Rethinking the Welfare State

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Abstract

The U.S. spends non trivially on non-medical transfers for its working-age population in a wide range of programs that support low and middle-income households. How valuable are these programs for U.S. households? Are there simpler, welfare-improving ways to transfer resources that are supported by a majority? What are the macroeconomic effects of such alternatives? We answer these questions in an equilibrium, life-cycle model with single and married households who face idiosyncratic productivity risk, in the presence of costly children and potential skill losses of females associated with non-participation. Our findings show that a potential revenue-neutral elimination of the welfare state generates large welfare losses in the aggregate, although most households support the move as losses are concentrated among a small group. We find that a *Universal Basic Income* program does not improve upon the current system. If instead per-person transfers are implemented alongside a proportional tax, a *Negative Income Tax* experiment, it becomes feasible to improve upon the current system. Providing per-person transfers to all households is costly, and reducing tax distortions helps providing for resources to expand redistribution.

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1 Introduction

In this paper, we focus on the set of means-tested government transfers available to households of working age in the United States. These transfers are sizable and cover a wide range of programs and tax credit provisions. We refer to them as the *welfare state* for short. We ask: to what extent households value the current welfare state in the U.S.? Are there simpler, welfare-improving ways to transfer resources that are supported by a majority? What are the macroeconomic effects of switching to such alternatives?

Several observations motivate our work. First, the welfare state is far from insignificant: excluding health-care transfers (Medicaid), spending in all different programs add up to nearly 2.5% of GDP.[1] The rules and details of various programs are routinely discussed as key in affecting labor supply, inequality and well being in different ways. Hence, reforms or expansions of the current scheme are expected to have significant aggregate, distributive and welfare effects. Second, most households are potentially two-earner households.[2] This matters as current transfers depend critically on marital status/gender differences and the presence of children. Furthermore, households with two potential earners can cope with labor market shocks better than single-person households. As a result, social insurance and redistribution policy recommendations for an economy with two (potential) earners are likely to be different than those for a single-earner economy. Lastly, marital status and gender differences are usually not considered in the analysis of tax and transfer policies. In particular, differences by marital status and gender in wage and earnings inequality over the life cycle are typically ignored. In this paper, we fill a void by providing a macroeconomic analysis that considers all these aspects. We do so by developing an equilibrium framework with uninsurable shocks, labor supply decisions in two-earner households, costly children, and a detailed representation of taxes and transfers.

We build an equilibrium life-cycle model with a number of novel features. First, we introduce a rich degree of heterogeneity in our model economy. Individuals differ by skill (i.e., education levels), gender, and marital status. Skilled and unskilled individuals face

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[1] To place this number in international perspective, note that OECD (2019) calculates that income support to working age population as a fraction of GDP was 1.9% in the US. The numbers for several European countries are much higher: Germany (3.5%), France (5.4%), Belgium (7.5%).

[2] More than 60% of the U.S. labor force between ages 25 and 54 is married (Current Population Survey, 2000-2018).

distinct wage rates and differ on how fast their skills evolve as they age. In addition, single and married individuals face permanent shocks at birth and uninsurable persistent shocks over their life cycle. Second, we allow for labor-supply decisions of spouses at the extensive and intensive margins. Third, in line with data, we jointly account for the presence of children across married and single households, the timing of their arrival, and the associated childcare costs. In particular, we account for the level and variation of childcare costs over the life cycle as crucial determinants of female labor supply. Finally, we model the dynamic costs and benefits of participation decisions by allowing the labor market skills of females to depreciate due to childbearing disruptions.

Our parameterized model takes into account the different programs that comprise the U.S. welfare state and the progressive income tax system, excluding health-care transfers (e.g.,Medicaid and Medicare). Transfers in the model economy consist of three main components. The first is the Earned Income Tax Credit that provides a refundable tax credit to households with earnings. The second component relates to child-related transfers, e.g., the Child Tax Credit and childcare subsidies. The last part consists of the means-tested transfers, which are typically identified with the "welfare" system in the U.S., e.g., Temporary Assistance to Needy Families and Food Stamps. How much transfers households receive from different programs crucially depends on their marital status, earnings, number of children, and childcare expenses, and this dependence motivates our modeling choices. As such, a detailed description of the welfare state is a crucial input in the analysis. Any reform creates winners and losers, and the magnitude of these gains and losses critically depends on who benefits from the current system.

Given the welfare state and the tax system, we parameterize our model using U.S. aggregate and cross-sectional data. Our model economy is in line with how earnings inequality evolves over the life cycle (by gender, skill, and marital status), the levels and life-cycle changes in married females' participation rates, the life-cycle patterns of the gender wage-gap, and the rise in consumption dispersion with age. Altogether, our model economy presents a comprehensive macroeconomic model suitable to address the role and reforms to the welfare state.

Findings We conduct three sets of experiments. First, we consider the hypothetical complete elimination of the welfare state and concomitantly reduce the income taxes for all households to achieve budget balance. This allows us to gauge the aggregate effects of the welfare state, and the valuation of the welfare state vis-a-vis a reduction in the tax burden. Overall, eliminating the welfare state leads to an increase of hours worked and participation rates of married females of about 3% and 4.5%, respectively and an increase in output of about 1.7%. We find that eliminating the welfare state leads to a sharp aggregate welfare loss measured by a consumption compensating variation, of about 3.2% for a newborn individual under the veil of ignorance. Quite interestingly, a substantial majority of newborns support the hypothetical elimination of the welfare state (about 60.7%). This reflects the targeted nature of the current system, which is highly valuable to poor households and in particular to poor single mothers with children, while the majority of households either do not benefit from it or do so marginally.

We then introduce two major reforms to the welfare state. First, we replace the entire welfare state with a single transfer per person. We dub this case a *Universal Basic Income* (UBI). We search across steady states for the level of the transfer and the level of taxation that maximize ex-ante welfare (under the veil of ignorance) that keeps the budget balanced. We find that a generous transfer per person of about 3.2% of mean household income (about \$3,140 per person or \$12,550 for a family of four in 2019 dollars) maximizes the welfare of newborns.[3] However, even this welfare-maximizing level of transfers leads to an aggregate welfare *loss* of 1.3%. i.e., there is no UBI program that can improve upon the current system. If we introduce a UBI scheme on top of the current welfare state, as most proponents of a UBI advocate, only small transfers lead to welfare gains. A relatively small transfer of just 1% household income leads to welfare losses with a majority of individuals against such a program. Overall, our findings indicate that a UBI scheme is hardly a good idea in welfare terms.

Second, we replace all transfers and current income taxes with a single transfer per person and a proportional tax rate. We dub this case a *Negative Income Tax* (NIT). This case then combines a drastic transfer reform with a drastic tax reform. Similarly to the UBI case, we search across steady states for the level of the transfer and the associated tax rate that maximize the ex-ante welfare of newborns and satisfy budget balance. We find that a generous transfer of about 4.8% of mean household income (about \$4,700 per person or

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[3] The mean household income in 2019 was about \$98,000.

$18,800 for a family of four in 2019 dollars) maximizes ex-ante welfare with a gain of 0.2% and leads to strong majority support among newborns (about 68.2%). If a reform allows NIT transfers to differ between single and married households with more generous payments to singles, the welfare gains are larger (0.7%) and the program still has majority support of newborns (51.4%). The desirability of the NIT scheme becomes stronger when we take into account transitions across steady states.

The upshot for the relative success of an NIT scheme is that a larger degree of redistribution is feasible given the smaller tax distortions that ensue in this case. As tax distortions are reduced with a proportional tax, the size of the aggregate economy grows alongside the needed tax revenue to finance larger transfers. Therefore, an NIT scheme makes higher degrees of redistribution feasible. We show that the desirability of an NIT scheme is resilient to variations in the environment.

In placing our findings in perspective, one important case that we consider is an NIT reform in an economy with a different underlying inequality. The US economy has changed significantly during recent decades, with a sustained increase in inequality. Meanwhile, U.S. households changed with rising educational attainment, higher female labor force participation, and greater assortative mating. How do these changes affect the value of transfers for all and the desirability of an NIT reform? To answer this question, we recalibrate our model to salient features of the US economy in the 1980s and introduce a NIT reform. We find that the NIT reform leads to even more significant welfare gains in such an environment. With less inequality, there is a lower demand for transfers and the welfare-maximizing NIT transfer becomes smaller. As a result, the required proportional tax rate is also smaller and larger welfare gains are possible. In the 1980 economy, 80% of newborn households favor the NIT scheme, while the support in the baseline is 68.2%. Thus, introducing a NIT scheme in an economy with today's characteristics is more difficult since the demand for transfers is greater, and financing such larger transfers requires larger tax rates.

Related Literature Our paper is closely related to the literature that studies the welfare and aggregate effects of taxes and transfers in dynamic, general-equilibrium models with heterogeneous agents. Recent papers in this literature include Guner, Lopez-Daneri and Ventura (2016), Heathcote, Violante and Storesletten (2017), Badel, Huggett and Luo (2020), Kindermann and Krueger (2020), and Boar and Midrigan (2022). Within this literature, Kaygusuz (2010, 2015), Guner, Kaygusuz and Ventura (2012, 2020), Ortigueira and Siassi (2013), Holter, Krueger, and Stepanchuk (2019), Wu and Krueger (2021), and Borella, De Nardi and Yang (2023), among others, consider environments with two-earner households. Ortigueira and Siassi (2022) study how transfers can affect cohabitation vs. marriage incentives and Low, Meghir, Pistaferri and Voena (2022) analyze how marriage prospects can impact decisions to participate in programs with time limits. Blundell, Pistaferri, and Saporta-Eksten (2016) provide empirical evidence on the importance of family labor supply for consumption smoothing.

The UBI and its close-cousin NIT have a long intellectual history (Moffitt, 2003a) and gained support in recent public debate. Van Parijs and Vanderborght (2017) and Hoynes and Rothstein (2019) provide excellent reviews. Within macro-public-finance literature, Lopez-Daneri (2016) finds that an NIT transfer of about 11% of mean income leads to a large, 2.1%, welfare gain despite sharp output losses. Luduvice (2019) and Conesa, Li and Li (2021) consider replacing current transfers with a UBI and find that welfare gains are hard to achieve, as we find in this paper. Using search and matching models, Jaimovich et al. (2021) also find that UBI implies welfare losses, while Rauh and Santos (2022) suggest that welfare gains are possible if UBI also replaces the current unemployment benefits. Daruich and Fernandez (2023) study a UBI experiment within an overlapping generations model where the next generation's human capital depends on parents' decisions and find that UBI is not a good idea when the welfare of future generations is taken into account.

Our analysis differs from these papers on three key aspects. First, we provide novel facts on how inequality along the life cycle changes for individuals and households of different marital status and skill levels and use them to discipline the benchmark economy. Second, the model economy features a comprehensive welfare state, necessary to identify winners and losers in any reform. Finally, the model economy consists of single and married households, and married females who make participation decisions. These features are critical to understanding the implications of any reform to the current transfer system since female labor supply responds significantly to changes in tax-transfer policies, and the current welfare system treats different households (married/single, with and without children) differently.

The paper is organized as follows. In section 2, we document patterns of hours, earnings and consumption over the life cycle of individuals and household in the United States. Section 3 presents the model economy. In section 4 we describe the parameterization and calibration of the benchmark economy. Section 5 discusses the properties of the benchmark economy. In section 6, we present the main findings of our quantitative experiments. Section 7 places our findings in perspective. Section 8 concludes.

2 Earnings, Hours and Consumption: Life-Cycle Facts

We use the March Supplement of the CPS from 1980 to 2019 to document how average hourly wages, inequality of hourly wages and earnings, and labor market statistics (hours and participation) change over the life cycle. For age profiles for nondurable consumption, we use the Consumption Expenditure Survey (CEX) from 1984 to 2019. Our measure of inequality is the variance of logs. The Online Appendix provide sample restrictions and the definitions of all the variables.

We estimate age profiles repeated cross sections in the data. To this end, let $m_{j,t,c}$ be any statistic of interest for an age-j individual (or household) at time t, of cohort c. We construct an age profile from repeated cross sections by regressing $m_{j,t,c}$ on a set of age, year, and cohort dummy variables:

$$m_{j,t,c} = \beta_j' \mathbf{D}_j + \beta_t' \mathbf{D}_t + \beta_c' \mathbf{D}_c + \varepsilon_{j,t,c}, \tag{1}$$

where $\mathbf{D}_j$, $\mathbf{D}_t$ and $\mathbf{D}_c$ are a set of age, year and cohort dummies. Equation (1) is estimated separately for each gender (men and women), marital status (married and single), and skill group. For skills, we divide individuals in two groups; *skilled (s)*, those with at least four years of college education or more, and *unskilled (u)*, with strictly less than college education. The age profiles are given by the estimated β_j values. As it is well known, the collinearity between time (year) and cohort dummies limits the applicability of the regression above. We use in our analysis the year-effect specification, which we view as a more appropriate specification from a macroeconomic standpoint (see, e.g. Heathcote, Storesletten and Violante 2005). In section 7 and in the Online Appendix, we present the profiles with cohort effects. The key findings that emerge from the analysis are listed below.

1. For males, as it is well known in the literature, the variance of log-hourly wages increase non-trivially along the life cycle; see Figure 1 (left panel). As dummies, estimated β_j values only capture variance of log wages for each age relative to an omitted one. Therefore, we normalize β_{25} to its value in the data (the variance of log wages for 25 years olds, averaged

across years) and rescale all other coefficients accordingly. The increase is more pronounced for skilled than for unskilled men. The increase is of nearly 30 log points for married skilled men between ages 25-60, versus a corresponding increase of about 14 log points for married unskilled men. These patterns hold for single men as well, albeit with a smaller increase in variances over the life cycle. These patterns are mirrored when inequality in labor earnings rather on hourly wages is considered.

Figure 1 - Variance of Log Wages, Males (left) and Females (right)

2. For females, married or single, we *do not observe* a similar increase. This is largely independent of marital status and skill – see Figure 1 (right panel). The increase in dispersion in hourly wages for unskilled (skilled) females is of about five (ten) log points up to age 40, and after that, the level of dispersion is roughly *constant*. This is in stark contrast with the increase in dispersion for males discussed in point 1 above.[4]

3. For both married and single households, the variance of log earnings increase non-trivially along the life cycle, but the level of inequality is *much lower* among married households. At age 25 (45), variance of log earnings is about 0.38 (0.55) for all households, but only 0.30 (0.41) for married households.

4. The gender wage gap, defined as the ratio of average hourly earnings of females relative to males, increases over the life cycle. These changes are sharper for skilled individuals, with a decline in this ratio from about 92% at age 25 to about 70% at age 45. For unskilled

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[4] Bayer and Kuhn (2020) document similar gender differences in life-cycle profiles of earnings inequality in Germany.

individuals, the corresponding change is smaller and of about 11 percentage points. Figure 2 (left panel) displays these patterns.

5. Over the life cycle, the participation rate of married females first declines and then rises up to ages 45-48, and then declines again. These changes are much more pronounced for married *skilled* females. Figure 2 (right panel) displays these patterns.

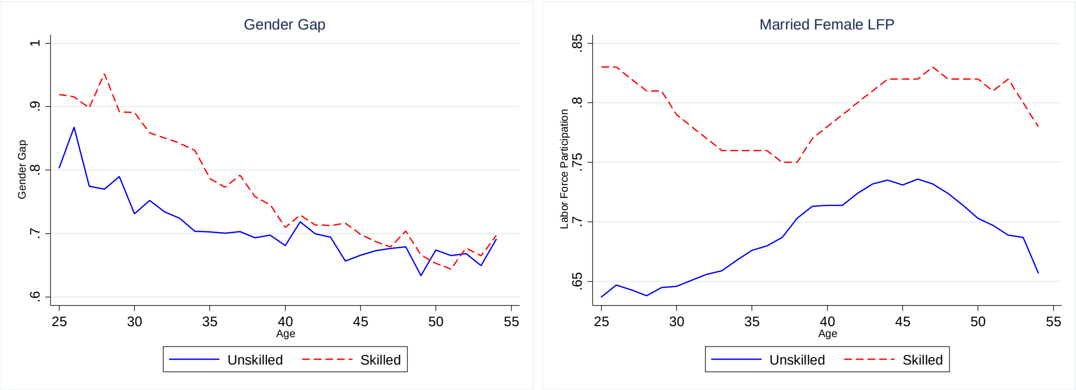

Figure 2 - The Gender Wage Gap (left); LFP of Married Females (right)

6. Conditional on work, there is significant variation in hours of work among married females, measured by the variance of log hours at each age. The level is, nevertheless, roughly constant over the life cycle, at around 0.13; see Figure 3 (left panel).

7. The correlation between earnings of husbands and wives is low, around 0.15 at ages 40-50, and slightly ∩-shaped early in the life–cycle. Figure 3 (right panel) displays these patterns.

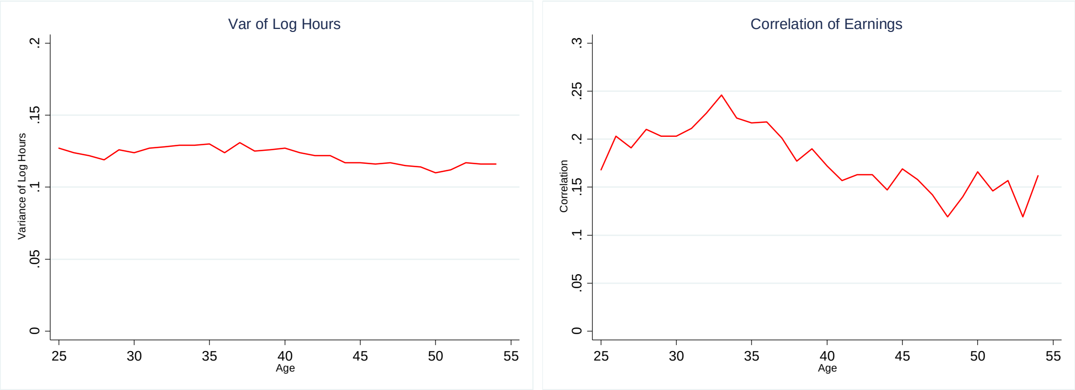

Figure 3 - Var. of Log Hours, Married Females (left); Correlation of Spousal Earnings (right)

8. The variance of log consumption increases along the life-cycle, but *much less than* the increase in the variance of household or individual earnings. The increase peaks at age 55, about 0.12 log points above its level at age 25. This is a well-known fact by now, and documented in Aguiar and Hurst (2013) and Primiceri and van Rens (2009), among others.

3 The Economic Environment

We study a stationary life-cycle economy populated by a continuum of males (m) and a continuum of females (f). Let $j \in \{1, 2, ..., J\}$ denote the age of each individual. Each model period is one year, and the first model period corresponds to age 25. Population grows at rate n. The life-cycle of agents is split into two parts. Each agent starts life as a worker and at age J_R, individuals retire and collect pension benefits until they die at age J.

Individuals differ in their marital status. We assume that they are born as either *single* or *married* and their marital status does not change over time. Each individual is also born with a given intrinsic type (education) that defines the rental rate for his/her labor services, and the growth of their labor endowment as they age. Married households are comprised by individuals who are of the same age.

Married households and single females also differ in terms of the number of children attached to them. They can be childless or endowed with children. The number of children depend on the educational attainment of the parents and they appear either early or late in the life-cycle exogenously. Children affect the resources available to households for several periods, and this is mitigated partially or fully by government policies targeted to children. Children do not provide any utility.

Individuals also differ in terms of permanent shocks received at the start of life, which are correlated among spouses. Furthermore, each period, individuals experience uninsurable productivity shocks, which affect how much they can earn per hour. We assume that these shocks are persistent. We also assume that shocks that husbands and wives receive are correlated. Hence, heterogeneity among households arises due to different factors; their education level, the permanent and life-cycle shocks of their members, and who is married with whom. These forms of ex-post and ex-ante heterogeneity determine, in conjunction with labor supply and savings decisions, the degree of income, consumption and wealth inequality in the economy.

Production and Markets There is an aggregate firm that operates a constant returns to scale technology. The firm rents capital, skilled and unskilled labor services from households at the rates R, w_s and w_u, respectively. Using K units of capital and L units of the composite labor input, the firm produces

$$F(K,L) = K^{\alpha}L^{1-\alpha}, \text{ with } L \equiv \left(\xi L_s^{\rho} + (1-\xi)L_{u,g}^{\rho}\right)^{\frac{1}{\rho}}, \ \rho \in (-\infty, 1),$$

where L_s and $L_{u,g}$ stand for the stock of skilled labor, and unskilled labor used in the production of goods, respectively. The elasticity of substitution between labor of different types is constant and given by $\sigma = \frac{1}{1-\rho}$.

We assume that capital depreciates at rate δ_k. Childcare services are provided using unskilled labor services only. Thus, the price of childcare services is the wage rate, w_u. As a result, unskilled labor services available are split between the production of consumption and investment goods, $L_{u,g}$, childcare services, $L_u - L_{u,g}$. Households save in the form of a risk-free asset that pays the competitive rate of return $r = R - \delta_k$.

Ex-ante Heterogeneity and Demographics At the start of life, each male is endowed with an exogenous type z that remains constant over his life cycle: $z \in Z = \{u, s\}$. This type of heterogeneity defines whether the agent is *skilled* (s) or *unskilled* (u) that we later map to educational levels in the data. For females, we equivalently have $x \in X = \{u, s\}$. We assume that each cohort is $1 + n$ bigger than the previous one. These demographic patterns are stationary so that age-j agents are a fraction μ_j of the population at any point in time. The weights are normalized to add up to one, and obey the recursion, $\mu_{j+1} = \mu_j/(1+n)$.

3.1 Labor Efficiency Units

We consider a general structure, where individuals differ at the start of the life cycle in their skills, permanent shocks, as well as uninsurable shocks experienced as they age. These shocks are dependent on the skill of individuals (u, s), their gender (m, f) and their marital status (M, S).

Singles Consider first single males. Their labor endowment (efficiency units) at age j is given by

$$\varpi_m(z,j)\exp(\nu^S_{m,z}+\eta^S_{m,z,j}), \quad z\in Z=\{u,s\},$$

where the function $\varpi_m(.,.)$ summarizes the combined effects of skill and age on the labor endowment. ν is a *permanent* shock and η is a *persistent* shock. We assume that the permanent shock is normally distributed: $\nu^S_{m,z}\sim N(0,\sigma^2_{\nu^S_{m,z}}),\ z\in Z$.

We assume that for $j>1$, the persistent shock is governed by a random walk, given by

$$\eta^S_{m,z,j+1}=\eta^S_{m,z,j}+\varepsilon^S_{m,z,j+1}, \quad z\in Z,$$

with $\varepsilon^S_{m,z,j+1}\sim N(0,\sigma^2_{\varepsilon^S_{m,z}})$ representing innovations over time. We furthermore assume that the initial value of η at the start of the life cycle is zero; i.e., $\eta^S_{m,z,1}=0,\ z\in Z$.

The structure is different for single females, as their efficiency units evolve endogenously, with growth and depreciation rates that depend on intrinsic skills and labor market experience. Intrinsic skills determine their initial human capital: $h_1=\varpi_f(x,1),\ x\in X$. For $j>1$, we have

$$h'=\mathcal{H}(x,h,l,e)=\exp\left[\ln h+\alpha^e_x\chi(l)-\delta_x(1-\chi(l))\right], \quad x\in X=\{u,s\}, \tag{2}$$

where e stands for labor market experience and $\chi(.)$ is an indicator function that is 1 if hours worked are positive and zero otherwise. The parameter α^e_x is the experience-skill growth rate and δ_x stands for the depreciation rate. It follows that for a single female of age-j who has human capital h, her realized labor efficiency is given by $h\times\exp(\nu^S_{f,x}+\eta^S_{f,x,j})$. The permanent and the persistent shock obey the same representation as for males, with innovation variances that depend on marital status and skill.

