of tax reforms in our model. In Figure 1 we plot the employment rates of married men and women over the life cycle in the model and data. It should be noted that we have targeted moments from the life-cycle profile of employment for married women (using an age-dependent disutility of participation) but not for married men.

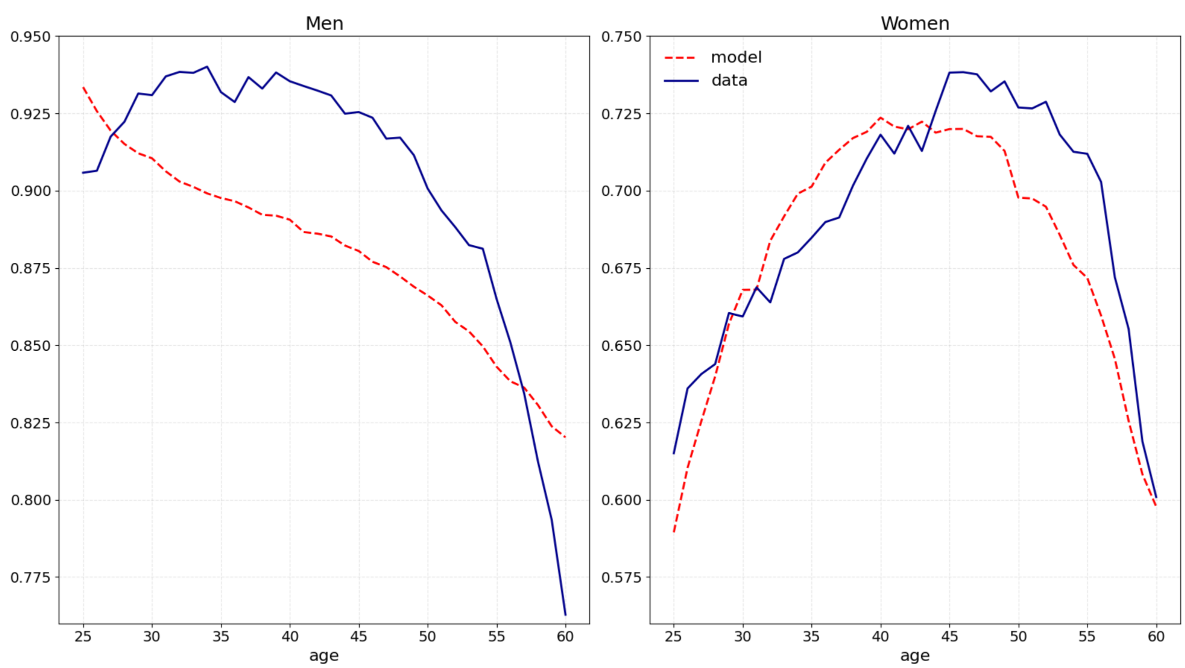


**Figure 1:** Employment Rates for Married Men and Women by Age

Table 5 displays simulated Frisch elasticities by gender, marital status and age. We observe that the overall labor supply elasticity is highest for married women and lowest for married men. We also observe that for men and single women the labor supply elasticity is increasing with age. In contrast, for married women the labor supply elasticity is U-shaped. This is due to the age-dependent utility cost of participation for married women, which is supposed to resemble the higher disutility of work during the years when children are born. These patterns of labor supply elasticities are broadly consistent with other papers in the literature, such as Attanasio et al. (2018) and Borella et al. (2023). Attanasio et al. (2018) study the elasticity of labor supply of women. Their median estimate of the total Frisch elasticity for women is 0.87, which lies between our model-generated total Frisch elasticities for single (0.835) and married (0.940) women.[25] The range of the total Frisch elasticity estimates that they report (between 10th and 90th percentile), from 0.80 to 1.92, is close to the range of Frisch elasticities that our model generates for women. Borella et al. (2023) report their model-implied participation elasticities by gender, marital status and age group. Figure 13 in the Appendix compares them to the ones we get in our model (reported in Table 5), and shows that they are close to each other.

**Table 5:** Simulated Frisch Labor Supply Elasticities

| Statistic | All | Married men | Single men | Married women | Single women |
|---|---|---|---|---|---|
| Total Hours | | | | | |
| all | 0.688 | 0.396 | 0.598 | 0.940 | 0.835 |
| young (20-29) | 0.459 | 0.254 | 0.445 | 1.026 | 0.364 |
| prime-aged (30-54) | 0.675 | 0.346 | 0.563 | 0.846 | 1.108 |
| old (55-64) | 0.949 | 0.560 | 1.086 | 1.136 | 1.281 |
| Participation | | | | | |
| all | 0.375 | 0.154 | 0.413 | 0.479 | 0.494 |
| young (20-29) | 0.246 | 0.029 | 0.304 | 0.661 | 0.129 |
| prime-aged (30-54) | 0.341 | 0.098 | 0.355 | 0.392 | 0.714 |
| old (55-64) | 0.586 | 0.331 | 0.851 | 0.626 | 0.820 |

The table displays simulated Frisch labor supply elasticities. Frisch elasticities for individuals of a given gender, family type and age are computed using a one-period increase in wages of 5% for all individuals of that gender, family type and age. Elasticities for different genders and family types are then computed as average population-weighted elasticities for that gender/family type group over all ages. The total elasticity is the population-weighted average of all the different demographic groups.

# 6 Separate Progressive Taxes and Government Revenues

In this section, we study the effects of tax progressivity on government revenue under the alternative assumptions that married couples are taxed either separately or jointly. In a nutshell, we find that a relatively progressive, but *individual-based* tax system maximizes government tax revenue.

[25] See Table VII in Attanasio et al. (2018).

To arrive at this conclusion we first describe the reform from a system that taxes couples jointly to one where individuals constitute the basic tax unit. We then study the relationship between the average tax rate and tax revenues (i.e., the Laffer curve) for different degrees of tax progressivity, both under joint and individual-based taxation, and finally explore the main mechanism underlying our findings. A normative analysis of the optimal tax system is contained in Section 7.

### *6.1 Changing to a Separate Tax System*

In the benchmark model described in Section 4 married couples are taxed jointly according to the tax function in equation (1) and thus their after tax earnings are given by $y_{\text{net}} = \theta_0^M (y_m + y_f)^{1-\theta_1^M}$[26]. We now consider an alternative specification where both individuals within a couple are taxed separately, and thus household net earnings is determined by:

$$y_{\text{net}} = \theta_0^M y_m^{1-\theta_1^M} + \theta_0^M y_f^{1-\theta_1^M} \tag{16}$$

This tax system imposes the restriction that both household members face the same tax progressivity.

### *6.2 Laffer Curves, Tax Progressivity and Tax Jointness*

We now address the main question in this paper, namely how tax progressivity impacts the government's capacity to generate additional tax revenue, and crucially, how the answer depends on the jointness of the tax code. To do so, we trace out simulated Laffer curves, i.e., schedules with the average tax rate on the x-axis and total tax revenue (from labor income-, capital income- and consumption taxes) on the y-axis. We do this for different levels of tax progressivity, first, under a tax system where married couples are taxed jointly and, second, under a tax system in which they are taxed individually. For each system we change the average labor income tax rate and generate Laffer curves by multiplying the tax function parameters $\theta_0^M$ and $\theta_0^S$ by a constant, $\varpi_0$. This changes the level of tax rates but keeps tax progressivity constant. We vary tax progressivity (and thus generate a new Laffer curve) by scaling the tax parameters $\theta_1^M$ and $\theta_1^S$ by a constant, $\varpi_1 \in \{0, 1, 2, 3\}$. We keep the other taxes in the economy constant, and, in the benchmark, assume that the government spends the additional revenues on government purchases (that are, equivalently, either wasteful or enter separably in the household utility function). As sensitivity analysis we also display Laffer curves when the extra revenues are returned to households in a lump-sum fashion.[27]

Figure 2 displays Laffer curves for different levels of tax progressivity. The diamond at a 12% tax rate with benchmark progressivity marks the current U.S. status quo system, see Section 5. The left panel represents a tax system in which married couples are taxed jointly (as in the current

[26] As mentioned earlier, earnings are normalized by the average earnings in the economy.

[27] The key differences between the two uses of revenue is that the latter entails a negative income effect on household labor supply whereas the former does not.

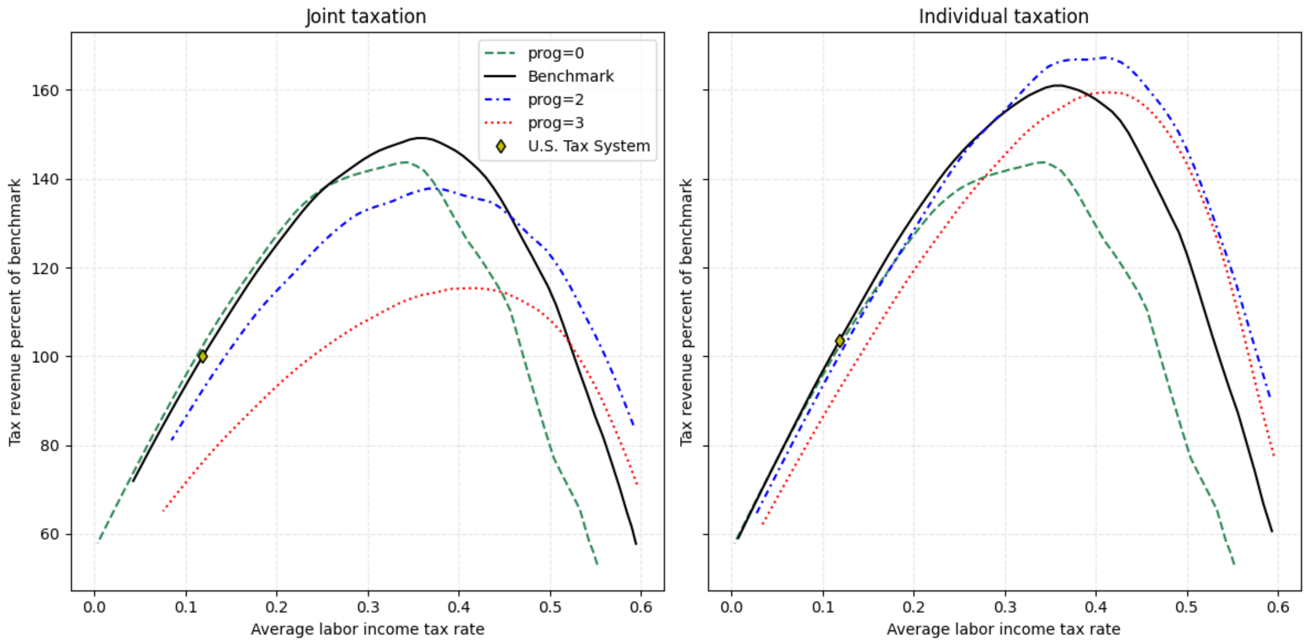


**Figure 2:** The Impact of Tax Progressivity on Laffer Curves (assuming new revenue is spent on G). Note: the left and right plot have the same y axis and share the same legend.

U.S. system) and the right panel shows the Laffer curves for an individual-based tax system. As can be seen comparing the two subplots (which share the same y-axis), the government can raise significantly more revenue with individual taxation, for a given level of tax progressivity.

Furthermore, under joint taxation of married couples an increase in tax progressivity typically leads to less revenue.[28] The maximum revenue is attained with a progressivity level which is 90% of that of the current U.S. status quo (see Table 6 below).[29] Although the difference is not that large between a flat tax and the current U.S. progressivity level, once progressivity is doubled or tripled revenue falls rather quickly for a given average tax rate.

With individual-based taxation, in contrast, there is a clear "progressivity Laffer curve". The revenue maximizing progressivity is 2.0 (twice as high as in the U.S.), see Table 6. We observe that compared to a flat tax, the peak of the Laffer curve is significantly higher with a progressivity equal to the current U.S. tax system (first row of the table) and also with a tax system that is twice as progressive as the current U.S. system, and it occurs at an average tax rate that is about five percentage points higher as well (see the third row of the table).

