Final Report Marshall Plan Scholarship

Somewhere in Between? Cohabiting Couples, and Their Role in Tax Policy*

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Abstract

Around 10 percent of working-age individuals in the U.S. are currently cohabiting - living with their partner without being married. These couples are treated as two individual singles regarding income taxation. At the same time, married couples file their taxes jointly and face a different tax schedule. In this paper, I study how income taxation and changes in income tax policy affect cohabiting couples differently than married couples or singles and what the optimal degree of tax progressivity would look like. I develop a dynamic life-cycle model with endogenous household formation and four types of households - cohabiting couples, married couples, single females and single males. All individuals face labor market risks, couples also face the risk of household dissolution. Decisions about labor supply, consumption and saving are made jointly on a household level. The assortative mating behavior by education from the data is replicated in the model. I calibrate the model to the U.S. and quantify how labor and income taxation influences labor supply responses, savings and household formation. Finally, I search for the optimal tax progressivity system for cohabiting, married and single households.

1 Introduction

One of the biggest changes in household structures in the U.S. over the recent decades is the rise in cohabitation rates - today, around 10 % of working-age individuals in the U.S. live together with their partner without being married, compared to only around 4 % in 1990. The large majority of people living in the U.S. have lived in cohabitation at least once in their lives. However, this household type is rarely considered when discussing tax policy, even though it has been shown that cohabiting couples behave differently than married couples or single households with regard to major economic household decisions like labor supply and savings.

It will be crucial to consider this new type of household when discussing changes in the tax system. Cohabiting couples are treated as singles in terms of income taxation, and married couples file their taxes jointly and face a different tax schedule. This directly affects household income, but how it affects it depends on overall household income and the share of each partner's contributions.

The questions I want to answer in the paper resulting from this project are (i) how do cohabiting couples react to changes in income taxation and how different are their responses from those of married couples or singles?; (ii) how do marriage and cohabitation rates change?; (iii) What would be the optimal degree of labor income taxation and should cohabiting couples be taxed differently than they currently are? Cohabiting couples play a unique role in-between married couples and singles regarding self-insurance since they do have this option but also have fewer commitment devices available than married couples. Therefore, the optimal income tax progressivity in this framework is not obvious. One of the main working packages during the research stay was implementing the model into Matlab. Therefore, this report does not yet contain the answers to these questions but sets up the framework for answering these questions by developing a model, presenting its calibration, model fit and outlook to future extensions of the model. It also features a first small computational exercise to understand the effect of tax changes on household formation and labor supply decisions in the current setting.

To this end, I develop a dynamic life-cycle model with four types of households - cohabiting couples, married couples, single females and single males. The model exhibits endogenous household formation with a marriage market equilibrium, with assortative mating by education happening. Individuals face uninsurable idiosyncratic labor market risk and couples face a separation risk. Divorce is costly, but assets are distributed equally. At the same time, break-ups impose no monetary costs on the couple, but the assets are split according to relative productivity shares. To mention the most important differences in incentives, the degree of commitment in cohabiting relationships tends to be significantly lower for cohabiting couples than for married couples in the U.S.. For females, there is an extensive and intensive margin of labor supply; males, for the moment, decide

on the extensive margin. Households make joint consumption-savings choices.
I calibrate the model to U.S. data from the CPS, SCF, PSID and others. Then I study the model fit and study the strengths and weaknesses of the model, followed by a small first policy analysis of changing the tax progressivity to be the same for cohabiting couples, singles and married couples. In the future, this paper aims to determine how cohabiting couples are affected differently by labor and capital income taxation than married couples or singles. Furthermore, I want to determine the optimal progressivity of taxation for each household type and all household types altogether. To this end, I will first conduct some small changes in tax progressivity for all households to determine and analyze the results in three ways. Firstly, I will look at the direct responses of households to the reform overall, and disaggregated by gender, education, household type and age groups. Secondly, I look at the changes in the shares of household types. How do different tax changes influence the incentives to marry or cohabit, and how strongly do these translate into changes in marriage and cohabitation rates? Thirdly, I look at the redistribution happening in-between and across household types.
Finally, I will determine the optimal income tax progressivity when keeping the structure of the current U.S. tax system and when allowing cohabiting couples to be taxed following a different tax schedule than married couples or singles. I will also investigate whether joint taxation for cohabitation would be optimal. I will study the implications of this optimal tax progressivity scheme for marriage and cohabitation rates, labor supply, savings, and redistribution.

There is a large, established literature that takes into account the differences between couples and singles when studying the effects of potential policy reforms like Alesina et al. (2011), Borella et al. (2023), Guner et al. (2023), Guner et al. (2020). Some papers explicitly study the optimal tax progressivity of couples like Malkov (2021) or Leung (2019) or the evolution of the tax treatment of couples like Bierbrauer et al. (2023). Usually, the couples considered in these works are married couples, I will additionally look at cohabiting couples, how they react differently and how the existence of this third household type affects the response of the whole economy.
The other strand of literature I will add to is the one explicitly studying cohabiting couples and household formation. Laufer and Gemici (2011) develop a rich household formation model focusing on the characteristics of cohabiting couples. Focusing on low-income households, Ortigueira and Siassi (2022) look at how the U.S. tax-transfer system affects the labor supply and household formation decisions, with cohabitation being a prominent option for this population group. Blasutto (2023) studies the link between assortative mating and the different shares of education levels in married versus cohabiting couples, Blasutto and Kozlov (2020) quantify the impact the introduction of unilateral divorce in the U.S. had on cohabitation. Very recently, Adamopoulou et al. (2020)

and Calvo (2023) investigate how cohabitation of parents affects children's human capital. The main contribution of this paper will be a relatively straightforward household formation process that is still credible but allows the model to be richer in other dimensions, like labor supply and productivity.

The remainder of the paper is structured as follows. In section 2, the model will be described in detail, and in section 3, the calibration of the model will be discussed. Section 4 contains the model fit, while in section 5, the discussed policy experiment will be presented. Section 6 provides an outlook to future adaptations of the model.

2 Tax system in the U.S.

The tax system in the U.S. differentiates household by marital status. The tax brackets as well as most of the transfers are calculated differently for married couples versus for singles. Even though married couples also technically have the option to file their taxes separately, the tax schedule they would face if doing so is not the same as for single individuals. What is more, nearly no married couples decide to do so - in 2020, only around 2 % of taxpayers decided to file their taxes as married filing separately. Theoretically, there are two different filing statuses for singles - filing as head of household or as singles. The status of head of household can be used when the taxpaying individual also has dependents living in the same household, typically children. I will use a tax function that only differentiates between married and unmarried individuals. The reasons for this are twofold. First, I abstract from children in the current setting of the model. Secondly, there there are well-established tax functions that have been estimated for married versus unmarried households.