Married Couples Married individuals draw permanent shocks at the start of their life cycle that are potentially *correlated*. They also draw values for their persistent shocks which are potentially correlated as well. The labor endowments (labor efficiency) of a married male and a married female are given by

$$\varpi(z,j)\times\exp(\nu^M_{m,z}+\eta^M_{m,z,j}) \ \text{ and } \ h\times\exp(\nu^M_{f,x}+\eta^M_{f,x,j}), \quad z\in Z,\ x\in X.$$

The labor efficiency of a married female is correspondingly given by $h\times\exp(\nu^M_{f,x}+\eta^M_{f,x,j})$, where h follows the same law of motion for singles; equation (2).

The initial conditions are such that $\eta^M_{m,z,1} = 0$ and $\eta^M_{f,x,1} = 0$. For $j > 1$, $\eta^M_{m,z,j}$ and $\eta^M_{f,x,j}$ follow a bivariate process, given by

$$\eta^M_{m,z,j+1} = \eta^M_{m,z,j} + \varepsilon^M_{m,z,j+1} \text{ and } \eta^M_{f,x,j+1} = \eta^M_{f,x,j} + \varepsilon^M_{f,x,j+1} \text{ for } z \in Z,\ x \in X$$

with

$$(\varepsilon^M_{m,z,j+1}, \varepsilon^M_{f,x,j+1}) \sim N\left(\begin{matrix} 0 \\ 0 \end{matrix}, \begin{matrix} \sigma^2_{\varepsilon^M_{m,z}} & \sigma_{\varepsilon_f \varepsilon_m} \\ \sigma_{\varepsilon_f \varepsilon_m} & \sigma^2_{\varepsilon^M_{f,x}} \end{matrix}\right), \quad z, x \in Z \times X.$$

The values of permanent shocks for married individuals are draws from a bivariate normal distribution as well. That is,

$$(\nu^M_{m,z}, \nu^M_{f,x}) \sim N\left(\begin{matrix} 0 \\ 0 \end{matrix}, \begin{matrix} \sigma^2_{\nu^M_{m,z}} & \sigma_{\nu_f \nu_m} \\ \sigma_{\nu_f \nu_m} & \sigma^2_{\nu^M_{f,x}} \end{matrix}\right), \quad z, x \in Z \times X.$$

Note that we assume that while innovations depend on skills, the covariance structure for both permanent and persistent shocks does not. This parsimonious specification allows us to capture key correlations across married spouses, both at the start as well as in along the middle of the life cycle – see section 5.

Labor Earnings We now summarize the notion of labor *earnings* resulting from our choices, taking into account skill prices (w_s and w_u), endowments and labor supply choices – described later. For an age-j single male of type z, earnings are given by

$$\underbrace{w_z}_{\text{wage by skill}} \underbrace{\varpi(z,j)\exp(\nu^S_{m,z} + \eta^S_{m,z,j})}_{\text{labor efficiency}} \underbrace{l_m}_{\text{labor supply}}$$

For a single female of skill $x \in X$ who has human capital h, age j, earnings are given by

$$\underbrace{w_x}_{\text{wage by skill}} \underbrace{h\ \exp(\nu^S_{f,x} + \eta^S_{f,x,j})}_{\text{labor efficiency}} \underbrace{l_f}_{\text{labor supply}}$$

Finally, for a married couple of skill $z, x \in Z \times X$, of age j, when she has h units of human capital, earnings are given by

$$\underbrace{w_x}_{\text{wage by skill}} \underbrace{h\exp(\nu^M_{f,x} + \eta^M_{f,x,j})}_{\text{labor efficiency}} \underbrace{l_f}_{\text{labor supply}} + \underbrace{w_z}_{\text{wage by skill}} \underbrace{\varpi(z,j)\exp(\nu^M_{m,z} + \eta^M_{m,z,j})}_{\text{labor efficiency}} \underbrace{l_m}_{\text{labor supply}}$$

3.2 Children and Childcare Costs

Children are assigned exogenously to married couples and single females at the start of life, depending on the education of parents. Each married couple and single female can be of three types: *without* any children, *early* child bearers, *late* child bearers. We denote this dimension of heterogeneity by $b = \{0, 1, 2\}$.

If $b \neq 0$, children appear deterministically at parents' age $\bar{j}(x, z, b)$ for married households and $\bar{j}(x, b)$ for single females. Married households have $k(x, z)$ children, while single females have $k(x)$ children. For married households, half of the children appear at age $\bar{j}(x, z, b)$ and the other half at age $\bar{j}(x, z, b) + 2$; i.e., children are spaced by two years. It is equivalent for single households: half of the children appear at age $\bar{j}(x, b)$ and the other half at age $\bar{j}(x, b) + 2$. Each child stays with their parents for N model periods.

We assume that if a female with children works, married or single, then the household has to pay for childcare costs. Childcare costs depend on the age of the child, t, and are priced at rate w_u. We assume that children in single female households require $d(x, t)$ units of childcare services per child, $t = 1, 2, ..., N$. Married households require $d(x, z, t)$ units of childcare services per child. Since competitive price of childcare services is the unskilled wage rate w_u, the cost of childcare services per child equals $w_u d(x, t)$ for single females and $w_u d(x, z, t)$ for married households.

3.3 Preferences

The momentary utility function for singles is given by

$$U^S(c, l) = \log(c) - B_i (l)^{1+\frac{1}{\gamma}}, \quad i = m, f$$

where c is consumption, l is time devoted to market work, and γ is the intertemporal elasticity of labor supply (Frisch elasticity). The parameter B_i captures potential gender-driven differences in the disutility of work.

Married households maximize the sum of their members utilities. We assume that when the female member of a married household works, the household incurs a utility cost q. We assume that at the start of their lives married households draw a $q \in Q$, where $Q \subset R_{++}$ is a finite set. These values of q represent the utility costs of joint market work for married couples. For a given household, the initial draw of utility cost depends on the type (education) of the husband. Let $\zeta(q|z)$ denote the probability that the cost of joint work is q, with $\sum_{q\in Q}\zeta(q|z) = 1$. We assume that for married households with children at home, the utility cost q is multiplied by a factor that depends on the age of the youngest child at home, t_{min} and the mother's skill level, $\vartheta_x(t_{\min})$, $x \in X$. This specification captures the idea that joint work becomes more costly with arrival of children, beyond childcare costs, and that this additional cost changes as children grow older.

Formally, if $b \in \{1, 2\}$ and the household age is such that $\bar{j}(x, z, b) \leq j \leq \bar{j}(x, z, b)+N+2$, i.e., children are at home (recall that the first child arrives at $\bar{j}(.)$ and the second one leaves at $\bar{j}(.) + N + 2$), then the period utility of a married household is given by

$$U^M(c, l_f, l_m; \theta, q, j) = 2\log(c) - B_m\, l_m^{1+\frac{1}{\gamma}} - \theta B_f l_f^{1+\frac{1}{\gamma}} - \chi\{l_f\}q(1 + \vartheta_x(t_{min})). \qquad (3)$$

where $\chi\{.\}$ denotes the indicator function.[5] For households without any children at home, $\vartheta_x(t_{min}) = 0$.

Note that consumption is a public good within the household. The variable θ captures heterogeneity in the disutility of work across married females. We assume that θ is realized at the start of life, and takes two values with equal probability; $\theta \in \{\theta_L, \theta_H\}$. Note also that the parameter $\gamma > 0$, the intertemporal elasticity of labor supply, is common for all individuals; males or females, married or single. It is also important to note that following the tradition in macroeconomics literature, we restrict the preferences to be consistent with a balanced-growth path. As in, e.g., Attanasio et al. (1999, 2005), we could allow the marginal utility of consumption to be affected by the female labour force participation decision. In the current specification, the female labour force participation and demographics (the number of children) affect the level of utility through the cost of joint work.

3.4 Taxes and Transfers

There is a government that taxes labor and capital income, and uses tax collections to pay for government consumption, tax credits, transfers to individuals. It also runs a pay-as-you-go social security system, so it collects payroll taxes and pays retirement benefits.

Transfers Households in the model have access to transfers that depend on gender, marital status and household income. Income for tax and transfer purposes is labor plus asset

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[5] Note that if x, z and j are known, the age of the youngest child can be readily calculated.

income. For a household with income level I, number of children k, childcare expenses D, the transfers are represented by functions $TR^S_f(I,k,D)$, $TR^S_m(I)$ and $TR^M(I,k,D)$, for a single-female, single-male and married-couple households, respectively. This generic formulation of transfers allows us to capture a host of transfers and tax credit programs in the United States. We describe below how these functions are parameterized in light of data.

Taxation and Social Security The total income tax liabilities of married and single households, before any tax credits, are affected by the presence of children in the household, and are represented by tax functions $T^M(I,k)$ and $T^S(I,k)$, respectively, where k stands for the number of children at the household. These functions are continuous in I, increasing and convex. This representation captures the effective variation in tax liabilities associated to income, marital status and the presence of children in households.

There is a (flat) payroll tax that taxes individual labor incomes, represented by τ_p, to fund social-security transfers. Moreover, each household pays an additional flat capital income tax for the returns from his/her asset holdings, denoted by τ_k. Retired households have access to social security benefits. The social security benefits depend on agents' education types, i.e., initially more productive agents receive larger social security benefits. This allows us to capture in a parsimonious way the positive relation between lifetime earnings and social security transfers, as well as the intra-cohort redistribution built into the system. Let $p^S_f(x)$, $p^S_m(z)$, and $p^M(x,z)$ indicate the level of social security benefits for a single female of type x, a single male of type z and a married retired household of type (x,z), respectively. The social security system has to balance its budget every period.

3.5 Decision Problem

We now present the decision problem for different types of agents in the recursive language. We provide a formal definition of a stationary equilibrium in Guner, Kaygusuz, and Ventura (2023). We focus on single females and married couples, since the problem of single males is rather standard. For ease of notation, the dependence of shocks on type, gender and marital status is suppressed whenever possible. For single females, the individual state is $(a,h,e,x,\nu^S_{f,x},\eta^S_{f,x},b,j)$, where a stands for asset holdings. For married couples, the state is given by $(a,h,e,x,z,\theta,\nu^M_{m,z},\nu^M_{f,x},\eta^M_{m,z},\eta^M_{f,x},q,b,j)$.

Note that the dependency of transfers and taxes on the presence of children in the household is summarized by age of parents (j) and childbearing status (b), in conjunction with x for single females and the pair (x, z) for married couples. The same reasoning applies for childcare costs, or the utility costs of joint participation for married couples when children are present. That is, if we know the intrinsic type of a single female or a married household, the age of parents (j) and fertility type (b), we know the age of each child and the childcare costs. Given parents' types, the half of children appear at parents' age $\bar{j}(.)$ and the other half at $\bar{j}(.) + 2$. Then, when their parents are of age j, young and old children at home have ages $j - \bar{j}(.) + 1$ and $j - \bar{j}(.) + 3$.

For expositional purposes, we collapse the permanent/exogenous characteristics in the household problems in a single vector of state variables. For single females, let $\mathcal{S}^S_f \equiv (x, \nu^S_{f,x}, b)$ be the vector of variables that do not change along the life-cycle for single females and single males, respectively. For married households, let $\mathcal{S}^M \equiv (x, z, \theta, \nu, q, b)$ be the vector of such states for married households, with $\nu \equiv (\nu^M_{f,x}, \nu^M_{m,z})$. In similar fashion, for the case of married couples, we summarize the pair of persistent shocks by $\boldsymbol{\eta} \equiv (\eta^M_{f,x}, \eta^M_{m,z})$. Likewise, for expositional purposes, we denote by $\mathcal{E}^S_f(x, h, \eta^S_{f,x}, \nu, l_f)$ and $\mathcal{E}^M(x, z, h, \boldsymbol{\eta}, \boldsymbol{\nu}, l_m, l_f, j)$, the labor earnings of single females and married couples, respectively, as defined in Section 3.1.

The Problem of a Single Female Household Given her current state, $(a, h, e, \mathcal{S}^S_f, \eta, j)$ the problem of a single female is

$$V^S_f(a, h, e, \mathcal{S}^S_f, \eta, j) = \max_{a', l} \{U^S(c, l) + \beta \mathbf{E}_{\eta'|\eta} V^S_f(a', h', e', \mathcal{S}^S_f, \eta', j + 1)\},$$

subject to

(i) With kids: if $b = \{1, 2\}$, $j \in \{\bar{j}(x, b), \bar{j}(x, b) + 1, ..., \bar{j}(x, b) + N + 2\}$

$$c + a' = \left\{ \begin{array}{l} a(1 + r(1 - \tau_k)) + \mathcal{E}^S_f(x, h, \eta, \nu, l)(1 - \tau_p) \\ +TR^S_f(I, \mathcal{K}, D) - T^S(I, \mathcal{K}) - w_u D \chi(l) \end{array} \right. ,$$

where $I = \mathcal{E}^S_f(x, h, \eta, \nu, l) + ra$. $\mathcal{K}$ is the number of children present in the household, either old, born at $\bar{j}(x, b)$, or young, born at $\bar{j}(x, b) + 2$. It is given by

$$\mathcal{K} = \frac{k(x, b)}{2} \left[\underbrace{\chi(\bar{j}(x, b) \leq j \leq \bar{j}(x, b) + N)}_{\text{old children}} + \underbrace{\chi(\bar{j}(x, b) + 2 \leq j \leq \bar{j}(x, b) + 2 + N)}_{\text{young children}} \right].$$

Meanwhile, D stands for the childcare expenses incurred:

$$\begin{aligned} D &= \frac{k(x,b)}{2}\, d(x, j-\bar{j}(x,b)+1)\chi(\bar{j}(x,b) \le j \le N) + \\ & \quad \frac{k(x,b)}{2}\, d(x, j-j(x,b)+3)\chi(\bar{j}(x,b)+2 \le j \le \bar{j}(x,b)+2+N). \end{aligned}$$

(ii) <u>Without kids but not retired:</u> if $b = 0$, or $b = \{1, 2\}$ and $j \notin \{\bar{j}(x,b), ..., N+2\}$, then there are no children at home and

$$\begin{aligned} c + a' &= a(1 + r(1-\tau_k)) + \mathcal{E}^S_f(x, h, \eta, \nu, l)(1-\tau_p) \\ & \quad + TR^S_f(I, 0, 0) - T^S(I, 0). \end{aligned}$$

iii) <u>Retired:</u> if $j \ge J_R$, then there are no children and

$$c + a' = a(1 + r(1-\tau_k)) + p^S_f(x) - T^S(ra, 0) + TR^S_f(ra, 0, 0).$$

In addition,

$$h' = \mathcal{H}(x, h, l_f, e) = \exp\left[\ln h + \alpha^x_e \chi(l_f) - \delta^x(1-\chi(l_f))\right], \tag{4}$$

$$e' = e + \chi(l) \text{ and } l \ge 0,\ a' \ge 0 \text{ (with strict equality if } j = J+1).$$

The Problem of Married Households Like singles, married couples decide how much to consume, how much to save, and how much to work. They also decide whether the female member of the household should work, taking into account the evolution of her skills, experience and childcare costs. Note that in the formulation below, we make the current utility of married households to depend on (x, z, b, j), as these variables fully determine the age of children present in the household that may affect the disutility of joint market work, $q(1 + \vartheta_x(t_{min}))$ term above. Formally, the problem is given by

$$V^M(a, h, e, \mathcal{S}^M, \boldsymbol{\eta}, j) = \max_{a',\, l_f,\, l_m} \{U^M(c, l_f, l_m, q, x, z, b, j) + \beta \mathbf{E}_{\boldsymbol{\eta}'|\boldsymbol{\eta}} V^M(a', h', e', \mathcal{S}^M, \boldsymbol{\eta}', j+1)\},$$

subject to

(i) <u>With kids:</u> if $b = \{1, 2\}$, $j \in \{\bar{j}(x,b), ..., N+2\}$, then

$$c + a' = \left\{ \begin{array}{l} a(1 + r(1-\tau_k)) + \mathcal{E}^M(x, z, h, \boldsymbol{\eta}, \boldsymbol{\nu}, l_m, l_f, j)(1-\tau_p) \\ -T^M(I, \mathcal{K}) + TR^M(I, \mathcal{K}, D) - w_u D \chi(l), \end{array} \right\},$$

where $I = \mathcal{E}^M(x, z, h, \boldsymbol{\eta}, \boldsymbol{\nu}, l_m, l_f, j) + ra$, and $l_m \ge 0$, $l_f \ge 0$, and $a' \ge 0$.

In this formulation, $\mathbf{E}_{\eta'|\eta}$ now represents the joint expectation over the shocks that husbands and wives face. The number of children present, $\mathcal{K}$, and childcare expenses are D are formulated as they were done for a single female. The household problem also takes into account the accumulation of human capital for the wife, given by $h' = \mathcal{H}(x, h, l_f, e)$ and $e' = e + \chi(l)$.The budget constraints when the household is not retired but without any children and when the household is retired, cases (ii) and (iii), are defined accordingly.

3.6 Sources of Inequality in the Model

What are the determinants of inequality at a point in time and over the life cycle across individuals and households in the model? This question is of central importance in assessing the effects of transfer policies.

First, individuals differ in their intrinsic skills and that experience permanent and persistent shocks at birth. Permanent and persistent shocks are common in life-cycle models with heterogeneous individuals. Different from most of the work in the area, differences in skill type at birth determine (i) potentially different growth rates in labor productivity between skilled and unskilled individuals, and (ii) between-group differences as individuals face different rental rates for labor services depending on their skill type. Point (i) implies that our model encompasses a mixture of traditional parameterization of heterogeneity (usually referred to as Representative Income Processes or RIP), with a human capital view of differences of individuals as they age, as emphasized in Guvenen (2009) and Huggett, Ventura and Yaron (2011), among others (Heterogeneous Income Processes or HIP).

The second layer of heterogeneity determining inequality concerns marital status. At birth, some individuals are single, some are married, and married ones are assigned to spouses according to their skill type. Besides, within a given skill pair, permanent and persistent shocks are potentially correlated between spouses. Overall, as in Greenwood et al. (2016) and others, marriage can amplify existing differences between individuals and contribute to propagating shocks over the life cycle.

Finally, differences in individuals by gender, coupled with children's presence, help define the level of gender premia in wages at birth and its evolution over the life cycle. As children appear and women leave the workforce, skill depreciation kicks in, and thus, the gender gap in wage rates grows over time. As children require fewer resources as they age, some women return to work, accumulate skills again and the gender-wage gap moderates its growth. As we describe below in our analysis of the benchmark economy, women's behavior regarding participation over time, in conjunction with uninsurable shocks, determines gender differences in the life-cycle profile of earnings inequality.

The reforms of the welfare state that we consider, the Universal Basic Income (UBI) and Negative Income Tax (NIT), have simple structures. However, they replace the existing welfare state, which is not simple at all. As a result, identifying the winners and losers requires rich ex-ante heterogeneity, since different socio-economic groups receive quite different transfers in the benchmark economy.

3.7 Modelling Choices

Several model elements are taken as exogenous in the current analysis. This allows us to simulate a model with extensive heterogeneity in educational attainment, marital status and sorting, and the number and timing of children. As we emphasize in the paper, such heterogeneity is crucial to understanding the welfare consequences of reforms to the welfare state. We model these features as exogenous, which allows us to focus on a subset of critical endogenous decisions: household labor supply, female human capital accumulation, and savings. There is an extensive empirical literature on the incentive effects of the welfare state on marriage and fertility, with a particular focus on the impact of the 1996 welfare reform. The findings from this literature suggest that the incentive effects of the welfare state on marriage, fertility, and single motherhood are modest; see Bitler et al. (2004), Kearney (2004), and Moffitt et al. (2020). Hence, we expect that the welfare state's direct impact on marriage and fertility incentives likely to be small. On the other hand, it is well established that children that grow with single mothers receive relatively much less investment than those with two parents. As a result, even small adverse effects on marriage incentives coupled with adverse effects on children can accumulate across generations, impacting intergenerational mobility. This is emphasized by Aiyagari, Greenwood, and Guner (2000), among others.

We also have a unitary model of household decisions. With a non-unitary model like in Voena (2015), transfers can affect within-household allocations even if they do not change marriage and divorce decisions. In particular, a non-unitary model could allow us to study how gender-specific taxes and transfers can alter household allocations and within-household distribution of welfare.

The model also abstracts from health shocks and government-provided health insurance programs, such as Medicaid, Children's Health Insurance Program (CHIP), and Social Security Disability Insurance (SSDI). Recent papers introduce exogenous health shocks into heterogeneous-agent macro models – see Hosseini, Kopecky, and Zhao (2021) for a recent example. In these models, health shocks affect earnings (mainly through labor supply) and act like income shocks, and as a result, government-provided health insurance is valued by individuals. Hosseini et al. (2021), for example, find that health shocks account for about 30% of lifetime earnings inequality, and government provided disability insurance is valued by consumers. Since health shocks are exogenous in these models, we see our paper and this literature as complementary, each focusing in detail on different aspects of the welfare system.

4 Parameter Values

This section describes how we select parameter values to compute a stationary equilibrium. We relegate details to the Online Appendix (Tables A11 and A12 summarize our parameter choices). The model period is one year. Agents start their life at age 25, potentially work for forty years, retire at age 65 ($j = J_R$), and then live until age 80 ($j = J$). The population grows at the annual rate of 1.1%. *Skilled* individuals are those with at least four-year college degree. The marital structure (who is single, who is married and who is married with whom), childbearing status, and the number of children for different types of households are taken directly from the data.

Endowments For males, following the procedure described in Section 2, we construct age profiles of mean hourly wages for each skill group using data from 1980-2019 CPS March Supplement, and set $\varpi_m(z, j)$, $z = u, s$, to these profiles (Figure A7 in the Online Appendix). For females, we use age-25 wage levels to calibrate their initial human capital levels, $h_1 = \varpi_f(x, 1)$. After age 25, female skills evolve according to equation (2).

We select the parameter α_x^e so that if a type-x female works for one more period, her wage grows exactly at the same rate as a male of the same type with the same experience level (e). Hence, if a female works in every period, her labor market productivity evolves exactly like a male, except for the observed age-25 wage gender gap. Figure A7 in the Online Appendix shows the calibrated values for the growth factors. For depreciation rates, we select each one so that the model is consistent with the evolution of the wage-gender gap for the first decade of the life cycle (ages 25-35). The resulting values are $\delta_u = 0.025$, and a non-trivially higher value for skilled females, $\delta_s = 0.059$. These values are required to reproduce the faster increase in the wage-gender gap with age for skilled females documented in section 2.[6]

Productivity Shocks There are in total *eighteen* parameters that determine the productivity shocks: eight variances for permanent shocks (by skill, gender, and marital status), eight innovation variances for persistent shocks (again by skill, gender, and marital status, plus two covariances (for permanent shocks and innovations to persistent shocks). Table A11 in Online Appendix presents these parameters. For permanent shocks (ν), we match the observed variances of log-wages at age 25 by skill, gender and marital status. To pin down the value of covariance term for married individuals, $\sigma_{\nu^f \nu^m}$, we target the correlation in log-wages among all spouses at age 25. For the variances of innovations to persistent shocks (ε), we target the observed variances of log-wages towards the end of the life cycle (age 54) for each group. For the covariance of innovation in persistent shocks across spouses, $\sigma_{\varepsilon^f \varepsilon^m}$, we target the correlation of wages between husbands and wives by middle age (ages 40-45). Overall, the variances of innovations for persistent shocks for men are substantially larger than for females, while the corresponding variances for skilled individuals, male or female, are larger than for unskilled ones. Overall, not surprisingly, the innovation variances are smaller than in related estimates, e.g., Heathcote, Storesletten, and Violante (2010) and Huggett et al (2011). This reflects the division of individuals between skilled –who experience faster growth in labor efficiency with experience– and unskilled ones, as well as the distinction of individuals by gender and marital status.

