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How do transfers and universal basic income impact the labor market and inequality?

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Abstract

This paper studies the impact of existing and universal transfer programs on vacancy creation, wages, and welfare using a search-and-matching model with heterogeneous agents and on-the-job human capital accumulation. We calibrate the general equilibrium model to match key moments concerning unemployment, wage and wealth distributions, as well as the distribution of EITC and transfers. In addition, unemployment insurance benefits are related to pre-unemployment earnings and subject to exhaustion, after which agents can only rely on transfers and savings. First, we show that existing transfers hamper economic activity but provide sizeable welfare gains. Next, we show that a universal basic income of nearly $12,500 to each household per year, which replaces all existing transfer programs and unemployment benefits, can lead to small aggregate welfare gains. These welfare gains mostly accrue to less skilled individuals despite their sizable fall in wages, and the overall rise in skill premia and wage inequality. Albeit the extra burden of higher taxes to finance UBI, we show that the increased action in hiring is a key channel though which outcomes for low education groups improve with the reform. However, if we keep the UI benefits in place, the positive effects on job creation vanish and UBI does not improve upon the current system.

Keywords: Transfer programs; EITC; Means-tested transfers; Welfare programs; Labor supply; On-the-job human capital accumulation; Life cycle; Inequality; Universal basic income; UBI; Unemployment; General equilibrium.

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1 Introduction

In 2017 the United States spent nearly 2 trillion USD on means-tested transfer programs (Salazar et al. 2017).[1] Excluding health-related transfers, Guner et al. (2021) estimates that the total expenditures in transfers to the working-age population at all levels amounted to nearly 2.3% of GDP. As expected, most of these transfers go to poor households. Guner et al. (2022) find that more than 50% of households in some point in a given year. Individuals without any income on average receive transfers worth more than $15,000 a year. Moreover, households with positive income receive considerable transfers, as even a household with mean income receives nearly $1,000 a year. Given these magnitudes, transfer programs are likely to have first-order effects on labor supply, inequality, and savings.

Conditional transfer programs seek to restrict payments to those in need. Since it is hard to observe individuals' earnings capacity, targeting is usually based on income. This feature imposes an implicit tax on earned income, and thus a key concern about conditional transfers is the potential disincentive to (search for) work, especially at the bottom of the earnings distribution.[2] In light of the convoluted transfer programs and inefficiencies accompanying eligibility checks, the concept of universal basic income has gained traction amongst certain politicians and interest groups.[3] The underlying idea is that each person receives the same pre-specified amount irrespective of a household's or aggregate economic circumstances.

While the effect of transfers on labor supply has been studied extensively, much less is known regarding the labor-market equilibrium impact of these policies, particularly their effects on vacancy creation, wages, and welfare. To fill this gap, we study the effects of means-tested and universal transfer programs on equilibrium labor market allocations and workers' welfare, using a model that combines three key ingredients.

First, we consider a search-and-matching model along the lines of a Diamond-Mortensen-Pissarides' (D-M-P) model featuring endogenous search intensity.[4] By doing so, we can study how transfers influence vacancy creation and wage bargaining between firms and workers. In this environment, employment opportunities are endogenous. They depend on how hard individuals search for a job and the aggregate labor market conditions that determine how easy it is to locate jobs per unit of search effort.

Second, we depart from the standard D-M-P setting with risk neutrality by combining

[1]The US has seven major means-tested transfer programs: Temporary Assistance for Needy Families (TANF - formerly AFDC), Supplemental Nutrition Assistance Program (SNAP - formerly foodstamps), Supplemental Nutrition Program for Women, Infants, and Children (WIC), Supplemental Security Income (SSI), Medicaid, housing assistance and the Earned Income Tax Credit (EITC).

[2]See Marinescu (2018) for an overview.

[3]For instance, Andrew Yang, a candidate in the 2020 Democratic Party presidential primaries, advocates for the "freedom dividend" of $1,000 per month for all American adults. In our analysis, we do not factor in the potential savings that could be made by replacing the administrative apparatus.

[4]Diamond (1982), Mortensen (1982) and Pissarides (1985)

the search-and-matching framework with incomplete markets as in Krusell et al. (2010) and introduce endogenous job separations as in Bils et al. (2011). Our motivation for doing this is to study the welfare effects of transfers when workers care about consumption smoothing. In addition, by allowing for diminishing marginal utility in consumption and imperfect insurance, wealth affects workers' reservation wages and thus the cross-sectional distributions of wealth play a critical role in determining the aggregate labor response to changes in the transfer system.

Third, working and earning a wage does not only have implications for the cross-sectional distribution of income and wealth, but also for life-cycle profiles through human-capital accumulation on the job. In particular, labor productivity is determined by two components. First, agents are ex-ante heterogeneous concerning their ability, which can be interpreted as pre-market skills such as innate ability or obtained through education. The second component reflects human capital or experience, and accumulates in a learning-by-doing fashion. In particular, we build on the work of Ljungqvist and Sargent (1998) in assuming that worker's productivity changes over time according to laws of motion that depend on whether the worker is employed or not. Employed agents can experience productivity increases, while the careers of idle workers stagnate.

We combine these key trade-offs by enhancing a Bewley-Huggett-Aiyagari incomplete-markets model (Bewley 1986, Huggett 1993, Aiyagari 1994) with labor-market frictions. The lifespan is uncertain and agents survive from one period to the next with a given probability. This stochastic OLG environment allows the model to accommodate the actual life-cycle earnings growth in a very tractable way. Individuals may resort to self-insurance to protect themselves against the uncertainty in labor income and thus savings will be, to some extent, motivated by precautionary reasons. As in the standard D-M-P model, firms enter by posting vacancies and match with workers bilaterally, with match probabilities given by an aggregate matching function. In addition, firms can direct their search by posting vacancies for agents of a given level of education.

We use microdata for the US to inform the model and proceed with a quantitative analysis. The model matches key facts concerning unemployment, and the wage and wealth distributions, as well as the distribution of EITC and transfers. Unemployment insurance (UI) benefits are related to pre-unemployment earnings and subject to exhaustion, after which agents rely on transfers and their own savings. The calibrated model allows us to conduct several counterfactual experiments to shed light on the impacts of existing and new transfer regimes on labor market outcomes, inequality, and welfare.

We find that removing transfers stimulates economic activity through higher precautionary savings, greater incentives to work and lower taxation, leading to an increase in output of 5.2% and a reduction of the unemployment rate by more than a quarter. However, this boost to the economy would be accompanied by a large increase in consumption inequality of 21%, and a 24% reduction in welfare as measured by the consumption equivalent variation (CEV), which is largely felt by the unemployed (-46%) but also by the employed (-9%). The main reasons that the employed also suffer is that transfers are not restricted to the unemployed and the employed might also become unemployed in the future. We find that removing the EITC has a mild negative impact on the economy with the unemployment rate going up by 2.7% and output falling by 1.2%. We also find that eliminating the EITC leads to a benign increase in income and consumption inequality and an aggregate welfare loss of 1.9%.

So far there is only limited evidence on unconditional basic income, mostly from small pilot schemes.[5] The machinery of our calibrated model provides a laboratory for an investigation into the potential impact of removing all existing forms of public insurance and transfers and replacing them with universal basic income (UBI), a lump sum transfer. We consider two sets of counterfactual simulations in which each person receives a predetermined amount, irrespective of their income and asset levels or employment status. In the first set, we remove transfers and the EITC. In the second set, we additionally remove unemployment benefits. Within each case, we consider four levels of universal basic income: 10%, 15%, 20%, and 25% of the benchmark average income. The costs of the scheme are financed by adjusting the level of labor income taxation.

We find that in the steady state, a low level of UBI, i.e. 10% of average benchmark income, leads to an even larger boost to the economy in terms of aggregate output and reduced unemployment than removing transfers. However, this boost comes at a sizeable welfare loss of 9% overall, albeit 41% of households still being better off than in the benchmark. As UBI becomes more generous, the aggregate economic impact dampens while overall welfare increases. We find that welfare gains peak at 0.7% when a UBI of 20% of average income – or nearly $12,500 to each agent per year – substitutes for all programs, with nearly 75% of the population preferring it over the benchmark. Under this scenario, even though aggregate capital falls by 1.9%, aggregate output is 0.5% larger than in the baseline due to lower unemployment and higher on-the-job human capital accumulation, which accounts for nearly one-fourth of the 1.6% increase in aggregate labor.

In addition, average wages fall but skill premia rise, leading to an increase in wage inequality. This is because a UBI of 20% provides less than what unskilled agents receive from the combination of transfers, EITC, and UI, while the opposite happens for the skilled ones and thus the fall in wages is larger for low educated groups. On the other hand, since unemployment benefits are related to earnings, the removal of UI weakens workers' hands in bargaining, especially for less-educated agents. The changes in wages by level of education go hand in hand with the changes observed in unemployment, with low education groups experiencing a much larger drop compared to the highly educated ones. This explains our findings that those who have not completed college prefer higher levels of UBI,

[5] See Hoynes and Rothstein (2019) for an overview.

in contrast to those who have completed college education.

The positive effects of UBI on vacancy creation are due to its universal nature, which reduces the disincentives to work since employed and unemployed agents receive the same amount. We show that the expected benefit of creating a vacancy increases for all education groups and is larger for the unskilled. The reason for this is twofold. On the one hand, the value of a filled vacancy is larger for poor agents compared to the benchmark. On the other hand, we show that there is also a composition effect due to an increase in human capital accumulation. In particular, there is an increase in the mass of workers in the upper end of the distribution of human capital where the value of a job is much higher. Intuitively, hiring workers is an investment activity in which costs are paid up front and benefits accrue gradually as agents become more productive when employed. Better incentives to work induce higher average tenure on the job and thus greater (expected) returns to job creation.

We conduct a decomposition exercise to quantify the importance of the different ingredients of our model in shaping the UBI effects. Since a UBI of 20% is very costly, 8.5% of output – as opposed to nearly 2.5% for the baseline transfers – tax distortions are likely to have first order effects. We show that keeping the level of labor income taxation at the benchmark would boost consumption by 19.5%, while the overall welfare gain from UBI would increase by 20%.[6] In addition, average wages would go up by nearly 7% instead of falling 2.8% when taxes are allowed to change. Assuming that labor market tightness is kept unchanged, a UBI of 20% that replaces all programs would lead to a drop in the job finding rate of 4.5 percentage points instead of an increase of 17 percentage points in the main experiment. The unemployment rate would increase by 0.4 percentage points, leading to a fall in labor of 0.7% as opposed to an increase of 1.6% when tightness can be adjusted. The fall in aggregate output would be much larger, -7%. All in all, these exercises highlight that despite the extra burden of higher taxes to finance UBI, the increased action in hiring makes up for the associated welfare losses.

We also show that a UBI policy reform would be harder to justify on welfare grounds if paired with unemployment insurance. When UI is kept in place, we find that CEV peaks at the same level of UBI but welfare gains attained in this case are nearly zero, 0.01%. The reason for this is a much poorer performance in terms of job creation with UI. Under this scenario, unemployment rises by 0.8 percentage points and aggregate output decreases by 6%. Unemployment increases since the presence of unemployment benefits exerts upward pressure on the equilibrium wage, which lowers firms' profits attained from filled jobs, reducing the incentives to vacancy creation. In addition, the job finding rate also falls due to lower search intensity. These effects are heterogeneous across education groups with low educated agents experiencing a greater rise in unemployment since their reservation wage are disproportionately more affected by the UI. In addition, wage inequality is lower

[6] Since we keep the level of taxes at the benchmark, we allow the wasteful government expenditure to adjust to balance the government budget.

but average wages fall more compared to the case where UI is also eliminated.

We contribute to the literature that studies the welfare and aggregate effects of taxes and transfer programs using general-equilibrium models with heterogeneous agents. Lopez-Daneri (2016) studies a revenue-neutral reform of the U.S. income tax and welfare system that involves the adoption of a negative income tax. Wellschmied (2021) studies the savings effects of the asset means-test in US income support programs. Ortigueira and Siassi (2021) study the effects of the U.S. anti-poverty system on savings, labor supply, and marital decisions of non-college-educated workers with children. Guner et al. (2020) study the effects of conditional transfers on households' labor supply with children.[7]

We also contribute to the emerging literature focusing on the impact of UBI using quantitative models in the Bewley-Huggett-Aiyagari tradition. Conesa et al. (2021) and Luduvice (2021) find that it is hard to justify a UBI policy reform on welfare grounds. Guner et al. (2021) find similar conclusions in a model that incorporates heterogeneity in gender and marital status. Daruich and Fernández (2020) study the impact of UBI on parental skill investments during early childhood and education decisions and find that UBI is not a good idea when the welfare of future generations is taken into account. Ferriere et al. (2021) build on the work in Heathcote et al. (2017b) to study the optimal negative relation between transfers and income-tax progressivity using a Ramsey approach. They show that most of the welfare gains in the benchmark plan can be attained by a UBI of $26,000 per household.