The aforementioned estimated tax functions I will be use have been estimated and discussed in Guner et al. (2014). They define income as salaries and wages, interest income, dividends, interest income, royalties, realized capital gains, business or professional income, total pensions and annuities received plus taxable IRA distributions, unemployment compensation, social security benefits, state income tax refunds and alimony received. In my model, there are only two possible forms of income at any point in time - during working-age, the two forms of income will be labor income and capital income, where capital income is the income derived from saving at an exogenously given fixed interest rate r. During retirement, instead of labor income, households receive exogenously determined retirement benefits, and can still save in the same kind of assets as during working age. Labor supply and savings are endogenous choices, and households (conditional on their earnings potentials and savings up to that point) are aware of the taxes they have to pay. Therefore, the tax scheme directly affects the economic decisions of households in the model.

The tax function I use in the model, also known as the HSV specification, reads as

$$T_j(y,a) = y + ra - \lambda_j (y+ra)^{1-\tau_f}, j \in \{M, S\}, \tag{1}$$

with λ being the level of tax rate and τ the degree of tax progressivity. The parameters of the tax function depend on the marital status (S being unmarried and M being married) of the households. Keep in mind that cohabiting households are considered as singles in this setting and both individuals in cohabitation will be taxed based on the tax formula for singles. The clear distinction between the level of taxes and the tax progressivity in the tax form makes it the ideal specification to use for studying income tax progressivity. Another feature of the HSV specification is that it also allows for negative income taxes, which are present in tax-and-transfer system of the U.S.. To account for transfers is important when looking at the U.S. tax and transfer system, a significant share of households receives transfers and changing tax progressivity also changes the thresholds and size of tranfers. In order to use the HSV specification, household income needs to be normalized to 1. In the data from the CPS of my sample, after capping household income at the 97th percentile, annual household income in 2019 was around 68,000 $ for working age households.

Furthermore, a consequence of the fact that the U.S. tax-and-transfer system is based on household rather than individual income is that secondary earners are treated very differently in married versus cohabiting households. Even though in both household forms there are two potential earners, for cohabiting households, the taxation of one partner's income does not depend on the income of the other partner. However, for married couples, the tax paid on the first dollar of income of the secondary earner depends on the income of the primary earner. Primary earner here refers to the person earning more, without specifying any other characteristics like education or gender. In the data, there are significantly more couples where the husband is the only on in the labor force while the wife stays at home, cohabiting couples have a higher share of dual-earners.

To illustrate these differences, in Figure 1 the average tax rates by household type and income distributions of household members are presented. Overall, the average tax rate for singles is higher than for married couples or cohabiting couples. It has to be taken into account though that the same household income in a single household and a couples household means lower income per person in a couples household than in a single household. The graphs show that the average income tax rates for singles are higher than those for married couples for all income combinations, but the tax rate of married couples approaches it for incomes closer to twice the mean annual household income. For even higher household incomes, it will actually be higher for married couples than single households.

The tax rates for married couples start below the tax rates of cohabiting couples for all possible income combinations, but at which household income level the curves of tax rates meet depends on the income shares of the members of the couples. If both partners have the same level of income,

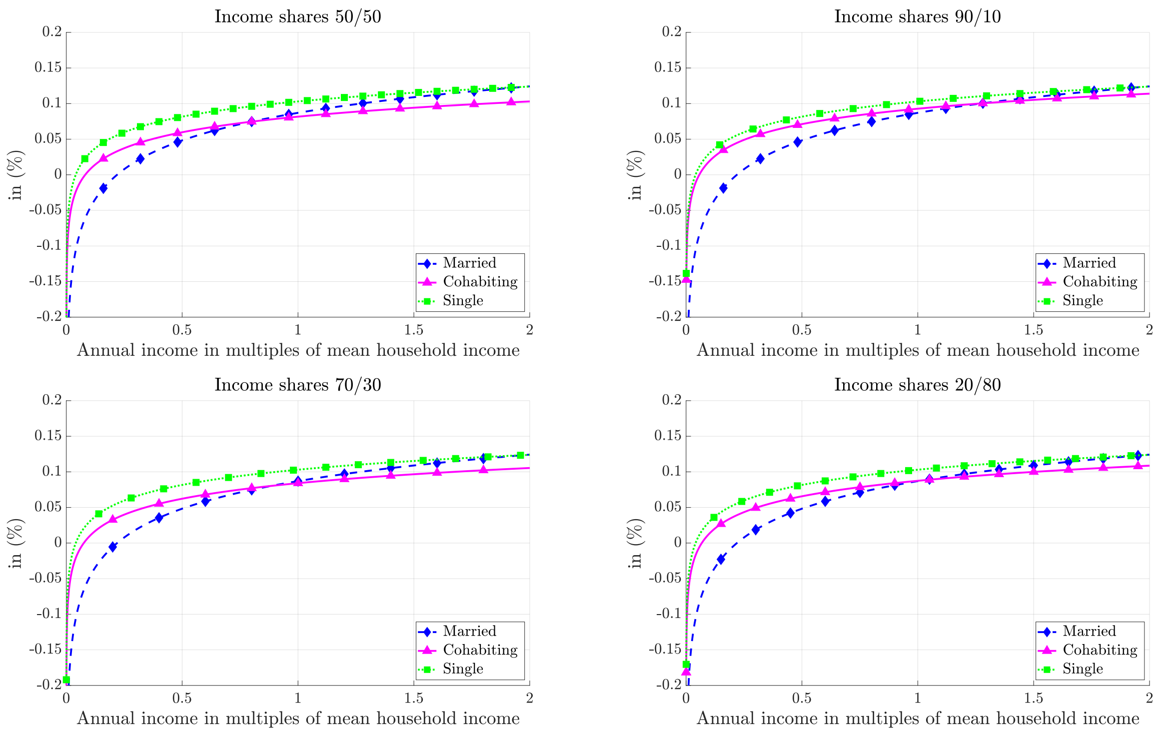


Figure 1: Average tax rates

the couple pays less income taxes if they are married up until they earn around 75 percent of mean household income. Above this threshold, they would pay less taxes if they were cohabiting. However, if the income is very unequally distributed within the couple, with one partner earning 90 percent of household income and the other one only contributing 10 percent of household income, married couples pay fewer taxes than cohabiting couples as long as their household income is above the mean household income. The less extreme cases of income shares of 70 vs. 30 percent resp. 20 vs. 80 percent, tell the same story, but also show that the form of the average tax function of cohabiting couples looks closer to the tax function of singles the more unequal the income is distributed within the couple. The more equal income is distributed between the partners, the lower the average tax rate for cohabiting couples.

This goes to show that the incentives to marry, cohabit or stay single depend highly on the income distribution and earnings prospects of the prospective partners.

3 The Model

I develop a dynamic life-cycle model - for the moment, I am looking at partial equilibrium, later on, the goal is to have a general equilibrium model. Time is discrete and a model period is one year.