Income Taxation To compute the tax functions, i.e., $T^S(I,k)$ and $T^M(I,k)$, we adopt a parametric form for the average tax rate:

$$\tau(I) = 1 - \lambda I^{-\tau},$$

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[6] Blundell et al (2016) find similar results for the UK.

where I (income) is measured in multiples of mean household income and $\tau(I)$ is the average tax rate. The parameter τ determines the progressivity of the tax scheme and λ determines its level. The parameters τ and λ depend on marital status and the number of children, and are estimated from IRS micro data on tax returns. Since the EITC, CTC and CDCTC are explicitly modeled in the benchmark economy, the tax functions are estimated using tax liabilities before these credits are applied.

Transfers In the Online Appendix and Guner, Kaygusuz, and Ventura (2023), we provide a description of the various means-tested programs in the United States, focusing on who qualifies for them and how household's marital status and number of children affect access.[7] We divide these programs into three groups (i) the Earned Income Tax Credit (EITC); (ii) child-related transfers, that encompass the Child Tax Credit (CTC), the Child and Dependent Care Tax Credit (CDCTC) and childcare subsidies; and (iii) the amalgam of programs that provide cash or in-kind transfers that are routinely identified as the "welfare system", such as the Temporary Assistance to Needy Families (TANF) and the Supplemental Nutrition Assistance Program (SNAP). We calculate that expenditures in all these programs at all levels amounted to about 2.3% of GDP in 2019.[8]

In computing the transfer functions $TR_f^S(I,k,D), TR_m^S(I)$, and $TR^M(I,k,D)$, the main object of this paper, we model tax credits exactly as they appear in the tax code. Following the discussion in Guner, Kaygusuz and Ventura (2020), the government covers 75% of the childcare costs for households whose income is below a threshold. We chose the threshold so that the poorest 5% of children receive the subsidy.

The final component is the means-tested transfers. Following Guner, Rauh and Ventura (2023), we use data from the Survey of Income and Program Participation (SIPP) to estimate an effective transfer schedule that relates transfers received by different household types to their income. The welfare payments include all the main means-tested programs as described in the Online Appendix. We assume that these transfers as a function of income take

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[7] More extended discussions can be found, among others, in Moffitt (2003b) and Guner, Rauh, and Ventura (2023).

[8] In 2019, the U.S. Federal government spent 361 billion dollars for non-medical means-tested transfer programs for the working-age population. This is about 8% of total federal budget and correspond to about 1.7% of the U.S. GDP. The total spending, federal and state-level, amounted to about 2.3% of the GDP and is expected to grow as we write. Total spending at all levels is calculated based on information from Rector and Menon (2018).

following form

$$W(I) = \begin{cases} \omega_0 \text{ if } I = 0 \\ \max\{0, \omega_1 - \omega_2 I\} \text{ if } I > 0 \end{cases},$$

where ω_0 is the transfers for a household with zero income and ω_2 is the benefits reduction rate. Our estimates show that a single female with two children receives about 12% of mean household income in the economy in terms of welfare transfers (about $12,000 in 2019). Transfers decline gradually with income and vanish at around 1.1 times mean income for a single female with two children (about $108,000 in 2019). A single female with two children and half of mean household income (about $44,000 in 2019) receives about $5,800 per year. A married couple with two children who has zero income, gets about $8,800. Transfers decline to zero, as they do for a single mother, at around 1.1 times the mean income.

Figure 4 shows how the total transfers (the sum of these three components) vary by household income in the benchmark economy. Households without any income receive transfers in excess of $8,000 per year. The transfers decline sharply for household with positive but very low income. After that, transfers bounce back to around $8,000 and decline smoothly with household income and amount to about $1,000 for households with 1.5 times the mean household income in the economy.

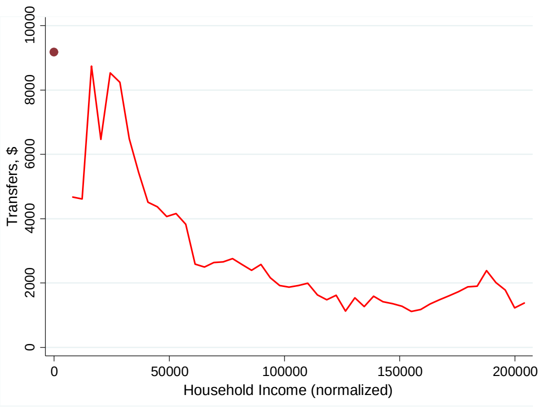

Figure 4 - Total Transfers in the Benchmark Economy

Childcare Costs To determine the requirement of efficiency units for childcare, $d^M(x,z,t)$, and $d^S(x,t)$, we use data on total spending (as a fraction of household income) on childcare and the relation between children's age and childcare spending (as shown in Figure A4 in Online Appendix). In particular, we use data from the Survey of Income and Program

Participation (SIPP), and estimate a relationship between spending in childcare per child and the average age of children, conditional of the mother's skill and marital status. Given the price of unskilled labor services, we recover the efficiency units required at each age in stationary equilibrium.

Remaining Parameters We select the remaining parameters to match jointly several targets. (i) We set the Frisch elasticity parameter γ to 0.2, and given γ, select the parameters B_m and B_f to match average market hours per worker by gender. The disutility of work shocks are specified as $\theta_L = \exp(-\Delta)$ and $\theta_H = \exp(+\Delta)$, and $\triangle$ is set so as to reproduce the observed variance of log-hours of married females at age 40. We choose the discount factor to match capital-to-output ratio (2.9) (ii) We parameterize the distribution of the disutility of joint market work, $\zeta(q|z)$, as a Gamma distribution and infer its parameters to generate the observed female force participation by married females conditional on the husbands' types. Given $\zeta(q|z)$, we determine the loading factors $\vartheta_x(t_{min})$ so that the model is consistent with the participation rate of mothers by the age of their youngest child present at home (shown in Figure A4 in Online Appendix). (iii) We set the capital share to $\alpha = 0.343$ and the depreciation rate of capital to $\delta^k = 0.055$. To select the parameter governing the elasticity of substitution, ρ, we use standard estimates of this elasticity that suggest a value of 1.5 – see, e.g., Katz and Murphy (1992). This dictates $\rho = 1/3$. To calibrate the share parameter ξ, we force the model to reproduce the aggregate *skill premium* in the data, defined as per-worker earnings of workers in the skilled category to per-worker earnings of workers in the unskilled category. For this statistic, we target a value of 1.8. (iv) Finally, we pick the additional proportional tax, τ_k, on capital so that the model matches corporate tax collections from data, and select the social security benefits, b, for a given tax rate from the US data, to balance the social security budget.

5 The Benchmark Economy

In Table 1, we show summary statistics on how the model performs regarding targeted and non-targeted moments. Total transfers in the model are about 2.3% of the GDP, which (endogenously) matches the data counterpart. The model reproduces the growth in dispersion in hourly wages for married individuals by skill, the correlation of wages of married couples at the start and the end of the life cycle, and married females' participation rates. Differently from other papers in the literature, the model is in line with skill premia. Among other factors, this is driven by the fact that rental rates for labor services differ by skill as skilled and unskilled efficiency units are not perfect substitutes in production.

Importantly, the model is in line with the (non-targeted) initial level and growth in household consumption dispersion over the life cycle (Figure A8). The growth in consumption inequality is lower than the growth in earnings dispersion for males or for households as we noted in section 2. One reason for this finding is that several factors contributing to dispersion in earnings with age are anticipated as of the start of the life cycle (an aspect emphasized by Huggett et al., 2011). Furthermore, transfers contribute to total household income at the bottom of the income distribution and the total household income matters for consumption inequality. Finally, labor supply adjustments along the intensive and extensive margin help households smooth idiosyncratic wage shocks.

The bottom panel of Table 1 shows earnings inequality measures in the model and the data for households with heads between ages 25 and 65. The model captures the 90-10 and 90-50 ratios very well, and is able to produce earnings shares of the bottom 10%, 20% and 40% of households, which is critical for the analysis at hand.[9] Not surprisingly, taxes and transfers reduce income inequality non trivially; the 90-10 ratio for after-transfer household income (after tax), ages 25-65, is of about 6.8 (6.2), while for before taxes and transfers household income amounts to 7.9.

In sum, the benchmark economy is able to generate observed inequality in the data, it matches the total spending in transfers as a fraction of GDP when various transfer programs are modeled as closely as possible to how they operate, and it delivers the level,and the growth in consumption inequality observed in the data. Altogether, these features suggest that the model economy is a suitable framework for studying the welfare state.

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[9] Inequality measures in the data are from 2010 CPS, with sample restrictions as detailed in Online Appendix. As pointed out by Kuhn and Rios-Rull (2016), there is also significant inequality among single and married households as well. The model delivers substantial within-group heterogeneity for married and single households. The 90-10 earnings ratios for married and single households are 5.5. and 6 in the model. The 90-50 ratios are 2.3 and 2.4, respectively.

Life-cycle statistics Our model environment is consistent with a host of observations over the life cycle. We start by noting that our economy generates the observed growth in dispersion in hourly wages by skill, gender, and marital status. Figure 5 illustrates this. We now concentrate on three, interconnected life-cycle statistics. First, we note that our economy generates the life-cycle pattern of the wage-gender gap, as Figure 6 (left panel) demonstrates. The model, parameterized to generate the decline in the gender gap by skill in the early ages of the life cycle, captures quite well the slow opening of the gap for unskilled workers over the entire life cycle. The model generates the gradual opening of the gap for skilled workers but leaves a portion unaccounted for towards the end of the working life cycle. At age 50, skilled females earn 66% on average relative to men in the data, while the model implies a gender gap of 76%.

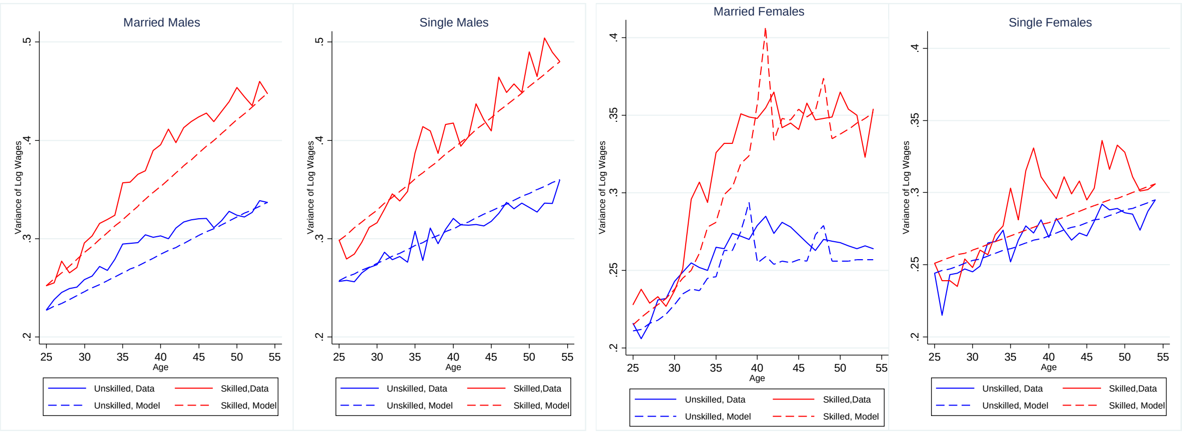

Figure 5 - Variance of Log Wages, Model vs. Data, Males (left), Females (right)

Figure 6 (right panel) shows the performance of the model regarding participation rates of married females as they age. The reader should recall that the economy is parameterized to reproduce the aggregate levels of participation rates by household type, and their levels as of age 40. The endogenous forces inside the model – costly children and utility costs of joint participation that vary with the age of children – lead to the horizontal S-like pattern of participation rates of married females in the data, as the figure demonstrates. The model environment also captures well the initial rise and slow decline of unskilled married females. Overall, this leads the model economy to reproduce well the aggregate pattern of participation rates as individuals age.

Table 1: Model and Data

Aggregates	Data	Model
Capital Output Ratio	2.9	2.9
Total Transfers (% of GDP)	2.3	2.3
Skill Premium	1.8	1.8
LFP of Married Females (%), 25-54		
Unskilled	68.2	68.7
Skilled	77.4	77.7
Total	71.8	72.3
Life-Cycle Inequality		
Variance log-wages (Married Males, age 54, S)	0.45	0.45
Variance log-wages (Married Males, age 54, U)	0.34	0.34
Variance log-wages (Married Females, age 54, S)	0.35	0.35
Variance log-wages (Married Females, age 54, U)	0.26	0.26
Variance log-hours (Married Females, age 40)	0.13	0.13
Correlation Between Wages of Spouses (age 25)	0.31	0.31
Correlation Between Wages of Spouses (age 40)	0.34	0.33
Variance log-consumption (Age 54 vs 25)	0.12	0.12
Earnings Inequality (25-64)		
90-10 ratio	7.8	7.1
90-50 ratio	2.6	2.5
Share, bottom 10%	1.8	2.1
Share, bottom 20%	4.5	5.5
Share, bottom 40%	13.2	15.8

Entries summarize the performance of the benchmark model in terms of empirical targets and key aspects of data. The data for aggregate inequality statistics takes into account the same data restrictions used in the empirical analysis in Section 2.

Overall, as a result of all the forces of our economy operating in tandem, our model implies an age pattern of dispersion in earnings for married females that is broadly consistent with observations. Recall from section 2 that dispersion in wages of married females first rises, and unlike the case of men, it flattens out as of age 35. As Figure 5 shows, our model generates the same patterns. Why? Early in the life-cycle, skilled females increase their skills faster as a group relative to their unskilled counterparts. This, in conjunction with life-cycle shocks, leads to the overall increase in earnings inequality. In the meantime, some women gradually return to work – given the gradual reduction in childcare and utility costs of joint participation as children age – and start increasing their skills by acquiring experience. Since their skills are lower but accumulate faster, inequality first grows but subsequently starts leveling off. Eventually, all differential rates in skill formation become less and less important as individuals age, and females become more homogenous. The net result is a flat profile of earnings dispersion after middle age, as the figure shows.

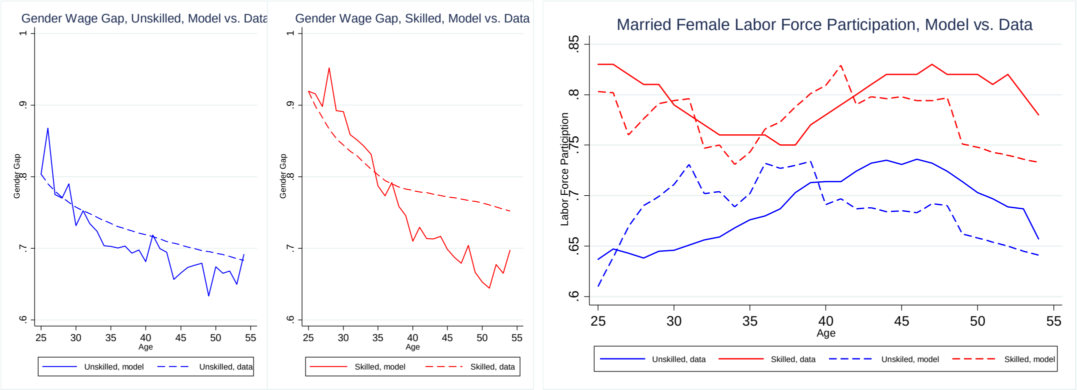

Figure 6 - Gender Wage Gap (left); LFP of Marr. Females (right), Model vs. Data

Children and Childcare Costs What is the quantitative importance of children and childcare costs? To answer this question, we set all childcare costs to zero, while keeping all other parameters constant. We find that childcare costs matter critically in determining the levels of participation rates, and how inequality in wages and earnings evolve over the life-cycle for married females. When childcare costs are set to zero, the participation rate of unskilled married females is 74.7%, while for skilled, it is 81.4%. The values in the benchmark model are 68.7% and 77.7%, respectively. The model cannot generate the observed sharp decline in labor force participation early in the life cycle, demonstrating it is associated with childcare requirements. Furthermore, without children, the variance of log wages grows linearly along the life cycle for women, exactly as it does for men (see Figure A9 in the Online Appendix).

5.1 How Valuable is the Welfare State?

How much do households value the current transfer scheme? What would be the effects of abolishing the welfare state? To answer these questions we proceed by fully eliminating all transfers comprising the welfare state. We balance the budget by adjusting the 'level' parameter of the tax function (λ) in a proportional and symmetric way for all households. Further, as in all subsequent experiments that we conduct, we assume that the rate of return on capital does not change across steady states. In Guner, Kaygusuz, and Ventura (2023), we also discuss the elimination of different transfers one at a time.

Table 2: Eliminating All Transfers

Aggregates		Welfare	
(% changes relative to benchmark)		(Newborns, %)	
Output	1.7	Single F	
Aggregate Hours	3.0	Unskilled	-5.2
Hours per worker (All Females)	3.2	Skilled	-1.2
Hours per worker (All Males)	1.9	Married	
		Unskilled, Unskilled	-0.1
Participation Married Females		Unskilled (f), Skilled (m)	0.4
Unskilled	6.3	Skilled, Skilled	1.7
Skilled	2.0	Skilled (f), Unskilled (m)	0.6
Total	4.5	All	
		All Newborns	-3.2
		Winning Households	60.7

Entries in the left panel show the effects (percentage changes) across steady states on selected aggregate Entries in the right panel show the corresponding welfare effects (consumption compensation) for newborn households.

Table 2 presents the main findings. Hours worked increase across the board, and these increases are concentrated among the unskilled. The participation rate of married females increases by 6.3% for unskilled women and by 2.0% for skilled ones. All this contributes to a total increase in labor hours of about 3.0% and an increase in aggregate output of 1.7%. The average tax rate at mean income falls substantially, by more than four percentage points across the board; from about 9.2% to 4.8% for a married household with two children, and from about 7.7% to about 3.3% for a single female with two children.[10] When transfers are eliminated, labor supply increases for low and middle-income households. The increase in labor supply is partly due to income effects and partly due to the incentives to increase labor supply for insurance motive. These changes occur despite the removal of programs that provide incentives for labor supply (e.g., childcare subsidies via the CCDF) or include provisions that subsidize work (e.g., EITC). For all households, the work incentives also increase because of lower taxes.

Table 2 also shows large negative effects on aggregate welfare, with a compensating

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[10] To balance the budget in this exercise, we multiply λ values in Table A6 in Appendix by 1.048 (recall that $1-\lambda$ is the tax rate at the mean income).

variation of about -3.2% for all newborn households. Benchmark transfers are substantial and concentrated at the bottom of the skill distribution. Hence, their elimination leads to significant welfare losses in a utilitarian sense. Single females bear the brunt of the transfer elimination. A newborn, single unskilled female experiences a loss of 5.2% on average, while an equivalent single skilled female faces a loss of 1.2%. Nonetheless, since tax rates fall substantially, a majority of adults benefit from the elimination of the welfare state – about 60.7% of households benefit.

Overall, these findings highlight and anticipate trade-offs associated with reforming the welfare state. The welfare state targets transfers to low and middle-income households. As a result, while they depress participation, hours, and output, they are highly valuable for some households and translate into substantial losses for all newborns associated with its elimination – even when tax rates are sharply reduced across the board. These losses mask gains for many agents, resulting in a significant majority of newborns in favor of this hypothetical move. The significant majority in favor of elimination of the system (60.7%) illustrates the trade-offs involved in an economy with substantial heterogeneity like ours.

6 Rethinking the Welfare State

We now conduct several quantitative experiments in which we provide answers to the questions that motivate the paper. In all experiments, the rate of return of capital is constant across steady states – but rental prices for labor services change in order to be consistent with equilibrium conditions. We first consider replacing the current transfer scheme with a Universal Basic Income scheme (UBI) and then with a Negative Income Tax (NIT) across steady state equilibria. We then discuss the effects of these reform cases when transitional dynamics are taken into account. In the benchmark economy, tax revenue is used to finance all the transfers and government spending G. When we eliminate existing transfers, we assume that the government adjust taxes to cover G and transfers associated with UBI or NIT.

6.1 A Universal Basic Income

In our first experiment, each household receives a transfer per household member (including children) in all dates and states. The current welfare state is abolished while the tax system is unchanged. We dub this experiment a *Universal Basic Income* scheme (UBI). Specifically, we search across steady states for the level of the UBI transfer that maximizes the ex-ante welfare of all newborns. We balance the budget by adjusting the 'level' parameter of the tax function (λ) proportionally.

Our findings are presented in Tables 3 and 4. We find that a per-person transfer of about 3.2% of mean household income maximizes the welfare of newborns. This corresponds to about \$3,100 per person in 2019 dollars (\$12,400 for a married household with two children at home). To balance the budget, tax rates need to substantially increase; for a married household with two children at mean income, the average rate increases to 14.4% from 9.2% in the benchmark.[11] This occurs as at the welfare-maximizing level, the aggregate expenditure on transfers increases in a significant way relative to the benchmark; from 2.3% in the benchmark case to 5.9%. The UBI transfers, coupled with higher taxes, depress hours, participation and output across steady states. Total hours and output decline by 0.9% and participation rates of unskilled and skilled married females decline by 4.4% and 1.9%, respectively. Since hours worked for those away from the margin of indifference do not change much relative to the benchmark, per-worker hours for females increase, as Table 3 shows.

Table 4 illustrates the welfare consequences of the UBI policy across steady states. Even at the best policy, ex-ante welfare for all newborns declines, with a compensating variation of -1.3%. But a majority of newborns, 53.2%, support a UBI program. As it was the case with eliminating the current welfare system, lifetime-poor households suffer under the UBI, since it does not fully replace the transfers they were receiving in the benchmark economy while they see their taxes go up. This contributes to an overall welfare loss. Unskilled single females experience a welfare loss at birth of about 2.5%, and skilled ones a loss of about 0.7%. On the other hand, unskilled married households are strong winners as Table 4 demonstrates, with a welfare gain of about 2.1% for a married couple with two unskilled adult members. This reflects that some low-to-middle income households, who did not receive much in terms of transfers in the benchmark economy, now get a generous UBI transfer contributing to generating majority support.

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[11] The λ values in Table A6 are multiplied by 0.9433 to balance the government's budget.

Transitional Dynamics What is the role of transitional dynamics in our welfare findings? To address this question, we compute the transitions associated to the non-anticipated introduction of the welfare-maximizing transfer discussed before. The budget is balanced by adjusting the level parameter of the tax function in each period of the transition across steady states.

Table 4 shows that the welfare losses are lower for newborn households at the start of the transition than in the steady state – 0.5% vs 1.3%. As the economy gradually shrinks along the transition, taxes to finance the UBI transfer increase, and therefore, welfare losses are larger when steady states are compared. Nonetheless, there is a majority of newborns who lose from the implementation of a UBI; the fraction of newborns who support the policy drops from 53.2% to 44.1%. If we only count all households alive at the start of the transition, there is still a majority against the implementation.

