Rethinking the Welfare State

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June 2021

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. Yet, most households support eliminating current transfers since 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, there are transfer levels and associated tax rates that improve upon the current system. Providing per-person transfers to all households is quite costly, and reducing tax distortions helps to provide for additional resources to expand redistribution.

JEL Classifications: E62, H24, H31
Key Words: Taxes and Transfers, Household Labor Supply, Income Risk, Negative Income Tax,

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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 suitable for policy analysis 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

[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).

unskilled individuals face 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 (i.e. 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 4.6%, respectively and an increase in output of about 1.8%. We find that eliminating the welfare state leads to a sharp aggregate welfare loss measured by a consumption compensating variation, of about 2.8% 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 62.1%). This reflects the targeted nature of the current system, which is very 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*, or UBI for short. 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 2.7% of mean household income (about $2,600 per person or $10,400 for a family of four in 2019 dollars) maximizes the welfare of newborns.[3] Aggregate output is marginally lower in this case; -0.4%. However, even this welfare-maximizing level of transfers leads to an aggregate welfare *loss* of 1.4%. i.e. there is no UBI program that can improve upon the current system. Despite aggregate welfare losses, a move from the current system to a UBI has the majority support among newborns; 58.9% of newborn experience a welfare gain. The UBI is not able to compensate the loss of the current transfers to poor households. But it provides transfers to all households, which generates the majority support. If we introduce a UBI scheme on top of the current welfare state, as most proponents of a UBI advocate, the result is even a sharper welfare loss, with a majority of individuals against such a program. In other words, a UBI scheme is hardly a good idea in welfare terms.

In the second experiment, 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*, or NIT for short. This case then combines a drastic transfer reform with a drastic tax reform.

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

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 the budget balance. We find that a generous transfer of about 4% of mean household income (about $3,900 per person or $15,600 for a family of four in 2019 dollars) maximizes ex-ante welfare (the gain is 0.03%) and leads to strong majority support among newborns (about 73.5%). If a reform allows NIT transfers to differ between single and married households with more generous payments to singles, the welfare gains are larger (0.6%) and the program still has majority support of newborns (53.7%). All these positive effects on welfare and majority support occur alongside a massive increase in the resources devoted to redistribution, from 2.3% of output in the benchmark economy to about 7% of output under NIT variations.

Then, why a NIT scheme can achieve welfare gains and lead to strong majority support? The upshot is that a larger degree of redistribution is feasible given the smaller tax distortions that ensue with a NIT regime. As tax distortions are reduced with a proportional tax, the size of the aggregate economy grows in alongside the needed tax revenue to finance larger transfers. Therefore, a NIT scheme makes higher degrees of redistribution feasible.

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, 2021), Badel, Huggett and Luo (2020), Kindermann and Krueger (2020), and Boar and Midrigan (2021). Within this literature, Attanasio, Low, and Sánchez-Marcos (2005), Kaygusuz (2010, 2015), Guner, Kaygusuz and Ventura (2012, 2020), Ortigueira and Siassi (2013), Borella, De Nardi and Yang (2019), Holter, Krueger, and Stepanchuk (2019), and Krueger and Wu (2021), among others, consider environments with two-earner households.[4] 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, 2003), and gained support in recent public debate. Van Parijs and Vanderborght (2017) and Hoynes and

[4]See also Aiyagari, Greenwood and Guner (2000) and Regalia and Rios-Rull (2001) for early studies that explicitly model the formation and dissolution of two-person households. Greenwood, Guner and Vandenbroucke (2017) provide a recent review.

Rothstein (2019) provide excellent reviews. Within macro-public-finance literature, Lopez-Daneri (2019) finds that a 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. Daruich and Fernandez (2020) study a UBI experiment within an overlapping generations model where the next generation's human capital depends on decisions of parents, 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 describe the different transfer programs and tax credits that constitute our description of the welfare state. In section 3, we document patterns of hours, earnings and consumption over the life cycle of individuals and household in the United States. Section 4 presents the model economy. In section 5 we describe the parameterization and calibration of the benchmark economy. Section 6 discusses the properties of the benchmark economy. In section 7, we present the main findings of our quantitative experiments. Section 8 concludes.

2 Transfers to Households in the United States

Means-tested transfers in the United States encompass a wide range of programs that are administered at the federal or state level. Individuals or households must have incomes or assets below certain thresholds to qualify for these programs. Some of them, such as the refundable portions of the Earned Income Tax Credit (EITC) or the Temporary Assistance for Needy Families (TANF), provide direct cash assistance. Others, such as the Supplemental

Nutrition Assistance Program (SNAP), provide in-kind transfers. Some programs, such as the EITC and the Child Tax Credit (CTC), are part of the federal tax system, while others have separate application processes. We refer to all these transfer and tax-credit schemes as the *welfare state*. We purposefully exclude health-related transfers (e.g. Medicaid) and focus on transfers that accrue to the working-age population.

Means-tested programs play an important role in the economic lives and well-being of low and middle-income families. Using data from the Survey of Income and Program Participation (SIPP) on non-medical means-tested transfers, Guner, Rauh and Ventura (2021) find that more than 50% of households in the bottom 10% of the income distribution receive some kind of transfer at some point in a given year. The numbers for households in the second and third deciles are 37 and 24%, respectively. They also show that these transfers reduce 90-10 and 50-10 income ratios from 12.5 to 9.2 and from 5.3 to 3.9. Along similar lines, Ben-Shalom, Moffitt, and Scholz (2012) calculate that the means-tested programs reduce the number of families below the poverty line from 29% to 13.5%.