3.1 Economic Environment

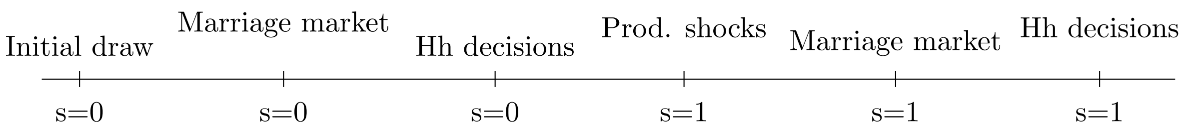
Demographics, household formation and dissolution. The population of interest consists of single females, single males, married couples and cohabiting couples. In the model, couples consist of two people of opposite sex and same age. All individuals enter the economy at an age of 25 after having finished their education. A certain share of males resp. females will hold a college degree while the rest do not and these shares do not change over the life cycle. After 42 years of working age, everyone retires when they are 67 (s_W) and dies at the age 82 (s_T).

At the beginning of the first period, before having made any decisions, all singles meet a random potential partner. They know the distribution of potential partners as well as all future distributions of partners. The randomly matched couple draws a preference shock together that depends on their education states. They then decide whether to marry, cohabit or stay single. Both individuals have to be better off being a couple and will compromise on a relationship form that is better than being single for both of them - so, even if one of them would have been even better off being married if the other one would not like to get married, they will cohabit if that makes both of them better off than staying single. It is important to note that the marriage market clears every time there is a marriage market.

Couples pool their assets and make their decisions together as long as they are a couple. Every period, there is a probability to divorce, π_d, for married couples and to break up, π_b, for cohabiting couples. Cohabiting couples are split up more often than married couples, $\pi_b > \pi_d$. After retirement, no changes in household structure are possible - neither divorce/break-up nor household formation.

After a divorce happens, married couples split up their assets equally but there is a divorce cost - they can only split up a share δ_d of assets, which reflects the fact that divorce costs are usually rising in household assets. Breaking up does not impose a monetary cost for cohabiting couples, but the share of potential earnings of overall potential earnings of the couple decides how their assets are divided - the more productive member of the household will leave the relationship with more assets as they probably contributed more to the household's assets over time.

There will be marriage markets each period for the first 20 years and every five years after that until retirement. They work the same as the first one described above, and singles have no memory of their relationship history, every single participates in the marriage market, and remarriage is possible. The timing is also the same for all periods, as depicted below. In the first period, individuals draw on their education and productivity status. Then, they enter the marriage market, draw their preference shocks, and decide on their household formation. Finally, the households make their decisions on consumption, labor supply and savings. If the potential couple decided to pair up, this will already be a joint decision.



Preferences. Preferences for married and cohabiting couples are described by a household utility function $U(c_f, c_m, l_f, l_m, e_f, e_m)$, singles have a utility function $U(c_g, l_g,)$ for $g \in f, m$. The variables c_g and l_g denote the consumption and hours worked by the household member of gender g. Males can decide between working full-time or not at all while women have a discrete set of labour supply options. Momentary utility also depends on the combination of education states of the couples to mimic the level of assortative mating seen in the data.

Labor productivity, earnings, income, and assets. For each individual, labor productivity depends on an idiosyncratic stochastic component z, where

$$\ln z' = \ln z + \epsilon, \text{ with } \epsilon \sim N(0, \sigma_\epsilon^2), \tag{2}$$

where $\sigma_\epsilon^{g,e}$ depends on gender $g \in \{f, m\}$ and education level $e \in \{l, h\}$. The initial labor productivity of an individual is drawn from a log-normal distribution with mean 0 whose parameter $\sigma_{\epsilon,0}^{g,e}$ also depends on gender and education. Labor income also depends on an age-dependent deterministic component that also differs by gender and education, $d_{s,g,e}$. Furthermore, the earnings depend on an exogenous wage rate w and the labor supply decision l of the individual. This leads to pre-tax labor income of singles looking like

$$y(l, z, e, s) = lzd_{s,e,g}w, \ g \in \{f, m\}, \ e \in \{l, h\}, \ s \in \{1, \ldots, s_W\}, \tag{3}$$

and the pre-tax labor income of couples reading

$$y(l_f, l_m, z_f, z_m, e_f, e_m, s) = l_f z_f d_{s,e,f} w + l_m z_m d_{s,e,m} w. \tag{4}$$

Taxes. As explained above, the government taxes income of households, the parameters of the tax function depend on the marital status (S being unmarried and M being married) of the households. I use the HSV specification with mean household earnings normalized to 1,

$$T_j(y, a) = y + ra - \lambda_j (y + ra)^{1-\tau_f}, j \in \{M, S\}, \tag{5}$$

with λ being the level of tax rate and τ the degree of tax progressivity.
The government provides retired individuals with retirement benefits b - for the moment they are the same for all different types of households for computational reasons.

Bellman equations. The Bellman equation for singles during working-age when there is a marriage market next period is

$$V_s^{i,S}(a,e,z) = \max_{a\prime,c,l} u^{i,S}(c,l) + \beta \mathbb{E}\Big[V_{s+1}^{i,S}(a',e',z') + C_{s+1}V_{s+1}^{i,C}(a',e',z',\Omega')$$
$$+M_{s+1}V_{s+1}^{i,M}(a',e',z',\Omega') + (1-M_{s+1})(1-C_{s+1})V_{s+1}^{i,S}(a',e',z',\Omega')\Big]$$

subject to the budget constraint

$$\lambda_S(y(l,z,e,s)+ra)^{(1-\tau_S)} + a = a' + c,$$

where z follows the law of motion described in 2. The decisions on whether to cohabit (C_{s+1}) or marry (M_{s+1}) are binary variables that take the value 1 if they want to marry resp. cohabit and 0 it not - these are not solely decisions of the individuals but of the potential couple, the decision process works as described above in the model description. Because this decision can not be made by the individual considered alone, but also depends on their prospective partner, the variables C_{s+1} and M_{s+1} are not included as decision variables. The individuals know how they and their respective future partners would decide for each possible combination of characteristics. The probability of meeting a potential partner in each marriage market period equals 1. The distribution Ω' of characteristics of potential partners is known to individuals. The Bellman equation for singles during working-age without a marriage market in the following period simplifies to the following,

$$V_s^{i,S}(a,e,z) = \max_{a\prime,c,l} u^{i,S}(c,l) + \beta \mathbb{E}\Big[V_{s+1}^{i,S}(a',e',z')\Big]$$

also subject to the budget constraint

$$\lambda_S(y(l,z,e,s)+ra)^{(1-\tau_S)} + a = a' + c.$$

The Bellman equation for married couples during working age reads as

$$V_s^M(a,e_f,e_m,z_f,z_m) = \max_{a\prime,c_f,c_m,l_f,l_m} u^P(c_f,c_m,l_f,l_m,e_f,e_m)$$
$$+\beta \mathbb{E}\Big[(1-\pi_d)V_{s+1}^M(a',e_f',e_m',z_f',z_m') + \pi_d\left(\theta^f V_{s+1}^{S,f}(a_f',e_f',z_f') + \theta^m V_{s+1}^{S,m}(a_m',e_m',z_m')\right)\Big]$$

with

$$\frac{\delta_d a'}{2} = a_f' = a_m'$$

subject to the budget constraint

$$\lambda_M(y(l_f, l_m, z_f, z_m e_f, e_m, s) + ra)^{(1-\tau_M)} + a = a' + c_f + c_m,$$

where π_d denotes the exogenous probability of the married couples divorcing. Note that due to the choice of the utility function (see below) and $\theta_f = \theta_m = 0.5$, for all couples it holds that $c_f = c_m$.