A UBI on top of the Welfare State? It is worth noting that the welfare-maximizing transfer level is substantially below the magnitudes advocated in policy discussions. For instance, there are proposal of a UBI transfer of $1,000 per month per adult, which is a much higher transfer than what we find as optimal. Indeed, we find that with transfer levels higher than the optimal one, welfare losses non-trivially increase and popular support dissipates quickly,

A natural next question is: what if the UBI transfer is given on top of the existing welfare state? We find that a relatively small transfer of about 0.5% of mean household income maximizes ex-ante welfare. There is a welfare gain of 0.1%, but only 48.9% of households are in favor of such a program. Larger transfers lead to welfare losses. For instance, if the transfer is 1% of the mean household income per person, an ex-ante welfare loss emerges and 52.5% of adults oppose it. If instead, we impose the transfer that maximizes welfare under the UBI reform (a transfer of 3.2% of mean income) on top of the existing programs, output losses are more significant, and ex-ante welfare and popular support decline much further.

These findings follow from the fact that the welfare system is resilient, as its elimination leads to large welfare losses. Likewise, a common transfer to all is quite expensive and requires non-trivial tax hikes that depress welfare. We conclude from these findings that only small transfers on top of the existing welfare state –far from those advocated by proponents of a UBI – can improve marginally welfare but without majority support.

Summary Overall, our findings indicate that a UBI policy reform is hard to justify on ex-ante welfare grounds as a replacement for the current welfare state. Yet, it is supported by a majority despite its macroeconomic magnitude and the additional tax revenue it requires. A UBI policy on top of the current welfare state is not a good idea; only marginal welfare gains emerge for a small transfer and there is clear majority against the move.

6.2 A Negative Income Tax

We now evaluate a more drastic reform that eliminates the current welfare state *and* the progressive income taxation. Specifically, we introduce a proportional income tax combined with a transfer for all, adult and children. Following Friedman (1962) and the literature that followed, we dub this linear income tax a *Negative Income Tax* system, or NIT for short. We again search for the welfare-maximizing per household member transfer and balance the budget by adjusting the proportional tax rate that applies to all households.

Table 3 shows the effects on aggregates. The transfer at the welfare-maximizing level is about 4.8% of mean household income, or \$4,700 in 2019 dollars (\$18,800 for a married couple with two children). Thus, the welfare-maximizing NIT transfer is significantly more generous than the best one in the UBI case, and involves a drastic increase in resources devoted to redistribution – about 8.8% of output. The proportional tax rate that supports the welfare-maximizing NIT is 19.8%. Thus, tax rates are higher for most households – a married household with two children at around mean income faces an average tax rate of about 9.2% in the benchmark economy – but marginal rates are lower for those with top incomes. For instance, the marginal rate for a married household at three times mean income amounts to 21.4% in the benchmark case.

Overall, in net terms, the NIT reform leads to depressing effects on hours worked and output, as Table 3 demonstrates. Indeed, given its generosity at the welfare-maximizing case, its effects on total hours worked and participation rates are stronger than in the UBI case. But output declines less with the NIT than it does with the UBI (0.9% vs. 0.6%) since a proportional tax encourages higher labor supply from more productive households.

Table 3: Aggregate and Inequality Findings
(changes relative to benchmark)

	UBI Maximum Welfare	NIT Maximum Welfare	NIT (2) Maximum Welfare
Output	-0.9	-0.6	-0.4
Aggregate Hours	-0.9	-1.2	-1.0
Hours per worker (All Females)	0.8	0.5	-0.0
Hours per worker (All Males)	-0.5	-0.5	-0.2
Participation Married Females:			
Unskilled	-4.4	-6.0	-4.2
Skilled	-1.9	-2.3	-1.5
Total	-3.4	-4.4	-3.1
Proportional Tax Rate (%)	-	19.8	19.8
Transfer (% Household Income)	3.2	4.8	7.0, 4.1
Transfers (% Output)	5.9	8.8	8.7
Inequality			
△ Var Log-Household Income	-0.027	0.01	0.009
△ Var Log-Household Income (after taxes and transfers)	-0.006	0.029	-0.014

Entries in the top panel show effects (percentage changes) across steady states on selected variables driven by the different quantitative experiments. Entries in the bottom panel are changes in the variance of log-household income before and after tax and transfers, relative to the benchmark economy.

Welfare Table 4 shows that an NIT generates ex-ante welfare gains of about 0.2% of consumption, which are accompanied by substantial majority support for the reform among newborns – more than two thirds of newborns support the reform at birth. There are of course winner and losers. Married households enjoy substantial welfare gains, which is most significant among couples with two unskilled partners. On the other hand, single female households as a group experience ex-ante losses. The losses are more significant among unskilled and those with children.

In the Online Appendix (see Figure A10) we show how aggregate output, ex-ante aggregate steady state welfare, and majority support changes for different levels of as the NIT transfers. When the transfer equals zero, i.e., when the tax system is simply a proportional tax with no transfers whatsoever, output is about 3.2% higher than in the benchmark case. But there is a substantial welfare cost. As transfers increase, tax rates, welfare and popular support increase as well, but output declines. Altogether, as the lump-sum transfer increases, both welfare and support for the reform first sharply increase and then decline when the decline in output dominates.

If we consider transitional dynamics, the welfare gains associated to the welfare-maximizing transfer among newborns at the start the transition are higher than under the comparisons across steady states (0.4% vs 0.2%). A majority of newborn households support the policy shift (55.1%). This majority is even higher (59.4%) if we consider all households alive at the start of the transition.

Comparison with a Proportional Income Tax Since the NIT has two elements, i.e., the replacement of all transfers with a common payment to individuals and a move to a proportional tax system, it is informative to study what happens with a simple proportional tax that leaves the welfare state in place. We find that in this case, aggregate hours and output increase by about 1.6% and 1.4%, respectively, requiring a supporting tax rate of 10.8%. In terms of welfare, we find effectively no gains or losses on an ex-ante basis. Again there are sharp differences between winners and losers. Our results show that skilled married couples have a welfare gain of 1.1%, whereas unskilled single females experience a loss of about 0.4%. A strong majority of newborn households, about 62.3% of them, are *against* it. Hence generous transfers, made possible by a proportional income tax, is key for the success of NIT.

Differentiated Transfers Since welfare gains from an NIT reform are unevenly distributed between married and single households and relatively small in the aggregate, we consider an NIT regime with transfers differentiated by the marital status of adults but with a common tax rate. We refer to this case as NIT(2). Specifically, we search for a transfer and ratio of transfers to individuals in married households relative to single households that maximize ex-ante welfare *and* preserve majority support.

The welfare-maximizing transfer per person in single households is about 7% of the mean household income, while about 4.1% in married households (about \$6,860 and about \$4,000 in 2019 dollars). The tax rate that supports this arrangement is about the same as in the baseline NIT exercise (19.8%). Output and aggregate hours decline by 0.4% and 1.0% relative to the benchmark economy. This reform effectively means that a single female with 2 children, under an income level of one-half mean household income, would receive a net transfer after taxes of about 11.1% of mean household income (about $10,850 in 2019 dollars). The net transfer for a married couple with the same income and two children would be about 6.50% of mean household income (about $6,350 in 2019 dollars).

An NIT reform of this type leads to ex-ante welfare gain of about 0.7%, with 51.4% of adults supporting the reform in the welfare-maximizing scenario. Clearly, gains are larger than in the undifferentiated NIT. As earlier, if we consider transitions across steady states, welfare gains for newborn households are larger, and a substantial majority supports the policy move.

Inequality The alternative tax-transfer schemes have ambiguous effects on inequality, as Table 3 shows. The variances of log-household income, before and after taxes and transfers, decline with a shift to a UBI. Meanwhile, both measures increase with the NIT case, and move in opposite directions in the case of an NIT with differentiated transfers for marital status.

In understanding these results, it is key to bear in mind that several forces are at play here. First, the removal of transfers in the benchmark and the replacement for a smaller UBI transfer leads to increases in labor supply for some groups (e.g., low-skilled single females), contributing to a reduction in inequality in the UBI case. Second, an NIT reform involves a larger transfer alongside the full elimination of increasing marginal rates on household income. The result is a net increase in household income inequality. The same forces, with differentiated transfers dictate larger increases in inequality before taxes and transfers in the second NIT experiment. Overall, the effects on inequality of drastically different alternatives appear of second order.[12]

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[12] The changes in the log-variances are quite small relative to the changes in variances due to taxes and transfers. For instance, while a baseline NIT increases the pre-tax and transfer inequality by about 1 log point, taxes and transfers reduce the variance by about 14.7 points.

Table 4: Welfare Effects
(Consumption Compensation, Newborns, %)

	UBI Welfare	NIT Welfare	NIT (2) Welfare
Single F			
Unskilled	-2.5	-2.0	0.5
Skilled	-0.7	-0.7	0.3
No Child	-0.6	-0.6	0.3
Early Childbearing	-2.2	-1.7	0.3
Late Childbearing	-0.5	-0.4	0.2
Married			
Unskilled, Unskilled	2.1	2.8	0.2
Unskilled (f), Skilled (m)	0.2	0.3	-0.1
Skilled, Skilled	0.0	0.6	-0.3
Skilled (f), Unskilled (m)	0.2	0.4	-0.1
No Child	0.1	0.1	-0.2
Early Childbearing	1.4	2.3	-0.1
Late Childbearing	1.0	1.7	-0.0
All Newborns	-1.3	0.2	0.7
Winning Households	53.2	68.2	51.4
Including Transitional Dynamics			
All Newborns	-0.5	0.4	1.0
Wining Households	44.1	55.1	56.8
Wining Households (All Alive)	46.8	59.4	75.3

Entries show the welfare effects (consumption compensation) driven by the reform of the welfare state. The top panel report welfare gains across steady states with a constant interest rate across steady states. The calculations in the panel below take into transitional dynamics between steady states.

Summary Quantitatively, welfare gains under an NIT regime are substantially larger than the (negative) gains under a standard UBI scheme, and even larger gains can be obtained when NIT transfers differentiated by marital status. Taking into account transitional dynamics makes these welfare findings even stronger. Overall, what accounts for the relative success of a Negative Income Tax in terms of ex-ante welfare and majority support? The upshot is that a larger degree of redistribution is feasible given the smaller tax distortions under an NIT regime; i.e., with the elimination of increasing marginal tax rates and lower taxes on secondary earners. As tax distortions are reduced with a proportional tax, compared to the UBI case, the size of the aggregate economy is larger and collecting the tax revenues that are necessary to finance transfers becomes easier. The net result is that a higher transfer level becomes feasible under an NIT relative to a UBI scheme. Put differently, a drastic tax reform that reduces marginal tax rates at top incomes while making them common across all earners, makes more extensive redistribution possible.

7 Findings in Perspective

In this section, we place our results in perspective, with a focus on the effects and consequences of an NIT. We study an NIT reform in an economy with a lower level of inequality than our benchmark. We then evaluate an NIT reform when life-cycle facts are parameterized under a cohort instead of time effects. We also assess the use of progressive taxation to finance transfers and the effects of changes in the parameterization of preferences.

7.1 Rethinking the Welfare State When Inequality is Lower

The U.S. economy has changed in critical ways relative to what it was in the recent past. In particular, there have been drastic changes in the demographic composition of U.S. households and in dimensions of inequality. For instance, only about 19% of females were skilled under our definition in 1980, while this figure more than doubled to nearly 39% in 2008, our baseline year for demographics. Substantial changes in marital sorting accompanied these changes; about 14% of married households were of the skilled-skilled category in 1980, while the corresponding figure in our parameterization is nearly 27%. Meanwhile, the skill premium was 1.4 under our assumptions in 1980, and it increased to 1.8 in our benchmark parameterization.

Since these changes can affect the importance of the redistributive component of the NIT vis-a-vis its effects on tax distortions, they could be of importance for our conclusions. To what extent these underlying differences matter for the implications of an NIT? To address this question, we parameterize our economy to demographic and endowment targets of the past (circa 1980). We impose the demographics prevailing in 1980, use corresponding wage inequality over the life cycle to parameterize endowments, and force our economy to be consistent with the skill premium in 1980. We refer to this case as the *1980 economy.* We then search for the welfare-maximizing NIT as in our baseline exercises.[13]

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[13] We describe the 1980 data in detail in the Online Appendix.

Table 5: Findings in Perspective (% changes relative to benchmark)

	Baseline Findings	1980 (I)	1980 (II)	Cohort Effects	CRRA & Scale Economies
Output	-0.6	0.7	0.6	0.7	-3.8
Aggregate Hours	-1.2	0.9	0.8	0.4	-5.8
Participation Married Females:					
Unskilled	-6.0	-0.1	-0.3	-1.1	-18.3
Skilled	-2.3	0.3	-0.2	1.4	-8,1
Total	-4.4	0.1	-0.3	0.0	-13.9
Welfare					
All Newborns (%)	0.2	0.8	0.7	0.8	0.8
Winning Households	68.2	80.0	81.0	67.5	49.5
Proportional Tax Rate (%)	19.8	14.8	14.8	19.6	30.8
Transfer (% Household Income)	4.8	3.0	3.0	4.7	8.2
Transfers (% Output)	8.8	5.9	5.9	8.6	15.6

Entries in the top panel show effects of a welfare-maximizing NIT experiment. The second column shows the baseline findings for comparison. The third column displays the results when shocks and demographics are calibrated to data circa 1980, but married female participation rates are from the benchmark. The fourth column shows the corresponding results when shocks, demographics and participation rates are calibrated to data from circa 1980. The fifth column shows the results when the benchmark economy is calibrated under a cohort effects-view of the data. The final column shows results when preferences allow for a risk aversion coefficient exceeding 1 and scales economies in household consumption.

We conduct our exercises in two levels. In our first case, we do not impose the participation rates of 1980 to parameterize the 1980 economy, while we do so in our second case. We summarize our results in Table 5. We find that the welfare-maximizing NIT does not lead to a contraction in output in the long run. Furthermore, the resulting welfare gains are larger than in our baseline case (0.2% vs 0.7-0.8%), with more substantial majority support, under an NIT transfer that is smaller – about 3% of household income. In short, these findings follow from the factors leading to lower underlying inequality among households. These factors determine that an NIT reform requires a lower transfer to maximize ex-ante welfare and a concomitant lower tax rate than in the baseline case. Hence, the detrimental effects on aggregates from taxes and transfers are of smaller magnitude, resulting in turn in the expansion (not contraction) of output and hours that Table 5 shows.

We conclude from these findings that an NIT reform in an economy with the characteristics of the United States circa 1980 is more appealing on several fronts, regardless of whether we consider changes in participation rates or not (case I or case II). Different factors leading to lower levels of inequality result in an environment more favorable to the implementation of an NIT reform.

7.2 Cohort Effects in Data

As described in sections 3.1 and 4, our analysis relies on a parameterization in which life-cycle facts were characterized controlling by time effects. In the Online Appendix, we describe our main empirical findings when we extract age profiles controlling instead by cohort effects. Under cohort effects we find steeper profiles of hourly wages as well as steeper profiles of wage inequality relative to the time effects case. These findings are in line with the literature.

What are the implications of assuming cohort effects in our parameterization for our results? Table 5 summarizes our findings. We find a welfare-maximizing NIT transfer of around 4.7% of mean household income, roughly at the same level of the baseline case under time effects. Welfare gains are higher, at about 0.8% for all newborn households. Aggregate output and hours expand across steady by 0.7% and 0.4%, respectively, unlike the baseline case under time effects.

Qualitatively, these results are unsurprising. Steeper inequality profiles lead to higher variances of persistent shocks relative to the time effect case, and therefore, there is a larger role of transfers for all provided by an NIT transfer. Likewise, steeper wage profiles lead to potentially larger gains related to the replacement of increasing marginal rates of household taxation. Hence, larger gains welfare gains are available. We conclude from these findings that parameterizing our economy under a cohort effect view of the life-cycle data makes a basic NIT reform more desirable.

7.3 Funding Transfers with Higher Progressivity

In our main exercises, common transfers are funded by taxing household income in the least distorting ways possible; either by shifting the tax function (UBI) or by using a proportional income tax (NIT). What if transfers are financed by changing the progressivity of the tax function? Can this improve upon the UBI or NIT schemes analyzed earlier?

To address this question, we proceed as follows. We eliminate existing transfers, and search for the level of tax progressivity (curvature) of the income tax function and a common transfer to all individuals that are consistent with budget balance and maximize ex-ante welfare. Since the curvature of tax functions differs (married, single, etc.), we search for the common factor that increases or reduces the level of progressivity in all cases. Note here that increasing the curvature of the tax function implies a rotation in the tax function; it increases average rates at the top, but reduces average tax rates at the bottom.

We find a welfare-maximizing transfer relatively small, of only about 1.25% of mean household income, and that this transfer level implies a non-trivial *reduction* in the curvature of the tax functions – about 60% reduction across the board. This determines an ex-ante welfare loss of about -1.8%. Put differently, the welfare maximizing transfer-progressivity combination does not dominate the status quo and leads to a worse outcome than our basic UBI.

To understand these findings, it is important to note that increases in progressivity from the benchmark levels, as they lead to steeper marginal rates, lead to non-trivial declines in economic aggregates and can only increase revenue marginally in the long run. Guner et al (2016) make explicitly this point in the context of life-cycle model with heterogeneity. Using revenues to provide for transfers to all make the problem of obtaining additional revenues even worse. We conclude from these findings that a shift to common transfers to all hinge critically on imposing taxes that distort decisions little, either by shifting taxes for all (UBI) or by drastically changing the nature of income taxation (NIT).

7.4 CRRA preferences and Economies of Scale

We have conducted all of our analysis using preferences in which preferences for consumption are logarithmic, with a coefficient of relative risk aversion of 1. Likewise, our analysis did not include scale economies in consumption as scale economies are not relevant with log-preferences, but scale economies could become relevant with CRRA preferences. What are the implications for our conclusions regarding an NIT reform if CRRA preferences and scale economies are considered?

To answer this question, we set the relative risk aversion to a higher level (1.5) and impose a commonly used adjustment for scale economies, equal to the square root of the number of people in the household. We then parameterize the model economy again in this scenario and find the welfare-maximizing NIT arrangement. Our findings are summarized in Table 5.

In this scenario, an NIT experiment leads to much larger transfers and associated tax rates, and to substantial declines in output and labor supply aggregates. The welfare-maximizing transfers to all reach 8.2% with a tax rate of about 31%. Welfare gains are of about 0.8%, but without a majority of households in support of the NIT reform.[14]

In interpreting these results, it is important to note that this exercise is a major departure in our analysis and should be taken with caution. Our benchmark parameterization is consistent with a host of facts – including the growth of consumption dispersion over the life cycle – and in macroeconomic terms, it is consistent with balanced growth. This alternative case is not consistent with balanced growth, with income effects dominating substitution effects. This implies that increasing wages for all would reduce labor supply and that increasing tax rates would *increase* it. We would then expect that much (higher) transfers emerge in the welfare-maximizing case, with concomitantly large depressing effects on aggregates as our results show.

8 Concluding Remarks

Three main points emerge from our analysis so far. First, it is hard to improve upon the current structure of the welfare state via simple transfer schemes. Transfers to poorer households are highly valued, and thus, any reform to the current system needs to confront the fact that non-trivial resources accrue to poorer households. As a result, simpler schemes that maximize ex-ante welfare relative to the status quo require drastic changes in taxation.

Second, a UBI scheme is generically not a good idea and is dominated by an NIT. Why? Considerable resources need to be transferred to poorer households for their welfare not to fall. And since transfers would accrue to all individuals, taxes need to increase substantially, leading to ex-ante welfare losses. A generous UBI transfer imposed on top of the current welfare state, or a UBI transfer financed via increases in tax progressivity, do not change this conclusion. It follows that in our economy, a UBI scheme, as proposed in popular discussions, is not a good idea.

Lastly, NIT arrangements generate ex-ante welfare gains and lead to popular support

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[14] If we impose a CRRA coefficient of 1.5 without any scale economies in consumption, calibrating the economy to data, the results are more moderate but similar. Output and hours worked decline by 3.1 and 4.9% across steady states, respectively, under a transfer of about 7.75% of mean household income. Welfare gains amount to 0.4%.

due to the associated reduction in distortions and the concomitant increase in output and revenues. Our findings hold when transitional dynamics are taken into account and when life-cycle data is interpreted via cohort effects instead of time effects. Interestingly, we also find that the desirability of an NIT reform is higher for an economy with the characteristics of the U.S. economy in the past (circa 1980).

We end this paper with three comments. First, the administrative costs of running a welfare state can be large. Isaacs (2008), for example, calculates that the cost of running Food Stamps, Housing Subsidies and the TANF programs are as high as 15 cent per each dollar benefit issued. Our analysis abstracts from such administrative costs, and hence might underestimate the potential benefits of moving to a simpler system like the NIT. Second, a variant to the NIT system could use a consumption tax instead of a flat-rate income tax. As a consumption tax does not distort capital formation, this implementation could lead to larger gains in output, labor supply and welfare than we found in our analysis. Finally, it might be important to evaluate reforms to the welfare state when health and health-related transfers are taken into account. In this vein, we consider that a model of endogenous health where both medical and nonmedical means-tested transfers are modeled and non-medical income support can affect investments in health, is a promising line of future research.[15] We leave this and other issues for future research.

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[15] Mahler and Yum (2022) for instance, build a model of endogenous health where changes in healthy behavior are subject to adjustment costs.

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Appendix

1 Transfers to Households in the United States

In this section of the Appendix, we provide a brief description of various means-tested programs.

1.1 The Earned Income Tax Credit

The EITC is a fully-refundable tax credit that subsidizes low-income working families. The EITC is a fraction of a family's earnings until earnings reach a certain threshold. Then, it stays at a maximum level, and when the earnings reach a second threshold, the credit starts to decline so that the household does not receive any credit beyond a certain earnings level. The maximum credits, income thresholds, and the rate at which the credits decline depend on the household's tax filing status (married vs. single) and the number of children. By design, the EITC only benefits working families, and families with children receive a much larger credit than workers without qualifying children. For 2019, households with earnings up to 41,000 to 56,000 qualified for the EITC. For a married couple or a single parent with two children, the maximum credit, which applied for earnings around 15 to 20,000$, was 5828$ (a subsidy of more than 25%). The maximum credit for households without children was much smaller, only 529$. In 2019 about 25 million taxpayers received an average EITC of $2,476.[1]

1.2 Child-Related Transfers

Child Tax Credit The CTC provides households a tax credit for each child, independent of parents' childcare expenditures and labor market status. Until the 2017 Tax Cuts and Jobs Act (TCJA), the CTC started at $1,000 per qualified children under age 17 and stayed at this level up to a household income of $75,000 for singles and $110,000 for married couples. Beyond this limit, the credit declines by 5% for each dollar earned until it is completely phased out when the household income is $115,000 for singles and $150,000 for married couples. The 2017 tax reform increased the maximum credit to 2000$ per child and allowed households with much higher income to qualify for the maximum credit ($200,000 for single parents and $400,000 for married couples). The CTC is partly refundable: if the credit exceeds taxes owed, taxpayers can receive up to $1,400 per child, known as the additional child tax credit (ACTC). To qualify for the ACTC, a household must have minimum earnings of 2500$.[2]

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[1] See https://www.eitc.irs.gov/eitc-central/about-eitc/about-eitc for further details.