The maximum revenue that can be raised is obtained with individual taxation of married couples and a significantly higher progressivity than the current U.S. tax system ( $\varpi_1 = 2.0$) and with an average tax rate of 42%. This maximum revenue equals 168% of the benchmark tax

[28] The exception is a flat tax with high tax rates. In this case, an increase in tax progressivity encourages participation of single individuals so strongly (see Table 7) that tax revenue may rise with progressivity.

[29] To obtain the Laffer curves in Figure 2, we scale the progressivity tax parameters by $\varpi_1 \in \{0, 1, 2, 3\}$. To obtain the results in Table 6, we calculate Laffer curves for all the values of $\varpi_1$ between 0 and 3 in small increments of 0.1.

**Table 6:** Maximizing Revenue with Joint and Individual Taxation and Different use of Revenue

| Tax System | Progressivity (U.S.=1) | $\bar{\tau}(y)$ | Revenue (% of benchmark) |
|---|---|---|---|
| Benchmark (G) | 1.0 | 36.3% | 149.9 |
| Joint (G) | 0.9 | 35.2% | 150.3 |
| Individual (G) | 2.0 | 41.9% | 167.7 |
| Benchmark (lump-sum) | 1.0 | 33.7% | 138.4 |
| Joint (lump-sum) | 0.5 | 36.5% | 139.5 |
| Individual (lump-sum) | 1.6 | 37.2% | 148.3 |

The table displays the revenue maximizing levels of tax progressivity, the associated average tax rate and tax revenue in % of benchmark tax revenue for joint and individual taxation of married couples, assuming that excess revenue is redistributed lump-sum and assuming it is spent on wasteful government spending (G). For reference, the rows labeled "benchmark" shows the maximum revenue and associated average tax rate for a tax system with the current U.S. system (joint taxation and progressivity equal to 1).

revenue and is 18 percentage points higher than the peak of the Laffer curve under the current U.S. tax structure, see again Table 6. Contrast this with a joint taxation system where maximal revenues are attained at about the same average tax rate of 35%, but with *lower* tax progressivity of $\varpi_1 = 0.9$); it only raises 50% (rather than 68%) of additional revenues. This demonstrates the main point of the paper, that a *combination* of individual-based and progressive taxation is beneficial for the government's ability to generate additional tax revenues.

That the peak of the Laffer curve is located at an average tax rate of 42% may at first seem a bit low, compared to other papers in the literature. For example, Holter et al. (2019) find that the peak of the Laffer curve is at an average tax rate of 58%. There are two reasons why the peak is located at this lower level. First, we model an explicit extensive margin of labor supply and human capital accumulation for *both* women and men.[30] Second, we keep other tax rates as well as the social security system constant when increasing the labor income tax. Because these other taxes are already relatively high, there is limited room for generating more revenue through the labor income tax system alone.

Figure 3 displays Laffer curves for different levels of tax progressivity, under the assumption that new tax revenue is distributed lump-sum to households. Again, the left panel is for a tax system where married couples are taxed jointly and the right panel is for a tax system where married couples are taxed individually. As can be seen from the figure, our conclusions are qualitatively unaltered from the case where government spending adjusts to a change in tax revenue. Again, the government raises more revenue with individual taxation, for a given level of tax progressivity. With joint taxation of married couples an increase in tax progressivity leads to less revenue. With individual-based taxation there still is a "progressivity Laffer curve", at

[30]Several papers have considered this channel only for women, see e.g. Guner et al. (2012) and Holter et al. (2019). The finding that the peak of the Laffer curve is not the highest with a flat tax reverses a finding in Holter et al. (2019), and also stems from the fact that this paper considers the endogenous accumulation of experience and the extensive margin of labor supply for *men* who were assumed to always work in Holter et al. (2019).

least for higher average tax levels. Overall, the maximum revenue that can be raised with lump-sum redistribution of revenue is obtained with individual taxation of married couples, a level of progressivity that is about 60% higher than in the current U.S. tax system ($\varpi_1 = 1.6$), and an average tax rate of 37%. This maximum revenue equals 148% of the benchmark tax revenue and is ten percentage points higher than the peak of the Laffer curve with the current U.S. tax structure (see again Table 6).

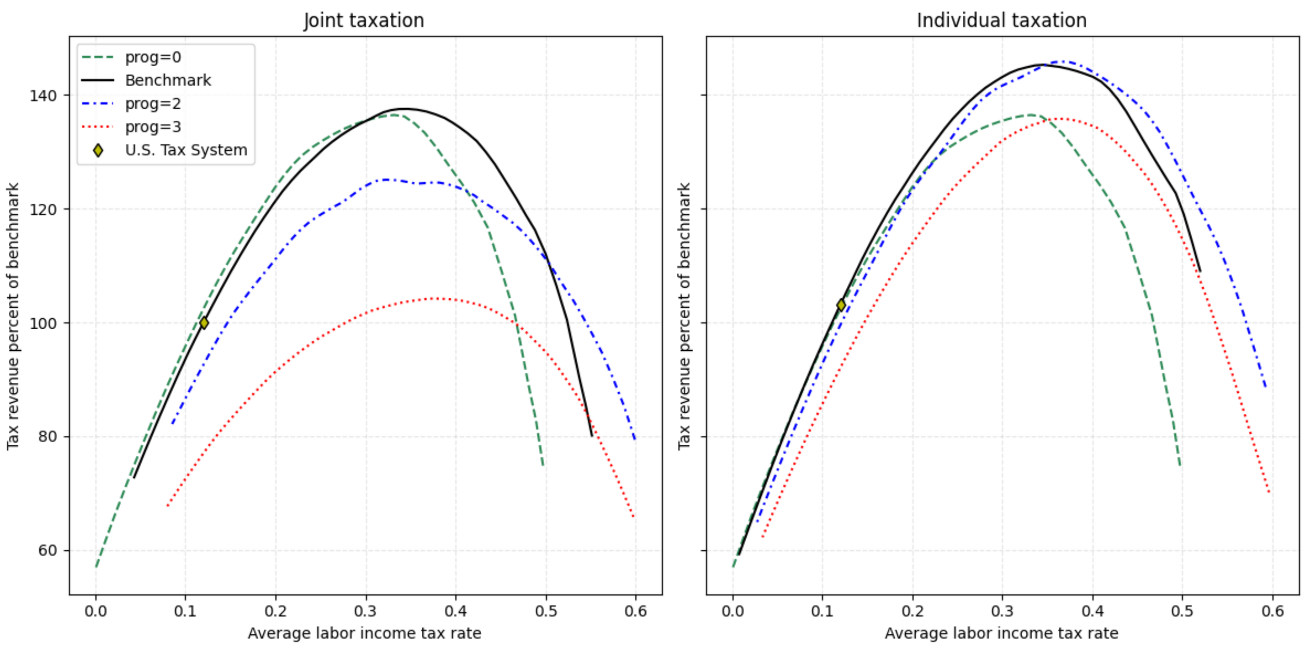


**Figure 3:** The Impact of Tax Progressivity on Laffer Curves (assuming new revenue is lump-sum redistributed. Note: the left and right plot share the same y axis.

### *6.3 Tax Jointness, Tax Progressivity and Labor Supply: Exploring the Mechanism*

Why are progressive taxes more favorable for government revenue when the tax unit is the individual rather than the household? To shed light on the key mechanism we fix the level of taxes and vary its progressivity, by performing the following experiment. Similarly to the experiment in section 6.1, we multiply the tax progressivity parameters, $\theta_1^M$ and $\theta_1^S$ by a constant, $\varpi \in 0, 1, 2$. Unlike in section 6.1 where we trace the whole Laffer curve by changing the average tax rate, here we keep the average tax rate (measured as labor income tax revenue divided by labor income) at 11.9% as in the benchmark tax system. In Table 7 we focus on the case where government spending adjusts, but also document results for the case in which lump-sum transfers change to balance the budget in Table 11 of the Appendix.

We observe that at this relatively low average tax rate, a flat tax is revenue maximizing for joint taxation and does not produce much less revenue than benchmark tax progressivity for individual taxation (see also Figure 2). In Section 6.2 we saw that at higher tax rates this is typically not the

**Table 7:** Selected Statistics for Joint and Separate Taxation and Different Tax Progressivity

| | Joint Taxation | | | Individual Taxation | | |
|---|---|---|---|---|---|---|
| | Flat tax | US Prog. | 2×US Prog. | Flat Tax | US Prog. | 2×US Prog. |
| Tax revenue per capita | 102.38 | 100.00 | 92.50 | 102.38 | 103.44 | 100.36 |
| Aggregate labor supply | 100.12 | 100.00 | 94.32 | 100.12 | 107.04 | 108.06 |
| Single male labor supply | 87.48 | 100.00 | 103.91 | 87.48 | 95.46 | 99.89 |
| Married male labor supply | 101.45 | 100.00 | 89.16 | 101.45 | 106.79 | 104.89 |
| Single female labor supply | 94.37 | 100.00 | 105.99 | 94.37 | 102.83 | 105.13 |
| Married female labor supply | 113.01 | 100.00 | 85.44 | 113.01 | 120.30 | 122.05 |
| Single male LFP | 84.25 | 100.00 | 108.73 | 84.25 | 95.77 | 105.37 |
| Married male LFP | 98.46 | 100.00 | 92.53 | 98.46 | 108.70 | 113.28 |
| Single female LFP | 88.86 | 100.00 | 113.96 | 88.86 | 103.67 | 114.91 |
| Married female LFP | 104.91 | 100.00 | 91.89 | 104.91 | 120.45 | 133.01 |
| Married male intensive margin | 103.04 | 100.00 | 96.35 | 103.04 | 98.24 | 92.59 |
| Single male intensive margin | 103.83 | 100.00 | 95.57 | 103.83 | 99.68 | 94.80 |
| Married female intensive margin | 107.72 | 100.00 | 92.98 | 107.72 | 99.87 | 91.76 |
| Single female intensive margin | 106.20 | 100.00 | 93.01 | 106.20 | 99.19 | 91.48 |

The table displays selected model statistics with individual and joint taxation at the benchmark average tax rate of 11.9%. All numbers are in % of the U.S. benchmark. Additional tax revenues are used for government spending, $G$.

case when individuals are the tax unit. What is clear from Table 7 is that the output and revenue cost of increasing tax progressivity is much smaller for individual taxation. For a joint tax system, a flat tax generates 2.4 percentage points more revenues than the benchmark and a system that is twice as progressive as the current U.S. system generates 7.5 percentage points less receipts than the benchmark. With individual taxation a flat tax also generates 2.4 percentage points more revenue but now revenue increases by 3.4 percentage points at benchmark progressivity.[31] With individual taxes and a tax system that is twice as progressive as the current U.S. system, revenue increases by 0.4 percentage points relative to the benchmark, at an average tax rate of 11.9%.

Under both joint and individual taxation higher tax progressivity reduces labor supply of those who already work (the intensive margin). This is due to higher marginal tax rates distorting the labor choice in the agents' first order conditions (see e.g., Holter et al. (2019), and many other papers in the literature that quantify this point). The lower cost of progressive taxation with an individual-based tax system is due to the very different effects on the labor force participation (LFP) of married couples. Under joint taxation the LFP of married women and men tend to fall with increasing tax progressivity (even if married male LFP is highest at benchmark progressivity in Table 7). Under individual-based taxation the LFP of these couples, in contrast, is strongly increasing in tax progressivity. With a flat tax the LFP of married women is 104.9% of benchmark LFP and this increases to 133% of benchmark LFP when the tax system is twice as progressive as the current U.S. system. The pattern for married men is similar, although the elasticity of LFP with respect to $\theta_1$ is smaller.

[31] With a flat tax it does not matter whether couples are taxed jointly or individually.