The Bellman equations for cohabiting couples during working age looks similar to the Bellman equation for married couples during working age, but differs in three important aspects. First, they additionally contain the choice to marry in the following period. Secondly, the break-up probability differ. Thirdly, they face different asset division prospects at an exogenous break-up than married couples face when getting divorced. Therefore, the Bellman equation for cohabiting couples reads

$$V_s^C(a, e_f, e_m, z_f, z_m) = \max_{a', c_f, c_m, l_f, l_m} u^P(c_f, c_m, l_f, l_m, e_f, e_m) + \beta\mathbb{E}\Big[(1-\pi_b)$$
$$\Big((1-M_{s+1})V_{s+1}^C(a', e'_f, e'_m, z'_f, z'_m) + M_{s+1}V_{s+1}^M(a', e'_f, e'_m, z'_f, z'_m, \zeta')\Big)$$
$$+\pi_b\left(\theta_f V_{s+1}^{S,f}(a'_f, e'_f, z'_f) + \theta_m V_{s+1}^{S,m}(a'_m, e'_m, z'_m)\right)\Big]$$

subject to the budget constraint

$$\lambda_S\left(y(l_f, z_f, e_f, s) + \frac{ra}{2}\right)^{(1-\tau_S)} + \lambda_S\left(y(l_m, z_m, e_m, s) + \frac{ra}{2}\right)^{(1-\tau_S)} + a = a' + c_f + c_m$$

with $a'_f = a'\frac{y_f^p}{y_f^p + y_m^p}$; $a'_m = a'\frac{y_m^p}{y_f^p + y_m^p}$. Note that as above $c_f = c_m$ will hold for the same reasons.

So far, we have looked at the Bellman equations on the household level, because this entity makes the decisions since couples maximize their utility jointly. However, singles need to decide whether to enter into marriage, cohabitation or stay single. For them to compare their options, we also need the value functions for individuals in marriage and cohabitation.

The value functions for an individual in a married couple during working-age are as follows,

$$V_s^{M,g}(a, e_f, e_m, z_f, z_m, \zeta) = u^{M,g}(c_g, l_f, l_m, \zeta)$$
$$+\beta\mathbb{E}\Big[(1-\pi_d)V_{s+1}^{M,g}(a', e'_f, e'_m, z'_f, z'_m, \zeta') + \pi_d\left(V_{s+1}^{S,g}(a'_g, e'_g, z'_g)\right)\Big].$$

It should be noted that no decision is being made on this individual level; the savings decisions and the labor supply and consumption of both married partners are decided jointly on the household level.

Similarly, the value functions for individuals in cohabiting couple during working-age are

$$V_s^{C,g}\left(a,e_f,e_m,z_f,z_m,\zeta\right)=u^{P,g}\left(c_f,c_m,l_f,l_m,\zeta\right)+\beta\mathbb{E}\Bigg[(1-\pi_b)$$

$$\Bigg(\left(1-M_{s+1}\right)V_{s+1}^{C,g}\left(a',e_f,e_m,z_f,z_m,\zeta'\right)+M_{s+1}V_{s+1}^{M,g}\left(a',e_f,e_m,z_f,z_m,\zeta'\right)\Bigg)$$

$$+\pi_b V_{s+1}^{S,g}\left(a_g',e_g',z_g'\right)\Bigg].$$

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3.2 Parameterization

The momentary utility function of single females reads as

$$u^{S,f}(c,l)=\frac{c^{1-\sigma}-1}{1-\sigma}-\phi\frac{l^{1+\psi}}{1+\psi}-\mathbb{I}_{\{l>0\}}\nu^{f,S},$$

where σ denotes the coefficient of relative risk aversion and ϕ stands for the utility weight on leisure. The curvature of leisure ψ controls the Frisch elasticity of female labor supply. The fixed utility cost of working $\nu^{f,S}$ also depends on relationship status since the incentives of joining the labor market might differ between women in a relationship and single women, according to the data.

The utility function of single males only depends on consumption and since the labor supply choice set is binary, ν^m here is the fixed utility cost of working full-time instead of not at all,

$$u^{S,m}(c,l)=\frac{c^{1-\sigma}-1}{1-\sigma}-\mathbb{I}_{\{l>0\}}\nu^m.$$

The momentary utility of cohabiting and married couples reads as

$$\begin{aligned} u^P(c_f,c_m,l_f,l_m,e_m,e_f) &= \theta^f\left(\frac{(\frac{c_f}{\chi})^{1-\sigma}-1}{1-\sigma}-\phi\frac{(l_f)^{1+\psi}}{1+\psi}-\mathbb{I}_{\{l_f>0\}}\nu^{f,P}\right) \\ +\ \zeta^{e_f,e_m} &+ \theta^m\left(\frac{(\frac{c_m}{\chi})^{1-\sigma}-1}{1-\sigma}-\mathbb{I}_{\{l_m>0\}}\nu^m\right) \end{aligned}$$

where χ denotes equivalence scales. The fixed utility cost of working for women in a relationship, $\nu^{f,P}$, differs from that of working for singles. The parameter ζ^{e_f,e_m} denotes the bliss of being part of a couple with the partners' respective combination of education levels and does not change.

As discussed above, the value function of individuals is needed for the decision on marriage, cohabitation, or remaining single, and the momentary utility function of individuals is needed to compute it. The individual's utility function of a female individual in a relationship reads as

$$u^{P,f}(c_f,c_m,l_f,e_f,e_m)=\frac{(\frac{c_f}{\chi})^{1-\sigma}-1}{1-\sigma}-\phi\frac{(l_f)^{1+\psi}}{1+\psi}-\mathbb{I}_{\{l_f>0\}}\nu^{f,P}+\zeta^{e_f,e_m}.$$

The individual's utility function of a male individual in a relationship follows

$$u^{P,m}(c_f, c_m, l_m, e_f, e_m) = \frac{(\frac{c_m}{\chi})^{1-\sigma} - 1}{1-\sigma} - \mathbb{I}_{\{l_m > 0\}}\nu^m + \zeta^{e_f, e_m}.$$

4 Data and Calibration

4.1 Data

CPS ASEC. At first, we are going to take a look at the current cross-section of household types. To this end, we will use the CPS ASEC for the year 2018. We focus on the working-age population, which, in the context of our model and the data, will mean individuals aged 25 to 66 unless indicated otherwise. I exclude all households where the household head or, if present, their partner are in the military. I define single households as unmarried householders who do not have a partner living with them, married couples are just that and cohabiting couple households as unmarried householders living with their partner. For the data on wealth the latest SCF was used.