We add to this literature by evaluating a UBI policy reform in a framework that combines job search and job creation with incomplete markets. This is important because, on the one hand, transfers affect the precautionary savings motive and wealth inequality. On the other hand, redistribution policies also influence the labor market and the opportunities it provides. Thus, the efficiency-equity trade-off associated with transfers depends on the endogenous relationship between vacancy creation, incentives to work, and savings behavior. In addition, unlike the papers above in which the wage level is competitively determined, in our model wages are determined by Nash bargaining and thus more generous transfers affect workers' outside options and firms' incentives to create vacancies.

In related work, Jaimovich et al. (2021) also study the effects of UBI in a search-and-matching model with incomplete markets. Our model and our analysis differ from this paper in several ways. First, in their framework, pre-reform transfers are modeled as a fixed amount received by agents with zero income. In contrast, we estimate transfers and the Earned Income Tax Credit separately using microdata. Our baseline economy closely matches the distribution of transfers by income in both cases. Second, agents in our econ-

[7] Our work also relates to the literature that studies optimal tax progressivity (e.g., Conesa and Krueger 2006; Kindermann and Krueger 2020; Guner et al. 2016; Heathcote et al. 2017b), capital taxation (Golosov et al. 2003; Conesa et al. 2009; Boar and Midrigan 2021) or age-dependent taxation (da Costa and Santos 2018; Ndiaye 2017; Heathcote et al. 2017a).

omy are heterogeneous in terms of education. Since ex-ante heterogeneity is a key determinant of inequality in earnings and wealth as well as in labor market outcomes, this ingredient is important to evaluate the redistribute consequences of transfers programs.[8] Third, we allow for on-the-job human capital accumulation, which implies that the returns to forming a match are backloaded and thus more sensitive to transfers that affect the incentives to work and to separate. Fourth, in our model search intensity is endogenous. Fifth, we study a reform in which UBI replaces not only the current transfer system but also unemployment benefits and show that this is an important perspective one should bear in mind when thinking about the consequences of the UBI policy.

The paper is organized as follows. In section 2, we present the model economy. In section 3 we describe the parameterization and calibration of the benchmark economy as well as how the different transfer programs and tax credits are estimated. Section 4 discusses the properties of the benchmark economy. In section 5, we present the main findings of our quantitative experiments, and section 6 concludes.

2 Model

2.1 Demography and preferences

Time is discrete and runs eternally. The economy is populated by overlapping generations of individuals who face an exogenous probability, ν, of surviving to the next period. At each period, $1-\nu$ new agents are born, and $1-\nu$ die, so that the population remains constant at the normalized unit level. Individuals' labor productivity is determined by two components. The first one, denoted by e, is realized at birth and retained throughout one's life. It can be interpreted as innate ability and pre-market skills obtained through education. The second one, z, is a stochastic component and its law of motion is explained below.

Agents have preferences over random streams of consumption, c_t, according to

$$\mathbb{E}\left[\sum_{t=0}^{\infty}\beta_e^t\left(\prod_{s=0}^{t}\nu\right)u(c_t,\ell_t,s_t)\right], \tag{1}$$

where $\mathbb{E}$ is the expectation operator conditional on information at birth and the intra-period utility takes the following separable functional form:

$$u(c_t,\ell_t,s_t)=\frac{c_t^{1-\gamma}}{1-\gamma}+\ell_t\left(d-\chi\frac{s_t^{1+\phi}}{1+\phi}\right). \tag{2}$$

[8] For instance, Huggett et al. (2011) show that ex-ante heterogeneity is a key determinant of inequality in earnings, wealth, and consumption, while Setty and Yedid-Levi (2021) show that it is important to consider ex-ante heterogeneity to assess the redistributive consequences of unemployment insurance.

The parameter d captures the utility from leisure when unemployed, while ℓ_t is an indicator function which assumes value 1 when unemployed and zero otherwise. The valuation of leisure in (2) entails that the marginal rate of substitution between leisure and consumption is decreasing in c, and thus the worker's reservation match quality is increasing in savings as in Bils et al. (2011). In addition, an unemployed worker looks for a job by exertingchoosing search intensity s. The cost of searching for a job depends on how intensively the worker searches. The parameter χ determines the cost of search effort, while ϕ is an elasticity parameter that governs how search effort responds to a change in transfers.

We allow the discount factor β_e to depend on individual's ability as a way to generate an empirically plausible cross-sectional wealth distribution, which has been already explored in Krusell and Smith (1998) and more recently in Krueger et al. (2016), among others.[9]

2.2 Human capital accumulation

In line with Ljungqvist and Sargent (1998) and Kehoe et al. (2019), we think of z as representing the individual's human capital, which is accumulated on the job in a leaning-by-doing fashion. It captures the fact that while working, agents can practice their skills and learn, thereby increasing productivity. The dynamics of z are stochastic and are characterized by shocks moving agents up and down the job ladder. In particular, the human capital of an employed worker evolves according to the following law of motion:

$$\log z' = (1-\varphi)\bar{z} + \varphi \log z + \sigma\varepsilon' \tag{3}$$

where φ determines the persistence, σ the volatility and $\bar{z}$ the mean of the process, while ε is a Gaussian disturbance with zero mean and unit variance.

While off the job, the worker has less opportunities to practice her skills and we assume that those who transit from employment to non-employment maintain their most recent z throughout the unemployment spell. The human capital of a non-employed agent who has just found a job evolves according to a similar AR(1) process but with $\bar{z} = 0$, that is:

$$\log z' = \varphi \log z + \sigma\epsilon'. \tag{4}$$

We represent below the Markov processes in (3) and (4) as $F_w(z, z')$ and $F_u(z, z')$. Newborn workers enter the economy endowed with a draw of z from the invariant distribution associated with $F_u(z, z')$. These laws of motion imply that a worker's productivity increases on average over time since it converges to $\exp(\bar{z})$ from below. The speed at which productivity and, as a consequence, the wage grow over the employment spell is determined by the persistent parameter φ. For instance, the slope of the life-cycle earnings profile will be steeper, the lower the value of φ.

[9] See Falk et al. (2018) for experimental evidence on heterogeneity in discount rates.

In addition, the higher the human capital of a worker who loses her job, the higher the likelihood of her falling down the ladder since $F_u(z, z')$ converges to $\exp(0)$ from above. The model thus produces saw-toothed individual productivity profiles: growth while employed and decline in transitions from unemployment into employment.

2.3 Labor market frictions

Workers and firms come together via random search. We assume that a worker's type is observable and that firms can direct their search by posting vacancies for individuals of a given level of education e. Let u_e be the measure of nonemployed agents of type e, S_e be the aggregate search effort in market e, and v_e the corresponding measure of vacancies posted by firms for agents in submarket e. The flow of successful matches within a period are given by the following matching function:

$$M(S_e, v_e) = \frac{(S_e u_e)v_e}{[(S_e u_e)^\eta + v_e^\eta]^{\frac{1}{\eta}}} \tag{5}$$

where η determines the interaction between the measure of job searches $S_e u_e$ and vacancies v_e.

We use this matching function, which was proposed by Haan et al. (2000), to ensure that job finding rates are between 0 and 1. Specifically, dividing (5) by S_e, the probability per search effort that a nonemployed individual of type e matches with a vacancy in submarket e is then

$$m(\theta_e) = \frac{\theta_e}{(1 + \theta_e^\eta)^{\frac{1}{\eta}}}$$

where $\theta_e = \frac{v_e}{S_e u_e}$ is labor market tightness in the submarket e. A worker supplying search effort s then finds a job with probability $sm(\theta_e)$. The job filing rate in the submarket e can similarly be obtained dividing (5) by v_e:

$$q(\theta_e) = \frac{1}{(1 + \theta_e^\eta)^{\frac{1}{\eta}}}.$$

2.4 Asset markets

Consumers face idiosyncratic income shocks. Because markets are incomplete, they cannot perfectly smooth consumption. Thus, savings may be precautionary and allow partial insurance against shocks. Agents can accumulate two kinds of tangible assets: physical capital, k, which is used as an input for production, and equity x, which is a claim for the aggregate profit. Let r be the return to capital and div be the dividend paid to the holders of equity. The total amount of equities is normalized to one. As there is no aggregate risk, the equity price remains constant in equilibrium. The equity price p has to satisfy a standard no-arbitrage condition, which implies that the returns on holding capital and equity are equal:

$$p = \frac{div + p}{1 + r - \delta} \tag{6}$$

where δ is the depreciation rate of capital.

Since capital and equity both are riskless and provide the same return and therefore are the same from the consumer's viewpoint, we do not have to keep track of the asset composition of the consumers. In the following, we define total financial resources as:

$$(1 + r - \delta)(k + px) = (1 + r - \delta)a \tag{7}$$

and use a as the state variable for a consumer.

Asset holdings are subject to an exogenous lower bound. More precisely, for our main exercise, we assume that agents are not allowed to contract debt, so that the amount of assets carried over from one period to the next is such that $a' \geq 0$.

2.5 Government

The government levies taxes on capital income, consumption, and labor income. We assume that consumption is taxed at a flat rate τ_c and capital income at a flat rate τ_k. In addition, the government collects a non-linear and progressive tax schedule on labor income according to the tax function suggested by Benabou (2002) and more recently used by Heathcote, Storesletten, and Violante (2017):

$$T(w) = \max\{w - \tau_w w^{1-\xi}, 0\} \tag{8}$$

where w is the individual's wage, and $T(w)$ is tax paid. Parameters τ_w and ξ regulate the level and progressivity of taxation, respectively. For instance, if $\xi = 0$ then the tax rate is flat at $1 - \tau_w$, and the system is progressive if $\xi > 0$.

Government revenue is used to finance a stream of exogenously given government consumption, G. In addition, there are two government-run programs in the economy. Newly unemployed workers are eligible to receive unemployment insurance (UI) benefits. The UI system consists of a replacement rate ϑ and a ceiling on the benefits $\bar{b}$. As long as the cap does not bind, the UI benefit is a fraction ϑ of the average wage $\bar{w}(e, z)$ earned by employed workers of type e and productivity z. In particular, the formula for the UI benefits is given by $b(e, z) = \min\left\{\vartheta \bar{w}(e, z), \bar{b}\right\}$. Note that since a worker who transits from employment to unemployment maintains the most recent z throughout the unemployment spell, the benefits are directly linked with the worker's wage in the last job.

Hereafter, we use ι as an indicator function that takes value 1 if the unemployed worker is collecting unemployment insurance and 0 otherwise. To economize on the state space, we assume that the exhaustion of UI benefits are stochastic events, which is governed by the following transition matrix:

$$\Pi_{\iota,\iota'} = \begin{pmatrix} 1 & 0 \\ 1-\pi & \pi \end{pmatrix}. \tag{9}$$

Thus, for example, if an unemployed worker is not currently receiving UI benefits, $\iota = 0$, then she will not receive it next period, i.e. $\iota' = 0$ with probability one. On the contrary, if $\iota = 1$, the parameter π denotes the probability of UI benefits not being exhausted next period.

The government also runs a welfare system designed to mimic the social programs in the US economy. Households can receive two different types of transfers. The first one, $Tr_1(y)$, can be considered welfare and is a function of individual's total income, consisting of wage or unemployment benefits, interest, and dividend income. In particular, y is defined as follows:

$$y = \begin{cases} ra + w(a,e,z), & \text{if employed} \\ ra + b(e,z), & \text{if unemployed with } \iota = 1 \\ ra, & \text{if unemployed with } \iota = 0. \end{cases}$$

The second type of transfer, $Tr_2(y)$, represents the EITC which is paid to low income employed agents and it is essentially a work subsidy. It is a function of total income y since capital income is also part of the eligibility criteria. We assume that the amount of both types of transfers are given by a Ricker function:

$$Tr_j(y) = \begin{cases} e^{\rho_j^1} e^{\rho_2^j y} y^{\rho_3^j} & \textit{if } y > 0 \\ \rho_0^j & \textit{if } y = 0. \end{cases} \tag{10}$$

That is, the transfers of an individual with no income are given by ρ_0^0 and ρ_0^1, while the transfers of a household with positive income are determined by the three parameters $(\rho_1^j, \rho_2^j, \rho_3^j)$ each for $j = 1, 2$. Because EITC is contingent on work requirements, we have that ρ_0^2 is actually zero, which implies that agents at the bottom of the income distribution do not necessarily receive the highest transfers due to the fact that many of these individuals do not have a job.