The elasticity of labor force participation of married women and men with respect to tax progressivity in the model is large when they are taxed individually. In Tables 12 and 13 in the Appendix, we show that this observation is driven by low-income individuals (those with low permanent ability). Making the tax code more progressive lowers the average tax rate on low-income individuals, and this encourages participation. At the same time there is a positive income effect on the LFP of the secondary earner in a couple from a higher average tax rate on the primary earner. Since more women are secondary earners (on average they have lower earnings potential), it is then natural that the effect is stronger for married women than for married men.

Table 7 also shows that LFP is increasing in tax progressivity for single individuals. This is again driven by the response of low-income individuals, see Table 14 in the Appendix. The effect of a more progressive tax system for singles is to lower the average tax rate on low-earners, those who are typically close to the participation margin. There is no income effect from a higher tax on the primary earner in the family, though. However, there is a lifetime income effect from progressive taxation on labor supply due to the idiosyncratic productivity shocks. An individual will optimally choose to work and save when enjoying high labor productivity. With larger tax progressivity, take-home pay in these states of the world declines, reducing lifetime earnings and potentially encouraging participation also in low(er) productivity states in which, with lower progressivity of the tax code, the individual would have decided to stay at home.

To demonstrate the importance of the extensive margin for our results for the Laffer curve, Figure 4 displays this curve obtained in a version of the model where the participation margin of labor supply is removed, so that all individuals work, but can still choose their hours of work along the intensive margin.[32] The key observation is that in this version of our model there is little difference between the Laffer curves that we obtain for joint and individual taxation of married couples; higher tax progressivity unambiguously lowers Laffer curves under both systems.

Figure 5, in contrast, plots the Laffer curves for a version of the model with only an extensive margin of labor supply. We assume that those who choose to work supply hours equal to the corresponding average values for their demographic group in the benchmark model (where we differentiate between married and single men and women). In this case, and in contrast to our results with only intensive margin of labor supply, Laffer curves with individual-based family taxes differ drastically from those that we obtain with joint taxation of families. In particular, with only the extensive margin operational, we obtain the results that are qualitatively similar to those in Figure 2, but quantitatively even stronger.

With joint taxation, it tends to be the case that Laffer curves are decreasing in tax progressivity. In addition, all Laffer curves with individual taxation of families lie noticeably above those with joint family taxation. This clearly demonstrates that the extensive margin of labor supply is the key component in our model that leads to the results we documented in section 6.

[32] And again under the assumption that the additional tax revenues are spent on higher government spending $G$.

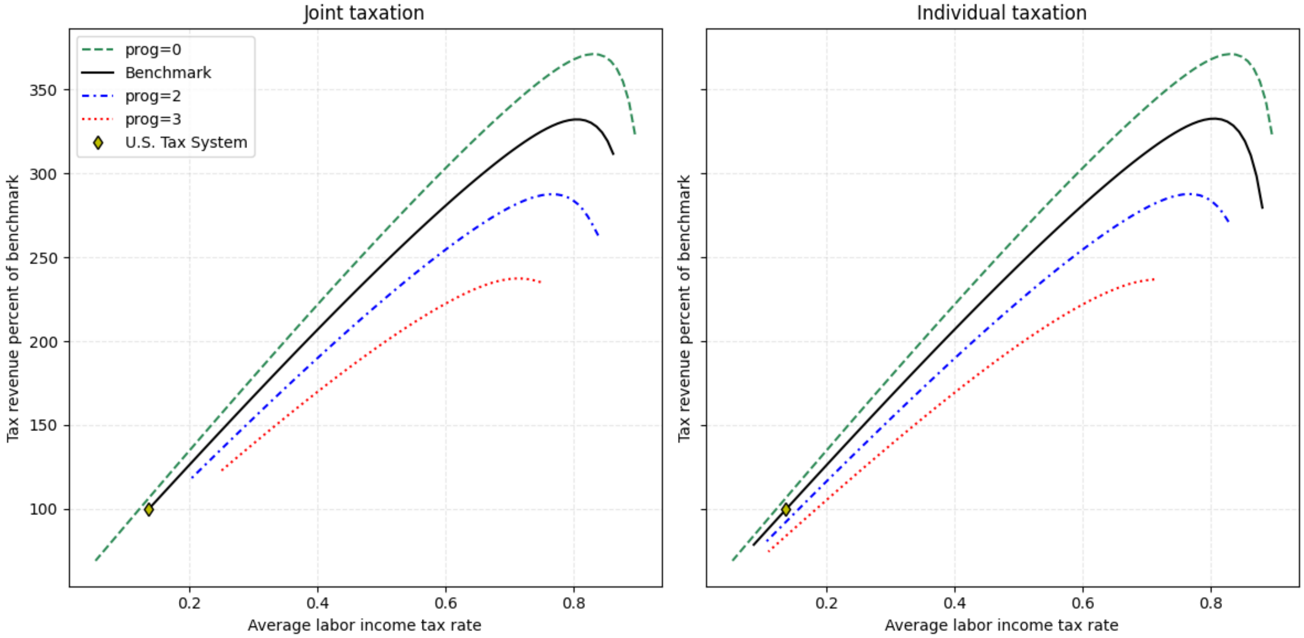


**Figure 4:** Laffer Curves in a Model with Only Intensive Margin (assuming that additional tax revenue is spent on G). Note: the left and right plot have the same y axis.

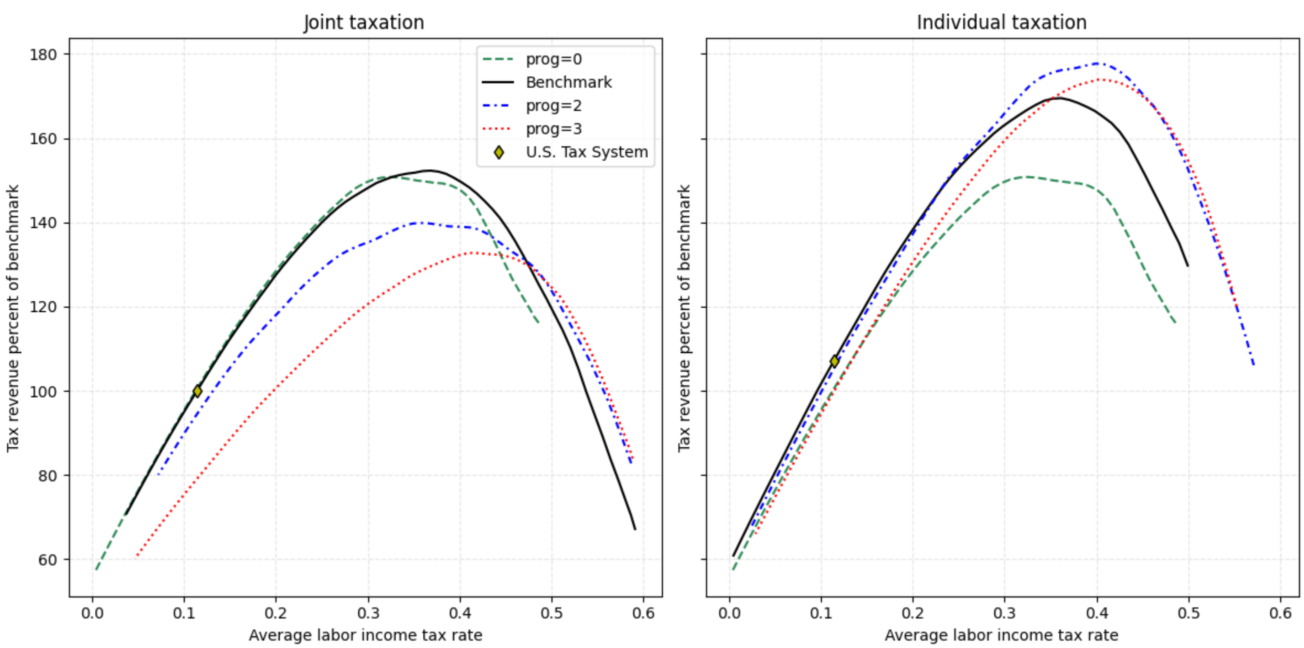


**Figure 5:** Laffer Curves in a Model with Only Extensive Margin (assuming that additional tax revenue is spent on G). Note: the left and right plot have the same y axis.

# 7 Optimal Taxation of Families

Although maximizing tax revenue, and more broadly, tracing out Laffer curves, is important for positive policy analysis as it measures the fiscal space a government still has, it is not the normative end goal. Although our main focus is on the positive analysis of Laffer curves, our model also naturally lends itself to optimal tax policy exploration. To conduct this analysis, we now search for the optimal tax system in the same way as we draw Laffer curves. Our initial welfare objective is to maximize expected life time utility of an unborn individual entering the economy at age 20.

To do so, we start from the benchmark tax level and progressivity and, keeping relative tax levels and tax progressivity between married and single individuals constant, change the progressivity of the tax system by multiplying $\theta_1^M$ and $\theta_1^S$ by the *same* constant, $\varpi_1$. We conduct this analysis under the assumption that government spending, $G$, and the lump-sum transfer to households, $g$, stay at their benchmark levels. We clear the government budget constraint by adjusting the tax level (multiplying $\theta_0^M$ and $\theta_0^S$ by another constant, $\varpi_0$). In other words we are searching for the most efficient way to rise a fixed amount of revenue. This is the classic optimal taxation exercise in the public finance literature and has the advantage of not having to take a stance on the extent to which government spending yields utility enhancing public goods or services in our normative analysis. We first explore the tax system that maximizes steady state welfare, and then, in Subsection 7.2 argue that the welfare gains we will document are robust to an explicit modeling of the economic transition induced by an unanticipated reform of the tax code towards the steady state optimum. We should note that ours is a small open economy, and therefore the main reasons why steady state welfare analysis can lead to misleading results (the policy affecting the capital stock and therefore wages in general equilibrium) are by construction absent.

## *7.1 The Optimal Steady State Tax System*

Table 8 displays the results of optimizing ex ante steady state welfare of a newborn individual, both for a tax system in which married couples are taxed jointly and under separate taxation. Broadly speaking, conditional on not changing the tax unit (i.e., maintaining the status quo of joint taxation), the welfare gains from reforming the level and progressivity of the tax system are small, in the order of 0.1% of lifetime consumption, see the first row of the table.[33] This welfare gain is attained with a less progressive tax (50% less progressive than the benchmark) and with an average tax rate of 11.5%.

Shifting to a separate, individual-based tax system engenders larger welfare gains, based on the insights from the Laffer curve analysis that individual taxation in general delivers higher revenue for similar average tax rates (in turn allowing the average tax rate to be lowered when targeting the same revenue). As Table 8 (second row) shows, the optimal tax system is about 10% more

[33] The welfare gain in consumption equivalents, assuming a utilitarian social welfare function, are calculated as described in Appendix A.4.

**Table 8:** Maximizing Welfare with Joint and Individual Taxation

| Tax System | Optimal Progressivity (U.S.=1) | $\bar{\tau}(y)$ | Welfare Gain (% of benchmark $c$) |
|---|---|---|---|
| Joint | 0.5 | 11.5% | 0.08% |
| Individual | 1.1 | 9.1% | 0.77% |

The table displays the optimal levels of tax progressivity, the average tax rate that clears the government budget constraint and the average welfare gain in % of benchmark consumption with joint and individual taxation of married couples. Government spending adjusts to guarantee budget balance of the government.