[2] See https://www.irs.gov/newsroom/the-child-tax-credit-benefits-eligible-parents and https://www.taxpolicycenter.org/briefing-book/what-child-tax-credit for further details.

The Child and Dependent Care Tax Credit The Child and Dependent Care Tax Credit (CDCTC) is a non-refundable tax credit that allows parents to deduct a fraction of their childcare expenses from their tax liabilities. To qualify for the tax credit, both parents must work. The maximum qualified childcare expenditure is $3,000 per child, with an overall maximum of $6,000. Parents receive a fraction of qualifying expenses as a tax credit. This fraction starts at 35%, remains at this level up to a household income of $15,000, and then declines with household income. The lowest rate, which applies to families with a total household income above $43,000, is 20%.[3] Since the CDCTC is not refundable, only households with positive tax liabilities benefit from it.

Childcare Subsidies The main program that provides childcare subsidies for low-income families in the US is the Child Care Development Fund (CCDF). The program was created as part of the 1996 welfare reform and consolidated an array of programs. To qualify for a subsidy, parents must be employed, in training, or in school. The program targets low-income households. In 2010, 1.7 million children (ages 0-13) were served by the CCDF, which is about 5.5% of all children (ages 0-13) in the US, and the average income of those receiving a subsidy was about $20,000 (28% of the mean household income) - Guner, Kaygusuz, and Ventura (2020). Families receiving assistance must make a co-payment, which is about 25% of childcare costs, while the remaining 75% constituted the subsidy.

1.3 Welfare System

Another group of means-tested programs consist of programs provide cash or in-kind transfers to poor households, and that are routinely identified with "welfare" system in the US.

Temporary Assistance to Needy Families The TANF was created by the 1996 welfare reform and replaced the Aid to Families with Dependent Children program (AFDC). Under TANF, the federal government provides a block grant to the states, which use them to operate their own programs. To receive federal funds, states must also spend some of their own dollars. The TANF provides monthly cash payments to families, which differ significantly across states. The average maximum monthly payments for a family of three was 462$ in 2018. The most and least generous states' payments were 170$ (Mississippi) and 1039$ (New Hampshire).[4] In contrast to the AFDC, the TANF has a 5-year life-time participation limit and a stronger emphasis on encouraging recipients to work. As a result, less than 50 percent of TANF spending goes to cash assistance (CBO 2013). The rest pays for various services for low-income families with children, including child care, transportation to work, and other types of work-related assistance.

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[3] See http://www.taxpolicycenter.org/briefing-book and https://www.irs.gov/uac/Ten-Things-to-Know-About-the-Child-and-Dependent-Care-Credit.

[4] The Urban Institute's Welfare Rules Database, TANF Policy Tables, Table II.A.4 https://wrd.urban.org/wrd/tables.cfm. See also Congressional Research Service (2020).

Supplemental Nutrition Assistance Program The SNAP is a federal program that supports low-income households through electronic benefit transfer cards that can be used to buy food. To be eligible, household income, before any of the program's deductions, must be at or below 130 percent of the poverty line. For a family of three in 2021, this is $1,810 a month (about $28,200 a year). A family of three with no income receives the maximum benefit of 535$ a month. Maximum benefits are reduced by 30% for each dollar of monthly household income. On average, SNAP households received about $246 a month in the fiscal year 2020 (Center on Budget and Policy Priorities, 2020).

Supplemental Nutrition Program for Women, Infants, and Children (WIC) Pregnant, postpartum, and breast-feeding women, infants, and children up to age 5 are eligible to the WIC if they are poor and an appropriate professional determines them to be at nutritional risk. An applicant who already receives SNAP, Medicaid, or TNAF is automatically considered income-eligible for WIC. Applicants who receive no other relevant means-tested benefits must have a gross household income at or below 185 percent of the federal poverty level (currently $37,296 annually for a family of three) to qualify. WIC provided an average value of $61.24 in food per participant per month in the fiscal year 2016 (Center on Budget and Policy Priorities, 2017).

Supplemental Security Insurance The SSI is a federal program that provides monthly cash assistance to disabled, blind, or elderly who have little or no income and few assets. The monthly maximum Federal amounts for 2021 are $794 for an eligible individual, $1,191 for a qualified individual with an eligible spouse. In 2019, 79% of payments were for disabled individuals under age 65 (Social Security Administration, 2020).

Housing Subsidies Several federal programs provide rental assistance to families with low income. These programs are administered by the Department of Housing and Urban Development and the U.S. Department of Agriculture and take two forms: i) Public Housing and ii) Vouchers. In 2017, about 4.6 million households (3.8% of all households in the U.S.) received some form of federal rental assistance (Mazzara 2017). The amount of aid can be substantial. Guner, Rauh, and Ventura (2023) calculate that households at the bottom decile of the income distribution receive about $7,000 per year (about $5,000 for the second and third lowest deciles).

2 Data and Sample Restrictions

In this section of the Appendix, we presents details on data sources and sample restrictions for the constructions of age-profiles presented in Section 2 of the paper. We use the March Supplement of the CPS from 1980 to 2019 to document how average hourly wages, inequality of hourly wages and earnings, and labor market statistics (hours and participation) change over the life cycle. Our measure of inequality is the variance of logs. The analysis is restricted to household heads and their spouses who are between ages 25 to 60. If a head or a spouse reports positive earnings or hours, we require that they work at least 520 hours in a year. To account for top-coded observations, we fit a Pareto distribution to the right tail, as in Heathcote, Perri and Violante (2010). Finally, we drop observations where the hourly wage rate (calculated as yearly earnings divided by yearly hours) is less than half of the federal minimum wage. Given the sensitivity of variance of logs to observations at the lower tail, we also trim the observations associated with the bottom 0.5% of hourly-wages. These restrictions are standard in the literature – see Heathcote, Perri, and Violante (2010) and Huggett, Ventura and Yaron (2011). We calculate total earnings, hours, and hourly wage rates for each individual in the sample. For households, we sum the head and spouse's earnings and assign the age of the head to the households.

We then repeat an equivalent procedure using data from the CEX for consumption. We construct for each household a measure of expenditure of nondurables and services, which includes food, alcoholic beverages, tobacco products, apparel and services, personal care, gasoline for transportation, public transportation, household operations, medical care, entertainment, reading, and education. The definition of nondurable consumption follows Heathcote, Perri, and Violante (2010). The analysis is again based on repeated cross-sections from the CEX between 1984 and 2019.

A key set of targets for the calibration is the evolution of inequality along the life-cycle, measured by the variance of log wages in the data. Let $m_{j,t,c}$ represent the variance of log wages for individuals of age j, cohort c, observed at date. We estimate the following regression, using data from the CPS between 1980 and 2019,

$$m_{j,t,c} = \beta_j' \mathbf{D}_j + \beta_t' \mathbf{D}_t + \beta_c' \mathbf{D}_c + \varepsilon_{j,t,c},$$

where $\mathbf{D}_j$ is a set of age dummies, $\mathbf{D}_t$ is a set of time dummies and $\mathbf{D}_c$ is a set of cohort dummies. The age profiles of interest are given by the estimated β_j values. Since birth cohorts are given by $c = t - j$, one cannot estimate the time and cohort effects simultaneously. Hence, without further restrictions, we estimate the age effects either controlling by time effects (setting $\beta_s = 0$ for all c), or controlling by cohort effects (setting $\beta_t = 0$ for all t). The same approach can be applied to any statistics of interest, such as average wages, the gender wage gap, married female labor force participation, etc.

All life-cycle profiles we use in the benchmark calibration, targeted or non-targeted, are constructed by controlling for year effects (YE). Here, we show how the life-cycle profiles look like when we control for cohort effects (CE) and discuss the properties of the alternative benchmark economy that uses these profiles as targeted moments.

Figure A1 shows the variance of log wages by age, skill level, and marital status for year-effect (dash lines) and cohort-effect (solid lines) specifications. The main message that emerges is that these two specifications are broadly consistent. For males, inequality increases more or less linearly along the life cycle. For females, that is not the case; the increase in inequality slows down after an initial rise around age 35. Quantitatively, there is a higher increase in inequality over the life cycle under the cohort-effect specification, which is consistent with estimates provided by Heathcote, Storesletten, and Violante (2010) and Huggett, Ventura, and Yaron (2011).

Figures A2 and A3 show the other life-cycle profiles we report in Section 2 of the paper:

the gender wage gap, married female labor force participation, the variance of log hours worked for females and the correlation of earnings for husbands and wives. The impact of two alternative specifications on these outcomes is negligible.

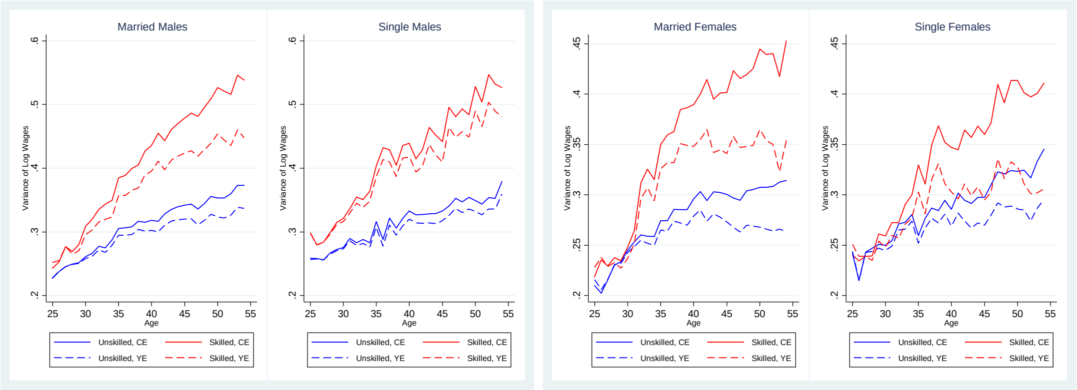

Figure A1 - Variance of Log Wages, Males (left) and Females (right), YE and CE

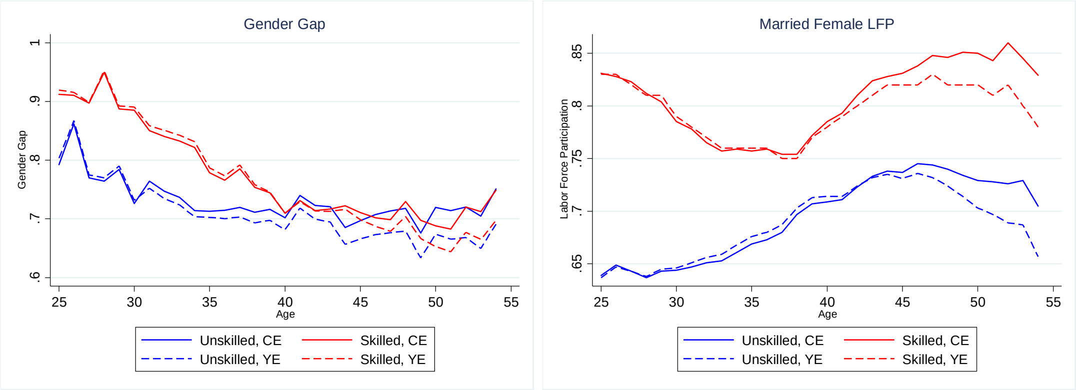

Figure A2 - The Gender Wage Gap (left), LFP of Married Females (right), YE and CE

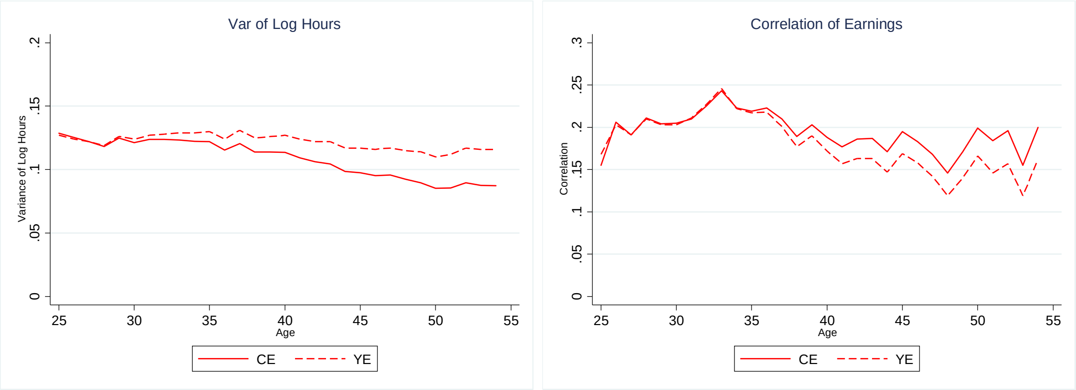

Figure A3 - Var. of Log Hours, Mar. Females (left), Cor. of Spousal Earnings (right), YE and CE

3 Equilibrium

In this section of the Appendix, we define a stationary equilibrium for the model economy. For all j, let $M_j(x,z) = M(x,z)$ denote the fraction of marriages between age-j, type-x females and age-j, type-z males, and let $\omega_j(z) = \omega(z)$ and $\phi_j(x) = \phi(x)$ be the fraction of single type-z males and the fraction of single type-x females, respectively. The fraction of type-z males and type-x females are then given by

$$\Omega(z) = \sum_{x \in X} M(x,z) + \omega(z), \tag{1}$$

and

$$\Phi(x) = \sum_{z \in Z} M(x,z) + \phi(x). \tag{2}$$

Let let $\mathcal{S}^M \equiv (x, z, \theta, \boldsymbol{\upsilon}, q, b)$ be the vector of states that *do not change* along the life-cycle for married households, with $\boldsymbol{\upsilon} = (\upsilon^M_{f,x}, \upsilon^M_{m,z})$. For married couples, also summarize the pair of persistent shocks by $\boldsymbol{\eta} \equiv (\eta^M_{f,x}, \eta^M_{m,z})$. Similarly, let $\mathcal{S}^S_f \equiv (x, \upsilon^S_{f,x}, b)$ and $\mathcal{S}^S_m \equiv (z, \upsilon^S_{m,z})$ be the vector of exogenous variables for single females and single males, respectively. In equilibrium, factor markets clear. The aggregate state of the economy consists of distribution of households over their types, labor productivity shocks, assets, labor market experience, and human capital levels. Let the function $\psi^M_j(a, h, e, \boldsymbol{\eta}, \mathcal{S}^M)$ denote the number of married individuals of age j with assets a, human capital level h, female labor market experience e, current persistent shocks $\boldsymbol{\eta}$, and exogenous state $\mathcal{S}^M$. The function $\psi^S_{f,j}(a, h, e, \eta^S_{f,x}, \mathcal{S}^S_f)$, for single females, and the function $\psi^S_{m,j}(a, \eta^S_{m,z}, \mathcal{S}^S_m)$, for single males, are defined similarly. Note that household assets, a, and female human capital levels, h, are continuous decisions. Let $a \in A = [0, \overline{a}]$ and $H = [0, \overline{h}]$ be the sets of possible assets and female human capital levels. Let the set for possible values of the market experience be denoted by $E = [0, \overline{e}]$. By construction, $M(x,z)$, the number of married households of type (x,z), must satisfy for all j

$$M(x,z) = \sum_{\theta, \boldsymbol{\upsilon}, q, b} \int_{A \times H} \psi^M_j(a, h, e, \boldsymbol{\eta}, \mathcal{S}^M) dh\ da\ de\ d\boldsymbol{\eta}.$$

Similarly, the fraction of single females and males must be consistent with the corresponding measures $\psi^S_{f,j}$ and $\psi^S_{m,j}$, i.e. for all ages, we have

$$\phi(x) = \sum_{\upsilon, b} \int_{A \times H \times E} \psi^S_{f,j}(a, h, e, \eta, \mathcal{S}^S_f) dh\ da\ de\ d\eta,$$

and

$$\omega(z) = \sum_{\upsilon} \int_{A} \psi^S_{m,j}(a, \eta, \mathcal{S}^S_m) da\ d\eta.$$

For married couples, let $\lambda^M_b(x,z)$ be the fraction of type-(x,z) couples who have childbearing type b (where $b \in \{0,1,2\}$ denotes no children, early childbearing and late childbearing, respectively), with $\sum_b \lambda^M_b(x,z) = 1$. Similarly, let $\lambda^S_b(x)$ be the fraction of type-x

single females who have childbearing type b, with $\sum_b \lambda_b^S(x) = 1$. Let the decision rules associated with the dynamic programming problems outlined in Section 3.5 of the paper be denoted by $a_m^S(a, \eta_{m,z}^S, \mathcal{S}_m^S, j)$ and $l_m^S(a, \eta_{m,z}^S, \mathcal{S}_m^S, j)$ for single males, by $a_f^S(a, h, e, \eta_{f,x}^S, \mathcal{S}_f^S, j)$ and $l_f^S(a, h, e, \eta_{f,x}^S, \mathcal{S}_f^S, j)$ for single females, and by $a^M(a, h, e, \boldsymbol{\eta}, \mathcal{S}^M, j)$, $l_f^M(a, h, e, \boldsymbol{\eta}, \mathcal{S}^M, j)$ and $l_m^M(a, h, e, \boldsymbol{\eta}, \mathcal{S}^M, j)$ for married couples. Finally, let the functions $\mathfrak{h}^S(a, h, e, \eta, \mathcal{S}_f^S, j)$ and $\mathfrak{h}^M(a, h, e, \boldsymbol{\eta}, \mathcal{S}^M, j)$ describe the next period's human capital for a single and married female, respectively. They are defined as

$$\mathfrak{h}^M(a, h, e, \boldsymbol{\eta}, \mathcal{S}^M, j) = \mathcal{H}(x, h, l_f^M(a, h, e, \boldsymbol{\eta}, \mathcal{S}^M, j), e),$$

and

$$\mathfrak{h}^S(a, h, e, \eta, \mathcal{S}_f^S, j) = \mathcal{H}(x, h, l_f^S(a, h, e, \eta, \mathcal{S}_f^S, j), e),$$

where $\mathcal{H}$ is the human capital accumulation function. Let $\chi\{.\}$ denote the indicator function. Summarize the transition functions for persistent shocks by $\Gamma^M(\boldsymbol{\eta}'|\boldsymbol{\eta})$, $\Gamma_f^S(\eta'|\eta)$ and $\Gamma_m^S(\eta'|\eta)$ and the initial draws for permanent shocks by $\Pi^M(\boldsymbol{\upsilon})$, $\Pi_f^S(\upsilon)$, and $\Pi_m^S(\upsilon)$.

In equilibrium, the distribution functions $\psi_j^M(a, h, e, \boldsymbol{\eta}, \mathcal{S}^M)$, $\psi_{f,j}^S(a, h, e, \eta_{f,x}^S, \mathcal{S}_f^S)$, and $\psi_{m,j}^S(a, \eta_{m,z}^S, \mathcal{S}_m^S)$ must obey the following recursions:

Married agents

$$\begin{aligned} \psi_j^M(a', h', e', \boldsymbol{\eta}', \mathcal{S}^M) &= \int \Gamma^M(\boldsymbol{\eta}'|\boldsymbol{\eta}) \psi_{j-1}^M(a, h, e, \boldsymbol{\eta}, \mathcal{S}^M) \times \\ \chi\{a^M(a, h, e, \boldsymbol{\eta}, \mathcal{S}^M, j-1) &= a', \ \mathfrak{h}^M(a, h, e, \mathcal{S}^M, \boldsymbol{\eta}, j-1) = h'\} dh\ da\ de\ d\boldsymbol{\eta}, \end{aligned} \tag{3}$$

for $j > 1$ with

$$e' = \begin{cases} e, \ \text{if } l_f^M(a, h, e, \boldsymbol{\eta}, \mathcal{S}^M, j-1) = 0 \\ e+1, \ \text{otherwise} \end{cases} .$$

For $j = 1$,

$$\psi_1^M(a, e, h, \boldsymbol{\eta}, \mathcal{S}^M) = \begin{cases} M(x,z)\lambda_b^M(x,z)\pi_\theta \Pi^M(\boldsymbol{\upsilon})(\zeta(q|z) \text{ if } a = 0, e = 0, \boldsymbol{\eta} = \mathbf{0}, \ h = \varpi_m(x,1), \\ 0, \ \text{otherwise} \end{cases} ,$$

where $\varpi_m(x,1)$ is a function that maps female types their initial human capital, $\zeta(q|z)$ is the fraction of households that draw q (given z), and π_θ is the probability of drawing θ.