2.6 Workers' maximization problem

Let $V_w(a, e, z)$ denote the value function of an employed worker with individual productivity (e, z) who owns a assets. Similarly, $V_u(a, e, z, \iota)$ denotes the value function of an unemployed worker, where ι indicates the UI eligibility status as explained above. Workers move between employment and unemployment according to the endogenous job-finding rate $m_w(\theta_e)$, and the exogenous job separation rate ς_e. Workers take both probabilities as given. We can write the recursive problem of an employed agent as

$$V_w(a,e,z) = \max_{a' \geq 0, c} : u(c,0,0)$$
$$+ \beta_e \nu \Big[(1-\varsigma_e) \sum_{z\prime} F_w(z,z') \max\{V_w(a',e,z'), V_u(a',e,z',\iota=1)\} + \varsigma_e V_u(a',e,z',\iota=1)\Big] \quad (11)$$

subject to the following budget constraint:

$$(1+\tau_c)c + a' = [1+(1-\tau_k)\,r]\,a + w(a,e,z) - T(w(a,e,z)) + Tr_1(y) + Tr_2(y). \quad (12)$$

Notice that the continuation value in (11) reflects the consumer's survival probability, ν, the type-specific exogenous separation probability ς_e and the decision of whether to continue a relationship. Equation (12) is the household's budget constraint. The worker's wage, w, is determined through Nash bargaining between the firm and the worker every period as explained below, and thus depends on her individual state (a,e,z).

$$V_u(a,e,z,\iota) = \max_{a' \geq 0, c, s} : u(c,1,s)$$
$$+\beta_e \nu \sum_{\iota'} \Pi_{\iota,\iota'} \Big[sm(\theta_e) \sum_{z'} F_u(z,z') \max\{V_w(a',e,z'), V_u(a',e,z,\iota')\} + (1-sm(\theta_e)) V_u(a',e,z,\iota')\Big]$$
$$(13)$$

subject to

$$(1+\tau_c)c + a' = [1+(1-\tau_k)\,r]\,a + \iota b(e,z) + Tr_1(y). \quad (14)$$

2.7 Firms

On the other side of the market, there is a continuum of risk-neutral, infinitely-lived firms. They maximize the expected value of the sum of profit streams and use the net real interest rate r to discount the future. Firms use both capital and labor inputs to produce according to a standard Cobb-Douglas production function $f(k,n) = k^\alpha n^{1-\alpha}$. Production can take place only in a worker-job match and each match consists of one job and one worker. Labor efficiency units, n, are thus given by ez.

To create a job, a firm first posts a vacancy. The flow cost of posting a vacancy is denoted by κ_e. There is free entry of firms, so that the asset value of holding a vacant position is always zero in equilibrium.

$$\kappa_e = \frac{q(\theta_e)}{1+r} \sum_{\iota} \sum_{z'} F(z,z') \max\{J(a',e,z'),0\} \frac{\lambda_u(a,e,z,\iota)}{u_e} \tag{15}$$

where $a' = a_u(a,e,z,\iota)$.

A firm with a vacancy does not know what worker type it will meet next period. The firm does know, however, the distribution of worker types among the unemployed. The population of unemployed workers at state (a,e,z,ι) is given by $\lambda_u(a,e,z,\iota)$, so that $\lambda_u(a,e,z,\iota)/u_e$ is the conditional density function. Since the matching process is random, the firm can be matched with any worker of type e in the current period unemployment pool.

The free entry condition (15) pins down the vacancy-unemployment ratio in each submarket e, θ_e. Clearly, no vacancies are created in submarket e if the value of expected profits conditional on matching is sufficiently low in that submarket. This may occur for all values of e such that even if a vacancy leads to a match for a firm with probability one, expected profits are lower than the vacancy posting cost.

Once a match is formed, firms choose the amount of capital employed in the job. The value of a job filled by a type's e worker with asset level a and productivity shock z is given by

$$\begin{aligned} J(a,e,z) = \max_k \Bigg\{ & \psi k^{\alpha} n^{1-\alpha} - (r+\delta)k - w(a,e,z) \\ & + \frac{(1-\varsigma_e)(1-\nu)}{1+r} \sum_{z'} F_w(z,z') \max\{J(a',e,z'),0\} \Bigg\} \end{aligned} \tag{16}$$

where $a' = a_w(a,e,z)$, meaning that the firm internalizes the worker's next period asset decision. The continuation value takes into account that a worker-firm pair is dissolved exogenously with the worker's death or with a per-period probability ς_e, which depends on the worker's type. It also captures the possibility that a match no longer yields a positive value to the firm and is thus destroyed.

Note that with a frictionless capital market, all firms pay the same rental rate r, implying equal marginal products across firms. Thus, the same capital to labor ratio, k/n, is employed at each filled job. In fact, the first order condition implies that

$$\bar{k} = \frac{k}{n} = \left(\frac{\alpha}{r+\delta} \right)^{\frac{1}{1-\alpha}} \tag{17}$$

and plugging (17) into (16), the flow profit can be written as $\pi(a,e,z) = (1-\alpha)\left(\frac{\alpha}{r+\delta}\right)^{\frac{\alpha}{1-\alpha}} n - w(a,e,z)$.

2.8 Wage setting

Wages are determined, period by period and without commitment, using Nash bargaining within each worker-firm pair. To define the Nash product, we assume that the outside option of the worker is the value function of an unemployed worker collecting UI benefits, $V_u(a, e, z, \iota = 1)$. We think this is relevant for a number of reasons. First, in standard search-and-matching models, UI benefits are supposed to exert a push effect on wages throughout the duration of employment. In order to generate this outcome, one should let the incumbent worker use $V_u(a, e, z, \iota = 1)$ as her threat point to bargain with the firm. An empirical justification for this is that fair and unfair dismissals cannot be distinguished, but generally the burden of the proof that a dismissal was fair lies with the employer. Therefore, we use $V_u(a, e, z, \iota = 1)$ to define the outside option of all workers and thus the Nash bargaining solution solves the problem

$$\max_{w} \left[V_w(a, e, z) - V_u(u, e, z, \iota = 1)\right]^{\zeta} J(a, e, z)^{1-\zeta} \tag{18}$$

where $\zeta \in (0, 1)$ is a parameter that represents the bargaining power of the worker. Similarly to Krusell et al. (2010), the Nash solution generates a wage that is increasing in a worker's assets, reflecting that being unemployed is less painful for a worker with greater assets. In turn, as can be seen in equation (15), this makes the vacancy creation decision to depend on the unemployed asset holdings. To the extent that social insurance affects the individual's savings behavior, it establishes a channel through which transfers affect wage and vacancy creation in the model.

In addition, marginal taxes and transfers affect wages and profits not only through their influence on net payoffs, J and $V_w - V_u$, but also through the sharing rule. In fact, as has been highlighted by Pissarides (1985), marginal taxes and transfers strengthen the firm's hand in the wage bargain since its share of the surplus from the job increases. Intuitively, a small increment in the negotiated wage benefits the worker less since she attains a smaller part of it. In contrast, unemployment benefits strengthen the worker's hand in bargaining since a small increment in the bargained wage would give her an extra benefit in case of separation. The EITC has a similar effect for low levels of income as $Tr_2'(y_e) > 0$ in this case. These effects are important for one to bear in mind when thinking about the consequences of the UBI reforms considered below.

2.9 Equilibrium

A stationary equilibrium is a list of value functions $(V_w(a, e, z), V_u(a, e, z, \iota), J(a, e, z))$, decision rules for asset holdings $(a_w(a, e, z), a_u(a, e, z, \iota)$, and search intensity $s(a, e, z, \iota)$, a wage function $w(a, e, z)$, a population distribution across possible individuals' states $\lambda_e(a, e, z)$ and $\lambda_u(a, e, z, \iota)$, a value of type-specific labor-market tightness θ_e, and a tax rate τ_w such that:

1. Given the aggregate variable θ_e, the wage function $w(a, e, z)$ and the policy parameters, households solve the maximization problem in (11) and (13).

2. Given the wage schedule $w(a, e, z)$ and the workers asset-holding decision rule, $a_w(a, e, z)$, the value of a filled vacancy $J(a, e, z)$ satisfies equation (16).

3. Given the asset value $J(a, e, z)$, the asset-holding decision $a_u(a, e, z, \iota)$, the measure of unemployed workers $\lambda_u(a, e, z, \iota)$, the number of vacancies posted in each submarket e is consistent with equation (15).

4. The wage function $w(a, e, z)$ is determined through Nash bargaining between the firms and the workers according to (18).

5. Equilibrium distributions, $\lambda_e(a, e, z)$ and $\lambda_u(a, e, z, \iota)$, satisfy the equilibrium stock-flow equations across the different states of the economy implied by the sets of decision rules as well as the idiosyncratic shocks described above.

6. The tax parameter τ_w is such that the aggregate government's budget constraint

$$T_w + \tau_c C + \tau_k r A = G + B_{UI} + B_{Tr} \tag{19}$$

is satisfied every period, where B_{UI} and B_{Tr} are the aggregate UI benefits and transfers that are due, and T_w is the aggregate revenue from labor income tax.

7. The dividend paid to equity owners every period is the sum of flow profits from all matches, net of the expenditure on vacancies

$$div = \sum_e \left[\int \pi(a, e, z) d\lambda_e(a, e, z) - \kappa_e u_e \theta_e \right]$$

and p can be computed from (6).

8. Aggregate capital satisfies the asset market clearing condition:

$$k = \frac{1}{1 + (1 - \tau_k) r} A - p.$$

In addition, we assume that that newborn agents start off their lives in unemployment without UI benefits, and with zero asset holding.

2.10 Welfare measure

The government is a benevolent Ramsey planner that fully commits to fiscal policy. The planner maximizes social welfare by choosing a budget feasible level of transfers subject to allocations being an equilibrium. We consider an Utilitarian social welfare criterion that evaluates the ex-ante expected utility across all agents in the economy as in

$$\mathbb{E}\sum_{t=0}^{\infty}\beta^{t}\left(\prod_{s=1}^{t}\nu\right)u(c_t,\ell_t,s_t) \tag{20}$$

where $\mathbb{E}$ denotes the unconditional expectation operator with respect to all possible permanent types and histories. This welfare criterion takes into account the concern of the policy maker for redistribution and insurance against idiosyncratic shocks, as well as the distortions the transfer system imposes on labor supply, job creation, and capital accumulation decisions.

We compute the welfare change, Δ, as the amount of consumption that one would have to remove or add in order to make the utilitarian welfare criterion equal between a benchmark transfer system and some alternative policy. The welfare variation (CEV) is calculated as follows: Let $V(\omega)$ denote the expected utility of an agent who enters the economy with state ω under the transfer system we aim at evaluating. Then, define

$$V^{0}(\omega)=\mathbb{E}\left[\prod_{s=1}^{t}\nu U_{t,0}((1+\Delta)c_t,\ell_t,s_t)\right]$$

where $U_{t,0}(c_t,\ell_t,s_t)$ is the flow utility attained by the agent under the benchmark at period t. Our relevant measure of welfare variation is

$$CEV=\min_{\Delta}\left[\mathbb{E}_{\omega}V^{0}(\omega)-\mathbb{E}_{\omega}V^{1}(\omega)\right]. \tag{21}$$

3 Parameterization and calibration

A model period is 1.5 months. We separate the parameters into two groups: the exogenously given and parameters calibrated through the simulated method of moments. As is customary, we associate the parameters with the target that provides the most intuition for its value, but all parameters are determined jointly. The value of the parameters, their sources, and targets are shown in Table 1.

Agents in our model represent household heads and we divide the labor force into four productivity types according to levels of education: Less than high-school, high-school graduates, some college, and bachelor's degree. The population share of each group is denoted by μ_e and, according to CPS data, corresponds to $\mu_1=0.11$, $\mu_2=0.31$, $\mu_3=0.26$

and $\mu_4 = 0.32$, respectively.