**Table 9:** Welfare Gains by Ability, Age, Gender, and Marital status

| | | Men | | Women | |
|---|---|---|---|---|---|
| Ability | Age | Married | Single | Married | Single |
| 1 | 20 | 0.127 | 0.409 | -0.456 | 0.027 |
| 1 | 45 | 2.663 | 1.396 | 1.302 | 2.530 |
| 1 | 65 | 5.322 | 3.187 | 3.602 | 3.174 |
| 3 | 20 | 0.980 | 0.836 | 0.924 | 0.832 |
| 3 | 45 | 2.432 | 0.400 | 2.617 | 1.222 |
| 3 | 65 | 4.389 | 0.705 | 4.754 | 1.625 |
| 5 | 20 | 1.900 | 0.854 | 2.532 | 1.769 |
| 5 | 45 | 2.387 | -0.919 | 3.249 | -0.548 |
| 5 | 65 | 3.642 | -0.764 | 4.333 | -0.575 |
| All | 20 | 1.018 | 0.733 | 1.018 | 0.810 |
| All | 45 | 2.466 | 0.376 | 2.466 | 1.111 |
| All | 65 | 4.487 | 1.038 | 4.487 | 1.573 |

The table displays the steady state welfare gains from the optimal tax reform for different demographic groups.

progressive than the current U.S. system with an average tax rate of about 9.1%. The welfare gain with the optimal tax system is about 0.8%, which is substantial, especially considering that the reform only concerns the labor income tax system and keeps other taxes as well as the social security system unchanged.

To decompose and better understand the aggregate welfare gains, Table 9 displays these gains from the optimal tax reform by permanent ability of individuals, age, gender and marital status. Almost all demographic groups benefit from the reform to an individual-based, slightly more progressive tax schedule (the exceptions being young, married women of the lowest ability and older singles of the highest ability). Older people tend to benefit from the reform even more than the young, even though our welfare criterion for determining the optimal system was based on expected lifetime utility of the (unborn) young. The reason is that a larger income tax base due to an increase in employment also generates higher social security payments from the balanced-budged PAYGO system in the model.

On average both singles and married of all ages like the reform. Higher labor force participation with individual taxation allows for a lower average tax rate (and the aforementioned more generous social security benefits). Young married women of the lowest ability dislike the reform because many of them used to not participate in the labor force, while their high-earning husbands did bring home a sizable net paycheck under joint taxation. Now these women work, but without improving the family budget (since after-tax earnings of the spouse are now lower).[34] In Table 12 in the Appendix we show that most of the increase in female employment associated with a reform towards individual taxation is due to women with lowest permanent ability. The reason that older singles with highest permanent ability (of both genders) also lose (significantly) is due to the increase in tax progressivity, which, as highest earners in the economy, affects them adversely.

### *7.2 Transition to the Optimal Steady State*

In order to evaluate whether the previously documented steady state welfare gains from a reform towards a (somewhat more progressive) individual-based tax system are robust to an explicit consideration of the transitional dynamics induced by the (unexpected) reform, we now explicitly study the transition path. Starting from the calibrated benchmark steady state at $t = 0$, at $t = 1$ the government permanently changes to separate taxation and changes the tax progressivity to the level that *maximizes steady-state welfare*, as reported in Table 8 above. To ensure budget balance, the coefficient $\varpi_0$, which multiplies $\theta_0^M$ and $\theta_0^S$ and governs the tax level, needs to adjust in every period. As we approach the new steady state, the average tax rate adjusts to exactly the same level as in Table 8.

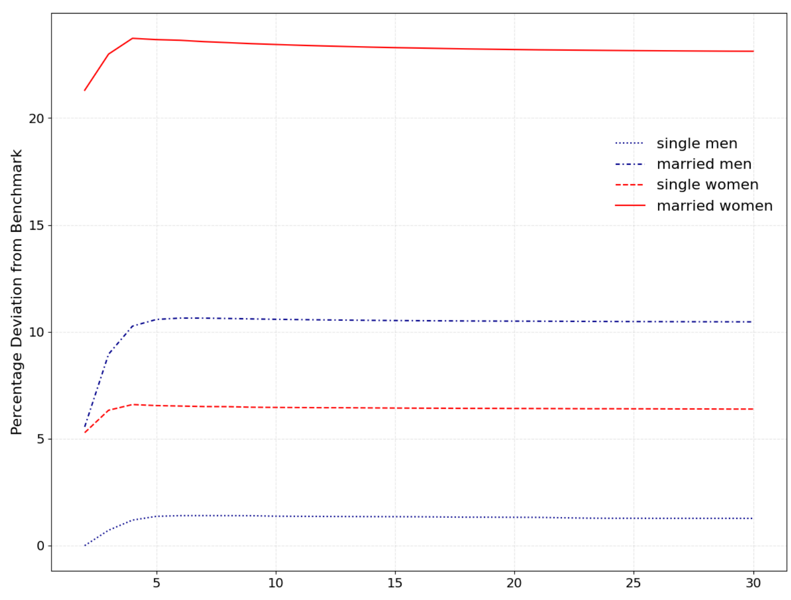


**Figure 6:** Labor Force Participation Along the Transition Path

[34]It might then be surprising that low-ability married men do not lose from the reform. Note, however, that these men and women do not live in the same type of families, due to imperfect sorting by ability. Families with low ability men tend to be poorer than families with low-ability women, and thus for them an increase in tax progressivity is more favorable than for married couples with low ability women. The LFP of the secondary earners (often the low-ability man) was also higher before the reform, compared to the families with low-ability women.

Figure 6 displays the labor force participation rates of single as well as married women and men along the transition path, whereas Figure 7 shows how aggregate hours, output, consumption and assets held by the private sector evolve over time. Finally, Figure 8 depicts the welfare consequences (measured again in terms of consumption equivalent variation) from the reform for different generations and time periods, both for newborn individuals (based on expected lifetime utility) as well as for a utilitarian aggregate of lifetime utilities of all individuals alive at that time.

Both participation rates as well as aggregate hours and output jump up upon impact of the tax reform, and show a hump-shaped evolution along the transition. Initially, the tax reform leads to a significant decline in average tax rates for most individuals that are close to the participation margin, especially secondary earners. This encourages labor force participation, boosting output in return.[35] Private asset accumulation and consumption rises throughout the transition towards the new steady state. As the economy accumulates more savings and experience, participation and hours drop below their peaks, but still remaining at a higher level than before the tax reform.

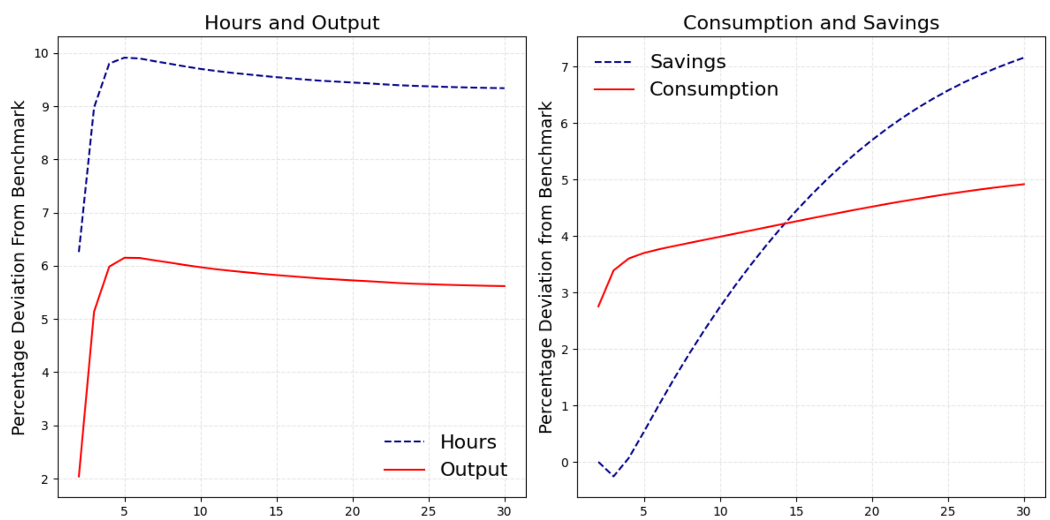


**Figure 7:** Hours Worked, Consumption, Output and Savings Along the Transition Path

Finally, we observe that most of the welfare gains for a newborn individual are realized almost immediately after the change in tax policy. There is also an initial jump in the average welfare in the population of about 0.6%. The optimal steady state policy policy with individual taxation and a relatively low average tax rate is beneficial for currently working generations and leads to an immediate jump in the labor force participation. And since PAYGO social security benefits rise, this reform is also welfare improving for older generations that receive a higher pension.

The results in this section confirm that the welfare gains from a steady-state optimal system extend to transitional generations, despite the fact that the welfare of these generations played no role in the determination of the optimal policy of the government in the previous section.

[35] The increase in output is smaller than the increase in hours because less productive individuals get drawn into participation under the reformed tax system.

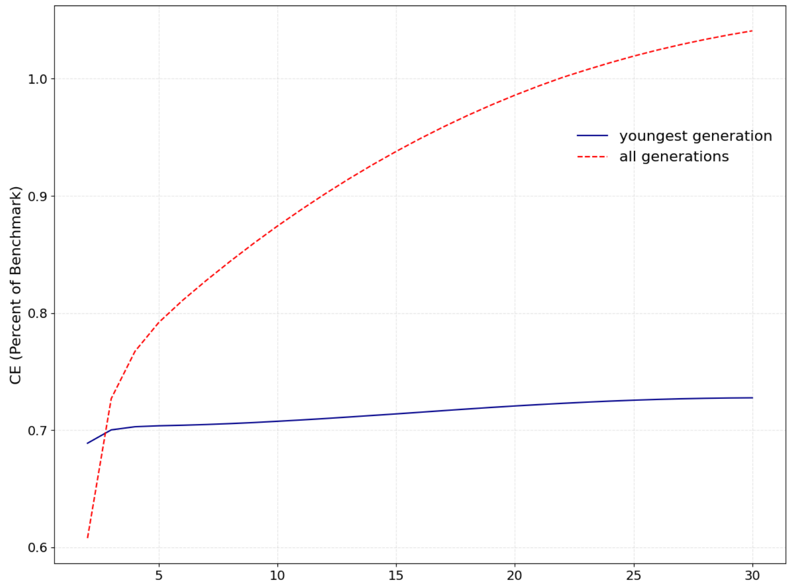


**Figure 8:** Welfare in Consumption Equivalent Units Along the Transition Path

# 8 Conclusion

In this paper we show that the U.S. could gain, both in terms of revenue and welfare, by changing to a relatively progressive tax system where married couples are taxed separately. We demonstrate, in cross-country micro data and in a heterogeneous agent dynamic macro model, that a separate, progressive tax system encourages labor force participation. Thus, it leads to a higher level of human capital in the economy, more fiscal space and higher welfare.

Our paper seeks to inform recent policy reform debates concerning the taxation of couples, such as the discussion of the "Ehegattensplitting" in Germany. We argue that reforms towards separate taxation do not only encourage female labor force participation and thus a more equal distribution of incomes within couples, but when combined with more tax progressivity, also more participation of single women towards the bottom of the (potential) earnings distribution. These distributional benefits from increased participation are combined, especially in the long run, with a higher aggregate distribution of human capital and bigger capacity of the government to raise tax revenue. Thus, up to a point, there need not be a trade-off between aggregate efficiency and redistributional concerns when raising the progressivity of the tax code, as long as the tax unit is the individual rather than the household.

Our (what we think are novel) empirical estimates of tax jointness for different countries suggest that many countries are characterized by mixed systems, indicating that moving the model-based analysis beyond the dichotomy of pure jointness and pure separateness is an interesting and empirically relevant next step, which we leave for future research.