In the Online Appendix, we provide a description of the various means-tested programs in the United States, who qualifies, and access to benefits in relation with household's marital status and number of children.[5] We divide these programs into three groups (i) the Earned Income Tax Credit; (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.[6]

[5] More extended discussions can be found, among others, in Moffitt (2003b), Guner, Kaygusuz and Guner (2020), and Guner, Rauh, and Ventura (2021).

[6] 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).

3 Earnings, Hours and Consumption: Life-Cycle Facts

In this section, we document how hourly wages, labor earnings, hours worked, labor force participation and household consumption, change along the life-cycle for individuals (males and females) and households (married and single). To this end, we use data from the Current Population Survey (CPS) and the Current Expenditure Survey (CEX). The CPS is a monthly survey that is the primary source of labor force statistics (employment, unemployment, the labor force participation, and hours) for the population of the United States. The Annual Social and Economic Supplement, also known as the March Supplement, provides additional information on income. The CEX provides data on expenditures on non-durables and services, income, and demographic characteristics of consumers in the United States.

To better capture the underlying differences across individuals and households, we divide individuals in two groups; *skilled (s)*, or those with at least four years of college education or more, and *unskilled (u)*, with strictly less than college education. Let $m^i_{j,t}$ be any statistic of interest for an age-j individual (or household) at time t, for $i = s, u$. We construct an age profile from repeated cross sections by regressing $m^i_{j,t}$ on a set of age and year dummies. We estimate

$$m_{j,t} = \beta_j' \mathbf{D}^i_j + \beta_t' \mathbf{D}_t + \varepsilon^i_{j,t},$$

where $\mathbf{D}^i_j$ is a set of age dummies and $\mathbf{D}_t$ is a set of time dummies. The age profiles of interest are given by the estimated β_j values.

We use the March Supplement of the CPS from 1980 to 2006 to document how hourly wages, earnings, 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 expenditure of non-durables and services, which includes food, clothing, gasoline, household operation, transportation, medical care, recreation, tobacco, and education. The analysis is again based on repeated cross-sections from the CEX between 1980 and 2006.

The key findings that emerge from the analysis are listed below.

1. For males, the variance of log-hourly wages increase non-trivially along the life-cycle as it is well known in the literature; see Figure 1 (left panel). This increase is more pronounced for skilled than for unskilled men. The increase is of nearly 30 log points for skilled men between ages 25-60, versus a corresponding increase of about 15 log points for unskilled men. Figure 1 displays these findings. These patterns largely hold for single vs. married men, and are mirrored when inequality in labor earnings rather on hourly wages is considered.

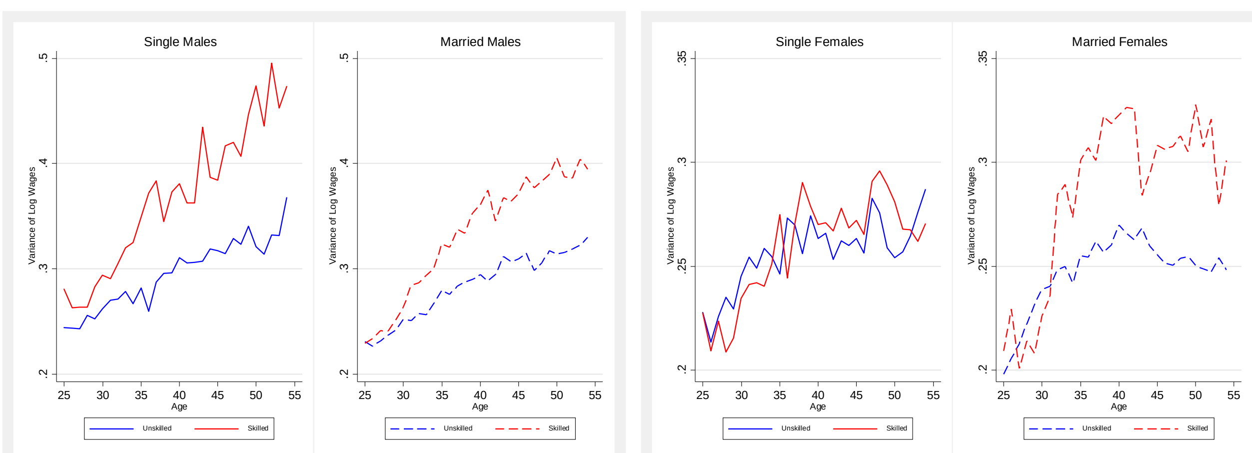

Figure 1 - Variance of Log Wages, Males (left) and Females (right)

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.[7]

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 0.37 (0.49) for all households, but only 0.28 (0.36) for married households.

4. The wage-gender 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 90% at age 25 to about 65% at age 45. For unskilled individuals, the corresponding change is smaller and of about 20 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.

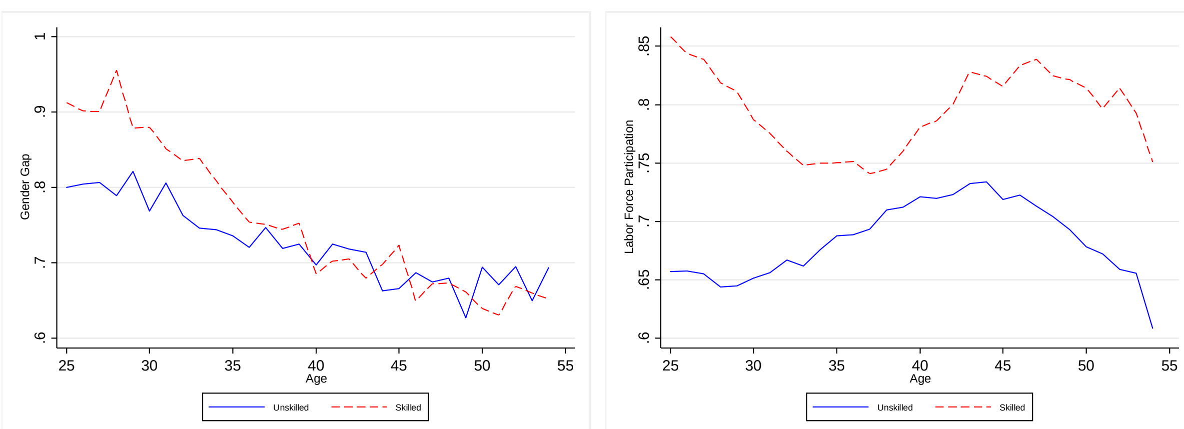

Figure 2 - The Gender Wage Gap (left); LFP of Married Females (right)

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 0.15; see Figure 3 (left panel).