As discussed above, the model period is one year. Individuals enter the economy at the age of 25, retire at 67, and die for certain at 82. There are two education states; people can enter the economy with or without a college degree, and their education status cannot change, the shares are shown in Table 1. This table contains the parameters that are set exogenously. The deterministic part of the life cycle profile of women and men by education is taken from the cross-section in the CPS for now. The costs of divorce are set at a conservative 0.1; while there are no great estimates available yet, Blasutto and Kozlov (2020) argue convincingly that divorce is more costly for wealthier households and when calibrating their model end up with a significantly higher δ_d. The divorce risk of marriage is set to 0.022 to match the expected duration until divorce for a newly married couple. The interest rate is set at 2%, and retirement income for now is the same for all individuals, at 0.2 of mean household income. The tax parameters are taken from Guner et al. (2014) as discussed above.

Note that we normalize average household income to be 1 in the model for the HSV specification of the tax function.

Table 2 presents the parameters calibrated within the model, each targeted data moment is most closely associated with one of the remaining parameters:

1. The employment rate is 73.9 percent for females, 86.9 percent for males, and 66 percent of all married households are dual-earner households. ($\nu^{f,S}, nu^m, \nu^{f,P}$)

2. Conditional on working, women spend an average 1,886 hours per year working. (ϕ)

Table 1: Externally calibrated parameters

Moment	Parameter	Value
Share of females with college degree	e_f	39 %
Share of males with college degree	e_m	36 %
Life-cycle profile hourly wage women	$d_{s,e,g}$	see text
Costs of divorce	δ_d	0.1
Curvature of leisure	ψ	2.5
Equivalence scale	χ	0.707
Divorce risk marriage	π_d	0.022
Interest rate	r	2 %
Retirement income	b	0.2
Tax level married	λ_M	0.913
Tax level unmarried	λ_S	0.897
Tax progressivity married	τ_M	0.06
Tax progressivity unmarried	τ_S	0.034

3. The average household income is 70,200 \$. (w)

4. Cohabiting individuals make up 10 percent of the overall population. (π_b)

5. Average household wealth is around 30,500\$ for households below the age of 35. (β)

6. The interquartile range of hourly wages of young females (25-29) is 8.2\$ for females without a college degree and 13.9\$ for females with a college degree. The respective values for males are 11.5\$ and 17.3\$. The interquartile range of hourly wages for women aged 50 to 54 is 11.8\$ for women without a college degree and 20.4\$ for women with a college degree. The respective numbers for males are 15.6\$ and 26.9\$. ($\sigma_{\epsilon,0}^{f,l}, \sigma_{\epsilon,0}^{f,h}, \sigma_{\epsilon,0}^{m,l}, \sigma_{\epsilon,0}^{m,h}, \sigma_{\epsilon}^{f,l}, \sigma_{\epsilon}^{f,h}, \sigma_{\epsilon}^{m,l}, \sigma_{\epsilon}^{m,h}$)

The assortative mating behavior of married couples in the data versus the model is depicted in Table 3. The parameter matrix ζ determines the overall share of married couples (by its level) as well as the sorting into the different education combinations (by the relative size of the parameters).

Table 2: Internally Calibrated Parameters

Moment	Parameter	Value	Description	Target	Model
Part. cost single f	$\nu^{f,S}$	4.15	Employment rates (in %) f	73.8 %	73.2 %
Part. cost couple f	$\nu^{f,P}$	0.52	Dual-earner married	66 %	65 %
Utility weight	ϕ	53	Avg hours f	1,886	1,844
Part. cost m	ν^{m}	1.17	Employment rates (in %) m	86.9 %	87.4 %
Wage rate	w	0.0719	Hh earnings	68,000$	66,690 $
Break-up prob.	π_b	0.0254	Share cohabiting	10 %	10%
Discount factor	β	0.984	Hh wealth under 35	30,500 $	28,664 $
Initial prod. f	$(\sigma_{\epsilon,0}^{f,l}, \sigma_{\epsilon,0}^{f,h})$	(0.4,0.3)	IQR wages 25-29	(8.2,13.9)	(9.5,11.8)
Initial prod. m	$(\sigma_{\epsilon,0}^{m,l}, \sigma_{\epsilon,0}^{m,h})$	(0.6,0.5)	IQR wages 25-29	(11.5,17.3)	(14.6,18.6)
Innov. f	$(\sigma_{\epsilon}^{f,l}, \sigma_{\epsilon}^{f,h})$	(0.08,0.07)	IQR wages 50-54	(11.8,20.4)	(11.8,15.1)
Innov. m	$(\sigma_{\epsilon}^{m,l}, \sigma_{\epsilon}^{m,h})$	(0.08,0.07)	IQR wages 50-54	(15.6,26.9)	(10.4,23.6)
Partner preference	ζ		Assortative mating	see	Table 3

Table 3: Assortative Matching Shares Married Couples

	Parameter	Value	Target (in %)	Model (in %)
Both college degree	ζ_{hh}	15	45	35
Both no college degree	ζ_{ll}	1.2	30	35
She college degree, he not	ζ_{lh}	9	16	16
He college degree, she not	ζ_{hl}	1.1	9	13
Overall share married couples	scale ζs	1.1	63	65

Before we delve into the model fit, I want to highlight two features of the data. Firstly, how the cohabitation rate varies by age group; secondly, how employment rates, especially female employment rates, differ by household type, education and age. Figure 2 shows how the shares of cohabiting and married couples, as well as single males and females, differ by the age of individuals - note that the graph presents a cross-section of individuals who participated in the survey in 2019. The data was not cleaned for cohort effects here, because the focus is on the current distribution of household types. It becomes apparent from the barplot that cohabitation is a popular partnership choice for young individuals, with around a quarter of households being cohabiting couples for the youngest age group consisting of 25- to 29-year-olds. Here, the age groups are determined by the mean age of the couple. So far, few mechanisms in the model would replicate this household formation by age, this will be addressed in the last section.

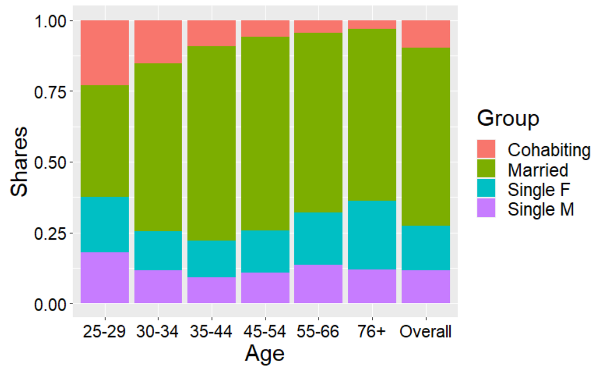

Figure 2: Shares of household types by age groups

The employment rates by education, household type, and age are shown in Figure 3, separately for females on the left and males on the right side. As in the model, c stands for having a college degree and nc for no college degree. The difference between individuals living in married couples, cohabiting couples, or single households is most distinct for young women. The difference of female employment rates by education type is apparent for women of all age groups, but the difference between household types conditional on education shrinks for women above 50. For young women with and without a college degree, the employment rates of married women are the lowest employment rates conditional on education and age. Young single women without a college degree have higher employment rates than cohabiting women while for women with a college degree, there seems to be little difference in employment rates between single and cohabiting women. This underlines the importance of differentiating education states. For males, the difference between employment rates is less distinct, single males without a college degree seem to have the lowest employment rates. This is exactly the opposite behavior of single females, who have the highest employment rates conditional on education.