Preference parameters: We set risk aversion to 2 and the survival rate ν to $1 - 1/320$, implying that workers stay in the market for an average of 40 years. We introduce heterogeneity in discount factors across education groups in order to match differences in wealth between the groups in the data. The SCF reports (every three years) the median family net worth and provides a breakdown by education of household heads. We normalize the median wealth of high school dropouts to 1 and compute the median wealth ratios by education for each year. Our calibration targets are the averages of these premia for the years 1998 to 2013: 2.9, 3.3, 12.0 for high school graduates, some college, and bachelor's degree and over, respectively. The four discount factors, reported in the lower panel of Table 1, are chosen to match the three premia. This procedure, together with the calibration of ν, yields an annual interest rate of 4.8%.

The parameter d captures the utility from leisure when unemployed. Since d governs the marginal rate of substitution between leisure and consumption, it also directly affects the extent to which the worker's reservation match quality is increasing in savings. Thus, we calibrate d to approximate the correlation between wages and asset holdings observed in the data. Figure A.1 shows the model replicates well the actual pattern of average wages by wealth deciles.

The parameters of the search cost function, (χ, ϕ), are calibrated as follows. The value of χ is chosen in such a way that the average time spent on job search is 3.8 percent of the disposable time in line with Krueger and Mueller (2010), which reports that an unemployed worker spends on average 32 minutes per day in job search activities. Since the parameter ϕ governs how search effort responds to a change in benefits of unemployment, we choose its value to match the average elasticity of unemployment duration with respect to unemployment benefit generosity. The model counterpart of this moment is computed by holding fixed the value of θ_e and thus it captures the response that would be observed if only search intensity responds to UI. We use as a target the estimate obtained by Chetty (2008), which indicates that a 10% increase in unemployment benefit level is associated with a 3-5% increase in unemployment duration. Table 1 reports the calibrated parameters.

Labor productivity shocks: To calibrate ex-ante productivity, e, we use data on hourly wages from the Panel Study of Income Dynamics (PSID). We restrict attention to male household heads who are 25 years or older, continuously employed and have no missing data on wages or hours of work. We compute the hourly wage for each person every year, assign people to the appropriate education group, and compute the median hourly wage within an education group for a given year. We use the median wages to compute the education premia in each year. The parameter values reported in the upper panel of Table 1 take into account the average wage premia over all years in our sample, while keeping the weighted average of ex-ante productivity equal to one.

The parameters that characterize the human capital dynamics are $(\bar{z}, \varphi, \sigma)$. We do not have direct information about events that may change human capital on the job, such as training or specific knowledge acquisition. Since $(\bar{z}, \varphi)$ are directly linked to life-cycle wage growth, we use information on age-earnings profiles to identify these parameters. In particular, we choose $(\bar{z}, \varphi)$ to approximate the simulated mean earnings profile with the one computed from a standard Mincer regression of log wages with standard controls, including education. Then, we use the residual variance to pin down σ. The values that we obtain are presented in Table 1. Our procedure implies that the difference in log wages between workers with 30 years of experience and those just entering the labor market is 1.04, which is comparable with the estimates in Elsby and Shapiro (2012) who use census data on full-time workers and find a value of 1.19. To compute $F_e(z, z')$ and $F_u(z, z')$, we apply the algorithm described in Tauchen (1986) to approximate the stochastic processes in (3) and (4) by a first-order Markov chain with 41 points.

Figure A.2 shows how human capital evolves over the employment spell under the baseline calibration. In the left panel, we show the evolution of human capital of a randomly chosen agent who enters the market with mean human capital drawn from the invariant distribution of $F_u(z, z')$. In the right panel, we show the average human capital of a sample of agents who enter the market with mean human capital. Even though there is a lot of volatility at the individual level, workers' productivity, on average, grows over time. The growth is steeper in the first few years and then slows down.

Technology: The values of the technological parameters are presented in Table 1. We choose a value for α based on the US time series data from the National Income and Product Accounts (NIPA). The depreciation rate, in turn, is obtained by $\delta = \frac{I/Y}{K/Y} - g$. We set the annual investment-product ratio I/Y equals to 0.22 and the annual capital-product ratio K/Y equals 3. The economic growth rate, g, is constant and consistent with the average growth rate of GDP over the second half of the last century. Based on data from Penn-World Table, we set g equal to 2.3%, which yields a depreciation rate of nearly 5% in annual terms. Finally, the scale parameter ψ is chosen so that the average wage in the benchmark is equal to 1.

Recruiting cost and separation rate: The difference in unemployment rates among types is directly related to the variation in the job separation rate. Thus, we compute the implied separation rates such that the unemployment rate for each education group is consistent with the data. According to the CPS data, the average unemployment rates decline with skill and equal 8.7%, 6.3%, 4.6%, and 2.9%, respectively. The resulting values of ς_e are reported in Table 1. The values we find for ς_e are in line with their counterpart in the data 3.3%, 2.1%, 1.6%, and 0.8%.

Next, we calibrate the recruiting cost parameters κ_e to match the job finding probability in the data. We compute monthly job transitions using the CPS Merged Outgoing Rotation

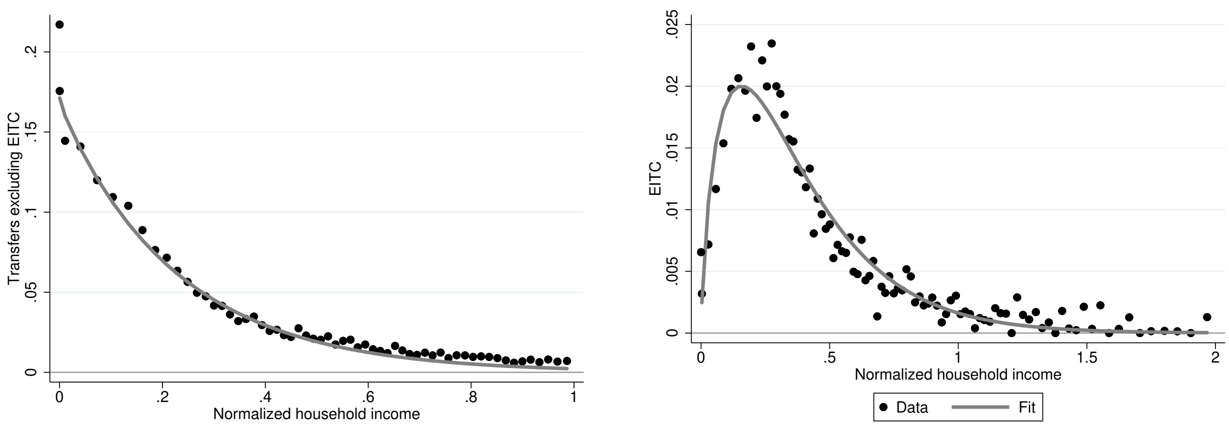
Group from 1995-2019, while restricting the sample to household heads aged 25-65. The resulting transition rates from unemployment to employment by level of education are 30.7%, 28.4%, 27.3%, and 27.6%, respectively. In particular, given the productivity levels e, the expected individual productivity, and the separation rates, we use the free entry of firms in 15 to solve for κ_e.

Matching function and worker's bargaining power: The matching function parameter η is chosen to be 1.60 in line with the value estimated by Schaal (2017). This value yields a matching elasticity of nearly 0.6. We then use the Hosio's condition to set the bargaining weight to 0.60 following Shimer (2005) and many others.

Transfers and EITC: We estimate transfer functions as in Guner et al. (2022). In Figure 1 we can see the estimated function (black dashed line) as given by equation (10) using microdata from the SIPP from 1998-2012. We can see that a household with zero income in a given year on average receives 22% of mean household income in terms of transfers. For a household with a positive income, the amount immediately drops to 17%, and the received amount continues to drop after that.[10]

Figure 1: Transfers and EITC as a function of household income (normalized) - data vs. fit

(a) Transfers excluding EITC (b) EITC



Notes: The x-axis shows normalized household income, while the y-axis shows the normalized amount of transfers received on average. The dots represent binned averages, while the gray line shows the approximated schedule according to the estimated function (10) via OLS using microdata from the SIPP.

We follow Guner et al. (2022) to compute the transfer schedules of the EITC, a refundable tax credit for low- to moderate-income households, in particular with children, which has working requirements attached to it. The official schedule is characterized by three intervals, the phase-in, plateau, and phase-out. This means that the credit is proportional

[10]The presented amounts are unconditional on receipt. For details on take-up, we refer to Guner et al. (2022).

Table 1: Estimation and calibration of model parameters

Parameter	Description	Values	Source/target
	External calibration		
Parameter	Description	Values	Source/target
γ	Risk aversion	2	Standard
ν	Death probability	$1-\frac{1}{320}$	40 years working life
α, δ	Capital share, depreciation rate	0.3, 1.04%	NIPA, I/Y ratio
τ_c, τ_k	Consumption and capital tax	7%, 30%	Fuster et al. (2007)
ξ	Tax progressivity	0.098	Guner et al. (2014)
$\vartheta, 1-\pi$	Repl. rate, prob. of UI expiring	0.40, 0.25	US policies
η	Matching function curvature	1.60	Schaal (2017)
ζ	Worker's bargaining power	0.60	Hosio's condition
e_1	Permanent productivity <HS	0.65	Median earnings PSID
e_2	Permanent productivity HS	0.83	Median earnings PSID
e_3	Permanent productivity SC	1.00	Median earnings PSID
e_4	Permanent productivity C	1.42	Median earnings PSID
	Internal calibration		
Parameter	Description	Values	Target
β_1	Discount factor <HS	0.9995	Wealth distribution
β_2	Discount factor HS	0.9996	Wealth distribution
β_3	Discount factor SC	0.9998	Wealth distribution
β_4	Discount factor C	1.0001	Wealth distribution
κ_1	Recruiting cost <HS	0.05	Job finding probability
κ_2	Recruiting cost HS	0.11	Job finding probability
κ_3	Recruiting cost SC	0.12	Job finding probability
κ_4	Recruiting cost C	0.15	Job finding probability
ς_1	Separation rate <HS	4.39%	Unemployment rate
ς_2	Separation rate HS	2.73%	Unemployment rate
ς_3	Separation rate SC	1.78%	Unemployment rate
ς_4	Separation rate C	0.99%	Unemployment rate
$\bar{z}, \varphi$	Mean and persistence of prod.	1.55, 0.985	Mean earnings profile
σ	Std of innovation	0.004	Residual inequality
τ_w	Tax level	0.77	Balance gov. budget constraint
b_{max}	Ceiling for UI benefits	0.24	48% of median wage
d	Utility from leisure	0.06	Corr. between w and a
χ	Cost of search	0.60	Time spent on job search
ϕ	Cost of search	1.90	Elasticity of u duration w.r.t b

Notes: The internally calibrated parameters are estimated using the simulated method of moments (SMM) in which we minimize the sum of the equally weighted squared distance between model and data moments.

Table 2: Parameters of transfer and EITC schedules

Function parameters		
	Transfers	EITC
ξ_0	0.217	0.007
ξ_1	-1.816	-1.873
ξ_2	-4.290	-4.551
ξ_3	-0.006	0.715

Notes: The parameters from the transfer function (10) are estimated using microdata from the SIPP 1998-2012.

to income up to a cutoff point before later declining with income, eventually reaching zero. Froemel and Gottlieb (2016) rely on the government's schedule to parameterize a relation between income and EITC which they use in their model. However, even amongst eligible households take-up has been found to be far below 100% (Currie 2004). Therefore, we use microdata from 2001-2012 from the Survey of Income and Program Participation (SIPP) to estimate EITC as a function of household income. In the right panel of Figure 1 we present this relationship where both are normalized by average household income ($75,932.91). We see that the average amount received plateaus at around 20% of normalized income at which households on average receive about 2% of normalized income.[11]

The parameters of the Ricker model as in equation (10) for transfers and the EITC are presented in Table 2.

Other government parameters: First, we set government consumption, G, to 17% of the economy's output under the baseline calibration. Following the literature, we assume a consumption tax of 7% and a capital income tax rate of 30%.[12] The parameter ξ, which governs the progressivity of the labor income taxes, is calibrated in line with the estimates provided by Guner et al. (2014). Marginal tax rates are chosen to raise enough revenue to balance the government budget constraint. The value we find for τ_w is 0.77.[13] The parameters of the UI system are then calibrated as follows. We set the replacement rate ϑ at 40%, which is a value typically used for the US economy (Krusell et al., 2010), and the ceiling on unemployment benefits, $\bar{b} = 0.24$, corresponds to about 50% of the mean wage in the model. This calibration is based on the mean of the maximum benefits by state as reported by the U.S. Department of Labor. The probability π is set to 0.75 to make UI benefits expire after 26 weeks – roughly four periods in the model – in line with US policies.