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

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.

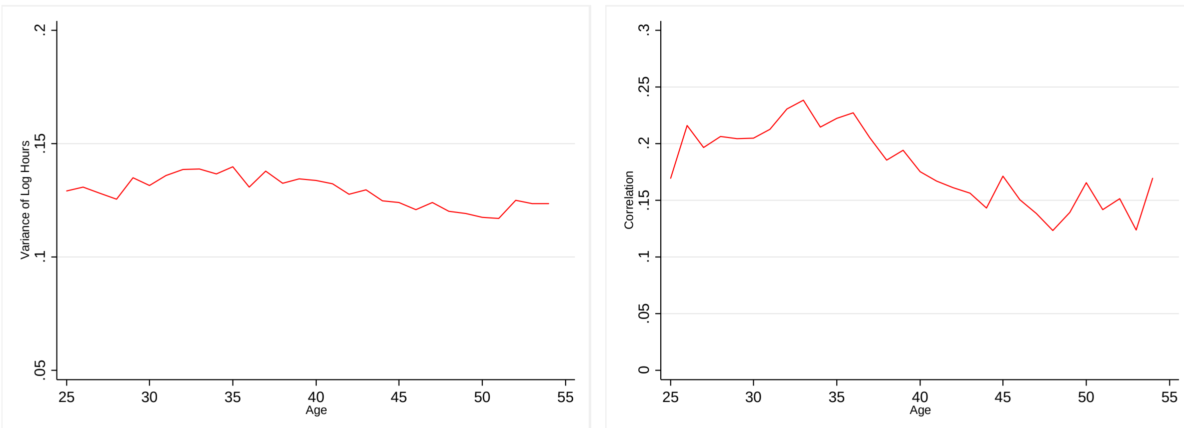

Figure 3 - Var. of Log Hours, Married Females (left); Correlation of Spouse Earnings (right)

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 ages 50-55, at about 5 log points. This is a well-known fact by now, and documented in Aguiar and Hurst (2013) and Primiceri and Van Rens (2009), among others.

4 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 a different number of children. These children 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 is 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 rate R, w_s and w_u, respectively. Using K units of capital and L units of the composite labor input, the firm produces

$$F(K, L_g) = K^{\alpha} L^{1-\alpha},$$

units of consumption (investment) goods, where

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

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 childcare services and in the production of consumption and investment goods, $L_{u,g}$. 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 $x \in X = \{u, s\}$.

Let $M_j(x, z)$ denote the fraction of marriages between an age-j, type-x female and an age-j type-z male, and let $\omega_j(z)$ and $\phi_j(x)$ be the fraction of single type-z males and the fraction of single type-x females, respectively. 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, $\mu_{j+1} = \mu_j/(1 + n)$.

4.1 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

$$\varpi_m(z, j) \exp(\upsilon^S_{m,z} + \eta^S_{m,z,j}), \quad z \in Z,$$

where the function $\varpi_m(.,.)$ summarizes the combined effects of skill and age on the labor endowment. υ is a *permanent* shock and η is a *persistent* shock. We assume that the permanent shock is normally distributed:

$$\upsilon^S_{m,z} \sim N(0, \sigma^2_{\upsilon^S_{m,z}}), \quad z \in Z$$

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

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

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_x^e 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

$$h \times \exp(\nu_{f,x}^S + \eta_{f,x,j}^S), \quad x \in X$$

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 endowment (labor efficiency) of a married male is given by

$$\varpi(z, j) \times \exp(\upsilon_{m,z}^M + \eta_{m,z,j}^M), \quad z \in Z.$$

The labor efficiency of a married female is correspondingly given by

$$h \times \exp(\upsilon_{f,x}^M + \eta_{f,x,j}^M), \quad x \in X.$$

where h follows the same law of motion for singles; equation (5).

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

$$\eta_{m,z,j+1}^M = \eta_{m,z,j}^M + \varepsilon_{m,z,j+1}^M, \quad z \in Z,$$

and

$$\eta^M_{f,x,j+1} = \eta^M_{f,x,j} + \varepsilon^M_{f,x,j+1}, \quad x \in X,$$

with

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

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

$$(\upsilon^M_{m,z}, \upsilon^M_{f,x}) \sim N\left(\begin{array}{c} 0 \\ 0 \end{array}, \begin{array}{cc} \sigma^2_{\upsilon^M_{m,z}} & \sigma_{\upsilon_f \upsilon_m} \\ \sigma_{\upsilon_f \upsilon_m} & \sigma^2_{\upsilon^M_{f,x}} \end{array}\right), \quad z, x \in Z \times X.$$

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 6

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

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

4.2 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.

4.3 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 leave at $\bar{j}(.) + N + 2$), then the period utility of a married household is given by

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

where $\chi\{.\}$ denote the indicator function.[8] Otherwise, the utility of the married household is given by

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

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.

4.4 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 income. For a household with income level I, number of children k, childcare expenses D, the

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

transfers are represented by functions $TR_f^S(I,k,D)$, $TR_m^S(I)$ 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 $p_f^S(x)$, $p_m^S(z)$, 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.