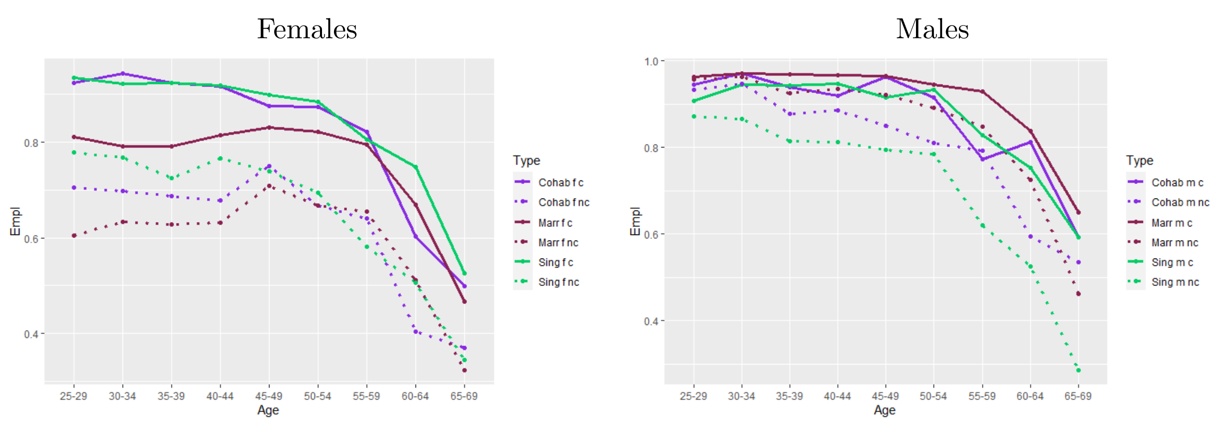

Figure 3: Employment rates by household type and education level

5 Model Fit

Table 4: Summary statistics by gender

	Females		Males	
	Data	Model	Data	Model
Employment rates (in %)	73.85	73.20	86.88	87.40
Avg annual hours	1,886	1,844	2,153	2,153
Median hours	2,080	2,081	2,080	2,153
P25 hours	1,664	1,533	2,080	2,153
P75 hours	2,080	2,081	2,340	2,153
Average annual earnings (in $)	43,220	43,606	57,905	59,377
Median earnings (in $)	37,000	38,911	50,000	54,551
P25 earnings (in $)	20,000	28,530	30,000	37,808
P75 earnings (in $)	60,000	53,360	80,000	77,104
Avg hourly wages (in $) (in $)	23.1	23.6	27.3	27.6
Median hourly wages (in $)	19.2	22.0	24.0	25.3
P25 hourly wages (in $)	12.5	16.3	15.0	17.6
P75 hourly wages (in $)	28.8	29.8	36.1	35.8

We should point out that some numbers reported in Table 4, like employment rates and average annual hours worked (conditional on working), are calibration targets. However, also the non-targeted data moments seem to be met by the model. The wage distribution seems to be a little off, with the lower quartile in the model still having values that are a little too high, but overall, the fit seems reasonable.

Next, we look at Table 5 which contains the shares of all possible education combinations of cohabiting couples. As described above, we targeted these shares for married couples but not cohabiting couples. The model does get the direction of shares right - the highest share of cohabiting couples are couples where neither partner has a college degree. However, it overestimates this share and produces significantly too little or no partners of other education combinations.

Table 5: Assortative Matching Shares Cohabiting Couples

	Data (in %)	Model (in %)
Both college degree	33	0
Both no college degree	41	90
She college degree, he not	8	0
He college degree, she not	18	10

Table 6 presents summary statistics by gender and education. The model has problems with matching employment rates by education. While in the data the employment rates of males and females with a college degree are significantly higher than for those without a college degree, the model cannot produce this difference yet. This might be intertwined with the assortative mating, where the model is not yet calibrated perfectly. The hours and wages conditional on working seem to act reasonably similar to the data, with room for improvement in the actual size of the hourly wages, which seem to be too high.

Table 6: Summary statistics by education and gender

	Females				Males			
	No degree		College degree		No degree		College degree	
	Data	Model	Data	Model	Data	Model	Data	Model
Employment rates (in %)	64.63	74.10	82.68	71.90	82.79	88.30	91.77	85.80
Avg annual hours	1,818	1,855	1,938	1,825	2,124	2,153	2,185	2,153
Median hours	2,080	2,081	2,080	2,081	2,080	2,153	2,080	2,153
P25 hours	1,560	1,533	1,820	1,533	2,080	2,153	2,080	2,153
P75 hours	2,080	2,081	2,080	2,081	2,340	2,153	2,340	2,153
Average annual earnings (in $)	30,573	34,560	52,695	58,189	45,678	46,418	71,073	83,101
Median earnings (in $)	27,000	31,822	49,000	51,755	40,000	45,126	65,120	80,815
P25 earnings (in $)	15,600	24,226	29,500	44,127	25,000	31,699	41,600	59,962
P75 earnings (in $)	40,000	40,883	70,000	69,049	60,000	60,858	100,000	106,283
Avg hourly wages (in $) (in $)	16.7	18.7	27.9	31.4	21.7	21.6	33.4	38.6
Median hourly wages (in $)	14.6	18.3	24.0	30.1	19.2	21.0	29.8	37.5
P25 hourly wages (in $)	10.0	13.7	16.2	24.1	12.6	14.7	19.6	27.9
P75 hourly wages (in $)	21.0	22.4	35.6	39.1	27.8	28.3	44.2	49.4

In Table 7, it becomes obvious that the model's difficulties with producing the right gradient of employment rates by education are also linked to the employment rates by household type. The same holds for males as presented in Table 8. Since the share of people without a college degree is very high in the model, the model gets right that hourly wages as well as annual earnings of cohabiting individuals in the data are lower than those of married individuals. Still, the earnings of singles are not met well yet.