[11]Given that the SIPP provides intervals with the highest category being $3,500 for 2001-2003, $4,000 for 2004-2007, and $5,000 as of 2008 this could be considered a lower bound. However, only 10% of household receiving positive amounts claim to receive an amount in this category so the impact of the cap should be rather small, especially when considering that the maximum amount that can be received according to federal rules is $5,112 in 2011.

[12]See, for example, Fuster et al. (2007).

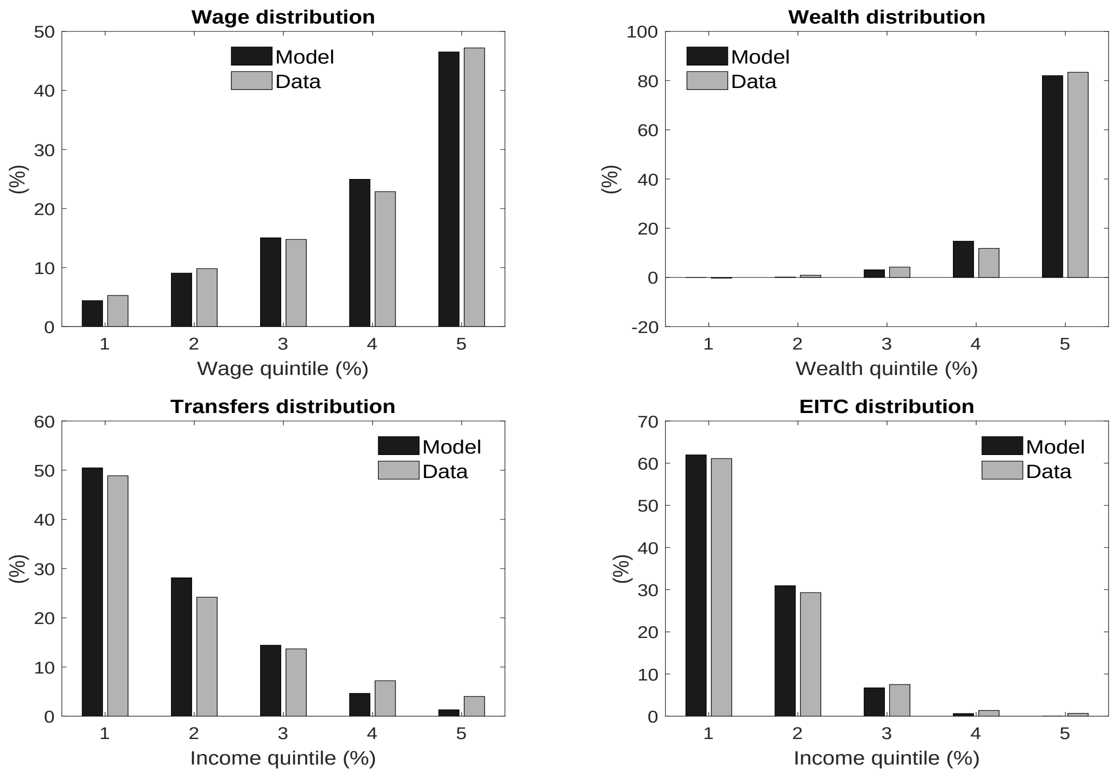
[13]Recall that $\tau_w(1-\xi)w^{-\xi}$ is the marginal retention rate, $1 - T'(y)$.

4 Benchmark economy

In Figure 2 we present the fit of the model (black bars) relative to the data (gray bars). In the top left panel, we see the share of total wages that accrue to each wage quintile. The model captures the distribution nicely with, for instance, 3.9% (3.7%) of wages being earned by the bottom wage quintile in the model (data), and 48% (47%) by the top wage quintile. The top right panel plots the same distribution for wealth quintiles. Again the model does an excellent job capturing the distribution of wealth, which is visibly more unequal than it is for labor income.

The bottom left panel shows that transfers are largely captured by the bottom income quintile in the model (49%) and the data (49%). The top income quintile receives 4.1% of transfers in the data, which is lower in the model (2.6%). This is because the calibration has only limited power to change the distribution of transfers, given that they are governed by exogenous parameters estimated outside the model. In the right panel in the bottom, we see that an even larger fraction of EITC payments accrue to the bottom income quintile in the data (61%) and the model (61%), while top income earners receive hardly any EITC payments.

Figure 2: Benchmark model fit: Inequality and transfers



Notes: The figure shows the model fit by comparing the shares of total wages, wealth, transfers, and EITC being held/received by each quintile in the model (black) and data (gray).

In Figure 3, we show the model fit in terms of labor market outcomes. In the top left panel, we see that the model matches the patterns of the unemployment rates across education groups closely. Out of those with less than high school education, 8.8% (8.7%) are unemployed in the model (data), while for those with a college degree, the unemployment rates in the model (data) are much lower at 2.9% (2.9%). The bottom right panel displays the job finding probability across education groups. Those with less than high school education face a 49% (50%) probability of transitioning from unemployment to employment in the model (data), while for those with college education the probability is 44% (44%).

Finally, in the bottom graph of Figure 3, we show the unemployment rate by wealth decile for the model and the data. The actual values are computed using the microdata from the SIPP for household heads aged 25 to 65. It can be seen that, both in the model and in the data, unemployment in the bottom decile is twice as high as for the second decile and four times higher than the remaining deciles. Since these are not directly targeted moments in our calibration, the figures provide an external validation by showing that our model replicates well not only the relationship between wages and wealth inequality observed in the data – as shown in the previous section – but also the relationship between unemployment and wealth inequality. This is important because the implied efficiency-equity trade-off of transfers depends on the endogenous relationship between vacancy creation, incentives to work, and savings behavior. Our general equilibrium framework allows us to study how these ingredients interact to determine the distributional and aggregate consequences of transfers.

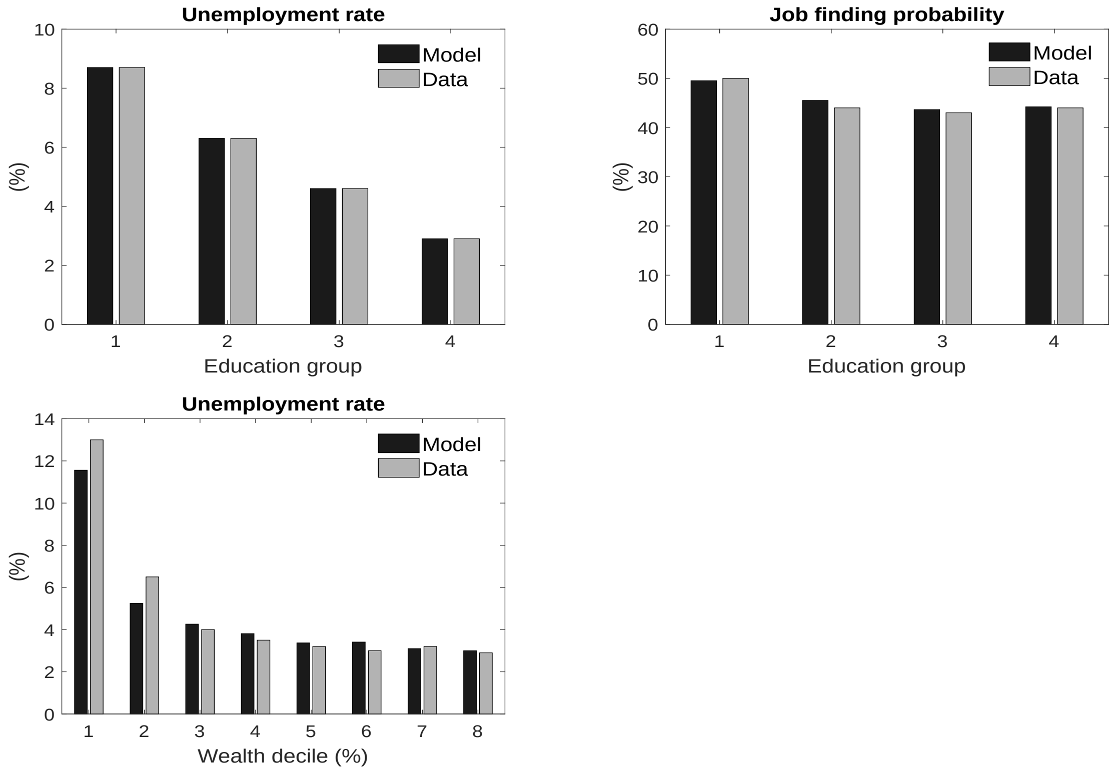
5 Policy experiments

5.1 The impact of transfers and EITC

In this section, we study how the current transfer system affects the labor market and inequality. Table 3 and Figure 4 display the findings for the case where we eliminate transfers, $Tr_1(y)$, and the EITC, $Tr_2(y)$. The second column displays the results for the benchmark economy. In the third column, we show the results when only transfers, $Tr_1(y)$, are removed, while in the fourth, we eliminate only the EITC, $Tr_2(y)$. Finally, the fifth column displays the findings when both types of transfers are removed. In the top panel, we show the relevant aggregate variables, while the bottom panel displays the Gini coefficient for gross and net income, assets, and consumption. Figure 4 displays the heterogeneous effects of the reforms.

We start by describing the effects on labor market outcomes. When transfers and EITC are removed, the unemployment rate goes down by nearly 1.3 percentage points, which is almost entirely driven by the elimination of transfers. In fact, as can be seen in Table 3, in the case that we eliminate only the EITC, the unemployment rate actually increases by 0.14 percentage points. This is not surprising given that the EITC is a subsidy to work.

Figure 3: Benchmark model fit: Labor market outcomes



Notes: In the top two panels the figure shows the model fit by comparing the unemployment rate and job finding probability by level of education (1 is less than high school, 2 is high school, 3 is some college, and 4 is college graduate) in the model (black) and data (gray). In the bottom left panel the figure shows the non-targeted fit of the unemployment rate by wealth decile in the model (black) and data (gray).

Note that unemployment goes up due to less job creation, which is explained by a lower level of aggregate capital. On the contrary, when only transfers are eliminated, the model predicts a sizeable increase in both job creation and search intensity, leading to an increase in job finding probability of nearly 17 percentage points. In the middle panel of Figure 4, we show that these effects are stronger among lower educated groups.

The model predicts a sizable increase of 7.7% in average wages when transfers and the EITC are removed. Interestingly, even though the removal of transfers has a negative effect on reservation wages for low-income groups, wages actually rise for all agents in the counterfactual economy. This is so because the increase in the precautionary savings motive leads to an increase of 14% in aggregate capital, raising the value of a job and pushing wages up. This effect, however, is heterogeneous, and labor income becomes more disperse. In fact, one can see in the top left panel of Figure 4 that the bottom quintiles experience a fall in their relative share of total wages, while workers in the top quintile reap the greatest share.

The increase in wage inequality is counteracted by a reduction in wealth inequality. In

Table 3: Eliminating transfers and the EITC

Variable	Benchmark	Removing Transfers	Removing EITC	Removing Both
Aggregate output Y	100	+5.21%	-1.18%	+4.79
Aggregate capital A	100	+14.38%	-3.62%	+12.99
$Labor$	100	+1.46%	-0.14%	+1.42
Consumption	100	+1.99%	-2.08%	+1.82%
Mean human capital	100	0.24%	-0.02%	0.22%
Unemployment rate u	5.03%	3.71%	5.17%	3.75%
Mean job finding prob.	45.06%	61.92%	43.90%	61.34%
Mean search intensity	100	+21.03	+0.31%	+21.45
Mean wage	100	+8.44%	-2.59%	+7.75%
Mean income	100	+4.49%	-1.28%	+4.26%
Interest rate r	0.59%	0.46%	0.64%	0.47%
τ_w	22.32%	15.42%	22.33%	14.91%
B_{Tr_1}/REV	16.01%	0.00%	16.44%	0.00%
B_{Tr_2}/REV	1.38%	1.91%	0.00%	0.00%
		Gini		
Gross income	0.480	0.483	0.493	0.484
Net income	0.386	0.441	0.401	0.447
Consumption	0.323	0.392	0.333	0.397
Assets	0.763	0.705	0.785	0.711
		Welfare		
CEV	—	-24.10%	-1.93%	-25.88%
CEV employed	—	-9.36%	-1.88%	-11.40%
CEV unemployed	—	-46.77%	-2.06%	-47.94%

Notes: The table presents changes to the economy when eliminating transfers, EITC, and both. Marked with '+/-' are relative changes to the benchmark economy set to 100 for outcomes for which levels do not have an obvious interpretation. For outcomes for which levels have a clear interpretation, we present actual levels indicated by the level in the benchmark column.

fact, Table 3 shows that the Gini measuring wealth inequality drops from 0.76 to 0.71. In addition, while the share of wealth held by the richest 20% falls from 81% to 63% – see the right panel in the top of Figure 4 – the shares of the quintiles one, two, three, and four increase by 0.05, 2.0, 5.8 and 7.2 percentage points, respectively.