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# A Appendix

## *A.1 Definition of a Recursive Competitive Equilibrium*

We model a small open economy where the factor prices are given exogenously. We call an equilibrium of the growth-adjusted small open economy a stationary equilibrium.[36] Let $\zeta^M = (k, e^{\mathrm{m}}, e^{\mathrm{w}}, u^{\mathrm{m}}, u^{\mathrm{w}}, a^{\mathrm{m}}, a^{\mathrm{w}}, F^{M\mathrm{m}}, F^{M\mathrm{w}}, j)$ be a vector of state variables for a married household, and similarly let $\zeta^S = (k, e, u, a, \iota, F^{\iota}_S, j)$ be a vector of state variables for a single household. Let $\Phi^M(\zeta^M)$ be the measure of married households with the corresponding characteristics, and let $\Phi^S(\zeta^S)$ be the measure of single households. We now define such a stationary recursive competitive equilibrium as follows:

*Definition:*

1. The value functions $V^M(\zeta^M)$ and $V^S(\zeta^S)$ and policy functions, $c(\zeta^M)$, $k(\zeta^M)$, $n^{\mathrm{m}}(\zeta^M)$, $n^{\mathrm{w}}(\zeta^M)$, $c(\zeta^S)$, $k(\zeta^S)$, and $n(\zeta^S)$ solve the consumers' optimization problem given the factor prices and initial conditions.

2. Given the factor prices, firms choose capital and labor input so that the following optimality conditions are satisfied:

$$
\begin{aligned}
w &= (1-\alpha)\left(\frac{K}{L}\right)^{\alpha} \\
r &= \alpha\left(\frac{K}{L}\right)^{\alpha-1} - \delta
\end{aligned}
$$

3. The government budget balances:

$$
\begin{aligned}
g\left(2\int d\Phi^M + \int d\Phi^S\right) + G + \nu\left(\int_{j<46}\left(\mathbb{1}_{[n^{\mathrm{m}}=0]} + \mathbb{1}_{[n^{\mathrm{w}}=0]}\right) d\Phi^M + \int_{j<46} \mathbb{1}_{[n^{\iota}=0]} d\Phi^S\right) \\
= \int\left(\tau_c c + T^M\left(n^{\mathrm{m}}w^{\mathrm{m}}, n^{\mathrm{w}}w^{\mathrm{w}}\right)\right) d\Phi^M \\
+ \int\left(\tau_c c + T^S\left(nw\right)\right) d\Phi^S + \tau_k r K
\end{aligned}
$$

4. The social security system balances:

$$
\Psi\left(2\int_{j\geq 46} d\Phi^M + \int_{j\geq 46} d\Phi^S\right) = \int_{j<46}(T_{ss}(n^{\mathrm{m}}w^{\mathrm{m}}) + T_{ss}(n^{\mathrm{w}}w^{\mathrm{w}}))d\Phi^M + \int_{j<46} T_{ss}(nw)d\Phi^S
$$

[36] the associated BGP can of course trivially be constructed by scaling all appropriate variables by the growth factor $Z_t$.

5. The assets of the dead are uniformly distributed among the living:

$$\Gamma\left(\int d\Phi^M + \int d\Phi^S\right) = \int (1-\omega(j))\, k' d\Phi^M + \int (1-\omega(j))\, k' d\Phi^S$$

6. The labor market clears:

$$L = \frac{1}{w}\left(\int \left(n^{\mathrm{m}}\widetilde{w}^{\mathrm{m}} + n^{\mathrm{w}}\widetilde{w}^{\mathrm{w}}\right) d\Phi^M + \int \left(n\widetilde{w}\right) d\Phi^S\right)$$

where $\widetilde{w} = w(a, e, u, \iota)$ are the individual wages that depend both on individual's characteristics and the market wages per efficiency units of labor, as described in section 4.4.

Note that because we assume a small open economy, the capital market does not have to clear domestically. Capital flows in or out of the economy to ensure a constant ratio between capital and labor.

### *A.2 Computational Details*

We put boundaries on the capital space and pick a 16 point grid in $K = [0, k^{max}]$. Capital is the only continuous state variable, which is also a choice variable. We interpolate years of experience using 6 grid points in $E = [0, e^{max}]$, where the maximum experience in a given period of life, $j$, would be, $j-1$. Following the method outlined by Tauchen (1986), we approximate the processes for the idiosyncratic productivity shocks, $u$, as finite state Markov processes. We use 5 equally spaced states for $u$ in $U = [-\frac{3}{2}\sqrt{\frac{\sigma_\epsilon^{\iota 2}}{1-\rho^{\iota 2}}}, \frac{3}{2}\sqrt{\frac{\sigma_\epsilon^{\iota 2}}{1-\rho^{\iota 2}}}]$. We also discretize the distributions of permanent ability and fixed disutility of work[37]} using 5 equally spaced grid points, $a \in A = [-\frac{3}{2}\sigma_a^\iota, \frac{3}{2}\sigma_a^\iota]$ and $F_X^\iota \in F = [\mu_{F_X^\iota} - \frac{3}{2}\sigma_{F_X^\iota}, \mu_{F_X^\iota} + \frac{3}{2}\sigma_{F_X^\iota}]$, $X \in \{M, S\}$. Let $J = \{1, ..., 80\}$ (age 20-100) be the state space for age. The state space for working age married individuals is then: $K \times E \times E \times U \times U \times A \times A \times F \times F \times J$. Letting $I = \{m, f\}$ be the state space for gender, the state space for working age single individuals is: $I \times K \times E \times U \times A \times F \times J$. For retired individuals, it is: $K \times J$ both for singles and for married. We compute the household's optimal policies for each state by iterating backwards. We start from age 100, the last possible period of life. In that period, the next period's value function is 0, and the optimal policy is to consume as much as possible. Knowing the value function at age 100, we can compute optimal policies and value functions for age 99, and so on. The labor market participation decisions are discrete, and so we compare the different options. For each choice of labor market participation, we must solve for the optimal level of consumption, assets for the next period as well as optimal work hours in the cases where the individual(s) are participating in the labor market. We find the optimal choice of consumption by "golden search". The choice of consumption implies the choice

[37] For married women we discretize the time invariant component, $F_M^{w0}$.

of work hours through the intratemporal optimality condition, which then implies the choice of next period's assets through the household budget constraint. To interpolate next period's value function outside of the grid, we use cubic splines.

### A.2.1 Simulation

We simulate an overlapping generations economy with 160,000 men and 160,000 women in each identical generation. Knowing today's state, the policy functions, and next period's marital status, we can find the next period's state. To determine next period's marital status, we draw a random number, $\nu \in (0,1)$, for every single individual and every married couple in each time period. We use the age dependent probabilities for divorce and marriage to determine whether a single individual is going to marry or a couple is going to split. Section A.6 describes the matching process in greater detail.

### A.2.2 Stationary Recursive Competitive Equilibrium

When we compute a steady state recursive competitive equilibrium we must have equilibrium in the marriage market, in the sense that single individuals have rational expectations about their potential partners in the next period. This expectation must be taken with respect to asset holdings, experience, idiosyncratic productivity shock, permanent ability and fixed disutility of work. Let $Q^{\iota}(e,k,u,a,F,j)$ be a matrix with the distribution of singles. $Q$ is an equilibrium object that has to be updated when computing equilibrium. In addition we must update the lumpsum transfer to households, $g$, the average earnings in the economy, $AE$ (an argument in the tax function), the amount of assets inherited from dying households, $\Gamma$, and the social security benefit, $\Psi$. A stationary recursive competitive equilibrium can thus be computed as follows:

1. Guess $Q^{\iota}_i$, $g_i$, $AE_i$, $\Gamma_i$, $\Psi_i$
2. Given the values of the equilibrium objects compute the value functions $V^M(\zeta^M)$ and $V^S(\zeta^S)$ and policy functions, $c(\zeta^M)$, $k(\zeta^M)$, $n^{\mathrm{m}}(\zeta^M)$, $n^{\mathrm{w}}(\zeta^M)$, $c(\zeta^S)$, $k(\zeta^S)$, and $n(\zeta^S)$
3. Simulate the model and obtain $Q^{\iota}_{i+1}$, $g_{i+1}$, $AE_{i+1}$, $\Gamma_{i+1}$, $\Psi_{i+1}$
4. Iff $|Q^{\iota}_{i+1} - Q^{\iota}_i| < \epsilon$, $|AE_{i+1} - AE_i| < \epsilon$, $|g_{i+1} - g_i| < \epsilon$, $|\Gamma_{i+1} - \Gamma_i| < \epsilon$ and $|\Psi_{i+1} - \Psi_i| < \epsilon$, where $\epsilon$ is some tolerance level we are done. Otherwise we update the guesses of $Q^{\iota}_i$, $g_i$, $AE_i$, $\Gamma_i$, $\Psi_i$.

### A.2.3 Transition Equilibrium

To compute an equilibrium on the transition path from the initial steady state to the a new steady state with a socially optimal tax system, the key difference is that all the equilibrium objects need to be indexed by time, $t$, and we must compute time-dependent value and policy functions. Assuming that the initial steady state is known, we can compute the transition path with $T$ time periods as follows:

1. Guess $Q^{\iota}_{ti}$, $\varphi_{ti}$, $AE_{ti}$, $\Gamma_{ti}$, $\Psi_{ti}$
2. Given the values of the equilibrium objects compute the value functions $V^M_t(\zeta^M)$ and $V^S_t(\zeta^S)$ and policy functions, $c_t(\zeta^M)$, $k_t(\zeta^M)$, $n^{\mathrm{m}}_t(\zeta^M)$, $n^{\mathrm{w}}_t(\zeta^M)$, $c_t(\zeta^S)$, $k_t(\zeta^S)$, and $n_t(\zeta^S)$, starting from the final time period, $T$, and moving backwards.
3. Simulate the model forward, starting from the initial steady state, and obtain $Q_{ti+1}$, $g_{ti+1}$, $AE_{ti+1}$, $\Gamma_{ti+1}$, $\Psi_{ti+1}$
4. Iff $|Q^{\iota}_{ti+1} - Q^{\iota}_{ti}| < \epsilon$, $|AE_{ti+1} - AE_{ti}| < \epsilon$, $|g_{ti+1} - g_{ti}| < \epsilon$, $|\Gamma_{ti+1} - \Gamma_{ti}| < \epsilon$ and $|\Psi_{ti+1} - \Psi_{ti}| < \epsilon$, where $\epsilon$ is some tolerance level we are done. Otherwise we update the guesses of $Q^{\iota}_{ti}$, $g_{ti}$, $AE_{ti}$, $\Gamma_{ti}$, $\Psi_{ti}$.

### *A.3 Tax Function*

Our augmented tax function in the main text was given by equation (2), which is reproduced here for convenience:

$$y_{\text{net}} = y_1 + y_2 - T(y_1, y_2) = \theta_0 \left( (y_1)^{1-\theta_1\varphi} + (y_2)^{1-\theta_1\varphi} \right)^{\frac{1-\theta_1}{1-\theta_1\varphi}} \tag{17}$$

which implies the tax function:

$$T(y_1, y_2) = y_1 + y_2 - y_{\text{net}} = y_1 + y_2 - \theta_0 \left( (y_1)^{1-\theta_1\varphi} + (y_2)^{1-\theta_1\varphi} \right)^{\frac{1-\theta_1}{1-\theta_1\varphi}} \tag{18}$$

The marginal tax rate of earner 1 is then given by

$$\frac{\partial T(y_1, y_2)}{\partial y_1} = 1 - \theta_0(1-\theta_1) \left( (y_1)^{1-\theta_1\varphi} + (y_2)^{1-\theta_1\varphi} \right)^{\frac{-(1-\varphi)\theta_1}{1-\theta_1\varphi}} y_1^{-\theta_1\varphi} \tag{19}$$

Differentiating this marginal tax rate (19) with respect to earnings $y_2$ of the other spouse delivers

$$\frac{\partial^2 T(y_1, y_2)}{\partial y_1 \partial y_2} = \theta_0(1-\theta_1)(1-\varphi)\theta_1 \left( (y_1)^{1-\theta_1\varphi} + (y_2)^{1-\theta_1\varphi} \right)^{\frac{-(1-\varphi)\theta_1}{1-\theta_1\varphi}-1} y_1^{-\theta_1\varphi} y_2^{-\theta_1\varphi} \tag{20}$$

as stated in equation (4) in the main text.