Table 7: Summary statistics females by household type

	Single		Cohabiting		Married	
	Data	Model	Data	Model	Data	Model
Employment rates (in %)	75.63	50.50	77.41	98.60	72.37	78.40
Avg annual hours	1,924	2,076	1,906	1,854	1,863	1,783
Median hours	2,080	2,081	2,080	2,081	2,080	1,533
P25 hours	1,820	2,081	1,820	1,533	1,664	1,533
P75 hours	2,080	2,081	2,080	2,081	2,080	2,081
Avg annual earnings (in $)	42,145	31,728	39,457	39,809	44,432	47,308
Median earnings (in $)	35,568	29,187	33,280	38,203	39,000	43,596
P25 earnings (in $)	20,000	22,050	20,000	33,694	21,000	29,584
P75 earnings (in $)	57,000	33,490	52,000	44,447	60,000	60,892
Avg hourly wages (in $)	22.7	15.3	20.6	21.6	23.8	26.0
Median hourly wages (in $)	18.3	14.0	17.1	21.0	20.1	24.7
P25 hourly wages (in $)	11.8	10.6	11.8	18.3	13.0	18.5
P75 hourly wages (in $)	27.9	16.1	26.3	25.5	30.8	31.2

Table 8: Summary statistics males by household type

	Single		Cohabiting		Married	
	Data	Model	Data	Model	Data	Model
Employment rates (in %)	79.57	97.90	88.13	97.30	89.48	81.80
Avg annual hours	2,071	2,153	2,097	2,153	2,190	2,153
Median hours	2,080	2,153	2,080	2,153	2,080	2,153
P25 hours	2,080	2,153	2,080	2,153	2,080	2,153
P75 hours	2,288	2,153	2,340	2,153	2,340	2,153
Avg annual earnings (in $)	49,922	43,425	47,727	45,345	62,197	69,306
Median earnings (in $)	45,000	37,808	40,000	44,344	56,000	64,571
P25 earnings (in $)	25,000	27,265	25,480	31,699	35,000	46,218
P75 earnings (in $)	70,000	53,982	62,000	55,581	85,000	83,520
Avg hourly wages (in $)	24.4	20.2	23.0	21.1	29.0	32.2
Median hourly wages (in $)	20.9	17.6	19.2	20.6	25.0	30.0
P25 hourly wages (in $)	13.7	12.7	13.0	14.7	16.5	21.5
P75 hourly wages (in $)	31.5	25.1	28.8	25.8	38.5	38.8

The household income by household type is displayed in Table 9, here the fact that married couples have on average higher household labor income than cohabiting couples in the data is replicated by the model - the higher end is met well. Still, the range of labor income is too small.

Table 9: Summary statistics household income by household type

	Married		Cohabiting	
	Data	Model	Data	Model
Avg labor income	93,487	93,794	78,278	83,383
Median	86,270	88,310	70,001	82,146
P25	51,800	72,182	41,531	69,201
P75	126,117	111,398	105,133	94,894

We have seen before that for cohabiting couples, there are two categories of education-combinations that are not yet represented in the model. Therefore, I do not display summary statistics on the household level based on these characteristics for cohabiting couples. However, the shares of married couples by assortative mating are met relatively well, so I display their summary statistics in Table 10. The model overestimates the share of dual-earner couples where neither spouse has a college degree, while for all other categories the share of dual-earners is too low. The average household labor income is too high in all categories, but since the shares do not correspond perfectly to those in the data yet, in the aggregate, household labor income is of the magnitude in the data. Again, the higher end of the income distribution is relatively well met, but the range is too small and the lower end is not met well yet.

Table 10: Summary statistics married couples household income

	Both college		Neither college		He college, she not		She college, he not	
	Data	Model	Data	Model	Data	Model	Data	Model
Share dual earners	75	54	55	75	61	38	75	60
Avg labor income	119,887	115,526	66,538	75,430	88,908	104,965	96,620	105,760
Median	115,103	113,316	59,120	74,241	84,401	105,231	92,077	102,560
P25	80,515	90,157	36,472	62,396	55,000	87,480	61,501	85,444
P75	155,245	135,428	90,000	88,325	118,000	119,500	127,020	121,990

6 Policy Analysis

Even though the model fit is not great yet, I will perform a small policy experiment already. The results are preliminary and to be taken with more than a grain of salt since the model fit is not sufficient yet, but the strength and direction of the responses might still be interesting.

The experiment I perform is changing the tax progressivity parameters for singles and married couples to 0.045, which is a value in-between the tax progressivity parameter for singles and couples in the benchmark. The share of individuals living in married couples changes from 65 percent in the benchmark to 50 percent after the reform, the cohabitation rate of individuals rises from 10 percent to 25 percent. This leaves 13 percent of individuals living in a single female resp. male household.

The average taxes paid per working-age household are 7,272 $ in the benchmark vs. 7,525 $ after the reform. The welfare of a newborn entering the economy under the veil of ignorance is lower in comparison with the benchmark.

Summary statistics by gender are presented in Table 11. Female employment rates rise more than male employment rates, the effects on annual and hourly earnings seems to be rather small in the aggregate.

Table 11: Results reform by gender

	Females		Males	
	Benchmark	Reform	Benchmark	Reform
Employment rates	73.20	75.30	87.40	88.40
Average hours	1,844	1,845	2,153	2,153
Median hours	2,081	2,081	2,153	2,153
P25 hours	1,533	1,533	2,153	2,153
P75 hours	2,081	2,081	2,153	2,153
Average annual earnings	43,606	43,226	59,377	59,249
Median earnings	38,911	38,458	54,551	54,401
P25 earnings	28,530	28,671	37,808	37,808
P75 earnings	53,360	52,885	77,104	77,075
Average hourly wages	23.6	23.4	27.6	27.5
Median hourly wages	22.0	21.9	25.3	25.3
P25 hourly wages	16.3	15.8	17.6	17.6
P75 hourly wages	29.8	29.8	35.8	35.8

In Tables 12 and 13, the employment rates and other summary statistics are disaggregated by household types. The reform increases employment rates of single females and married males while it decreases the employment rates of married females and cohabiting males. The disaggregation shows that hourly wages do change for the separate household types, even though these changes do not show up in the aggregates.

Table 12: Results reform by household type females

	Single		Cohabiting		Married	
	Bench	Reform	Bench	Reform	Bench	Reform
Employment rates	50.50	54.90	98.60	98.70	78.40	74.10
Average hours	2,076	2,077	1,854	1,813	1,783	1,778
Median hours	2,081	2,081	2,081	2,081	1,533	1,533
P25 hours	2,081	2,081	1,533	1,533	1,533	1,533
P75 hours	2,081	2,081	2,081	2,081	2,081	2,081
Average annual earnings	31,728	31,475	39,809	37,556	47,308	51,521
Median earnings	29,187	30,333	38,203	36,995	43,596	46,255
P25 earnings	22,050	22,055	33,694	27,534	29,584	34,525
P75 earnings	33,490	32,955	44,447	44,272	60,892	63,812
Average hourly wages	15.3	15.2	21.6	20.6	26.0	28.4
Median hourly wages	14.0	14.6	21.0	19.1	24.7	28.2
P25 hourly wages	10.6	10.6	18.3	16.4	18.5	21.0
P75 hourly wages	16.1	15.8	25.5	25.1	31.2	32.9