4.5 Decision Problem

We now present the decision problem for different types of agents in the recursive language. We leave the formal definition of a stationary equilibrium to the Appendix. 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 $(a,h,e,x,\upsilon_{f,x}^S,\eta_{f,x}^S,b,j)$, where a stands for asset holdings. For married couples, the state is given by $(a,h,e,x,z,\theta,\upsilon_{m,z}^M,\upsilon_{f,x}^M,\eta_{m,z}^M,\eta_{f,x}^M,q,b,j)$.

Note that the dependency of transfers and taxes on the presence of children in the household is summarized by age (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 $\mathcal{S}_f^S \equiv (x, \upsilon_{f,x}^S, b)$ be the vector of variables that do not change along the life-cycle for single females and single males, respectively. For married households, let $\mathcal{S}^M \equiv (x, z, \theta, \boldsymbol{\upsilon}, q, b)$ be the vector of such states for married households, with $\boldsymbol{\upsilon} = (\upsilon_{f,x}^M, \upsilon_{m,z}^M)$. In similar fashion, for the case of married couples, we summarize the pair of persistent shocks by $\boldsymbol{\eta} \equiv (\eta_{f,x}^M, \eta_{m,z}^M)$. Likewise, for expositional purposes, we denote by $\mathcal{E}_f^S(x, h, \eta_{f,x}^S, \nu, l_f)$ 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 4.1.

The Problem of a Single Female Household In contrast to a single male, a single female's decisions also depend on her current human capital h, child bearing status b, and labor market experience, e. Given her current state, $(a, h, e, \mathcal{S}_f^S, \eta, j)$ the problem of a single female is

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

subject to

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

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

where $I = \mathcal{E}_f^S(x, h, \eta, \nu, l) + ra$. $\mathcal{K}$ 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:

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

(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

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

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

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

In addition,

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

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

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, talking 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) With kids: 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 $I = \mathcal{E}^M(x, z, h, \boldsymbol{\eta}, \boldsymbol{\nu}, l_m, l_f, j) + ra$.

In this formulation, $\mathbf{E}_{\boldsymbol{\eta}'|\boldsymbol{\eta}}$ now represents the joint expectation over the shocks that husbands and wives face. The number of children present and childcare expenses are now given by

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

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

In addition,

$$h' = \mathcal{H}(x, h, l_f, e) = \exp\left[\ln h + \alpha_e^x \chi(l_f) - \delta^x(1 - \chi(l_f))\right], \qquad (5)$$

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

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.

4.6 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 essential to assess 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.

5 Parameter Values

This section describes how we select parameter values to compute a stationary equilibrium. We relegate multiple details to the Appendix. Tables A1 and A2 in the Online Appendix summarize our parameter choices.

The model period is one year. Agents start their life at age 25, 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 1980-2006 CPS March Supplement, and set $\varpi_m(z, j)$, $z = u, s$, to these profiles (Figure A1 in the 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 (5).

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 A2 in the 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 3.[9]

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 A2 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, $\sigma_{\epsilon^f \epsilon^m}$, 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

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

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.

Government 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:

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

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.

Transfers, $TR^S_f(I,k,D), TR^S_m(I)$, and $TR^M(I,k,D)$, the main object of this paper, 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. All tax credits are modelled exactly as they appear in the tax code, which were summarized in Section 2. 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. Details are provided in the Appendix.

The final component is the means-tested transfers. Following Guner, Rauh and Ventura (2021), we use data from the Survey of Income and Program Participation to estimate an effective transfer schedule that relates transfers received by different household types to their income. The welfare payments include the main means-tested "welfare" programs from Section 2. 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. 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. The details are again in the Appendix.

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.

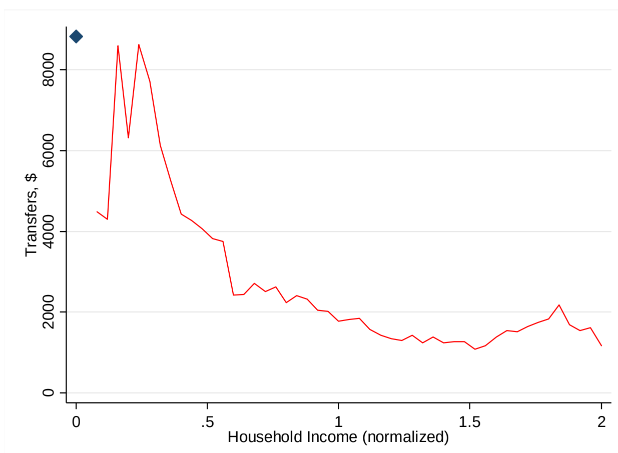

Figure 4 - Total Transfers in the Benchmark Economy

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 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. We provide details in the Online Appendix.

Remaining Parameters We select the remaining parameters to match jointly several targets in stationary equilibrium. This includes parameters on technology, preferences, taxation and social security taxes and benefits. We provide all relevant details in the Online Appendix.

6 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 the earnings premia by skill. 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) growth in household consumption dispersion over the life cycle – which is empirically much lower than the growth in earnings dispersion for males or for households as we noted in section 3. A central 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. In this sense, this finding is similar to the findings in Huggett et al (2011). In that paper, the growth in earnings dispersion for males with age is in line with data and concomitant to a much lower growth in consumption dispersion.

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.[10] Not surprisingly, taxes and

[10] Inequality measures in the data is based on 2010 CPS under the sample restrictions detailed in Section 3.

transfers reduce income inequality significantly in our model; the 90-10 ratio for after-tax and transfer household income is only 5.9, while for household earnings, it is 7.2.