Single female agents

$$\begin{aligned} \psi_{f,j}^S(a', h', e', \eta', \mathcal{S}_f^S) &= \int \Gamma_f^S(\eta'|\eta) \psi_{f,j-1}^S(a, h, e, \eta, \mathcal{S}_f^S) \times \\ \chi\{a_f^S(a, h, e, \eta, \mathcal{S}_f^S, \ j-1) &= a', \ \mathfrak{h}^S(a, h, e, \eta, \mathcal{S}_f^S, j-1) = h'\} dh\ da\ de\ d\boldsymbol{\eta}, \end{aligned} \tag{4}$$

for $j > 1$, with again

$$e' = \begin{cases} e, \ \text{if } l_f^S(a, h, e, \eta_{f,x}^S, \mathcal{S}_f^S, j-1) = 0 \\ e+1, \ \text{otherwise} \end{cases} ,$$

and

$$\psi^S_{f,1}(a,h,e,\eta,\mathcal{S}^S_f) = \begin{cases} \phi(x)\Pi^S_f(\upsilon)\lambda^S_b(x) \text{ if } e=0, \eta=0,\ h=\varpi_f(x,1) \\ 0,\ \text{otherwise} \end{cases}.$$

<u>*Single male agents*</u>

$$\psi^S_{m,j}(a,\eta,\mathcal{S}^S_m) = \int \Gamma^S_f(\eta'|\eta)\psi^S_{m,j-1}(a,\eta,\mathcal{S}^S_m)\chi\{a^S_m(a,\eta,\mathcal{S}^S_m,j-1)=a'\}da\ d\eta, \tag{5}$$

for $j>1$, and

$$\psi^S_{m,1}(a,\eta,\mathcal{S}^S_m) = \begin{cases} \varpi_m(z,1)\Pi^S_m(\upsilon) \text{ if } a=0,\ \eta=0 \\ 0,\ \text{otherwise} \end{cases}.$$

Given distribution functions $\psi^M_j(a,h,e,\boldsymbol{\eta},\mathcal{S}^M)$, $\psi^S_{f,j}(a,h,e,\eta^S_{f,x},\mathcal{S}^S_f)$, and $\psi^S_{m,j}(a,\eta^S_{m,z},\mathcal{S}^S_m)$, the aggregate capital stock is given by

$$\begin{aligned} K &= \sum_j \mu_j[\sum_{\mathcal{S}^M}\int a\psi^M_j(a,h,e,\boldsymbol{\eta},\mathcal{S}^M)dh\ da\ de\ d\boldsymbol{\eta} + \sum_{\mathcal{S}^S_m}\int a\psi^S_{m,j}(a,\eta,\mathcal{S}^S_m)da\ d\eta \quad (6) \\ &+ \sum_{\mathcal{S}^S_f}\int a\psi^S_{f,j}(a,h,e,\eta,\mathcal{S}^S_f)dh\ da\ de\ d\eta]. \end{aligned}$$

The skilled labor input, L_s, is given by

$$\begin{aligned} L_s &= \sum_j \mu_j[\sum_{\mathcal{S}^M:x=s}\int (h\exp(\nu+\eta)l^M_f(a,h,e,\boldsymbol{\eta},\mathcal{S}^M,j)\psi^M_j(a,h,e,\boldsymbol{\eta},\mathcal{S}^M)dh\ da\ de\ d\boldsymbol{\eta} \\ &+ \sum_{\mathcal{S}^M:z=s}\int (\varpi(z,j)\exp(\nu+\eta)l^M_m(a,h,e,\boldsymbol{\eta},\mathcal{S}^M,j)\psi^M_j(a,h,e,\boldsymbol{\eta},\mathcal{S}^M)dh\ da\ de\ d\boldsymbol{\eta} \\ &+ \sum_{\mathcal{S}^S_m:z=s}\int \varpi(z,j)\exp(\nu+\eta)l^S_m(a,\eta,\mathcal{S}^S_m,j)\psi^S_{m,j}(a,\eta,\mathcal{S}^S_m)da\ d\eta \quad (7) \\ &+ \sum_{\mathcal{S}^S_f:x=s}\int h\exp(\nu+\eta)l^S_f(a,h,e,\eta,\mathcal{S}^S_f,j)\psi^S_{f,j}(a,h,e,\eta,\mathcal{S}^S_f)dh\ da\ de\ d\eta]. \end{aligned}$$

In turn, the (total) unskilled labor input, is given by

$$
\begin{aligned}
L_u &= \sum_j \mu_j [\sum_{\mathcal{S}^M : x=u} \int (h \exp(\nu + \eta) l_f^M(a,h,e,\boldsymbol{\eta},\mathcal{S}^M, j) \psi_j^M(a,h,e,\boldsymbol{\eta},\mathcal{S}^M) dh\ da\ de\ d\boldsymbol{\eta} \\
&+ \sum_{\mathcal{S}^M : z=u} \int (\varpi(z,j) \exp(\nu + \eta) l_m^M(a,h,e,\boldsymbol{\eta},\mathcal{S}^M, j) \psi_j^M(a,h,e,\boldsymbol{\eta},\mathcal{S}^M) dh\ da\ de\ d\boldsymbol{\eta} \\
&+ \sum_{\mathcal{S}_m^S : z=u} \int \varpi(z,j) \exp(\nu + \eta) l_m^S(a,\eta,\mathcal{S}_m^S, j) \psi_{m,j}^S(a,\eta,\mathcal{S}_m^S) da\ d\eta \qquad (8) \\
&+ \sum_{\mathcal{S}_f^S : x=u} \int h \exp(\nu + \eta) l_f^S(a,h,e,\eta,\mathcal{S}_f^S, j) \psi_{f,j}^S(a,h,e,\eta,\mathcal{S}_f^S) dh\ da\ de\ d\eta],
\end{aligned}
$$

Furthermore, unskilled labor used in the production of goods, $L_{u,g}$, equals the total supply of unskilled labor net of its usage in the production of childcare services:

$$
\begin{aligned}
L_{u,g} &= L_u - [\sum_{\mathcal{S}^M} \mu_j \int \chi\{l_f^M\} D(x,z,b,j) \psi_j^M(a,h,e,\boldsymbol{\eta},\mathcal{S}^M, j) dh\ da\ de\ d\boldsymbol{\eta} \\
&+ \sum_{\mathcal{S}_f^S} \mu_j \int \chi\{l_f^S\} D(x,b,j) \psi_{f,j}^S(a,h,e,\eta,\mathcal{S}_f^S, j) dh\ da\ de\ d\eta].
\end{aligned}
$$

In equilibrium, total taxes must cover government expenditures, G, total government spending and total transfers, TR, i.e.,

$$
\begin{aligned}
G + TR &= \sum_j \mu_j [\sum_{\mathcal{S}^M} \int T^M(I, \mathcal{K}(.)) \psi_j^M(a,h,e,\boldsymbol{\eta},\mathcal{S}^M) dh\ da\ de\ d\boldsymbol{\eta} \qquad (9) \\
&+ \sum_{\mathcal{S}_m^S} \int T^S(I,0) \psi_{m,j}^S(a,\eta,\mathcal{S}_m^S)\ da\ d\eta \\
&\quad + \sum_{\mathcal{S}_f^S} \int T^S(I, \mathcal{K}(.)) \psi_{f,j}^S(a,e,h,\eta,\mathcal{S}_f^S)\ dh\ da\ de\ d\eta] + \tau_k r K,
\end{aligned}
$$

where I represents a household's total income and $\mathcal{K}$ the number of children as as defined in the description of the individual and household problems in Section 3.5 of the paper. The aggregate transfers are given by

$$
\begin{aligned}
TR &= \sum_j \mu_j [\sum_{\mathcal{S}^M} \int TR^M(I, \mathcal{K}(.), D) \psi_j^M(a,h,e,\boldsymbol{\eta},\mathcal{S}^M) dh\ da\ de\ d\boldsymbol{\eta} \\
&+ \sum_{\mathcal{S}_m^S} \int TR_m^S(I) \psi_{m,j}^S(a,\eta,\mathcal{S}_m^S)\ da\ d\eta \\
&+ \sum_{\mathcal{S}_f^S} \int TR_f^S(I, \mathcal{K}(.), D) \psi_{f,j}^S(a,e,h,\eta,\mathcal{S}_f^S)\ dh\ da\ de\ d\eta],
\end{aligned}
$$

where D stands for childcare expenditures, as defined in Section 3.5 of the paper.

Finally, the social security budget must balance

$$\begin{aligned} & \sum_{j\geq J_R}\mu_j[\sum_{\mathcal{S}^M}\int p^M(x,z)\psi_j^M(a,h,e,\mathbf{0},\mathcal{S}^M)dh\ da\ de+\sum_{\mathcal{S}_f^S}\int p_f^S(x)\psi_{f,j}^S(a,e,h,0,\mathcal{S}_f^S)dh\ da\ de \\ & +\sum_{\mathcal{S}_m^S}\int p_m^S(z)\psi_{m,j}^S(a,0,\mathcal{S}_m^S)\ da] \qquad (10) \\ = \ & \tau_p[w_sL_s+w_uL_u]. \end{aligned}$$

Equilibrium Definition For a given government consumption level G, social security benefits $p^M(x,z)$, $p_f^S(x)$ and $p_m^S(z)$, tax functions $T^S(.)$, $T^M(.)$, a payroll tax rate τ_p, a capital tax rate τ_k, transfer function $TR_f^S(.)$, $TR_m^S(.)$, $TR^M(.)$, and an exogenous demographic structure represented by $\Omega(z)$, $\Phi(x)$, $M(x,z)$, and μ_j, a *stationary equilibrium* consists of prices r and (w_s,w_u), aggregate capital (K), aggregate labor $(L_s,L_u,L_{u,g})$, household decision rules $a_m^S(a,\eta_{m,z}^S,\mathcal{S}_m^S,j)$ and $l_m^S(a,\eta_{m,z}^S,\mathcal{S}_m^S,j)$ for single males, by $a_f^S(a,e,h,\eta_{f,x}^S,\mathcal{S}_f^S,j)$ and $l_f^S(a,e,h,\eta_{f,x}^S,\mathcal{S}_f^S,j)$ for single females, and by $a^M(a,h,e,\boldsymbol{\eta},\mathcal{S}^M,j)$, $l_f^M(a,h,e,\boldsymbol{\eta},\mathcal{S}^M,j)$ and $l_m^M(a,h,e,\boldsymbol{\eta},\mathcal{S}^M,j)$ for married couples., and distribution functions $\psi_j^M(a,e,h,\boldsymbol{\eta},\mathcal{S}^M)$, $\psi_{f,j}^S(a,e,h,\eta_{f,x}^S,\mathcal{S}_f^S)$, and $\psi_{m,j}^S(a,\eta_{m,z}^S,\mathcal{S}_m^S)$, such that

1. Given tax and transfer rules, and factor prices, the decisions of households are optimal.
2. Factor prices are competitively determined; i.e. $w_s=\frac{\partial F(K,L_g)}{\partial L_s}$, $w_u=\frac{\partial F(K,L_g)}{\partial L_{u,g}}$ and $r=\frac{\partial F(K,L_g)}{\partial K}-\delta_k$.
3. Factor markets clear; i.e. equations (6) and (7) hold.
4. The functions ψ_j^M, $\psi_{f,j}^S$, and $\psi_{m,j}^S$ are consistent with individual decisions, i.e. they are defined by equations (3), (4), and (5).
5. The government and social security budgets are balanced; i.e. equations (9) and (10) hold.

4 Model Inputs and Calibration

The model period is a year. The population grows at the annual rate of 1.1%, the average values for the U.S. economy between 1960-2000.

4.1 Demographics

We determine the distribution of individuals by productivity types for each gender, i.e. $\Omega(z)$ and $\Phi(x)$, using data from the 2008 American Community Survey (ACS). We consider all household heads or spouses between ages 30 and 39 and for each gender calculate the fraction of population in each education cell. For the same age group, we also construct $M(x,z)$, the distribution of married working couples, as shown in Table A1. Given the fractions of individuals in each education group, $\Phi(x)$ and $\Omega(z)$, and the fractions of married households, $M(x,z)$, in the data, we calculate the implied fractions of single households, $\omega(z)$ and $\phi(x)$, from population accounting identities (1) and (2). The resulting values are reported in Table A2. About 74% of households consist of married households, while the rest (about 26%) are single. Since we assume that the distribution of individuals by marital status is independent of age, we use the 30-39 age group in the calibration. This age group captures the marital status of recent cohorts during their prime-working years, while being at the same time representative of older age groups.

Table A1: Distribution of Married Working Households by Type

	Females	
Males	Unskilled	Skilled
Unskilled	51.37	12.81
Skilled	8.93	26.90

Note: Entries show the fraction of marriages out of the total married pool, by wife and husband educational categories. The data used is from the 2008 ACS, ages 30-39. Entries add up to 100.

Table A2: Fraction of Agents by Type, Gender and Marital Status

	Males			Females		
	All	Married	Singles	All	Married	Singles
Unskilled	65.38	48.19	17.19	62.23	44.03	18.21
Skilled	34.62	26.51	8.11	37.77	29.10	8.66

Note: Entries show the fraction of individuals in each educational category, by marital status, constructed under the assumption of a stationary population structure.

4.2 Children

In the model each single female and each married couple belong to one of three groups: *without* children, *early* child bearer and *late* child bearer. We use information on the age of last birth of mothers by skill to determine who is in each category. The unskilled early child bearers have all children at age 1 (age 25). Skilled early-child bearers have children at age 1 (25) and at age 3 (27). Late child bearers have their children at ages 8 and 10, corresponding to ages 32 and 34. This structure captures the fact that births occur within a short time interval; between 25 and 29 for unskilled and between 30 and 34 for skilled households in the 2008 CPS June (Fertility) Supplement.[5] From the 2008 CPS June Supplement, we also calculate the fraction of 40 to 44 years old single (never married or divorced) females with zero live births. This provides us with a measure of lifetime childlessness. Then we calculate

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[5] The CPS June Supplement provides data on the total number of live births and the age at last birth for females, which are not available in the U.S. Census.

the fraction of all single women above age 25 with a total number of two live births who were below age 30 at their last birth. This fraction gives us those who are early child bearers, and the remaining fraction are assigned as late child bearers. The resulting distribution is shown in Table A3.

We follow a similar procedure for married couples, combining data from the CPS June Supplement and the U.S. Census. For childlessness, we use the larger sample from the U.S. Census.[6] The Census does not provide data on total number of live births but the total number of children in the household is available. Therefore, as a measure of childlessness we use the fraction of married couples between ages 35-39 who have no children at home.[7] Then, using the CPS June supplement we look at all couples above age 25 in which the female had a total of two live births and was below age 30 at her last birth. This gives us the fraction of couples who are early child bearers, with the remaining married couples labeled as the late ones. Table A4 shows the resulting distributions. Table A5 displays the number of children for single mothers by skill, and the corresponding ones for married couples.

Table A3: Childbearing Status, Single Females

	Childless	Early	Late
Unskilled	29.27	57.42	13.31
Skilled	54.63	28.17	17.20

Note: Entries show the distribution of childbearing among single females, using data from the CPS-June supplement.

Table A4: Childbearing Status, Married Couples

Childless			Early		
	Females			Females	
Male	Unskilled	Skilled	male	Unskilled	Skilled
Unskilled	9.22	13.17	Unskilled	63.46	40.58
Skilled	9.89	11.51	Skilled	45.88	26.95

Note: Entries show the distribution of childbearing among married couples. For childlessness, data used is from the U.S. Census. For early childbearing, the data used is from the CPS-June supplement. Values for late childbearing can be obtained residually for each cell.

---

[6] The CPS June Supplement is not particularly useful for the calculation of childlessness in married couples. The sample size is too small for some married household types for the calculation of the fraction of married females, aged 40-44, with no live births.

[7] Since we use children at home as a proxy for childlessness, we use age 35-39 rather than 40-44. Using ages 40-44 generates more childlessness among less educated people. This is counterfactual, and simply results from the fact that less educated people are more likely to have kids younger, and hence these kids are less likely to be at home when their parents are between ages 40-44.

Table A5: Fertility Differences

Singles		Married		
			Females	
		Male	Unskilled	Skilled
Unskilled	2.21	Unskilled	2.34	2.05
Skilled	1.82	Skilled	2.33	1.98

Note: Entries show, conditional on having children, the total number of children different types of households have by age 40-44. The authors' calculations from the 2008 CPS-June supplement.

Childcare Costs We use the U.S. Bureau of Census data from the Survey of Income and Program Participation (SIPP) to calibrate childcare costs. We estimate a relation that represents the relation between the average age of children at home and per-child childcare costs, conditional on mother's skills and marital status. We estimate:

$$\widehat{d}(x, t; mar) = a_x^{mar} + b_x^{mar} \ln(t),$$

where $mar \in \{M, S\}$ stands for marital status, and t is the average age of children at home. The childcare spending per children in the data, $\widehat{d}(x, t; mar)$, reflects effective spending, so captures differences among household in access to informal care or quality of childcare chosen. Figure A4 (right panel) shows the estimated values. Our estimates imply that childcare costs are larger for skilled mothers and decline fast as children age. The annual rate of decline is about 11-12% (10-11%) when the child age is five for skilled (unskilled) mothers.

The childcare costs of a married couple where the wife is of skill x are given by $w^u d^M(x, t) = \widehat{d}(x, t; M)$ for each t, while for a single woman are given by $w^u d^S(x, t) = \widehat{d}(x, t; S)$. The resulting values for efficiency units are scaled so that the total childcare expenditure for children between ages 0 to 5 is in line with the data. The total yearly cost for employed mothers, who have children between 0 and 5 and who make childcare payments, was about \$6,414.5 in 2005, which is about 10% of average household income. In the benchmark economy, this choice of parameter values results in 1.1% of the total labor input being used to produce childcare services. This is in line with the share of employment in the childcare sector in the U.S., which was about 1.1% in 2012.[8]

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[8] Total employment in childcare services (NAICS 6244) was about 1.6 million in 2012. This number is the sum of total paid employment and the number of establishments without paid employees. See http://thedataweb.rm.census.gov/TheDataWeb_HotReport2/econsnapshot/2012/snapshot.hrml?NAICS=6244.

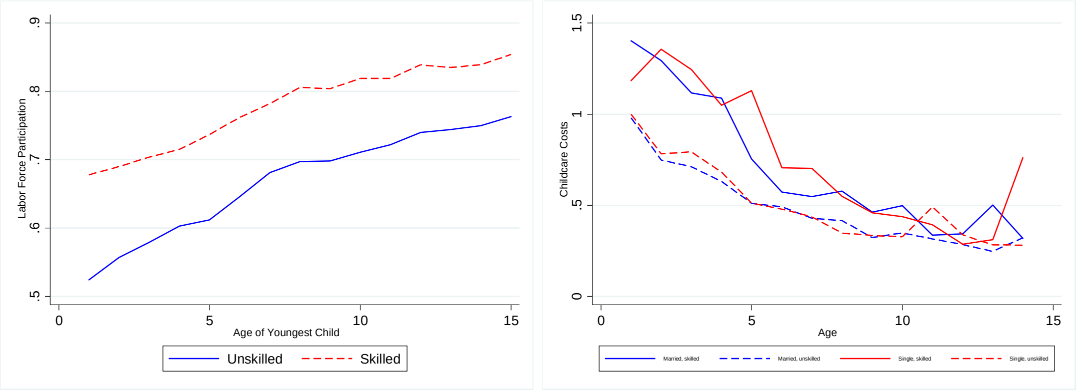

Figure A4 - LFP of Mar. Fem., by age of the youngest child (left); Childcare Costs per Child (right)

4.3 Taxes

4.3.1 Income Taxes

To construct income tax functions, we follow Guner et al (2014) and estimate *effective tax rates* as a function of reported income, marital status, and the number of children. The data is tax-return, micro-data from Internal Revenue Service for the year 2000 (Statistics of Income Public Use Tax File). For married households, the estimated tax functions correspond to the legal category *married filing jointly*. For singles without children, we use the legal category of *single* households; and for singles with children, the legal category *head of household*.[9] To estimate the tax functions for a household with a certain number of children, married or not, the sample is further restricted by the number of dependent children for tax purposes.

Since the EITC, CTC and CDCTC are explicitly modeled in the benchmark economy, we consider tax liabilities in the absence of these credits. To this end, let I stand for multiples of mean household income in the data and denote by $\widetilde{t}(I)$ the corresponding tax liabilities after any tax credits. Tax credits reduce the tax liability first to zero and if there is any refundable credit left, the household receives a transfer. Let $credit(I)$ be the total credits without any refunds, which we can identify in the IRS micro tax data. Taxes in the absence of credits is then given by $t(I) = \widetilde{t}(I) + credit(I)$. The incomes tax functions, i.e. $T^S(I,k)$ and $T^M(I,k)$,take the following form

$$\tau(I) = 1 - \lambda I^{-\tau},$$

where I is measured in multiples of mean household income, $\tau(I)$ is the average tax rate, parameter τ determines the progressivity of taxes and λ determines the taxes at the mean

---

[9] We use the 'head of household' category for singles with children, since in practice it is clearly advantageous for most unmarried individuals with dependent children to file under this category. For instance, the standard deduction is larger than for the 'single' category, and a larger portion of income is subject to lower marginal tax rates.

household income ($I = 1$). Parameters τ and λ depend on marital status and the number of children. The total tax liabilities amount to $\tau(I) \times I \times mean\ household\ income$.

Estimates for λ and τ are contained in Table A6. Guner et al (2014) show that this functional form does a great job matching average and marginal tax rates in the data. We estimate tax functions for households with zero and two children (and assign the number of children from Table A5 by rounding the numbers to the nearest integer). Figure A5 (left panel) displays estimated average and marginal tax rates for different multiples of household income.

Table A6: Tax Functions

Estimates	Married		Single	
	(no child)	(2 child.)	(no child)	(2 child.)
λ	0.9024	0.9078	0.8815	0.9227
τ	0.0569	0.0596	0.0356	0.0351

Note: Entries show the parameter estimates for the postulated tax function. These result from regressing effective average tax rates against household income, using 2000 micro data from the U.S. Internal Revenue Service. For singles with two children, the data used pertains to the 'Head of Household' category.

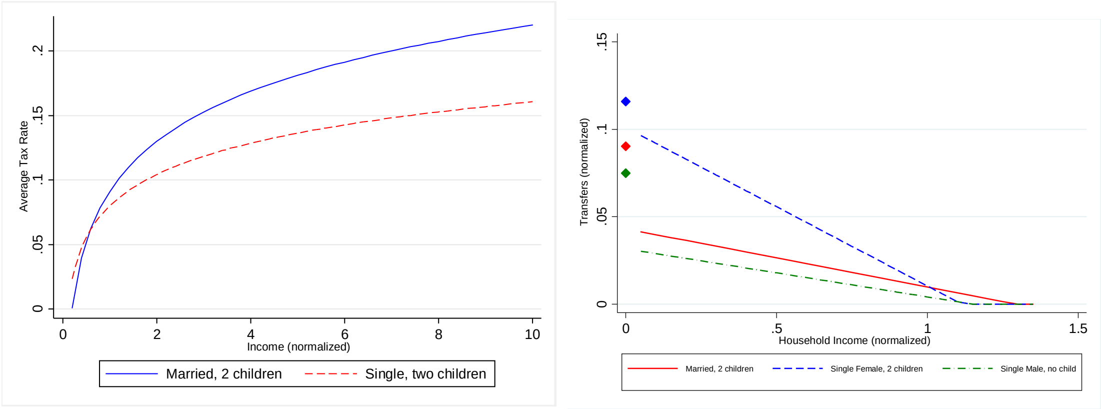

Figure A5 - Average Taxes (left); Welfare Payments (right)

4.3.2 Social Security and Capital Taxation

We calculate $\tau_p = 0.086$, as the average value of the social security contributions as a fraction of aggregate labor income for 1990-2000 period.[10] Using the 2008 ACS, we calculate total

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[10] The contributions considered are those from the Old Age, Survivors and DI programs. The Data comes from the Social Security Bulletin, Annual Statistical Supplement, 2005, Tables 4.A.3.

Social Security benefits for all single and married households.[11] Tables A7 shows Social Security benefits, normalized by the level corresponding to single males of the lowest type, $p_m^S(z_1)$. We treat $p_m^S(z_1)$ as a free parameter, and determine all other benefit levels according to Table A7. Then, given τ_p, choose $p_m^S(z_1)$ to balance the budget for the social security system. Hence, while the relative values social security benefits come from the data, the absolute level of one, $p_m^S(z_1)$, is adjusted to balance the budget of the system. The implied value of $p_m^S(x_1)$ for the benchmark economy is about 18.1% of the average household income in the economy.

We use τ_k to proxy the U.S. corporate income tax. We estimate this tax rate as the one that reproduces the observed level of tax collections out of corporate income taxes after the major reforms of 1986. Such tax collections averaged about 1.92% of GDP for 1987-2000 period. Using the technology parameters we calibrate in conjunction with our notion of output (business GDP), we obtain $\tau_k = 0.097$.

Table A7: Social Security Benefits

	Single		Married		
				Females	
	Unskilled	Skilled	Males	Unskilled	Skilled
Males	1	1.166	Unskilled	1.764	1.911
Females	0.888	0.995	Skilled	1.981	2.093

Note: Entries show Social Security benefits, normalized by the mean Social Security income of the lowest type male, using data from the 2008 ACS.

4.4 Welfare State

Transfers, $TR_f^S(I,k,D), TR_m^S(I)$, and $TR^M(I,k,D)$, consist of three components. The first component is the Earned Income Tax Credit (EITC). The second part is child-related transfers, which consists of Child Tax Credit (CTC), the Child and Dependent Care Tax Credit (CDCTC), and childcare subsidies. The final component is the means-tested transfers.

4.4.1 Earned Income Tax Credits (EITC)

We model all tax credits as they appear in 2004 tax code. Since we represent all variables as a fraction of the mean household income, in the absence of any changes in the tax code, the reference year is not critical. In 2004, for a married couple with 0 (2 or 3) children, the EITC started at \$2 (\$10) and increased by 7.6 (39.9) cents for each extra \$ in earnings up to a maximum credit of \$3,900 (\$4,300). Then the credit stays at this level until the household earnings are \$7,375 (\$15,025). After this level of earnings, the credit starts declining at a rate of 7.6 (21) cents for each extra \$ in earnings until it becomes zero for earrings above

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[11] Social Security income is all pre-tax income from Social Security pensions, survivors benefits, or permanent disability insurance. Since Social Security payments are reduced for those with earnings, we restrict our sample to those above age 70. For married couples we sum the social security payments of husbands and wives.