This fall in the dispersion of asset holdings is explained by a stronger response of savings among low-income individuals when we move to the counterfactual economy. In addition, the fall in the interest rate reduces wealth accumulation at the top, where a large share of income is accounted for by capital income. These effects come almost entirely from eliminating transfers rather than the EITC, which is due to the relative size of both types of programs.

Although the removal of transfers has positive effects on economic activity, with aggregate output increasing 5.2%, the model predicts a more dire picture when one considers the impact on welfare. In fact, in the bottom of Table 3, we show that overall welfare as measured by the consumption equivalent variation (CEV) declines 24%, with the unemployed bearing most of the loss, 47%, due not only to the loss of insurance but mainly to a rise in search cost. Note that the social insurance provided by transfers is also highly valued by employed workers, as is reflected by the sizeable welfare loss of 9.3% when this type of transfer is removed. The welfare effect of eliminating EITC is relatively small, -1.9%, with the impact on both groups being more similar.

5.2 Universal basic income

In the following, we present two sets of counterfactual simulations in which each person receives a pre-determined fraction of average total income in the benchmark, irrespective of their income level or employment status. In the first set, we remove transfers and the EITC. In the second set, we additionally remove unemployment benefits.[14] Within each set, we present the aggregate effects for four levels of universal basic income: 10%, 15%, 20%, and 25% of average income. The costs of the scheme are financed by adjusting the level of taxation through τ_w in order for the government budget to be balanced in equilibrium. In each panel of Figure 5 we present relative changes to the benchmark economy for outcomes for which levels do not have an obvious interpretation, and we present levels for outcomes with a clear interpretation.[15] The black dashed lines represent the experiment for UBI is paired with UI, while the solid gray line reflects the results with UBI only.

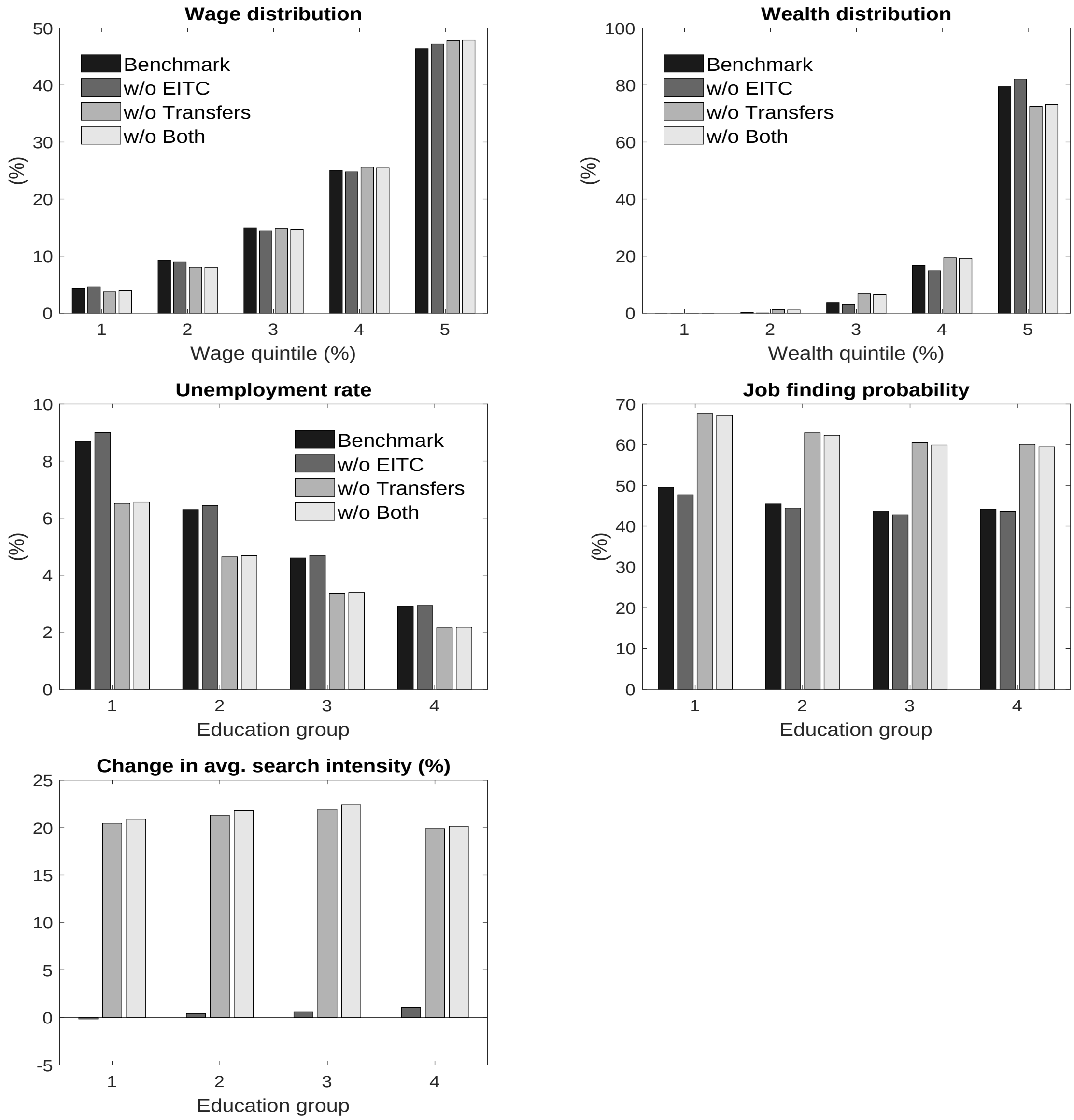
It can be seen that lower levels of UBI increase economic activity, but the effects are much smaller in the presence of UI. In fact, when a UBI of 10% is paired with UI, aggregate capital, labor and output go up by 2.89%, 0.58%, and 1.27%, respectively, while the figures are 14.4%, 2.15% and 5.73% for the case where UI is also removed. The increase in labor goes hand in hand with a drop in the unemployment rate: 0.5 percentage points in the former case and 1.8 in the latter. In addition, average human capital also goes up, accounting for nearly 22% of the increase in labor when UBI substitutes for all programs as opposed to 10% with UI.

To understand the stronger effects on the economy without UI, note first that low levels of UBI provide less than what unemployed agents receive from the combination of transfers, EITC, and UI in the benchmark. This drop in social insurance boosts the precautionary savings motive in good times and search effort in bad times, especially among agents in the lower rungs of the income distribution. Given the higher levels of asset accumulation, firms have more capital at their disposal, increasing the marginal returns to labor and, therefore

[14]Since UBI is set as a fraction of the benchmark average income, individuals receive the same amount in both cases.

[15]In Appendix Tables A.1 and A.2 we present the statistics.

Figure 4: Eliminating transfers and EITC

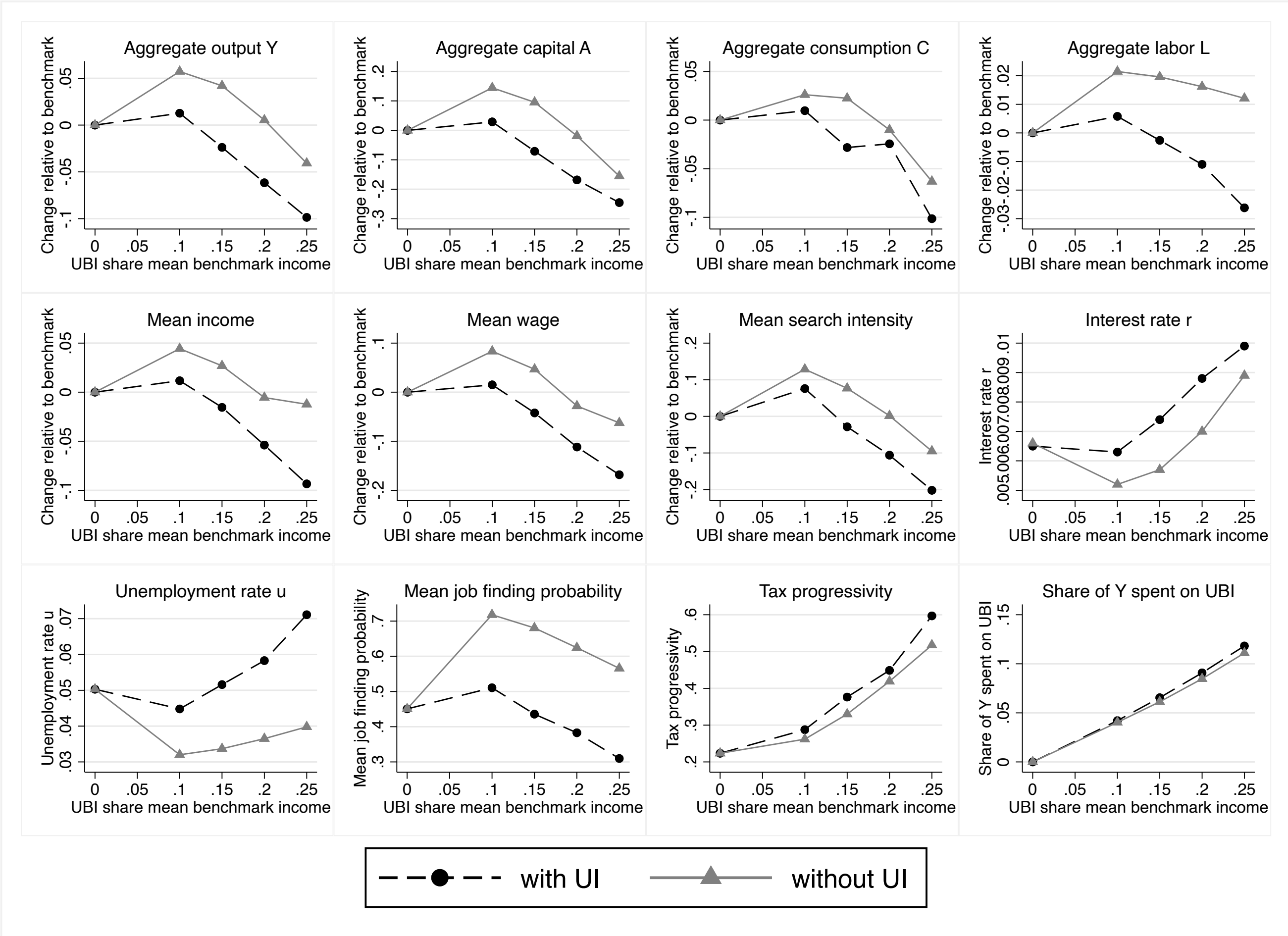


Notes: The figure shows the the shares of total wages and wealth (top) going to each quintile in the benchmark (black) and when eliminating EITC (dark gray), transfers (gray), and both (light gray). Similarly, the remaining panels show the unemployment rate, job finding probability, and change in mean search intensity for each education group (1 is less than high school, 2 is high school, 3 is some college, and 4 is college graduate).

the incentives to create vacancies. The second effect acts on the supply side. Since employed and unemployed agents receive the same value, a universal basic income policy – if not set too high – provides no ex-ante disincentive to work. This positive effect of UBI is tampered out when UI is in place through its effect on the amount of effort devoted to searching for a job and the reservation wage of the unemployed.