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	68.6
Skilled	77.4	76.6
Total	71.8	71.8
Life-Cycle Inequality		
Variance log-wages (Married Males, age 54, S)	0.40	0.41
Variance log-wages (Married Males, age 54, U)	0.33	0.33
Variance log-wages (Married Females, age 54, S)	0.25	0.25
Variance log-wages (Married Females, age 54, U)	0.30	0.30
Variance log-hours (Married Females, age 40)	0.13	0.13
Correlation Between Wages of Spouses (age 25)	0.27	0.27
Correlation Between Wages of Spouses (age 40)	0.31	0.31
Variance log-consumption (Age 50-54 vs 25-29)	0.08	0.07
Earnings Inequality (25-64)		
90-10 ratio	7.8	7.2
90-50 ratio	2.6	2.5
Share, bottom 10%	1.8	2.1
Share, bottom 20%	4.5	5.6
Share, bottom 40%	13.2	16.0

Note: 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 3.

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 pattern 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 64% on average relative to men in the data, while the model implies a gender gap of 75%.

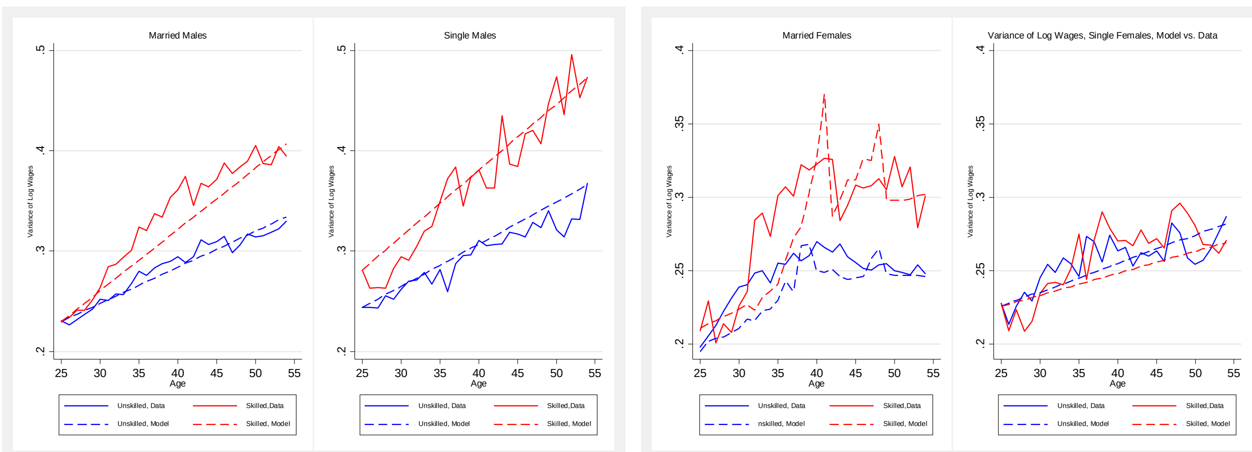

Figure 5 - Variance of Log Wages, Model vs. Data, Males (left), Females (right)

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.

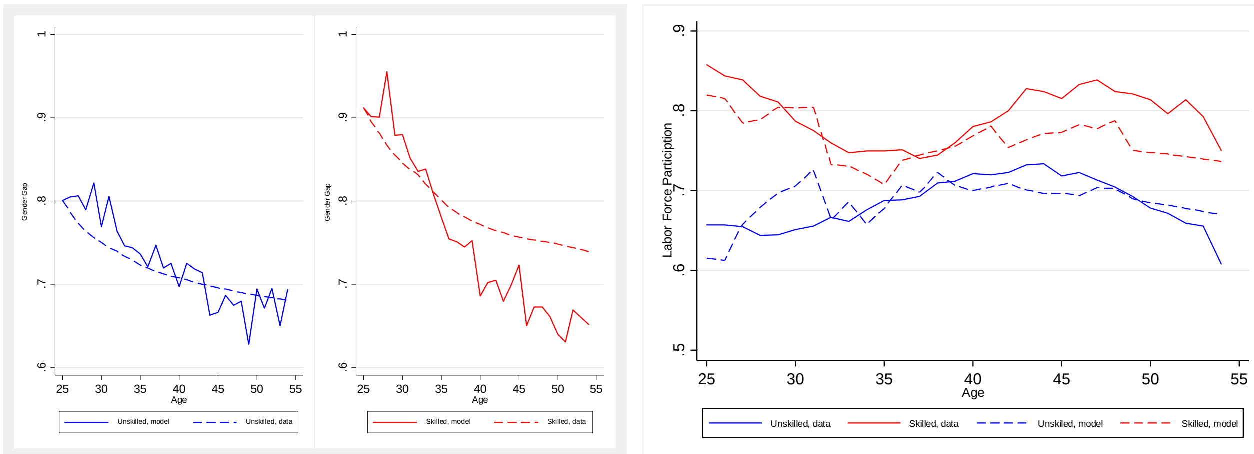

Figure 6 - Gender Wage Gap (left); LFP of Marr. Females (right), Model vs. Data

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 3 that dispersion in earnings 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.

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 80.9%, while for skilled, it is 84.8%. The values in the benchmark model are 68.6% and 76.6%, respectively. The model cannot generate the decline in the labor force participation associated with childcare requirements either. Furthermore, without children, the variance of log wages grows linearly along the life cycle for women, exactly as it does for men. Figures 7 illustrates these for skilled married females.