### *A.4 Cardinal Measure of Welfare Gains from Policy Reform*

Consider a household with discount factor $\beta$ that has unconditional probability, at birth (i.e. age 1 in our model) of survival until age $j$ of $\Omega_j \in [0, 1]$ which is weakly decreasing in age $j$. The household has period utility function that is logarithmic in consumption and separable in everything else. Let $v(s)$ denote expected lifetime utility of a household at economic age 0 born with idiosyncratic state $s$ and by

$$W = \int v(s)d\Phi(s) \tag{21}$$

utilitarian social welfare (or expected lifetime utility before one's type is realized). Note that $\int d\Phi(s) = 1$, that is, the initial distribution over types integrates to 1.

**Claim A.1.** *Fix an initial state $s$ and an allocation of consumption and labor. Denote by $v(s)$ the associated expected lifetime utility. Now scale consumption up by a factor $1 + g(s)$ in each period of life, in all states of the world, leaving the labor allocation unchanged, and denote the resulting expected lifetime utility from that allocation by $v(s; g)$. Then*

$$v(s; g) = v(s) + \left(\sum_{j=0}^{J} \beta^j \Omega_j\right) \log(1 + g(s)) \tag{22}$$

*Similarly, since $\Phi$ integrates to 1 and all individuals have the same discount factor and survival probabilities, utilitarian social welfare satisfies*

$$W(g) = W + \left(\sum_{j=0}^{J} \beta^j \Omega_j\right) \log(1 + g) \tag{23}$$

Finally, denote by $v(s; \tau)$ lifetime utility under an alternative tax system, with $W(\tau)$ being defined accordingly. Finally, let $g(s; \tau)$ and $g(\tau)$ denote the CEV (permanent percentage increase in consumption) needed to make an individual $s$ indifferent between the benchmark tax system and the alternative tax system $\tau$.

**Corollary A.2.** *The numbers $g(s; \tau)$ and $g(\tau)$ satisfy*

$$v(s; g(s; \tau)) = v(s; \tau) \tag{24}$$

$$W(g(\tau)) = W(\tau) \tag{25}$$

*Thus, given knowledge of the value functions we can compute them (expressed in percentage terms)*

$$g(s; \tau) = 100 * \left[\exp\left(\frac{v(s; \tau) - v(s)}{\sum_{j=0}^{J} \beta^j \Omega_j}\right) - 1\right] \tag{26}$$

$$g(\tau) = 100 * \left[\exp\left(\frac{W(\tau) - W}{\sum_{j=0}^{J} \beta^j \Omega_j}\right) - 1\right] \tag{27}$$

Obviously, since $g(\tau)$ is a monotonically increasing function of $W(\tau)$, maximizing $W(\tau)$ is equivalent to maximizing $g(\tau)$ but the latter gives a cardinal measure of the welfare gains. The way it is expressed, the units are "percent of permanent consumption". The number $g(s; \tau)$ is interpreted analogously, but conditions on $s$ and thus takes an ex interim perspective. Note that since the value function is not linear, $g(\tau)$ is not the population-weighted sum of the $g(s;\tau)$.

### A.5 Estimation of Returns to Experience and Shock Processes From the PSID

We estimate the log(wage) equation in (10) using data from the non-poverty sample of the PSID 1968-1997. Equation (11) is estimated using the residuals from (10).

To control for selection into the labor market, we use Heckman's 2-step selection model. For individuals of gender $\iota$ who are working and for which we observe wages, the wage depends on years of labor market experience, $e$, as well as dummies for the year of observation, $D$:

$$log(w_{it}) = \beta_0^\iota + D_t\zeta_t^\iota + \gamma_1^\iota e_{it} + \gamma_2^\iota e_{it}^2 + \gamma_3^\iota e_{it}^3 + \delta\widehat{\lambda}_{it} + u_{it} \tag{28}$$

Labor market experience is the only observable individual determinant of wages in the model apart from gender. $\widehat{\lambda}_{it} = \frac{\phi(Z'_{it}\xi)}{\Phi(Z'_{it}\xi)}$ is the inverse Mills ratio estimated in the first step (where $\phi$ and $\Phi$ are the normal pdf and cdf functions). We assume that the probability of participation (or selection equation) depends on various individual demographic characteristics, $Z_{it}$: marital status, age, the number of children, years of schooling, time dummies, and an interaction term between years of schooling and age.
To obtain the parameters, $\sigma^\iota$, $\rho^\iota$ and $\sigma_{\alpha^\iota}$ we obtain the residuals $u_it$ and use them to estimate the below equation by fixed effects estimation:

$$u_{it} = \alpha_i + \rho u_{it-1} + \epsilon_{it} \tag{29}$$

The parameters can be found in Table 3.

### A.6 Matching of Individuals in Marriage

Single households face an age-dependent probability, $M(j)$, of becoming married, whereas married households face an age-dependent probability, $D(j)$, of divorce. There is assortative matching in the marriage market, in the sense that there is a greater chance of marrying someone with similar ability, a fact that singles rationally foresee.

To implement assortative matching numerically, we introduce the match index, $M_n$, in the simulation stage of our computational algorithm. $M_n$ is a convex combination of a random shock, $\varsigma \sim U[0,1]$ and permanent ability, $a$:

$$M_n = (1-\psi)\varsigma + \psi a \tag{30}$$

where $\psi \in [0,1]$. Single men and women matched to get married in this period are sorted, within their gender, based on $M_n$, and assigned the partner of the opposite gender with the same rank.

The parameter, $\psi$, thus determines the degree of assortative matching, based on ability. If $\psi = 0$, then matching is random and if $\psi = 1$ spouses will be perfectly sorted by ability rank.

Singles have rational expectations with respect to potential partners. The matching function in Equation 30 implies conditional probabilities for marrying someone of ability, $a'$, given an individual's own ability, $a$. Conditional on gender, age and permanent ability, we also keep track of the distribution of singles with respect to assets, labor market experience, female participation costs and idiosyncratic productivity shocks. A single individual can thus have a rational expectation about a potential partner with respect to these characteristics and the expectation will be conditional on the individual's own gender, age and permanent ability.

In section 5 we calibrate the parameter $\psi$ to match the correlation of the wages of married couples in the data. We model the normal distributions of abilities, $a \sim N(0, \sigma_a^{\iota 2})$, using Tauchen (1986)'s method and 5 discrete values of $a$, placed at $\{-1.5\sigma_a^\iota, -0.75\sigma_a^\iota, 0, 0.75\sigma_a^\iota, 1.5\sigma_a^\iota\}$. Given our calibrated value of $\varphi$ we obtain the below matrix of marriage probabilities across ability levels:

$$\phi^{-\iota}(a|a^\iota;\psi) = \begin{bmatrix} 0.509 & 0.442 & 0.049 & 0.000 & 0.000 \\ 0.189 & 0.325 & 0.404 & 0.081 & 0.000 \\ 0.071 & 0.258 & 0.343 & 0.256 & 0.072 \\ 0.000 & 0.076 & 0.401 & 0.330 & 0.193 \\ 0.000 & 0.000 & 0.046 & 0.445 & 0.509 \end{bmatrix}$$

### *A.7 Data Description*

Below we describe the or data on taxes and labor force participation across countries used in the empirical exercise in Section 2.

#### A.7.1 Tax Data from the OECD Tax-Benefit Web Calculator

As explained in section 2, we obtain the data on personal income taxation from the OECD Tax-Benefit web calculator available at https://taxben.oecd.org/index.htm[38]. We use the online tax-benefit calculator to compute the tax liabilities and benefits "by Earnings levels" in each country and each year in our sample. For singles, we collect the data for gross earnings between 0 and 200 percent of the average earnings in a given year and country, in equal steps of 2 percent, while for married couples, we collect the data for all possible combinations of the earnings of the two spouses between 0 and 200 percent of the average earnings in the corresponding year and country. Net after-tax earnings are computed as:

$$Y_{\text{net}} = Y_{\text{gross}} + SA + HB + FB + IW - IT - SC$$

[38]The methodology used by OECD Tax-Benefit calculator is described in detail at https://www.oecd.org/els/soc/OECD-Tax-Benefit-model-Methodology.pdf

where $SA$ is "social assistance", $HB$ is "housing benefits", $FB$ is "family benefits", $IW$ is "in-work benefits", $IT$ is the "income tax" and $SC$ is "social security contributions"[39]. Central, state and local government income taxes are included[40]. The annual housing costs are assumed to be equal to 20 percent of the average wage income.

For married couples, we collect the data for the families with 0, 1, 2 and 3 children. In the families with one child, the age of the child is assumed to be 4. In the families with two children, they are assumed to be of 4 and 6 years of age. Finally, in the families with three children, they are assumed to be of 4, 6 and 8 years of age.

#### A.7.2 The European Labor Force Survey

To compute employment rates in European countries in our sample, we use the EU Labour Force Survey Database. Restricting our data to the individuals between 16 and 64 years of age, and excluding those in compulsory military service, we compute the employment rate as the share of individuals for whom the variable `ILOSTAT` takes on the value of 1 ("employed"). To compute the employment rates in the US, we use the CPS data. For the individuals between 16 and 64 years of age who are not in the armed forces, we classify them as employed if the value of `empstat` variable is equal to either "at work" or "has job, not at work last week".

### *A.8 Estimating Tax Functions using the Data from the OECD Tax-Benefit Web Calculator*

To obtain the estimates for the parameters in our tax functions, we minimize the distance between the net (after-tax) income for each type of household in the data and the one implied by our estimated tax function (expressed in terms of the average income in a given country and year), for each value of the earnings between 20 percent and 200 percent of the average earnings for the single households, and each combination of the earnings of the two spouses in this range for the married households with 0, 1, 2 and 3 children. We perform the minimization using a combination of the global grid search and local search (using the `scipy` library). Our estimates of the tax functions for married couples are a weighted average of the estimates for the families with 0, 1, 2 and 3 children, using the shares of these families in the US as the weights.

To illustrate how the tax functions that we estimate fit the data, figures 9 and 10 show the average tax rates faced by married households with no children in the US and Finland in 2001, defined as:

$$\tau(y_1 + y_2) = \frac{T(y_1, y_2)}{y_1 + y_2}$$

[39] Differently from when we obtain tax data from the OECD, when we obtain U.S. tax data from the NBER TAX SIM, to be used in the calibrated benchmark model, we do not include payroll taxes because the model contains a balanced social security system that is separate from the tax system and the government budget.

[40] The rates applying in the state of Michigan for the United States

**Table 10:** Average Tax Function Parameters by Country

| Country | $\varphi$ | $(1-\theta_0^M)$ | $\theta_1^M$ | $(1-\theta_0^S)$ | $\theta_1^S$ |
|---|---|---|---|---|---|
| Austria | 0.803 | 0.260 | 0.231 | 0.307 | 0.285 |
| Belgium | 0.633 | 0.305 | 0.334 | 0.404 | 0.332 |
| Switzerland | 0.000 | 0.224 | 0.104 | 0.259 | 0.201 |
| Germany | 0.000 | 0.252 | 0.228 | 0.387 | 0.288 |
| Denmark | 1.179 | 0.383 | 0.273 | 0.344 | 0.397 |
| Spain | 1.133 | 0.202 | 0.151 | 0.200 | 0.143 |
| Finland | 1.137 | 0.304 | 0.254 | 0.281 | 0.363 |
| France | 0.076 | 0.163 | 0.174 | 0.262 | 0.257 |
| UK | 1.075 | 0.256 | 0.219 | 0.226 | 0.270 |
| Greece | 1.285 | 0.274 | 0.157 | 0.243 | 0.186 |
| Ireland | 0.282 | 0.069 | 0.282 | 0.206 | 0.331 |
| Iceland | 0.672 | 0.266 | 0.216 | 0.290 | 0.273 |
| Italy | 1.378 | 0.366 | 0.269 | 0.314 | 0.244 |
| Netherlands | 1.217 | 0.370 | 0.240 | 0.332 | 0.369 |
| Portugal | 0.011 | 0.119 | 0.189 | 0.246 | 0.158 |
| Sweden | 1.414 | 0.337 | 0.217 | 0.285 | 0.288 |
| US | 0.028 | 0.142 | 0.163 | 0.251 | 0.156 |

The dashed lines show the ones that we compute from data that we have obtained from the OECD Tax-benefit calculator, while the solid lines show the ones implied by our estimated tax functions. Notice that we did not aim to minimize the distance in terms of these average tax rates when estimating our parametric tax functions (instead, we minimized the distance in terms of the net after-tax income). Nevertheless, our parametric tax functions appear to fit the data along this dimension reasonably well.