Both effects become clear when one compares the job finding probability in both economies. In fact, a UBI of 10% causes the job finding probability to go up by 13% when UI is kept

Figure 5: The impact of different levels of UBI with and without UI on the economy



Notes: Each panel shows the effect of introducing different levels of UBI relative to the benchmark economy without UI (gray solid line) and with UI (black dashed line). The outcomes are indicated in the titles of the panels. The numeric results can also be found in Appendix Tables A.1 and A.2.

in place, while it jumps nearly 60% without UI. Note that this stark difference can not be explained by the rise in search intensity, which increases only by 5 percentage points more when all programs are removed. As UBI becomes more generous, the incentives to save and search for a job reduce and the supply side effect mentioned above becomes dominant. For instance, for a UBI of 20%, even though aggregate capital falls -1.89% and search intensity is similar to the benchmark, the increase in the job finding probability is still large, nearly 38%, if all programs are removed. In contrast, when a UBI of 20% is paired with UI, the job finding probability collapses 15%. These patterns go hand in hand with the ones observed for unemployment and aggregate labor. Even for a UBI of 25% – nearly $15,600 annually – we find that unemployment (labor) is lower (higher) compared to the benchmark if UI is also eliminated.

To understand how the interaction between UBI and UI affects job creation in the model, the top left panel of Figure 8 shows the expected return of a match for a UBI of 20%.[16] It can be seen that the expected benefit of creating a vacancy increases without UI for all education groups, while it decreases when UI is kept in place. The reason for this is twofold. On the one hand, as is shown in the right top panel of Figure 8, the value of a filled vacancy is larger for poor agents when UBI substitutes for all programs. For richer workers – see the bottom left panel – the value of a filled vacancy without UI is still higher than with UI but lower than the benchmark. On the other hand, there is also a composition effect due to increased human capital accumulation. This is shown in the bottom right panel of Figure 8, which displays the change in the distribution of z. It can be seen that – without UI – there is an increase in the mass of workers in the upper end of the distribution of z for which the value of a job is much higher, while the opposite happens when UBI is paired with UI. Intuitively, hiring workers is an investment activity in which costs are paid upfront and benefits accrue gradually as individuals become more productive when employed. Better incentives to work induce higher average tenure on the job and thus greater incentives to job creation.

Note that, as expected, the cost of UBI is high due to its universal nature, requiring a large increase in the tax level to balance the government budget. Even for a UBI of 10% – nearly $6,250 annually – the program's total cost amounts to 4% of output when UBI replaces all programs, which corresponds to an increase of nearly 1.5 percentage points in government transfer payments as a share of output compared to the benchmark. Moreover, despite each individual receiving the same amount in both economies, UBI is more costly when paired with UI. In fact, for a UBI of 20%, the total cost of UBI equals 8.5% of output when UI is also eliminated as opposed to nearly 9.1% when UI is provided. The difference increases as the level of UBI grows since labor market outcomes deteriorate faster in the latter case.

It is important to highlight that average wages also increase initially and then fall steadily as UBI becomes more generous. As is shown in Figure 5, for a UBI of 10%, the increase in wages is much larger in the economy without UI (8.3% as opposed to 1.5%). For high levels of UBI, both the drop in capital and the rise in the tax level reduce wages. Interestingly, when one looks at the change in wage by education groups – see Figure A.3 – it can be seen that the pattern is very different between the two economies. As UBI becomes more generous, the average wage falls much more for low education groups when all programs are removed. In contrast, if we keep UI in place, the change in wage is more uniform across education levels and is smaller for less-educated workers. The reason for this is twofold. On the one hand, unemployment insurance disproportionately affects the reservation wage of low education groups, which prevents their bargaining wage from falling by as much as their more educated counterparts. On the other hand, the lower average tenure when UI is

[16] This corresponds to the right hand side of equation 15: $\sum_{\iota} \sum_{z'} F(z, z') \max \{J(a', e, z'), 0\} \frac{\lambda_u(a,e,z,\iota)}{u_e}$.

in place affects more highly skilled agents for whom human capital accumulation is a more important driver of earnings growth over the life cycle.

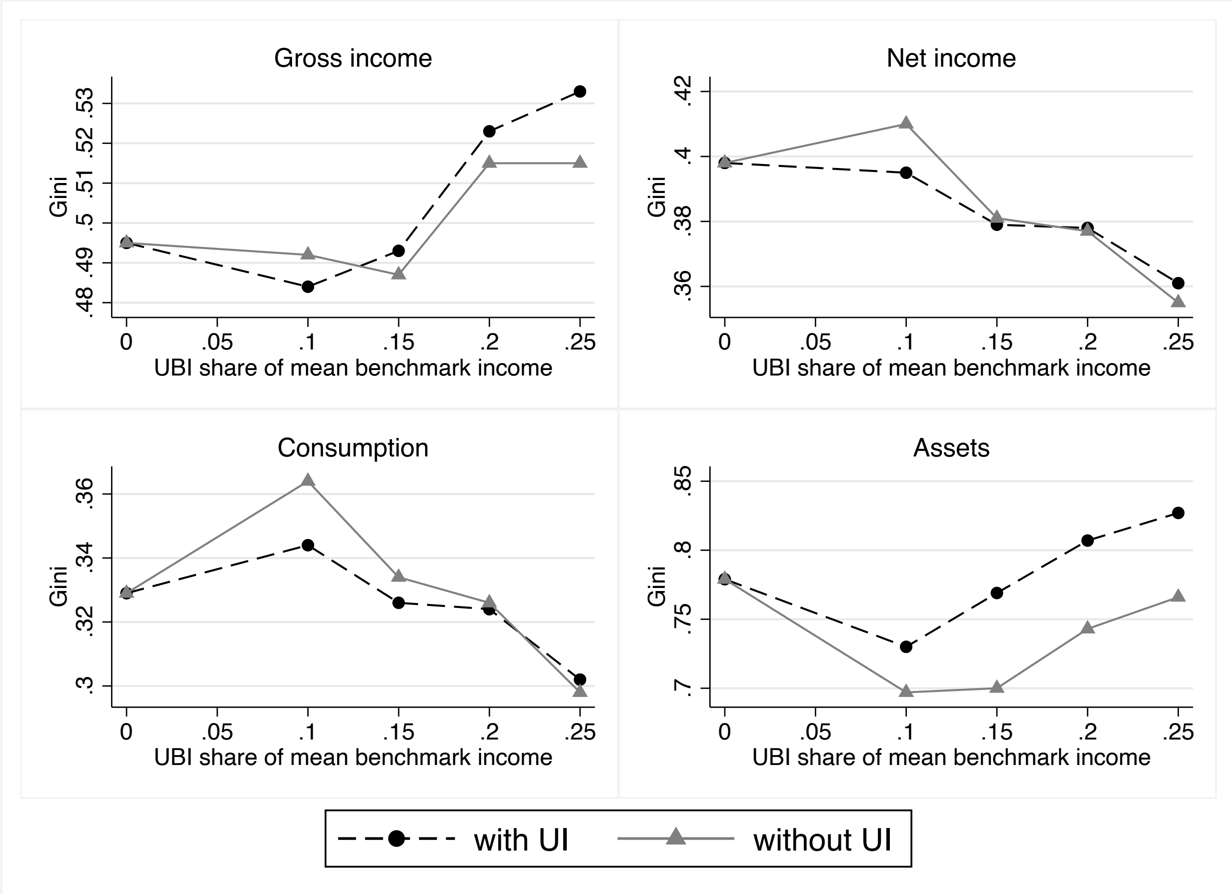
The changes in wages described in Figure A.3 imply that skill premium - and thus wage inequality – increases compared to the benchmark when UBI replaces all programs. This concentration of wages can also be seen in the top left panel of Figure 9, which displays the distribution of wages by quintile. Note that the shares of wages captured by the bottom four quintiles tend to be decreasing in the level of UBI, as the top quintile sees an increase. Given the progressive nature of the tax schedule, the increase in wage inequality amplifies the redistribution to the poor since a larger part of the costs is financed by high-income earners.

In Figure 6 we show how inequality in other dimensions is affected by the same sets of experiments. For the economy without UI, income inequality first falls slightly for low levels of UBI and then increases as UBI becomes more generous. When UI is kept in place, the fall in income inequality is initially more pronounced, but it increases faster for high levels of UBI. In contrast, consumption inequality spikes and increases by 10% when a UBI of 10% replaces all other programs. Increasing UBI further, consumption inequality drops and falls below benchmark levels when reaching 20% of benchmark income. Interestingly, for high values of UBI, the economy where UI is kept in place generates more net income and consumption inequality than the economy where all programs are eliminated. The reason for this is twofold. On the one hand, as discussed above, wages fall more in the economy with UI due to larger disincentives to capital accumulation and job creation. On the other hand, the associated increase in unemployment – see Appendix Figure A.4 – is larger for low educated individuals.

In addition, Figure 6 also shows that asset inequality falls for low levels of UBI in both cases and is always larger in the economy without UI. This is so because the absence of unemployment insurance generates a stronger precautionary savings motive among agents in the lower rungs of the wealth distribution. It can be seen in the top right panel of Figure 9 that the share of the top 20% exhibits a U-shaped pattern: it decreases nearly 9 percentage points for a UBI of 15% and then increases as the UBI becomes more generous, staying below the benchmark value for a UBI of 25%. The opposite pattern is observed for the lower quintiles. For the economy in which UBI is paired with UI – see the top right panel of Figure A.4 – the response is less pronounced when UBI is 15% but the share of the fifth (forth) quintile increases (decreases) rapidly as UBI increases. Note that the larger rise in interest rate also helps to explain the concentration of wealth in this case.

In Figure 7 we look at the share of the population that would favor UBI over the benchmark in a one-dimensional referendum. UBI combined with UI is favored over the benchmark at all levels of UBI, but peaks at 76% when UBI is 20% of benchmark income. Without unemployment insurance, UBI can only convince 40% of the population at a 10% level but also reaches an approval rating of 75% when it is 20% of benchmark income.

Figure 6: The impact of different levels of UBI with and without UI on inequality

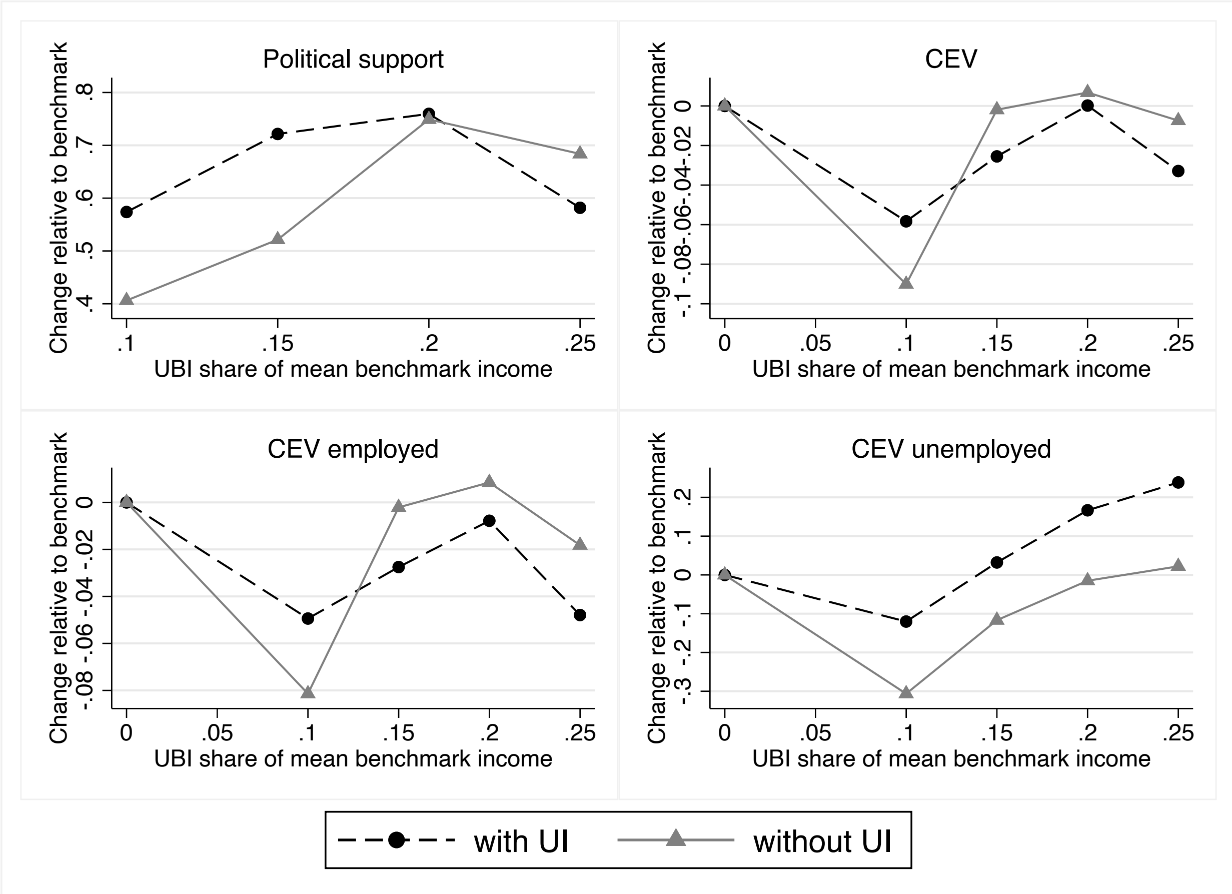


Notes: The figure shows changes in the Gini coefficient relative to the benchmark when introducing different levels of UBI (x-axis) with UI (black dashed) and without (gray solid).