If depreciation rates are zero, the wage-gender gap at age 45 becomes 75.8% for unskilled individuals and just 84.5% for skilled individuals; the values in the benchmark model are 69.6% and 75.7%. The depreciation has a larger impact for skilled individuals, since the estimated depreciation rates are higher for women for skilled females and they experience higher wage growth conditional participation.[11]

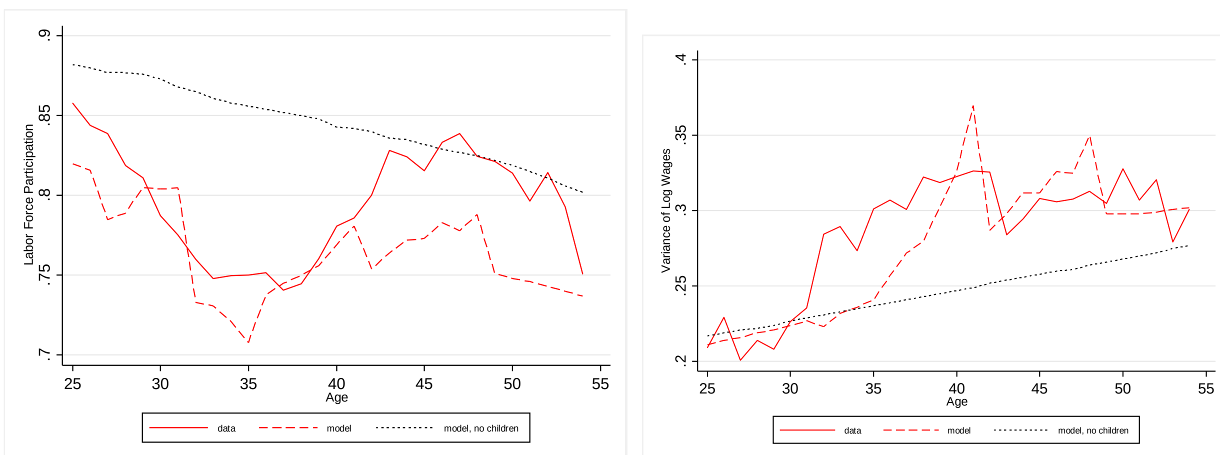

Figure 7 - LFP (left); Var. of Log Wages (right), Married Skilled Females

6.1 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 as described in Section 2. We balance the budget by lowering 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.

[11] Further details are provided in the working paper version – see Guner, Kaygusuz and Ventura (2021).

Table 2 presents the main aggregate 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 2.4% for skilled ones. All this translates in a total increase in labor hours of about 3.0% and an increase in aggregate output of 1.8%. Concomitantly, tax rates drop across the board. Note that the average tax rate at mean income falls substantially, 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, respectively.

Table 2: Eliminating Transfers (% changes relative to benchmark)

	Eliminating All Transfers	Eliminating Welfare Programs	Eliminating EITC Program	Eliminating Child-Related Programs
Output	1.8	1.2	0.5	0.2
Aggregate Hours	3.0	1.9	0.9	0.2
Hours per worker (All Females)	1.8	1.6	0.3	0.8
Hours per worker (All Males)	1.6	0.9	0.2	0.2
Participation of Married Females:				
Unskilled	6.3	4.2	4.0	-1.5
Skilled	2.4	1.7	1.2	-0.4
Total	4.6	3.1	2.8	-1.0

Note: 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').

When all transfers are eliminated, labor supply increases for low and middle-income, typically less skilled, households as they disproportionately benefit from these transfers. These changes in labor supply take place due to income effects, and as part of the incentives to increase labor supply for insurance purposes as transfers are no longer in place. 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). These incentives to increase labor supply are magnified by the reduction in tax rates for all households. Overall, changes in labor supply lead to changes in aggregate capital and result in the positive output changes for the economy in the aggregate that the table illustrates.

Welfare Table 3 shows sharp and negative effects on aggregate welfare, with a compensating variation of about 2.8% for all newborn households. This is expected; 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. Nonetheless, since tax rates fall substantially, a majority of adults benefit from their elimination – about 62.1% of households benefit as Table 3 demonstrates.

Married and skilled individuals tend to be winners from eliminating transfers, whereas single and unskilled individuals tend to lose, as Table 5 illustrates. We find that a newborn, married household comprised of two skilled individuals experiences a 1.8% of consumption gain, whereas their counterpart with two unskilled individuals faces a loss of 0.05% of consumption. Single females bear the brunt of the transfer elimination. A newborn, single unskilled female experiences a loss of 5.1% on average, while an equivalent single skilled female faces a loss of 0.25%.

Eliminating Programs: One at a Time What components of the welfare state have the biggest impact on aggregates? Table 2 provides the answers in detail. As the table shows, 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 1.2% – about 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 4.2% (3.1%).

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 0.9%, with unskilled single females experiencing a large loss of 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 multiple types of households with children.

Summary Overall, these findings highlight and anticipate trade-offs associated with reforming the welfare state. The welfare state target 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. 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 (62.1%) illustrates the trade-offs involved in an economy with substantial heterogeneity like ours.

Table 3: Eliminating Transfers – Welfare Effects (Newborns, %)

	Eliminating All Transfers	Eliminating Welfare Programs	Eliminating EITC Program	Eliminating Child-Related Programs
Single F				
Unskilled	-5.1	-3.0	-0.9	-0.6
Skilled	-1.2	-0.9	-0.1	-0.1
Married				
Unskilled, Unskilled	0.05	1.0	-0.0	-0.7
Unskilled (f), Skilled (m)	0.4	0.4	0.1	-0.0
Skilled, Skilled	1.8	1.4	0.3	0.1
Skilled (f), Unskilled (m)	0.7	0.6	0.2	-0.0
All Newborns	-2.8	-0.9	-0.2	-0.7
Winning Households	62.1	67.8	82.2	48.7

Note: 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.

7 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. All experiments are *revenue neutral* in the ways we specify in each case. We first consider replacing the current transfer scheme with a Universal Basic Income scheme (UBI) and then with a Negative Income Tax (NIT).