Figure 11 displays our family-type-weighted average estimates of the parameters that govern tax level, $\theta_0^M$, and tax progressivity, $\theta_1^M$, for married households in the U.S. over time. In the Figure, we have inserted several large U.S. tax reforms to see how they affected the estimates of tax-level and tax-progressivity. The tax reforms do appear to show up in our estimates. For example, the Bush tax credits from 2008 made the tax schedule more progressive ($\theta_1$ increased) and lowered the average tax rate ($\theta_0$ increased).

Important for a family's choice of having one or two earners is the net added income from the second earner. Figure 12 shows the average tax rate *on the second earner* in a married family with no children, in the US (top panel) and Finland (bottom panel) in 2001, implied by our estimated tax function (as a function of the earnings of both earners). We define the average tax rate on the

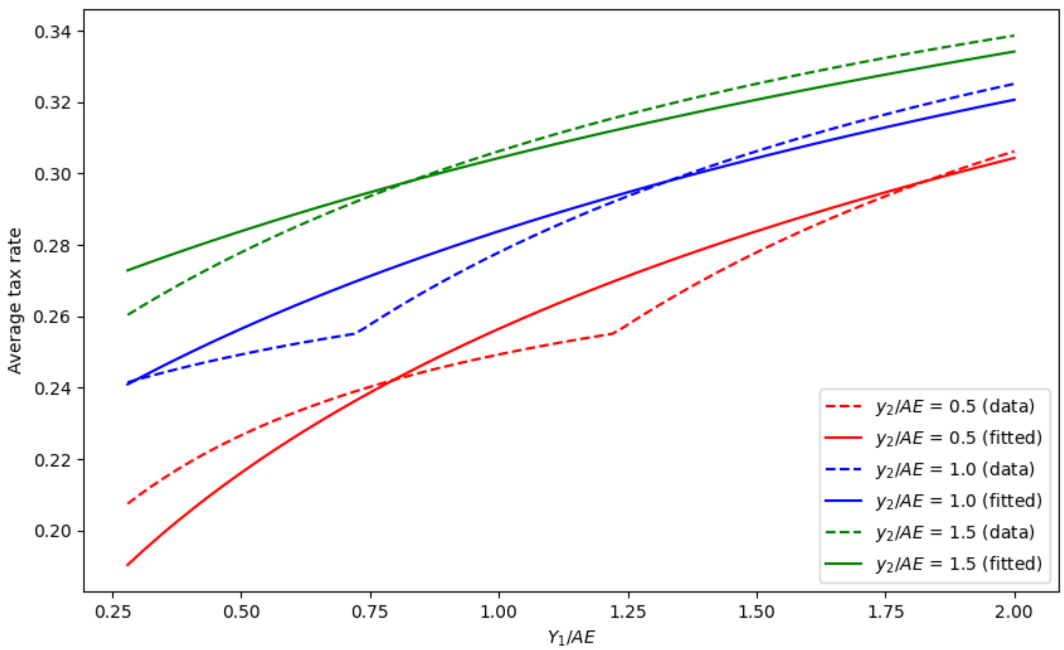


**Figure 9:** Household Average Tax Rate in the US (families without children, 2001)

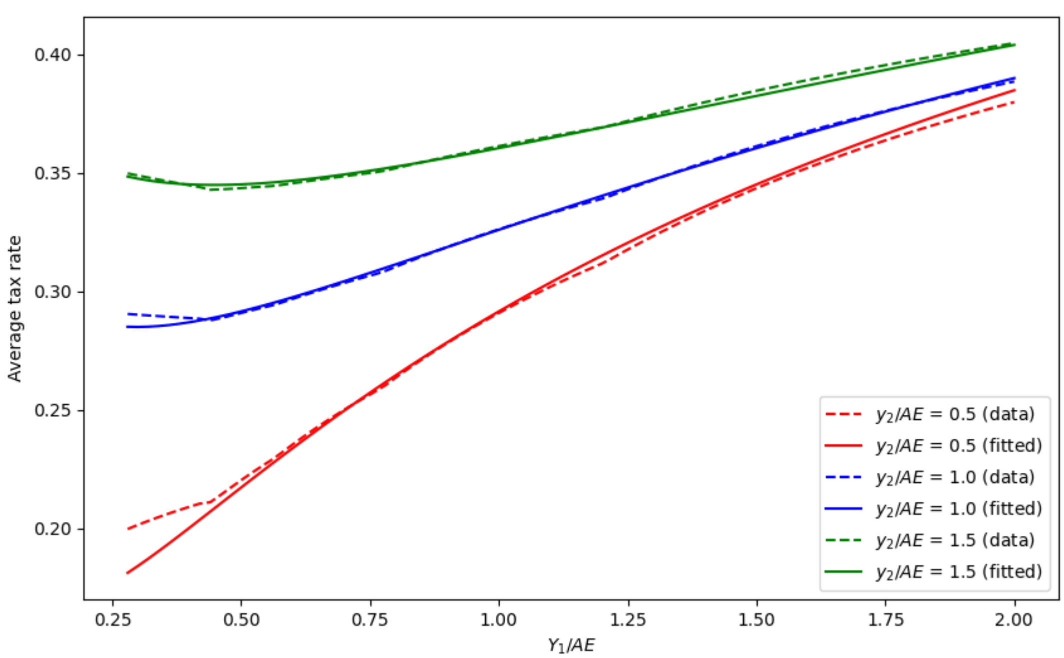


**Figure 10:** Household Average Tax Rate in Finland (families without children, 2001)

second earner's income, keeping the first earner's income constant, as follows:

$$\tau(y_2 \mid y_1) = 1 - \frac{y_{net}(y_1, y_2) - y_{net}(y_1, 0)}{y_2}$$

$$= 1 - \frac{\theta_0 \left( (y_1)^{1-\theta_1 \varphi} + (y_2)^{1-\theta_1 \varphi} \right)^{\frac{1-\theta_1}{1-\theta_1 \varphi}}}{y_2} + \frac{\theta_0 y_1^{1-\theta_1}}{y_2}$$

The top panel of Figure 12 shows that in the US, where our estimates suggest that families are taxed jointly, this average tax rate on the earnings of the secondary earner depends positively on the earnings of both spouses. In contrast to that, in Finland, where our estimates suggest that families are taxed individually ($\varphi$ is close to 1), this average tax rate essentially does not change with the earnings of the first earner ($y_1$).

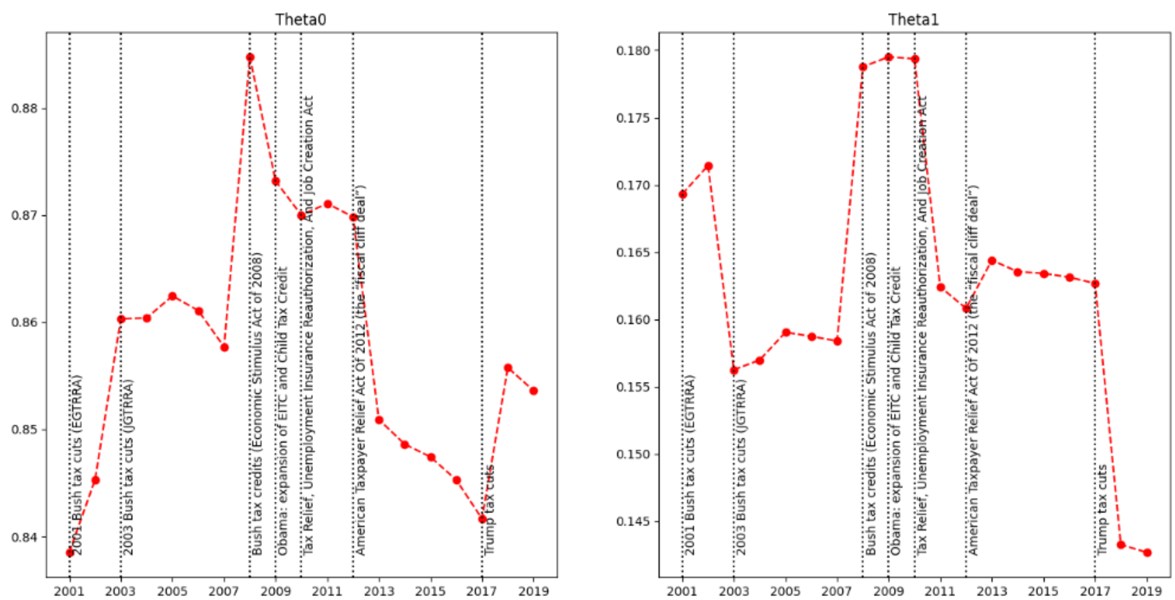


**Figure 11:** Estimated U.S. Tax Function Over Time

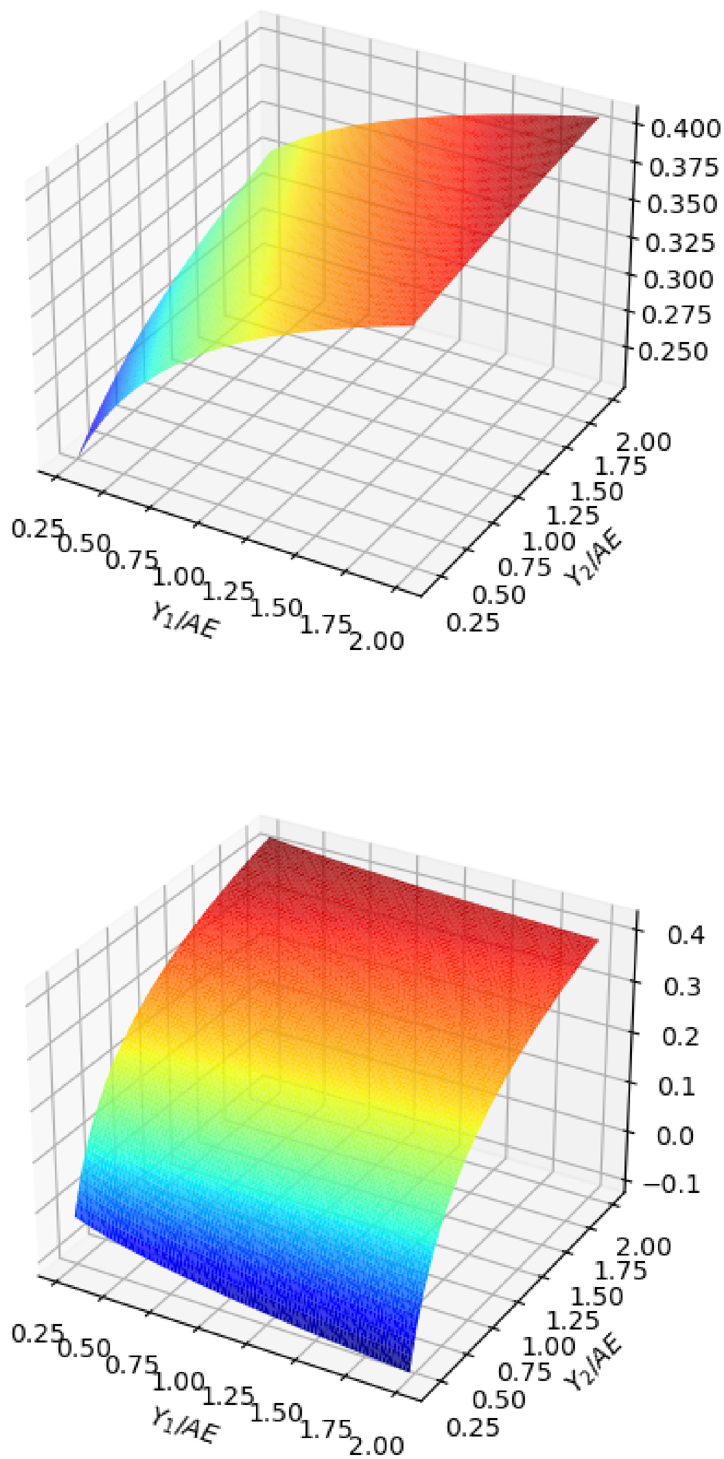


**Figure 12:** Average Tax Rate on the Second Earner in Families Without Children. Top Panel: US (2001). Bottom Panel: Finland (2001)