$12,490 ($35,458). The formulas for a single household with 0 (2 or 3) children are very similar. We calculate the level of $EITC$ as a function of earnings with the following formula,

$$\begin{aligned} EITC &= \max\{CAP\text{-}\max\{slope_1 \times (bend_1 - earnings), 0\} \\ &\quad - \max\{slope_2 \times (earnings - bend_2), 0\}, 0\}, \end{aligned}$$

where CAP, the maximum credit level, $bend_1$ and $bend_2$, the threshold levels, and $slope_1$ and $slope_2$, the rate at which credit increase and decline are given by (as a fraction of mean household income in 2014):

	CAP	$slope_1$	$bend_1$	$slope_2$	$bend_2$
Married					
No ch.	0.006	0.076	0.085	0.076	0.122
2 or 3 ch.	0.071	0.399	0.178	0.21	0.248
Single					
No ch.	0.006	0.076	0.085	0.076	0.105
2 or 3 ch.	0.071	0.399	0.178	0.21	0.232

Figure A6 (left panel) shows the EITC as a function of household income and the tax filing status.

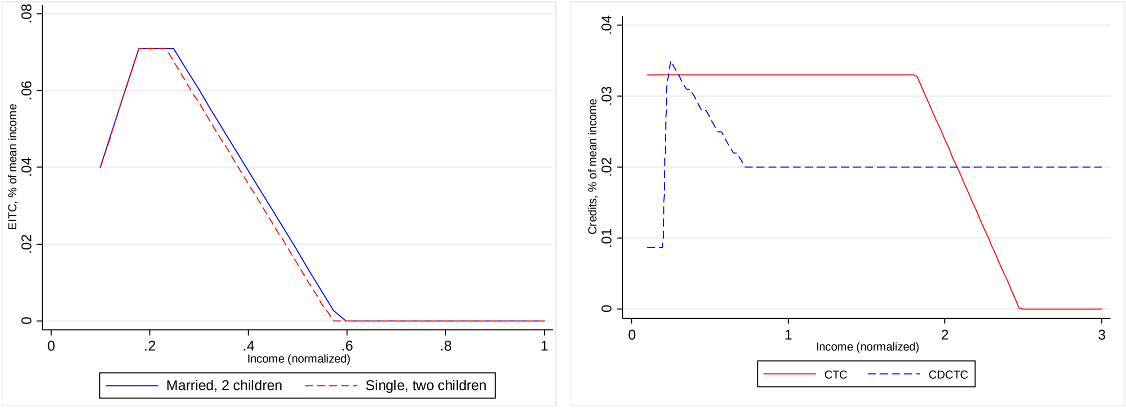

Figure A6 - The Earned Income Tax Credit (left); Potential CTC and CDCTC (right)

4.4.2 Child Tax Credits

Child credits operate as a means-tested transfer to households with children. If a household's income is below a certain limit, $\widehat{I}_{CTC}$, then the potential credit is $d_{CTC} = \$1,000$ per child in 2004. If the household income is above the income limit, then the credit amount declines by 5% for each additional dollar of income. In the current tax code, $\widehat{I}_{CTC}$ is $110,000 for a married couple and $75,000 for singles. As a result, a married couple with two children whose total household income is below $110,000 has a potential child credit of $2,000, a household with two children whose total household income is \$120,000 can only get \$1,500. The child credit becomes zero for married couples (singles) whose total household income is above \$150,000 (\$115,000). As the CTC is not fully refundable, the actual CTC that a household gets depends on the total tax liabilities of the household and other child-related credits that the household might qualify.

For a household with income level I (again indicated as a multiple of mean household income in the economy) and k children, the *potential CTC* is given by

$$CTC_{potential}(I) = \max\{[k \times 0.0165 - \max(I - \widehat{I}_{CTC}, 0) \times 0.05], 0\}, \tag{11}$$

with

$$\widehat{I}_{CTC} = \begin{cases} 1.819, \text{ if married filing jointly} \\ 1.240, \text{ if single} \end{cases},$$

where again the maximum amount of credit per child, 0.0165, and income limits, 1.819 and 1.240, are in multiples of mean household income in the U.S. in 2004. Both the CTC and the CDCTC are *non-refundable*, as a result, how much of the potential credit a household actually gets depends on its total tax liabilities and total tax credits (CTC plus CDCTC). Let $Credit_{potential}(I) = CTC_{potential}(I) + CDCTC_{potential}(I)$ and $Taxes(I)$ be the total potential tax credits and the tax liabilities of the household. Then,

$$CDCTC_{actual}(I) = \begin{cases} CDCTC_{potential}(I), \text{ if } Taxes(I) > Credit_{potential}(I) \\ \max\{Taxes(I) - CDCTC_{potential}(I), 0\}, \text{ if } Taxes(I) < Credit_{potential}(I) \\ \qquad\qquad \text{and } CDCTC_{potential}(I) > Taxes(I) \\ CDCTC_{potential}(I), \text{ if } Taxes(I) < Credits_{potential}(I) \\ \qquad\qquad \text{but } CDCTC_{potential}(I) < Taxes(I) \end{cases},$$

and

$$CTC_{actual}(I) = \begin{cases} CTC_{potential}(I), \text{ if } Taxes(I) > Credits_{potential}(I) \\ 0, \text{ if } Taxes(I) < Credits_{potential}(I) \\ \qquad\qquad \text{and } CDCTC_{potential}(I) > Taxes(I) \\ Taxes(I) - CDCTC_{potential}(I), \text{ if } Taxes(I) < Credits_{potential}(I) \\ \qquad\qquad \text{but } CDCTC_{potential}(I) < Taxes(I) \end{cases}$$

Hence, if the tax liabilities of a household are larger than the total potential credit implied by the CTC and the CDCTC, the household receives the full credit and its tax liabilities are reduced by $CTC_{potential} + CDCTC_{potential}$. If the total potential credits are larger than tax liabilities, then the household only receives a credit up to its tax liabilities. As a result, the households with low tax liabilities do not benefit from the CTC or CDCTC. This is partially compensated by the Additional Child Tax Credit (ACTC), which gives a household additional tax credits if its potential child tax credit is higher than the actual child tax credits it receives. In order to qualify for the ACTC, however, a household must have earnings above \$10,750. Thus, a household with very low earnings does not qualify for the ACTC. Given CTC_{actual} and CTC_{credit}, the ACTC is calculated as

$$ACTC(I) = \begin{cases} \min\{\max[(earnings - 0.178), 0] * 0.15, CTC_{potential}(I) - CTC_{actual}(I)\} \\ \qquad\qquad \text{if } CTC_{actual}(I) \leq CTC_{credit}\ (I) \\ 0, \text{ otherwise} \end{cases}.$$

4.4.3 Childcare Credits

All households with positive income can qualify for the Child and Dependent Care Tax Credit (CDCTC), or, as we refer in the paper, for *childcare credits*. For a married couple with k children, the qualified expenditure is calculated as follows

$$\text{Expense } = min\{d_{CDCTC} \times \min\{k, 2\}, earnings_1, earnings_2, d\},$$

where $earnings_1$ and $earnings_2$ are the earnings of the household head and his/her spouse and d is the child care expenditure (net of any childcare subsidy that a household might qualify). Note that a married couple household can have qualified expenses only if both the husband and the wife have non-zero earnings. The child care expenditures for the calculation of the childcare credits are capped at d_{CDCTC} per child per year, with a maximum of $2 \times d_{DCCTC}$.

For a single female household, the equivalent formula is given by

$$\text{Expense } = min\{d_{CDCTC} \times \min\{k, 2\}, earnings, d\}.$$

In 2004, d_{CDCTC} was \$3,000, i.e. maximum qualified expenditure for households with more than 1 child was capped at \$6,000. In multiples of mean household income in the U.S. (\$60,464 in that year), d_{CDCTC} was equal to 0.0496, i.e. about 5% of mean household income in the US. A household, however, only receives a fraction $\theta_{CDCTC}(I)$ of qualified expenses. The rate, θ_{CDCTC}, is a declining function of household income. It is set at 35% for households whose income is below \$15,000 ($\widehat{I}_{CDCTC}$), and after this point the rate declines by 1% for each extra \$2,000 that the household earns down to a minimum of 20%. Hence, the potential $CDCTC$ that a household can receive is then given by

$$CDCTC_{potential}(I) = \text{Expense} \times \theta_{CDCTC}(I), \tag{12}$$

with

$$\theta_{CDCTC}(I) = \begin{cases} 0.35, \text{ if } I \leq \widehat{I}_{CDCTC} \\ 0.35 - \min\{[\text{integer}(\frac{I-\widehat{I}_{CDCTC}}{0.033}) + 1] \times 0.01, 0.15\}, \text{ otherwise} \end{cases},$$

where $\widehat{I}_{CDCTC}$ is equal to 0.248 is in multiples of mean household income in the U.S. in 2004. Figure A6 (right panel) illustrates the sum of $CDCTC_{potential}(I)$ and $CTC_{potential}(I)$.[12]

4.4.4 Childcare Subsidies

We assume that the childcare subsidies in the model economy reflect the childcare subsidies provided by the Children Child Care and Development Fund (CCDF) in the US. Following Guner, Kaygusuz and Ventura (2022), we set $\theta = 0.75$ and choose $\widehat{I}$ such that the poorest 5.5% of families with children receive a subsidy from the government. This procedure sets $\widehat{I}$ at about 24.2% of mean household income in the benchmark economy. In the main policy experiments that we consider, we make the childcare subsides universal by setting $\widehat{I}$ to an arbitrarily large number.

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[12] The simulations for $CDCTC_{potential}(I)$ in Figure A4 are done under the assumption th at at each income level, the husband and the wife earns 60% and 40% of the household income, respectively, and the households spend 10% of their income on childcare.

4.4.5 Means-Tested Transfers

We use the 2004 wave of the Survey of Income and Program Participation (SIPP) to approximate a welfare schedule as a function of labor earnings for different household types. The sample of households with heads aged 25-54. The SIPP is a panel surveying households every three months retrospectively for each of the past three months. We compute the average amount of monthly welfare payments and monthly labor earnings, both corrected for inflation, for each household. The welfare payments include the following main means-tested programs: Supplemental Social Security Income (SSI), Temporary Assistance for Needy Families (TANF formerly AFDC), Supplemental Nutrition Assistance Program (SNAP formerly food stamps), Supplemental Nutrition Program for Women, Infants, and Children (WIC), and Housing Assistance.[13] We then estimate an "effective transfer function" (conditional on marital status and the number of children). We assume that these functions take the following form

$$W(I) = \begin{cases} \omega_0 \text{ if } I = 0 \\ \max\{0, \omega_1 - \omega_2 I\} \text{ if } I > 0 \end{cases},$$

where ω_0 is the transfers for a household with zero income and ω_2 is the benefits reduction rate and I is reported in multiples of mean household income. To determine ω_0, we simply calculate the average amount of welfare payments for households with zero non-transfer income. Then we estimate an OLS regression of welfare payments on household non-transfer income to determine α_0 and α_1. In Table A8 shows the estimated values of ω_0, α_1 and α_2 and Figure A5 (left panel) shows the welfare payments as a function of household income.

Table A8: Welfare System

Estimates	Married		Single Female		Single Male
	(no child)	(2 child.)	(no child)	(2 child.)	(no child)
ω_0	0.063	0.090	0.090	0.116	0.075
ω_1	0.023	0.043	0.044	0.101	0.032
ω_2	-0.017	-0.033	-0.042	-0.091	-0.028

Note: Entries correspond to the parameters summarizing our description of a host of transfer and social insurance programs ('welfare system'). Data comes from the 2004 wave of the SIPP.

4.5 Heterogeneity

There are 2 education types of males, corresponding to educational attainment levels *less than college* (u), and *college or more* (s). We use the March Supplement of the CPS from 1980 to 2019 to calculate age-efficiency profiles for each male type. For the benchmark economy,

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[13] The SIPP only provides the information of whether a household receives Housing Assistance, but does not contain information on actual payments. We use the methodology of Scholz, Moffitt and Cowan (2009) to impute Housing Assistance reception. For all other transfer programs, the SIPP provides information on the actual amount received.

we construct age profiles for different outcomes from cross-sectional data by removing year effects, as detailed in Section 2 of the paper. Within a skill group, efficiency levels correspond to mean weekly wage rates, which we construct using annual wage and salary income and weeks worked, normalized by the mean weekly wages for all males and females between ages 25 and 64. Figure A7 (left panel) shows the third-degree polynomials that we fit to the wage data. In the quantitative exercises, the male efficiency units, $\varpi_m(z, j)$, correspond to these fitted values.

There are also 2 education types for females. Table A9 reports the initial (age 25) efficiency levels for females together with the initial male efficiency levels and the corresponding gender wage gap. We use the initial efficiency levels for females to calibrate their initial human capital levels, $h_1 = \varpi_f(x, 1)$. After age 25, the human capital level of females evolves endogenously according to

$$h' = \mathcal{H}(x, h, l, e) = \exp\left[\ln h + \alpha_x^e \chi(l) - \delta_x(1 - \chi(l))\right], \quad x \in X = \{u, s\},$$

where e stands for labor market experience and $\chi(.)$ is an indicator function that is 1 if hours worked are positive and zero otherwise. Parameter α_x^e is experience-skill growth rate and δ_x stands for the depreciation rate.

We calibrate the values for δ_x and α_x^e as follows. First, we select α_x^e so that if a female of a particular education type works in every period, her wage profile has exactly the same shape as a male of the same type. This procedure takes the initial gender differences as given, and assumes that the wage growth rate for a female who works full time will be the same as for a male worker with the same level of experience; hence, it sets α_x^e values equal to the growth rates of male wages at each age. Figure A7 (right panel) shows the calibrated values for α_x^e. We then select two values of δ_x so that we match the level of gender gap for skilled and unskilled women by age 25-35 as closely as possible.[14]

Table A9: Initial Productivity Levels, by Type and Gender

	$\varpi_m(1, z)$	$\varpi_f(1, x)$	$\varpi_f(1, x)/\varpi_m(1, z)$
Skilled	0.88	0.81	0.92
Unskilled	0.69	0.56	0.80

Note: Entries are the productivity levels of males and females, ages 25, using 1980-2019 data from the CPS March Supplement. These levels are constructed as weekly wages for each type.

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[14] We target the gender gap in hourly wages *all* married females in the model. We impute wages for females who do not participate using a standard Heckman (1979) selection correction. For the population equation for wages, we assume a standard Mincer equation, i.e. log wages of women depend on years of education, age, and age squared. For the selection equation, we assume that the probability of participation in the labour market for a female depends on her marital status, number of children younger than age 5, and the variables in the population equation.

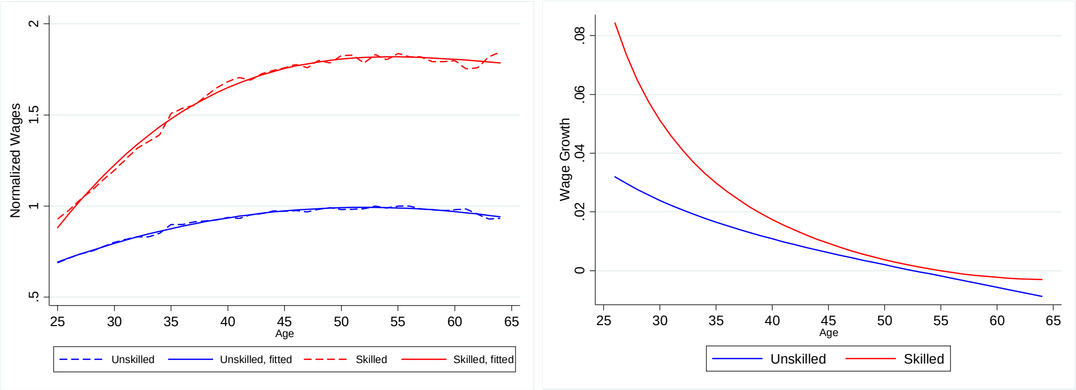

Figure A7 - Age-Labor Productivity Profiles, Males (left); Female Human Capital Growth (right)

4.6 Preferences and Technology

In this section of the Appendix, we provide further details on how we assign parameter values to the endowment, preference, and technology parameters of the benchmark economy.

There are three utility-function parameters to be determined: the intertemporal elasticity of labor supply (γ), the parameter governing the disutility of market work for males and females, B_m and B_f, and the disutility shock of market work for married females, θ. We set the Frisch elasticity parameter γ to 0.2. This is on the low side of recent available estimates, but via other choices in our economy, the macro elasticity is broadly consistent with estimates. Given γ, we select the parameter B_f and B_m to reproduce average market hours per worker observed in the data, about 42.7% and 37.0% of available time for males and females in 2008.[15] Finally, the disutility shocks are specified as $\theta_L = \exp(-\Delta)$ and $\theta_H = \exp(+\Delta)$. The parameter Δ is set so as to reproduce the observed variance of log-hours of married females at age 40 (0.127 in the data). As it is the standard in the literature, we select the discount factor β, so that the steady-state capital to output ratio matches the value in the data (2.93).

Utility costs associated to joint work allow us to capture the residual heterogeneity among couples, beyond heterogeneity in endowments and childbearing status, that is needed to account for the observed heterogeneity in participation choices. We assume that the utility cost parameter of joint participation is distributed according to a gamma distribution, approximated on a discrete grid, with parameters k_z and θ_z. Thus, conditional on the husband's type z,

$$q \sim \zeta(q|z) \equiv q^{k_z - 1} \frac{\exp(-q/\theta_z)}{\Gamma(k_z)\theta_z^{k_z}},$$

---

[15] The numbers are for people between ages 25 and 54 and are based on data from the CPS. We find mean yearly hours worked by all males and females by multiplying usual hours worked in a week and number of weeks worked. We assume that each person has an available time of $5,000$ hours per year.

where $\Gamma(.)$ is the Gamma function. This procedure allows us to exploit the information contained in the differences in the labor force participation of married females as their own wage rate changes with skill. In this way, we indirectly control the 'slope' of the distribution of utility costs, which is potentially key in assessing the effects of changing incentives for labor force participation.

Using the Census data, we calculate that the employment-population ratio of married females between ages 25 and 54, for each of the educational categories defined earlier.[16] Table A11 shows the resulting distribution of the labor force participation of married females by the productivities of husbands and wives for married households. The aggregate labor force participation for this group is 71.8%, and it increases from 68.2% for the unskilled group to 77.4% for the skilled. Our strategy is then to select the two parameters governing the gamma distribution, for every husband type, so as to reproduce each of the rows in Table A10 as closely as possible. This process requires estimating four parameters (i.e. a pair (θ, k) for each husband educational category). Given the estimated values for k_z and θ_z, we determine the loading factors $\vartheta_x(t_{min})$ so that the model is consistent with the participation rate of mothers by the age of their youngest child present at home, shown in Figure A4 (left panel). To compute the participation rate of married females by skill by the age of their youngest child at home, we use data from the 2008 ACS.

Table A10: Labor Force Participation of Married Females, 25-54

	Females	
Males	Unskilled	Skilled
Unskilled	69.1	85.2
Skilled	64.8	73.3

Note: Each entry shows the labor force participation of married females ages 25 to 54, calculated from the 2008 ACS. The outer row shows the weighted average for a fixed male or female type.

Finally, we set the capital share to $\alpha = 0.343$ and the depreciation rate of capital to $\delta^k = 0.055$.[17] To select the parameter governing the elasticity of substitution, ρ, we use standard estimates of this elasticity that suggest a value of 1.5 – see Katz and Murphy (1992) and Heckman, Lochner and Taber (1998). This dictates $\rho = 1/3$. To calibrate the share parameter ξ, we force the model to reproduce the aggregate *skill premium* in the data, defined as per-worker earnings of workers in the skilled category to per-worker earnings of workers in the unskilled category. For this statistic, we target a value of 1.8.[18] Tables A11 and A12 shows full set of parameters.

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[16] We consider all individuals who are *not* in armed forces.

[17] We calibrate the capital share and the depreciation rate using a notion of capital that includes fixed private capital, land, inventories and consumer durables. For the period 1960-2000, the resulting capital to output ratio averages 2.93 at the annual level. We estimate the capital share and the capital to output ratio following the standard methodology; see Cooley and Prescott (1995). The data for capital and land are from Bureau of Economic Analysis (Fixed Asset Account Tables) and Bureau of Labor Statistics (Multifactor Productivity Program Data).

[18] The empirical target for the skill premium is from our calculations using data from the 2005 American Community Survey (ACS). We restrict the sample to the civilian adult population of both sexes, between

Table A11: Parameter Values - Idiosyncratic Shocks
Benchmark Calibration

Statistic	Permanent Shocks	Persistent Shocks
Variance Single Skilled Males	0.2980	0.0063
Variance Single Unskilled Males	0.2570	0.0036
Variance Single Skilled Females	0.2510	0.0019
Variance Single Unskilled Females	0.2440	0.0018
Variance Married Skilled Males	0.2520	0.0068
Variance Married Unskilled Males	0.2270	0.0038
Variance Married Skilled Females	0.2240	0.0040
Variance Married Unskilled Females	0.2500	0.0008
Covariance (male, female)	0.0580	0.0010

Note: Entries are the variances of permanent and persistent innovations, by marital status, gender and skill. For married individuals, we covariances reported are independent of skill as assumed.

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ages 25 and 54 who work full time, and exclude those who are unpaid workers or make less than half of the minimum wage. Full time workers are defined as those who work at least 35 hours per week and 40 weeks per year. We estimate a value tightly centered around 1.8, when we include self-employed individuals or not.

Table A12: Parameter Values
Benchmark Calibration

Parameter	Value	Comments
Population Growth (n)	0.011	U.S. Data
Discount Factor (β)	0.9829	Calibrated - matches K/Y
Labor Supply Elasticity (γ)	0.2	Literature estimates.
Disutility from work, (B_f, B_m)	82.15, 28.67	Calibrated
Preference Shock $\triangle$	1.9	See text – Matches variance log hours at age 40
Skill depreciation, females (δ_x)	0.025, 0.059	Calibrated
Growth of skills (α_x^e)	-	See text - CPS data
Distribution of utility costs $\zeta(.\|z)$ (Gamma Distribution)	-	See text - matches LFP by education conditional on husband's type
Loading Factor $\vartheta_x(t_{\min})$	-	See text – matches LFP by age of youngest child
Capital Share (α)	0.343	Calibrated
Skilled Labor Share (ν)	0.5085	Calibrated
Substitution Elasticity (ρ)	1/3	Literature estimates
Depreciation Rate (δ_k)	0.055	Calibrated
Childcare costs for single females, $d^S(x,t)$	-	See text - matches expenditure by age, and skills.
Childcare costs for married females $d^M(x,t)$	-	See text - matches expenditure by age, and skills.
Tax functions $T^M(I,k)$ and $T^S(I,k)$	-	See Appendix - IRS Data
Transfer functions $TR^M(I,k)$,	-	See text and Appendix
$TR^S_f(I,k)$ and $TR^S_m(I,k)$	-	
Payroll Tax Rate (τ_p)	0.086	See Appendix
Social Security Incomes,	-	See Appendix - U.S. Census
$p^S_m(z)$, $p^S_f(x)$ and $p^M(x,z)$	-	
Capital Income Tax Rate (τ_k)	0.097	See Appendix - matches corporate tax collections

Note: Entries show parameter values together with a brief explanation on how they are selected. Values for the population growth rate, the discount factor and depreciation rates are at the annual level. See text and Appendix for details.