7.1 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 4 and 5. We find that a per-person transfer of about 2.7% of mean household income maximizes the welfare of newborns. This corresponds to about \$2,600 per person in 2019 dollars (\$10.400 for a married household with two children at home). To balance the budget, tax rates need to increase non trivially; for a married household with two children at mean income, the average rate increases to 12.8% from 9.2% in the benchmark. This occurs as at the welfare-maximizing level, the aggregate expenditure on transfers substantially increases relative to the benchmark; from 2.3% in the benchmark case to 4.9%. The UBI transfers, coupled with higher taxes, depress hours, participation and output across steady states. Total hours decline by 0.4% and participation rates of unskilled and skilled married females decline by 2.6% and 1.4%, respectively. On the other hand, hours worked per worker among females increase, as Table 4 shows.

Table 5 illustrates the welfare consequences of the UBI policy. Even at the best policy, ex-ante welfare for all newborns declines, with a compensating variation of -1.4%. But a majority of newborns, 58.9%, 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 getting in the benchmark economy. This contributes to an overall welfare loss. Unskilled single females experience a welfare loss at birth of about 2.8%, and skilled ones a loss of about 0.8%. On the other hand, unskilled married households are strong winners as Table 5 demonstrates, with a welfare gain of about 1.8% for a married couple with two unskilled adult members. This reflects that some low-to-middle income households, who did not receive transfers in the benchmark economy, now get the UBI transfer, contributing to generating majority support.

At welfare maximizing level of the NIT, aggregate hours are slightly below the benchmark case and output is marginally above. Participation rates for married females are lower than in the benchmark economy. 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 in the case of the UBI transfer. Therefore, there are no significant changes in steady-state aggregates when comparing the best transfer case with the benchmark economy.

Table 4: Aggregate Findings (% changes relative to benchmark)

	Elimination of Transfers	UBI Maximum Welfare	NIT Maximum Welfare	NIT (2) Maximum Welfare
Output	1.8	-0.4	0.1	-0.3
Aggregate Hours	3.0	-0.4	-0.1	-0.5
Hours per worker (All Females)	1.8	1.1	1.1	-0.8
Hours per worker (All Males)	1.6	-0.5	0.0	-0.2
Participation of Married Females:				
Unskilled	6.3	-2.6	-2.8	-0.4
Skilled	2.4	-1.4	-1.0	-0.3
Total	4.6	-2.1	-2.0	-0.4
Transfer (% Household Income)	-	2.7	4.0	6.0, 3.0
Transfers (% Output)	-	4.9	7.3	7.9

Note: Entries in the top panel show effects (percentage changes) across steady states on selected variables driven by the different quantitative experiments. The values for 'maximum welfare' UBI (Universal Basic Income) and NIT (Negative Income Tax) correspond to the transfers and corresponding taxes that maximize ex-ante welfare for all. In the first NIT experiment, all adults and children receive the same transfer. In the second NIT experiment, transfers are differentiated by marital status.

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, some advocate a UBI transfer of $1,000 per month, which is a much higher transfer than what we find as optimal. Indeed, we found that with higher transfer levels, welfare losses non-trivially increase, and popular support dissipates.

A natural next question is: what if the UBI transfer is given on top of the existing welfare state? We find large welfare losses and no popular support for it. For instance, if the transfer is 1% of the mean household income per person, an ex-ante welfare loss emerges of 0.15% and 56.1% of adults oppose it. Aggregate hours decline by 1.4% and output declines by 0.9%. If instead, we impose the transfer that maximizes welfare under the UBI reform, output losses are not surprisingly more significant (-2.8%); aggregate welfare declines by 1.26% and 60.6% of adults oppose this idea.

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 more clearly *not* a good idea, as ex-ante welfare declines and there is clear majority against the move.

7.2 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 4 shows the effects on aggregates. The transfer at the welfare-maximizing level is about 4% of mean household income, or $3,900 in 2019 dollars ($15,600 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 7.3% of output. The reform leads to a marginal increase in aggregate output, as Table 4 demonstrates.

Table 5 shows that at the welfare-maximizing level, married households enjoy substantial welfare gains while single households as a group experience ex-ante losses. Overall, there are ex-ante welfare gains in the best case scenario, albeit marginal, accompanied by substantial majority support for the reform among newborns – nearly three-fourths of newborns support the reform at birth.

Table 5: Welfare Effects (Newborns, %)

	Elimination of Transfers	UBI Maximum Welfare	NIT Maximum Welfare	NIT (2) Maximum Welfare
Single F				
Unskilled	-5.1	-2.8	-2.5	-0.05
Skilled	-1.2	-0.8	0.8	0.15
Married				
Unskilled, Unskilled	0.05	1.8	2.3	-0.5
Unskilled (f), Skilled (m)	0.4	0.2	0.4	0.03
Skilled, Skilled	1.8	0.3	1.1	0.3
Skilled (f), Unskilled (m)	0.7	0.3	0.5	0.04
All Newborns	-2.8	-1.4	0.03	0.6
Winning Households	62.1	58.9	73.5	53.7
Change in Variance log-consumption (relative to benchmark economy)	0.109	0.070	0.041	-0.043

Note: Entries show the welfare effects (consumption compensation) driven by the reform of the welfare state, for newborn households of different marital status and educational types. 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.

Different Tax-Transfer Levels 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. Figures 8 display these findings. When the transfer equals zero, the tax system is simply a proportional tax, 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 8 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, there are ex-ante welfare gains but no majority support since the tax rate required is much higher than at the welfare-maximizing level (about 23.8%).