### A.9 *Estimating Tax Functions using the Data from the NBER TaxSim*

Since OECD Tax-Benefit Web Calculator provides information on taxes for individual earnings only up to 200% of the average earnings, for model calibration we use the estimates of the tax function parameters using the data from the NBER TaxSim database. For married couples, we use the data for all possible combinations of the individual earnings of the two spouses at 201 equidistant points between 30% and 500% of average earnings in each year, for the couples with 0, 1, 2 and 3 children . To supplement that with 2 more points, at individual earnings equal to 550% and 600% of the average earnings, and also add a combination were the secondary earner's labor income is 0. For each possible combination of the earnings of the two spouses, we compute the sum of the federal and state income taxes, and assume that the couples are taxed jointly, which leaves only 2 parameters left to estimate, $\theta_0$ and $\theta_1$. For the singles, we consider all possible earnings at 301 equidistant points between 30% and 500% of the average earnings in a given year, supplemented with 10 additional points equally spaced between 550% and 1000% of the average earnings. We weight the types of households with different number of children using the corresponding shares in the data. Our estimates for $\theta_1$ parameters reported in Table 3 are close to those in Table 10. Note that we do not include social security taxes in this case, since we have a separate social security system in the model.

### A.10 *Additional Figures and Tables*

**Table 11:** Selected Statistics for Joint and Separate Taxation and Different Tax Progressivity (assuming lump-sum transfers clears the budget)

| | Joint Taxation | | | Separate Taxation | | |
|---|---|---|---|---|---|---|
| | Flat tax | US Prog. | 2×US Prog. | Flat Tax | US Prog. | 2×US Prog. |
| Tax Revenue | 102.36 | 100.00 | 92.35 | 102.36 | 103.52 | 98.20 |
| Aggregate Labor Supply | 100.28 | 100.00 | 94.66 | 100.28 | 105.73 | 106.86 |
| Single Male Labor Supply | 87.79 | 100.00 | 104.54 | 87.79 | 93.65 | 98.59 |
| Married Male Labor Supply | 101.70 | 100.00 | 89.55 | 101.70 | 105.87 | 104.39 |
| Single Female Labor Supply | 94.30 | 100.00 | 106.28 | 94.30 | 101.08 | 102.66 |
| Married Female Labor Supply | 113.04 | 100.00 | 85.47 | 113.04 | 119.12 | 120.78 |
| Single Male LFP | 84.51 | 100.00 | 109.28 | 84.51 | 94.33 | 104.47 |
| Married Male LFP | 98.66 | 100.00 | 92.88 | 98.66 | 108.09 | 113.15 |
| Single Female LFP | 88.72 | 100.00 | 114.11 | 88.72 | 102.74 | 113.31 |
| Married Female LFP | 104.89 | 100.00 | 91.85 | 104.89 | 119.95 | 132.55 |
| Single Male Intensive Margin | 103.88 | 100.00 | 95.66 | 103.88 | 99.28 | 94.37 |
| Married Male Intensive Margin | 103.08 | 100.00 | 96.41 | 103.08 | 97.95 | 92.26 |
| Single Female Intensive Margin | 106.29 | 100.00 | 93.14 | 106.29 | 98.39 | 90.61 |
| Married Female Intensive Margin | 107.77 | 100.00 | 93.05 | 107.77 | 99.30 | 91.12 |

The table displays selected model statistics with separate and joint taxation and different model statistics at the benchmark average tax rate of 12%. All numbers are in % of the U.S. Benchmark. Additional tax revenues are redistributed lump-sum back to households.

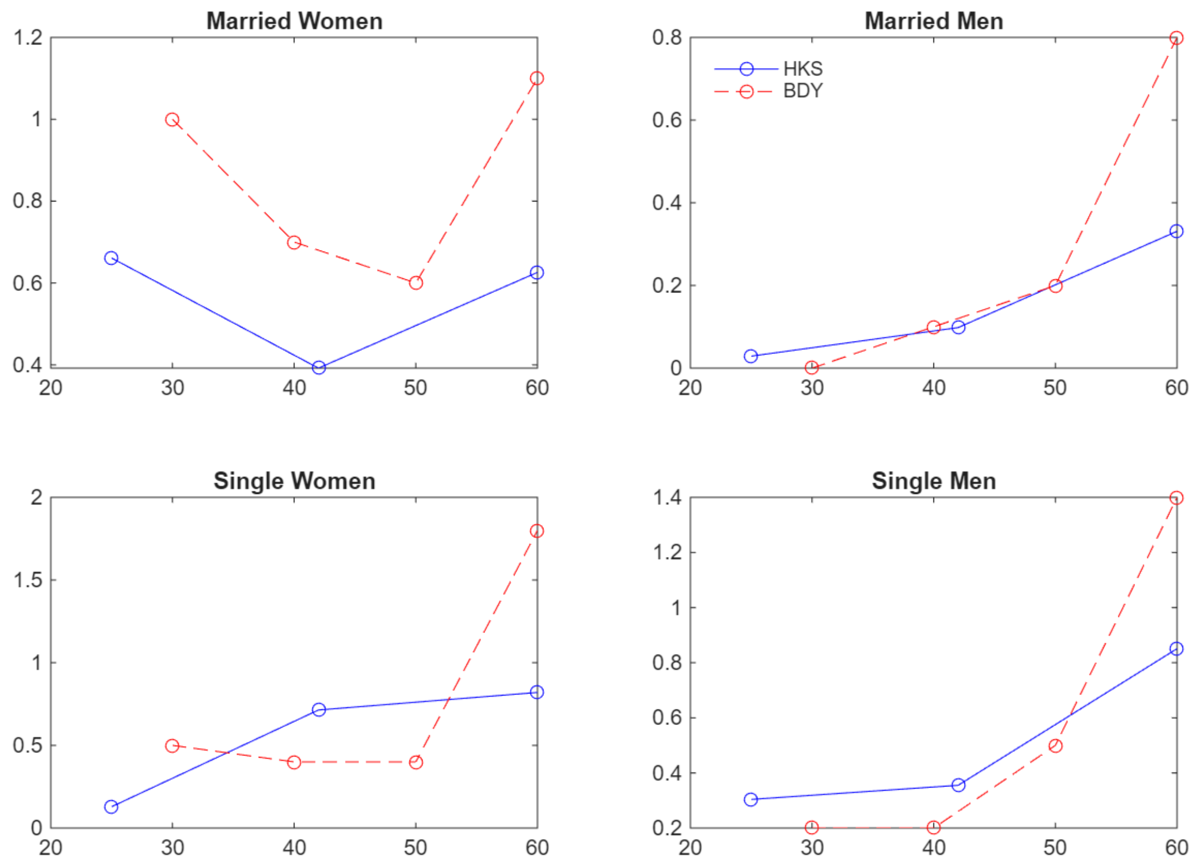


**Figure 13:** Comparing Model-Implied Participation Elasticities from our Model (HKS) to those from Borella, De Nardi and Yang (BDY)

**Table 12:** Percent Change in Married Women's Employment to Tax Changes by Ability and Age

| | **Change to Individual Taxation** | | | | | **Change to Ind. Tax (2X U.S. Prog.)** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Ability** | 20-28 | 29-37 | 38-46 | 47-55 | 56-64 | 20-28 | 29-37 | 38-46 | 47-55 | 56-64 |
| 1 | 68.4 | 54.2 | 37.3 | 37.8 | 39.4 | 154.4 | 104.4 | 84.2 | 85.3 | 77.8 |
| 2 | 43.6 | 29.4 | 27.8 | 27.4 | 28.1 | 77.4 | 47.6 | 41.1 | 39.2 | 54.0 |
| 3 | 26.8 | 22.2 | 18.1 | 21.9 | 25.8 | 40.1 | 32.7 | 31.4 | 35.1 | 41.0 |
| 4 | 18.2 | 13.0 | 11.6 | 11.8 | 22.0 | 21.1 | 16.3 | 14.7 | 18.0 | 30.6 |
| 5 | 6.5 | 4.8 | 6.1 | 9.3 | 15.2 | 7.4 | 6.9 | 8.4 | 11.4 | 22.1 |

The table displays the percent change in married women's employment rate when the tax system is changed from the benchmark system with joint taxation to a system with individual taxation or a system with individual taxation and two times U.S. tax progressivity. In both experiments the average tax rate is kept at the benchmark level.

**Table 13:** Percent Change in Married Men's Employment to Tax Changes by Ability and Age

| | **Change to Individual Taxation** | | | | | **Change to Ind. Tax (2X U.S. Prog.)** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Ability** | 20-28 | 29-37 | 38-46 | 47-55 | 56-64 | 20-28 | 29-37 | 38-46 | 47-55 | 56-64 |
| 1 | 39.7 | 47.3 | 46.3 | 43.5 | 39.0 | 52.2 | 76.2 | 83.3 | 88.8 | 91.7 |
| 2 | 10.0 | 16.0 | 18.2 | 19.5 | 19.1 | 10.7 | 18.6 | 22.7 | 27.0 | 31.6 |
| 3 | 1.4 | 2.9 | 4.0 | 6.4 | 8.0 | 1.4 | 3.0 | 4.4 | 7.5 | 12.4 |
| 4 | 0.0 | 0.1 | 0.6 | 1.7 | 4.1 | 0.0 | 0.1 | 0.6 | 1.8 | 5.4 |
| 5 | 0.0 | 0.0 | 0.0 | 0.3 | 1.9 | 0.0 | 0.0 | 0.0 | 0.3 | 2.4 |

The table displays the percent change in married men's employment rate when the tax system is changed from the benchmark system with joint taxation to a system with individual taxation or a system with individual taxation and two times U.S. tax progressivity. In both experiments the average tax rate is kept at the benchmark level.

**Table 14:** Percent Change in Single Women's and Men's Employment After a Change to a Tax System With Double Progressivity

| | **Women** | | | | | **Men** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Ability** | 20-28 | 29-37 | 38-46 | 47-55 | 56-64 | 20-28 | 29-37 | 38-46 | 47-55 | 56-64 |
| 1.0 | 61.6 | 43.0 | 16.4 | 15.2 | 22.4 | 43.5 | 46.3 | 43.9 | 41.3 | 44.7 |
| 2.0 | 34.2 | 33.0 | 22.1 | 17.8 | 19.6 | 14.2 | 10.8 | 10.7 | 8.0 | 5.7 |
| 3.0 | 20.4 | 12.2 | 11.0 | 16.8 | 16.2 | 2.7 | 4.3 | 3.6 | 10.2 | 10.4 |
| 4.0 | 9.0 | 5.9 | 3.3 | 3.9 | 4.9 | 7.8 | 3.3 | 3.0 | 2.9 | 5.8 |
| 5.0 | -1.2 | 1.7 | 1.1 | 2.3 | 3.4 | 0.3 | -0.4 | -0.4 | 0.7 | 1.9 |

The table displays the percent change in single women's and men's employment rate when the tax system is changed from the benchmark system to a system with two times U.S. tax progressivity. The average tax rate is kept at the benchmark level.