5 Benchmark Economy - Additional Outcomes

In this section of the Appendix we present two additional outcomes that are mentioned in the paper. Figure A8 shows the variance of log household consumption in the data and the model. The model does an excellent job matching the level of inequality in household consumption at the start of the life cycle and the size of increase along the life cycle.

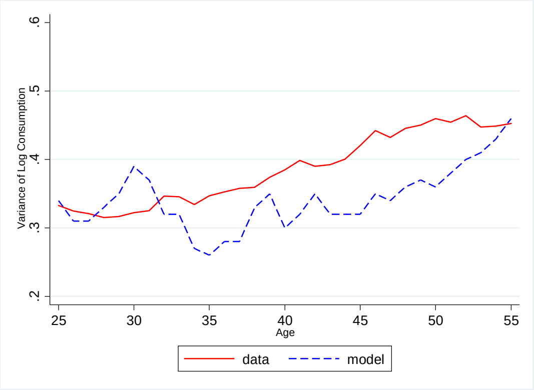

Figure A8 - Variance of Log Household Consumption

Figure A9 shows what happens to the variance of log wages and the labor force participation of married females in the benchmark economy when we set all childcare costs to zero, while keeping all other parameters constant. The children matter critically in determining the levels of participation rates, and how inequality in wages and earnings evolve over the life-cycle for married females. When childcare costs are set to zero, the participation rate of unskilled married females is much higher/ Furthermore, without children, the variance of log wages grows linearly along the life cycle for women, exactly as it does for men.

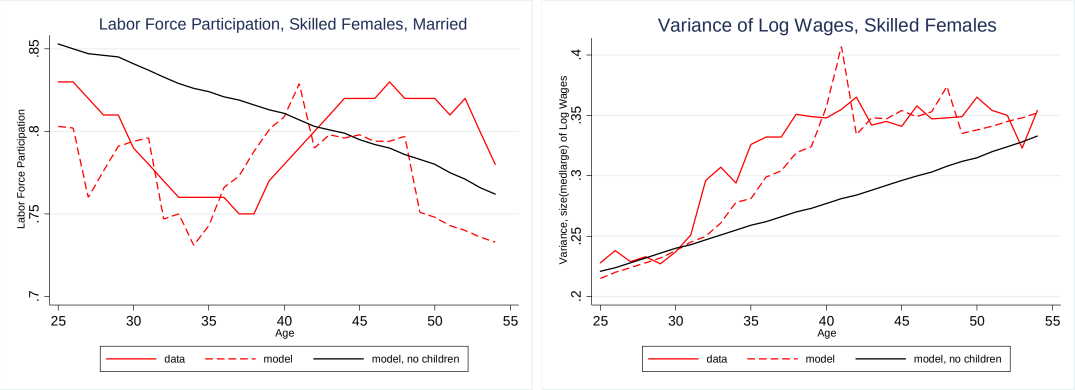

Figure A9 - LFP (left); Var. of Log Wages (right), Married Skilled Females

6 Optimal NIT

It is illustrative to visualize the main findings in terms of aggregate output, ex-ante welfare for all and majority support as the NIT transfer increases. Figure A10 displays these findings. When the transfer equals zero, the tax system is simply a proportional tax with no transfers whatsoever, and output is about 3.2% higher than in the benchmark case. As transfers increase, tax rates, welfare and popular support increase as well, but changes in output relative to the benchmark case become gradually lower and eventually become negative.

Figure 10 shows that as the lump-sum transfer increases, both welfare and support for the reform first sharply increase and then decline. For a transfer level of about 6% of mean income, ex-ante welfare gains are negative and majority support disappears. At this level, the tax rate required is not trivially higher than at the welfare-maximizing level (about 23.8%). Output is about 1.8% lower than in the benchmark case.

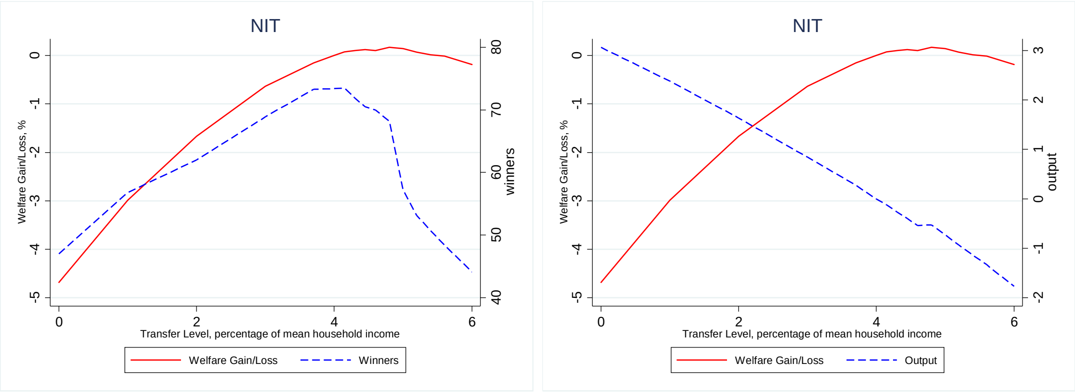

Figure A10 - Welfare Gains and Winners, NIT(left); Welfare Gains and Output, NIT (right)

7 Benchmark Economy with CE Profiles

Figure A11 shows that a recalibrated version of the benchmark economy has no trouble matching the age-inequality profiles produced using a cohorts-effects specification. Table A13 shows the other model outcomes. The parameter values we use for this alternative benchmark are presented in Tables A17-19.

Figure A11 - Variance of Log Wages, Model vs. Data, Males (left), Females (right), data with CE

Table A13: Model and Data (YE and CE Calibration)

Aggregates	Data	BM (YE)	Data	CE
Capital Output Ratio	2.9	2.9	-	2.9
Total Transfers (% of GDP)	2.3	2.3	-	2.4
Skill Premium	1.8	1.8	-	1.8
LFP of Married Females (%), 25-54				
Unskilled	68.2	68.7	-	68.5
Skilled	77.4	77.7	-	78.8
Total	71.8	72.3	-	72.6
Life-Cycle Inequality				
Variance log-wages (Married Males, age 54, S)	0.45	0.45	0.54	0.54
Variance log-wages (Married Males, age 54, U)	0.34	0.34	0.37	0.37
Variance log-wages (Married Females, age 54, S)	0.35	0.35	0.44	0.45
Variance log-wages (Married Females, age 54, U)	0.26	0.26	0.31	0.30
Variance log-hours (Married Females, age 40)	0.13	0.13	0.11	0.11
Correlation Between Wages of Spouses (age 25)	0.31	0.31	0.30	0.31
Correlation Between Wages of Spouses (age 40)	0.34	0.33	0.34	0.33
Variance log-consumption (Age 55 vs 25)	0.12	0.12	0.15	0.16
Earnings Inequality (25-64)				
90-10 ratio	7.8	7.1	-	7.4
90-50 ratio	2.6	2.5	-	2.6
Share, bottom 10%	1.8	2.1	-	1.95
Share, bottom 20%	4.5	5.5	-	5.2
Share, bottom 40%	13.2	15.8	-	15.2

Note: Entries show model outcomes for benchmark economy and the case where moments created using cohorts effects, as discussed in Section 7 in the paper

8 Rethinking the Welfare State When Inequality is Lower

In this section of the Appendix, we present calibration details for "the 1980" economy in the paper. Recall that for the benchmark economy, we use life-cycle profiles generated using the CPS for the 1980-2019 period, complemented by cross-sectional facts from the 2008 American Community Survey. For the 1980 economy, we estimate the life-cycle profiles using CPS data for the 1980-1994 period and use cross-sectional facts from the 1980 and 1990 US Census.

The 1980 economy differs from the benchmark along three dimensions. First, only about 19% of females had a college degree in 1980, and this number more than doubled to nearly 39% in 2008. For males, the fraction with a college degree increased from 29% to 35%. Substantial changes in marital sorting accompanied these changes; about 14% of married households were of the skilled-skilled category in 1980, while the corresponding figure in our parameterization is nearly 27%. These facts for the 1980 economy are reported in Tables A16 and A17 below.

Second, there has been a significant increase in inequality. The skill premium was about 1.5 in 1980 and increased to 1.8 in our benchmark parameterization. The left panel in Figure A12 shows the age-productivity profiles for males for the 1980 and the benchmark economy. In both figures, hourly wages are normalized by mean hourly wages in the data for each year, and relative wages of skilled are much higher in the benchmark. In Figure A13, we report the variance of log wages by age, skill level, and marital status for the benchmark (dash lines) and the 1980 (solid lines) specifications. The 1980 profiles have a lower intercept (lower inequality at age 25) and, particularly for women, imply a lower increase in inequality along the life cycle.

Finally, the labor force participation of married females was lower in 1980. Table A16 shows the labor force participation of married females by their and their husbands' productivity. Compared to the numbers in Table A11, the labor force participation of married females is about 4 (9) percentage points lower for couples composed of two skilled (unskilled) partners. Figure A14 show the labor force participation of married females by their (left panel) and their children's (right panel) age, calculated using data for the 1980-1994 and the 1980-2019 periods.

We capture the effect of these changes on our results in two steps. First, we focus on the role of inequality. To this end, we calibrate an alternative benchmark economy, where as model inputs we use the 1980 demographics (Tables A14 and A15) and age-productivity profiles for males (Figure A13, left panel) and the associated wage growth rates, α_j^x (Figure A13, right panel) for females. We also target the life-cycle inequality profiles estimated using the 1980-1994 CPS data (Figure A15) and a skill premium of 1.5. We call this alternative the 1980 (I) case in the paper. Then, we also target the married female labor force participation (Table A16 and Figure A15-left panel) and call it the 1980 (II) case.

In both exercises, all other model inputs and targets remain the same as in our benchmark economy. Hence, these exercises should be interpreted as our benchmark economy with lower levels of inequality and married female labor force participation rather than representations of the 1980 US economy. The parameter values are reported in Tables A18-20.

Table A14: Distribution of Married Working Households by Type
1980

	Females	
Males	Unskilled	Skilled
Unskilled	67.07	4.52
Skilled	14.43	13.98

Note: Entries show the fraction of marriages out of the total married pool, by wife and husband educational categories. The data used is from the 1980 Census, ages 30-39. Entries add up to 100.

Table A15: Fraction of Agents by Type, Gender and Marital Status
1980

	Males			Females		
	All	Married	Singles	All	Married	Singles
Unskilled	70.65	61.75	8.91	80.85	68.40	12.45
Skilled	29.35	24.50	4.85	19.15	15.44	3.71

Note: Entries show the fraction of individuals in each educational category, by marital status, constructed under the assumption of a stationary population structure from the 1980 Census.

Table A16: Labor Force Participation of Married Females, 25-54
1980

	Females	
Males	Unskilled	Skilled
Unskilled	60.05	78.95
Skilled	58.20	69.65

Note: Each entry shows the labor force participation of married females ages 25 to 54, calculated from the 1980 and 1990 Census (the average values are reported).

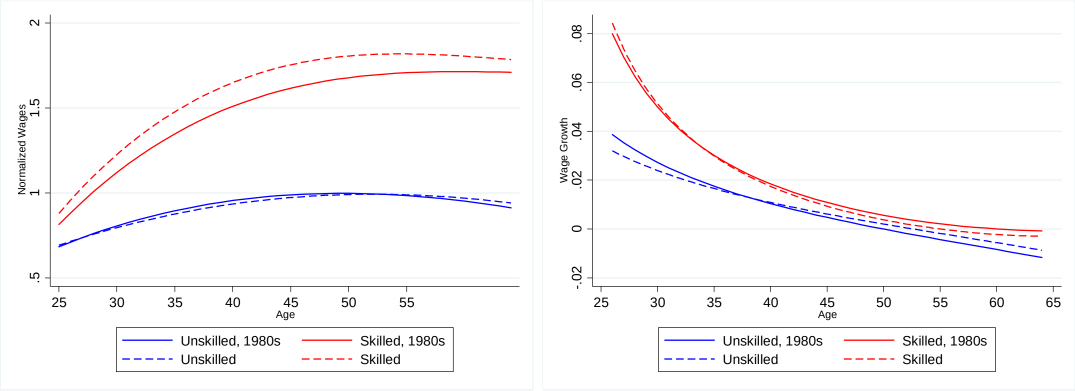

Figure A12 - Age-Labor Productivity Profiles, Males (left), Female Wage Growth, α_j^x (right), benchmark data vs. the 1980s

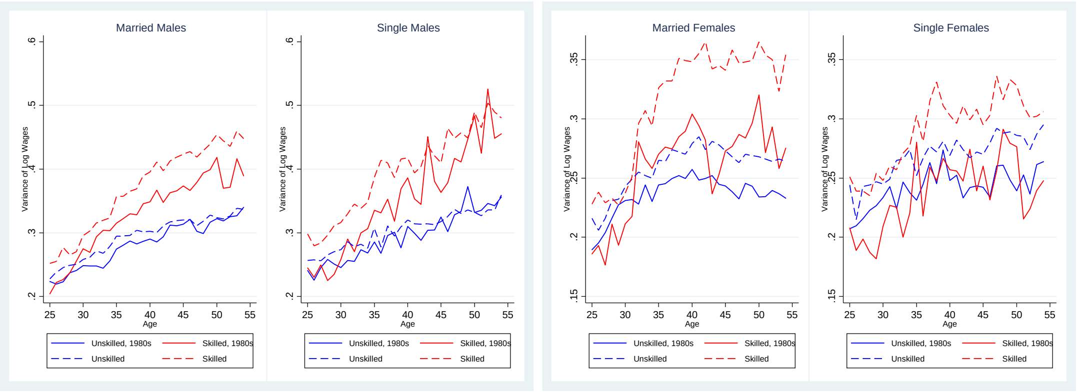

Figure A13 - Variance of Log Wages, Males (left) and Females (right), benchmark data vs. the 1980s

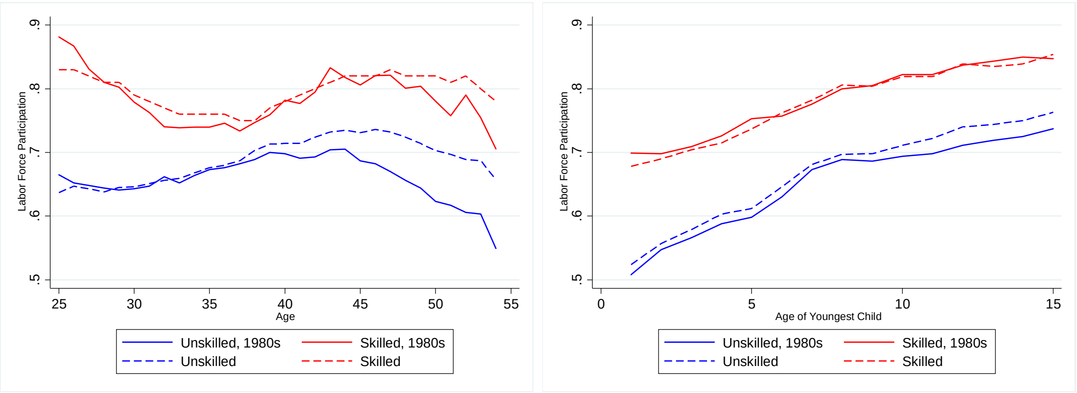

Figure A14 - LFP of Married Females (left panel), LFP by the age of youngest child (right panel), benchmark data vs. the 1980s

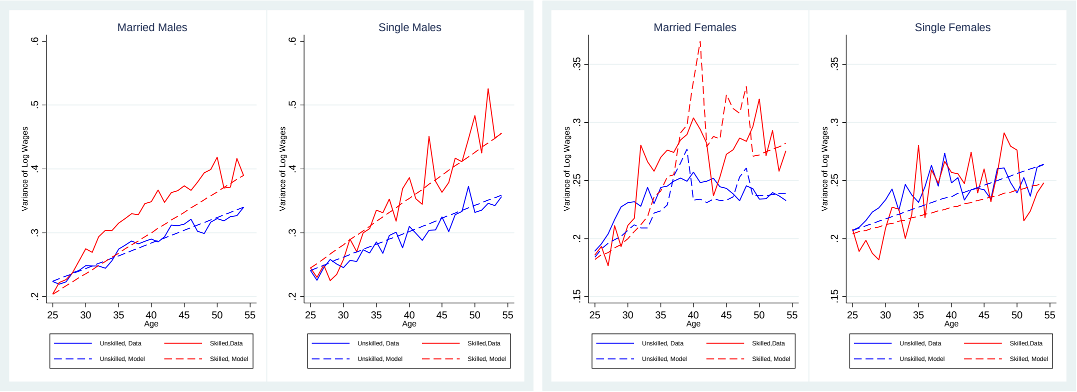

Figure A15 - Variance of Log Wages, Model vs. Data, Males (left), Females (right), the 1980 (I)

9 Other Parameterizations

In this section of the Appendix, we present the parameter values that are used for different economies discussed in Section 7 of the paper (Tables A17-A19). Table A20 shows the model outcomes.

Table A17: Parameter Values - Permanent Shocks
Different Cases

Statistic	BM	Cohort Effect	1980 I	1980 II	$\sigma = 1.5$ (scale econ.)
Variances					
Single Skilled Males	0.298	0.298	0.245	0.245	0.298
Single Unskilled Males	0.257	0.259	0.241	0.241	0.257
Single Skilled Females	0.251	0.24	0.204	0.204	0.251
Single Unskilled Females	0.244	0.242	0.207	0.207	0.244
Married Skilled Males	0.252	0.243	0.204	0.204	0.252
Married Unskilled Males	0.227	0.227	0.224	0.224	0.227
Married Skilled Females	0.224	0.224	0.192	0.192	0.224
Married Unskilled Females	0.250	0.228	0.220	0.220	0.250
Covariance (male, female)	0.058	0.059	0.043	0.039	0.053

Table A18: Parameter Values - Persistence Shocks
Different Models

Statistic	BM	Cohort E.	1980 I	1980 II	$\sigma = 1.5$	$\sigma = 1.5$ (scale econ.)
Variances						
Single Skilled Males	0.0063	0.0079	0.00727	0.00727	0.00627	0.00627
Single Unskilled Males	0.0036	0.0042	0.00406	0.00406	0.00356	0.00356
Single Skilled Females	0.0019	0.0060	0.00150	0.00150	0.00190	0.00190
Single Unskilled Females	0.0018	0.0035	0.00195	0.00195	0.00175	0.00175
Married Skilled Males	0.0068	0.0101	0.00642	0.00642	0.00675	0.00675
Married Unskilled Males	0.0038	0.0050	0.00400	0.00400	0.00380	0.00380
Married Skilled Females	0.0040	0.0072	0.00270	0.00270	0.00400	0.00400
Married Unskilled Females	0.0008	0.0028	0.00130	0.00130	0.00080	0.00080
Covariance (male, female)	0.0010	0.0017	0.00172	0.00172	0.001	0.0010

Table A19: Parameter Values
Different Cases

Parameter	Value	Cohort E.	1980 I	1980 II	$\sigma = 1.5$ (scale econ.)
Discount Factor (β)	0.9829	0.9825	0.9830	0.9829	0.9976
Preference Shock $\triangle$	1.88	1.70	1.957	2.055	1.9
Skill depreciation, females					
δ_s	0.025	0.025	0.025	0.025	0.025
δ_u	0.056	0.056	0.056	0.056	0.056
Skilled Labor Share (ν)	0.505	0.505	0.3745	0.3715	0.509

Table A20: Model and Data
Different Cases

Aggregates	Data	BM	$\sigma = 1.5$ (scale econ.)
Capital Output Ratio	2.9	2.9	2.9
Total Transfers (% of GDP)	2.3	2.3	2.3
Skill Premium	1.8	1.8	1.8
LFP of Married Females (%), 25-54			
Unskilled	68.2	68.7	68.1
Skilled	77.4	77.7	78
Total	71.8	72.3	72
Life-Cycle Inequality			
Variance log-wages (Married Males, age 54, S)	0.45	0.45	0.45
Variance log-wages (Married Males, age 54, U)	0.34	0.34	0.34
Variance log-wages (Married Females, age 54, S)	0.35	0.35	0.35
Variance log-wages (Married Females, age 54, U)	0.26	0.26	0.27
Variance log-hours (Married Females, age 40)	0.13	0.13	0.13
Correlation Between Wages of Spouses (age 25)	0.31	0.31	0.29
Correlation Between Wages of Spouses (age 40)	0.34	0.33	0.31
Variance log-consumption (Age 55 vs 25)	0.12	0.12	0.10
Earnings Inequality (25-64)			
90-10 ratio	7.8	7.1	6.5
90-50 ratio	2.6	2.5	2.4
Share, bottom 10%	1.8	2.1	2.3
Share, bottom 20%	4.5	5.5	5.9
Share, bottom 40%	13.2	15.8	16.8

10 Elimination of Transfers

In Tables A21 and A22 we present the aggregate and welfare effects of eliminating different transfers one at a time. The elimination of means-tested transfer programs or traditional 'welfare' programs, has the largest impact. This elimination leads to an increase in output in the long run of 1.1% – nearly two thirds of the increase when all programs are eliminated. Hours worked increase by 1.9% and participation rates of unskilled (all) married women goes up by 4.0% (2.9%). The aggregate findings associated to the elimination of individual programs have a counterpart in terms of welfare effects. The elimination of traditional welfare programs leads to an ex-ante welfare loss of 1.3%, with unskilled single females experiencing the largest loss (-3.%). Nonetheless, there is a concomitant majority support as taxes as reduced for the majority. Interestingly, the elimination of child-related transfers has the second-largest welfare loss but without majority support for its elimination. This occurs as its elimination impacts narrowly households with children.

Table A21: Eliminating Transfers (% changes relative to benchmark)

	Eliminating All Transfers	Eliminating Welfare Programs	Eliminating EITC Program	Eliminating Child-Related Programs
Output	1.7	1.1	0.4	0.1
Aggregate Hours	3.0	1.9	0.9	0.1
Hours per worker (All Females)	3.2	1.6	0.3	0.8
Hours per worker (All Males)	1.9	1.2	0.5	0.5
Participation Married Females:				
Unskilled	6.3	4.0	4.0	-1.9
Skilled	2.0	1.4	1.1	-0.6
Total	4.5	2.9	2.8	-1.4

Entries in the top panel show the effects (percentage changes) across steady states on selected variables driven by the elimination of different transfer programs, and all of them simultaneously (the entire 'welfare state').

Table A22: Eliminating Transfers - Welfare Effects (Newborns, %)

	Eliminating All Transfers	Eliminating Welfare Programs	Eliminating EITC Program	Eliminating Child-Related Programs
Single F				
Unskilled	-5.2	-3.0	-0.9	-0.6
Skilled	-1.2	-1.0	-0.1	-0.1
Married				
Unskilled, Unskilled	-0.1	0.8	-0.0	-0.7
Unskilled (f), Skilled (m)	0.4	0.3	0.1	-0.0
Skilled, Skilled	1.7	1.3	0.3	0.1
Skilled (f), Unskilled (m)	0.6	0.5	0.2	-0.1
All Newborns	-3.2	-1.3	-0.3	-0.8
Winning Households	60.7	66.5	81.0	47.5

Entries show the welfare effects (consumption compensation) driven by the elimination of different transfer programs, and all of them simultaneously (the entire 'welfare state'). The calculations report welfare gains across steady states under the assumption that the rental rate of capital (and interest rate) is constant across steady states.

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