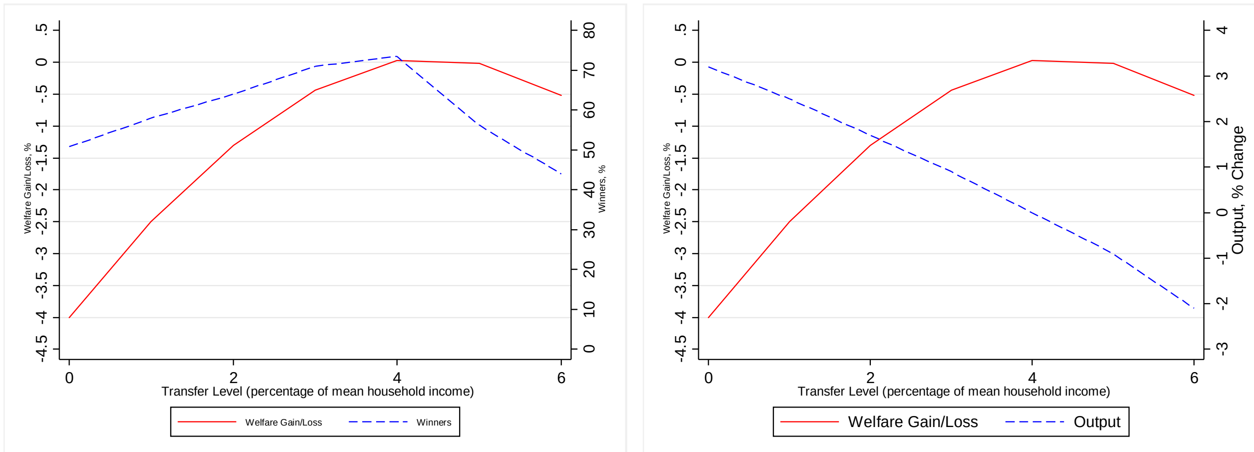

Figure 8 - Welfare Gains and Winners, NIT (left); Welfare Gains and Output, NIT (right)

Comparison with a Proportional Income Tax How different are the findings of NIT regime when compared to the case of a simple proportional tax that leaves the welfare state in place? We find that in this case, aggregate hours and output increase by 1.6% and 1.5%, respectively, requiring a supporting tax rate of 10.7%. Note that the increase in output is this case is less than half of the increase shown in Figure 8 (right panel) for the case of no transfers (3.2%). This highlights the depressing effects of the current welfare state on aggregates, and the need of a higher rate to finance the associated transfers.

In terms of welfare, we find in this case an ex-ante welfare gain for newborns of about 0.26% of consumption. Not surprisingly, there are sharp differences between winners and losers. We find that skilled married couples have a welfare gain of 1.2%, whereas unskilled single females experience a loss of about 0.4%. Overall, a simple proportional tax is not too popular. We find a strong majority of newborn households *against* this case; about 62.3%.

Differentiated Transfers Since welfare gains from a NIT reform are unevenly distributed between married and single households and small in the aggregate, we consider a NIT regime with transfers differentiated by the marital status of adults but with a common tax rate. 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.

We find a significant ex-ante welfare gain of about 0.6%, with 53.7% of adults supporting the reform. The transfer per person in single households is about 6% of the mean household income, while about 3% in married households (about $6,000 and $3,000 in 2019 dollars). The tax rate that supports this arrangement is 16.7%. Output and aggregate hours decline by 0.3% and 0.5% 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 9.65% of mean household income (about $9,465 in 2019 dollars). The net transfer for a married couple with the same income and two children would be about 3.65% of mean household income (about $3,580 in 2019 dollars).

Summary 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 a NIT regime; i.e. elimination of increasing marginal tax rates and lower taxes on secondary earners. As tax distortions are reduced with a proportional tax, the size of the aggregate economy grows 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 a NIT relative to a UBI scheme. Put differently, a drastic tax reform that reduces marginal tax rates makes more extensive redistribution possible. This also allows households to better cope with idiosyncratic labor market risk. Table 5 shows the overall variance of log-consumption for different economies compared to the benchmark. The variance of log consumption is about 10.9 log points higher than its benchmark value when the entire welfare system is eliminated. The variance of log consumption also increases non-trivially when the UBI replaces the welfare system. However, the increase is smaller with the NIT. In contrast, with a NIT in which transfers are differentiated by marital status and singles get relatively larger transfers, the variance of log consumption declines by 4.3 log points.

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, reforms that maximize ex-ante welfare relative to the status quo are difficult to find.

Second, a UBI scheme is generically not a good idea and is dominated by a 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 lower output, and ex-ante welfare losses. And if a UBI scheme is imposed on top of the current welfare state, ex-ante welfare losses can be substantial for moderate values of the associated transfer. It follows that in our economy, a UBI scheme, as portrayed in popular discussions, is not a good idea.

Lastly, an NIT arrangement can generate ex-ante welfare gains and lead to popular support due to the associated reduction in distortions and the concomitant increase in output and revenues. These arrangements require much larger levels of transfers to the working-age population than in the status quo. As a fraction of output, we find that transfers to working-age households need to be *more than triple* relative to the benchmark case to maximize ex-ante welfare.

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 accumulation, this implementation could lead to larger gains in output, labor supply and welfare than we found in our analysis. Finally, we have abstracted from transitions between steady states due to the large state space in our model. This abstraction is unlikely to affect our main findings for two reasons. First, all working-age households would potentially benefit from the transfers in a NIT or UBI scheme, as they do under the current welfare state, rendering differential effects for working-age households alive at the start of a hypothetical transition of second order. Second, we conjecture that changes in rates of return along a transition would be small in the extreme case of a closed economy. This is due to the fact that the optimal NIT or UBI do not fundamentally alter the incentives to accumulate capital, and keep the overall size of the labor input composite constant. We leave this and other issues for further research.

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