Table 13: Results reform by household type males

	Single		Cohabiting		Married	
	Bench	Reform	Bench	Reform	Bench	Reform
Employment rates	97.90	97.90	97.30	88.90	81.80	83.30
Average hours	2,153	2,153	2,153	2,153	2,153	2,153
Median hours	2,153	2,153	2,153	2,153	2,153	2,153
P25 hours	2,153	2,153	2,153	2,153	2,153	2,153
P75 hours	2,153	2,153	2,153	2,153	2,153	2,153
Average annual earnings	43,425	43,472	45,345	45,873	69,306	75,993
Median earnings	37,808	37,808	44,344	45,225	64,571	74,216
P25 earnings	27,265	27,265	31,699	32,622	46,218	57,542
P75 earnings	53,982	53,982	55,581	56,676	83,520	91,573
Average hourly wages	20.2	20.2	21.1	21.3	32.2	35.3
Median hourly wages	17.6	17.6	20.6	21.0	30.0	34.5
P25 hourly wages	12.7	12.7	14.7	15.2	21.5	26.7
P75 hourly wages	25.1	25.1	25.8	26.3	38.8	42.5

7 Outlook

This project is not finished yet, but important progress has been made during the research stay at the University of Pennsylvania. Some of the most important accomplishments were the presentation of the research project in front of students and faculty and discussions with renowned professors and other students about the model, research question, possible adaptions of the model, and the actual implementation of the model into Matlab.

The first adaption of the model will be changing the utility costs of working not to target the share of dual-earner couples, but to directly target the share of working single women and working women in couples. This will partly fix the problem of employment rates by household type not yet matching the data.

To better meet the assortative mating behavior from the data, I will introduce heterogeneity in the bliss states of being in a couple. Bliss will not only depend on the education type combination. Instead, there will be a distribution of bliss states for each pairing of education states that the couple draws from. This state is permanent until the couple dissolves.

Furthermore, to align the life cycle profile observed in the data, with young couples cohabiting significantly more than older couples, I will introduce a new preference state that individuals draw together with all their other characteristics in the very first period. This preference state divides people into two groups - those who want to cohabit before getting married and those who can get married right when meeting their partner. In this setting, for a significant share of couples, it will be a reasonable choice to cohabit when they meet and potentially get married later on, which should produce cohabitation rates by age closer to the ones in the data. This will also help with many other untargeted model fit moments since the age distribution by household type also plays a significant role for creating the disaggregated earnings distributions.

Then I will compute household formation elasticities with regard to changes in tax policy before conducting tax policy experiments to make sure the household formation reacts not too strongly or too weakly to tax reforms.. Once the model fit is improved, I will perform more policy analysis to quantify the effects of income taxation on cohabiting couples and document the differences to married couples and singles with regard to labor supply responses and savings. Finally, I will search for the optimal income tax progressivity in an economy that consists not only of married couples and singles, but also allows individuals to cohabit without being married.

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A Tables model fit

Table 14: Summary statistics females by household type and education

	Single				Cohabiting				Married			
	no degree		degree		no degree		degree		no degree		degree	
	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model
Employment rates (in %)	66.42	54.50	86.63	35.80	67.61	98.60	89.99	99.20	62.93	79.10	80.08	77.70
Avg annual hours	1,839	2,080	2,002	2,053	1,826	1,854	1,984	2,077	1,803	1,757	1,902	1,808
Median hours	2,080	2,081	2,080	2,081	2,080	2,081	2,080	2,081	2,080	1,533	2,080	2,081
P25 hours	1,560	2,081	1,872	2,081	1,560	1,533	1,872	2,081	1,560	1,533	1,760	1,533
P75 hours	2,080	2,081	2,080	2,081	2,080	2,081	2,080	2,081	2,080	2,081	2,080	2,081
Average annual earnings (in $)	30,006	27,178	53,265	57,363	29,224	39,805	49,333	92,643	31,231	35,797	52,906	58,249
Median earnings (in $)	26,000	23,977	49,000	52,890	26,050	38,203	44,000	97,397	28,000	32,265	50,000	51,658
P25 earnings (in $)	15,000	21,717	30,000	45,474	16,000	33,694	30,000	97,397	16,000	25,791	28,800	44,127
P75 earnings (in $)	40,000	31,538	70,000	66,858	37,000	44,447	65,000	97,397	42,000	42,367	72,000	69,629
Avg hourly wages (in $) (in $)	16.1	13.1	28.7	28.1	16.1	21.6	25.0	44.6	17.3	20.1	28.0	31.7
Median hourly wages (in $)	14.4	11.5	23.5	25.4	13.8	21.0	22.0	46.8	15.4	19.0	24.2	30.2
P25 hourly wages (in $)	9.6	10.4	16.0	21.9	9.6	18.3	15.4	46.8	10.4	15.7	16.6	24.1
P75 hourly wages (in $)	20.2	15.2	34.3	33.2	19.2	25.5	31.6	46.8	21.6	24.7	36.1	39.1

Table 15: Summary statistics males by household type and education

	Single				Cohabiting				Married			
	no degree		degree		no degree		degree		no degree		degree	
	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model
Employment rates (in %)	72.61	98.90	88.72	91.70	85.76	97.20	92.52	97.90	86.46	79.20	92.72	84.70
Avg annual hours	2,016	2,153	2,129	2,153	2,078	2,153	2,129	2,153	2,170	2,153	2,209	2,153
Median hours	2,080	2,153	2,080	2,153	2,080	2,153	2,080	2,153	2,080	2,153	2,080	2,153
P25 hours	1,976	2,153	2,080	2,153	2,080	2,153	2,080	2,153	2,080	2,153	2,080	2,153
P75 hours	2,080	2,153	2,340	2,153	2,184	2,153	2,340	2,153	2,340	2,153	2,496	2,153
Average annual earnings (in $)	39,777	39,037	60,841	70,855	39,636	42,611	61,621	71,187	48,936	53,570	75,511	85,084
Median earnings (in $)	35,000	35,316	55,400	60,556	35,000	42,801	55,500	61,279	45,000	46,713	71,000	81,702
P25 earnings (in $)	20,000	25,969	34,000	45,416	22,600	31,675	35,000	57,542	27,000	43,672	46,400	60,590
P75 earnings (in $)	54,000	47,930	85,000	86,835	52,000	51,702	80,000	82,667	65,000	65,518	100,000	109,015
Avg hourly wages (in $) (in $)	19.6	18.1	29.6	32.9	19.2	19.8	29.6	33.1	22.9	24.9	35.1	39.5
Median hourly wages (in $)	17.9	16.4	26.0	28.1	16.8	19.9	26.4	28.5	20.5	21.7	32.1	37.9
P25 hourly wages (in $)	11.7	12.1	16.8	21.1	11.7	14.7	16.8	26.7	13.5	20.3	21.4	28.1
P75 hourly wages (in $)	25.0	22.3	38.5	40.3	24.0	24.0	38.5	38.4	28.8	30.4	47.0	50.6