As for welfare, we report in the right top panel of Figure 7 the aggregate consumption equivalent variation (CEV) for both economies, while the bottom panels show the welfare change by employment status. It can be seen that a relatively low level of UBI – 10% of the benchmark average income – leads to a sizable welfare loss of 9% when all programs are removed. Note that the loss is large even if UI is kept in place, 6%. As UBI becomes more generous, aggregate welfare gains go up, increasing faster in the economy without UI. Under this scenario, we find that welfare gains peak at 0.7% when UBI is 20% of average income. In addition, all these gains are attained by employed workers as the unemployed experience a welfare loss of -1.5%. For the economy with UI, we find that CEV peaks at the same level of UBI, but welfare gains are nearly zero, 0.01%. In this case, winners and losers flip side, and a CEV of 16.7% attained by the unemployed is compensated by a welfare loss of -0.8% experienced by the employed.

Thus, our findings indicate that a UBI policy reform is more likely to improve welfare if it substitutes for all programs, including UI. It is worth noting that the welfare-maximizing level of UBI is in line with the magnitudes advocated in policy discussions. For instance,

Figure 7: The impact of different levels of UBI with and without UI on welfare



Notes: The figure shows changes in the share of the population preferring the new steady state relative to the benchmark (top left), and changes in welfare as measured using consumption equivalent variation when introducing different levels of UBI (x-axis) with UI (black dashed) and without (gray solid).

the policy proposal advocated by Andrew Yang, a candidate to the primaries of the Democratic Party for the presidential election of the United States in 2020 is to give every agent in the economy a UBI that would amount to $12,000 per year, or $1,000 monthly, which corresponds to nearly 20% of the average income in the U.S.[17]

In the bottom right panel of Figures 9 and A.4, we look at the impact of different levels of UBI by education. We see that a UBI of 20% generates a positive CEV for all education groups except for the highly educated ones. In general, those who have not completed high school prefer higher levels of UBI, while those with college education prefer lower levels. Note also that low (high) education groups benefit (lose) more (less) when UBI is 20% in the economy without UI, which explains the much larger welfare gains attained under this scenario.

To understand why low educated agents experience more improvements – and college

[17]The average income in 2020 is nearly $62,500.

workers do not – without UI, one can look at the heterogeneous impacts on labor market outcomes in both cases, which are also presented in Figures 9 and A.4. It can be seen that unemployment exhibits a U-shaped pattern and the levels are always below the benchmark values for all education groups in the economy without unemployment insurance. Note that, for high levels of UBI, unemployment decreases more for unskilled workers than for the skilled ones. In fact, for a UBI of 25%, the unemployment rate of workers with less than high-school is 24% lower than its benchmark value, while it is 9% lower for the highest education group. On the contrary, when UI is kept in place, the unemployment rate increases in the level of UBI, and it grows faster for college educated workers, being 55% higher when UBI is 25% as opposed to 35% for those with less than high school education. Note that high levels of UBI decrease search intensity in both cases, but the effect is bigger for more educated individuals and much larger in the presence of UI. Interestingly, when UBI replaces all programs, the increase in job creation compensates for the fall in search intensity, leading to an increase in job finding rate as can be seen in the middle right panel of Figure 9. Given that search intensity falls more for college workers, the increase in the job finding rate is smaller for this group.

The above results indicate that general equilibrium effects acting through job creation are important to understand the effects of UBI but are less informative about the quantitative importance of the different channels at work. To this end, we conduct a decomposition exercise to quantify the importance of i) taxes, ii) labor market tightness θ_e, and iii) the interest rate r in shaping the UBI effects. Given that the welfare gains peak for a UBI around 20% without unemployment insurance, we narrow the analysis under this scenario. Since a UBI of 20% is very costly, 8.5% of output, tax distortions are likely to have first-order effects. We show in Table 4 that keeping the level of labor income taxation, τ_w, at the benchmark would boost consumption by 19.5%. At the same time, the overall welfare gain from UBI would increase by 20%.[18] In addition, average wages would go up by nearly 7% instead of falling 2.8% when τ_w is allowed to change.

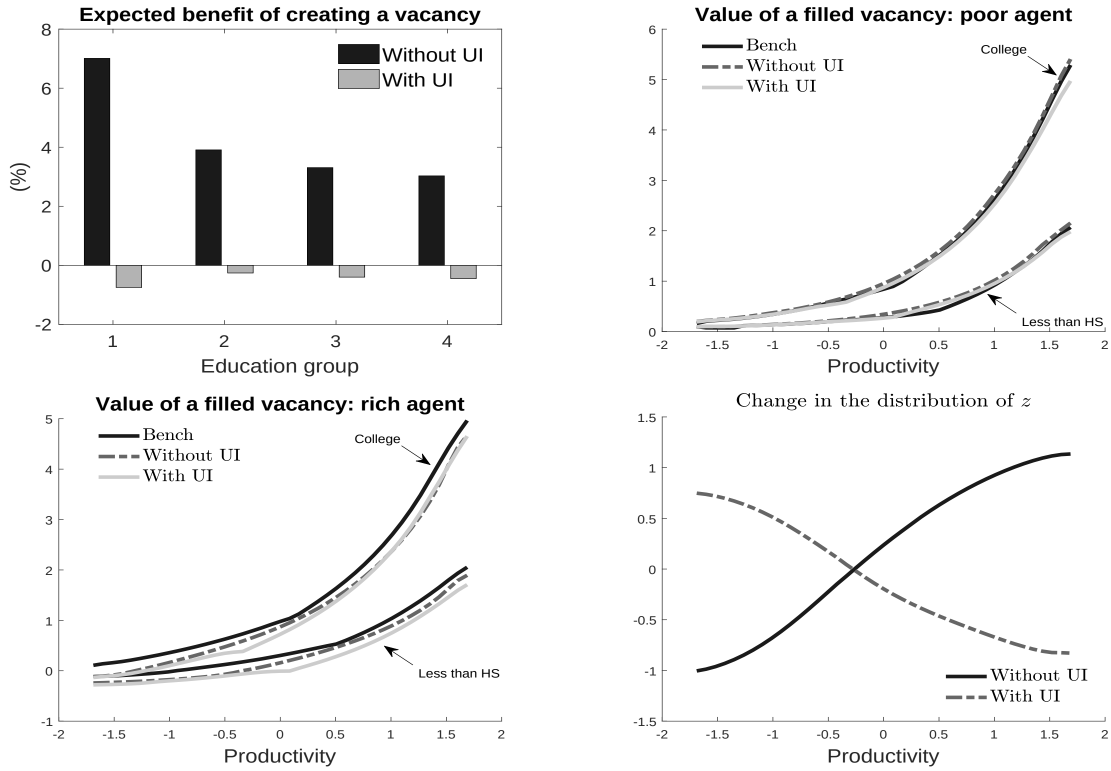
Assuming that labor market tightness is kept unchanged, a UI of 20% that replaces all programs would drop the job finding rate by 4.5 percentage points instead of an increase of 17 percentage points in the main experiment. The unemployment rate would increase by 0.4 percentage points, leading to a fall in aggregate labor by 0.7% instead of an increase of 1.6% when tightness is allowed to adjust. The aggregate capital and output fall would be much larger: -21% and -7%, respectively.

Finally, keeping the interest rate at the benchmark level would lead to an output growth of 2.7%, largely explained by an increase in capital of 5.5%. Job finding probability would not increase as much as the main experiment due to a fall of nearly 1% in search intensity.

All in all, these exercises highlight that despite the extra burden of higher taxes to fi-

[18]Since we keep τ_w at the benchmark, we allow the wasteful government expenditure G to adjust to balance the government budget.

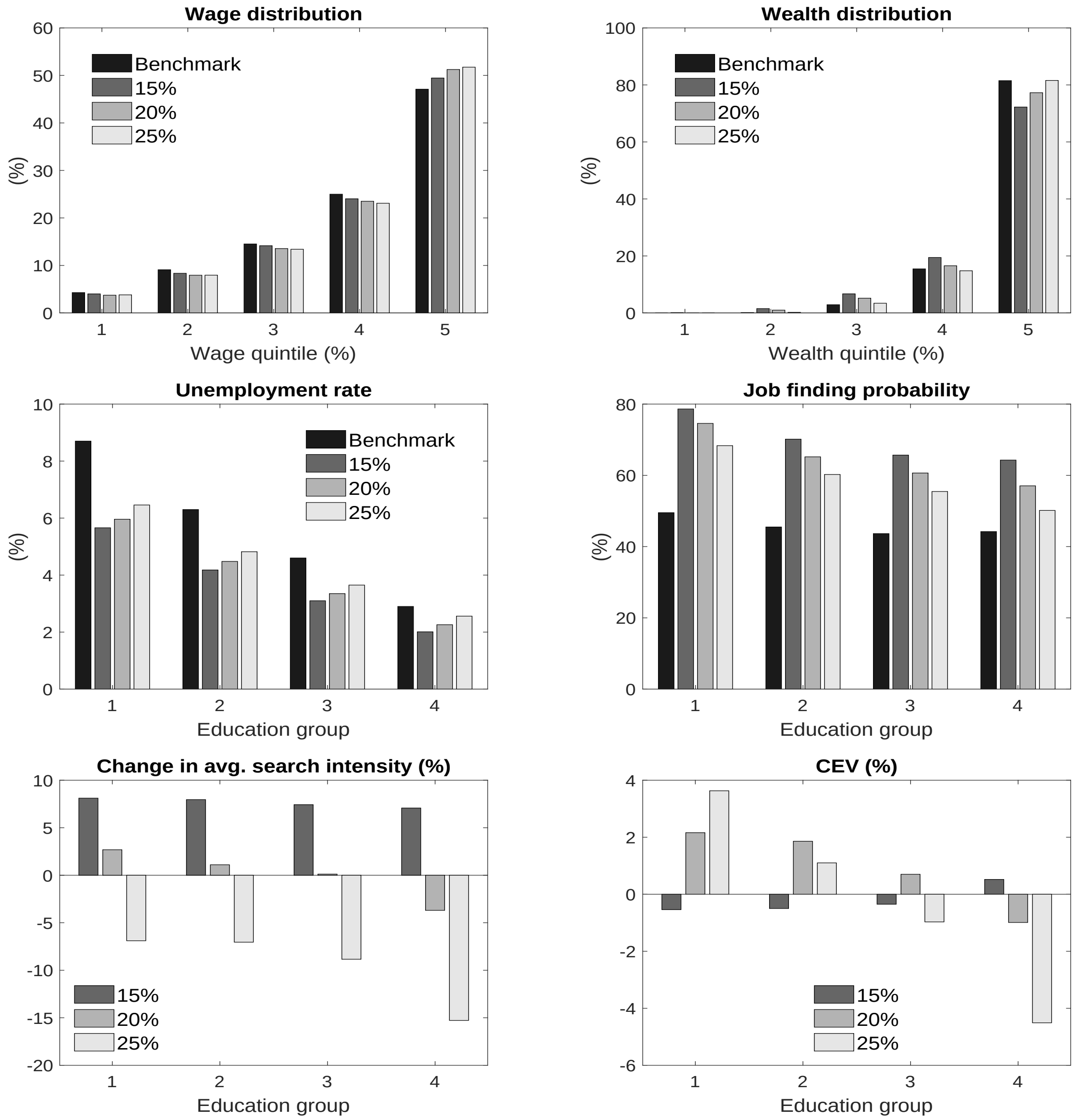
Figure 8: Understanding the impact of UBI on job creation



Notes: Top left panel shows the right hand side of the vacancy creation condition – equation 15 – by education level. Top right panel shows the value of a filled vacancy, $J(a, e, z)$, by z (log scale) and by education level for a worker with low a. $J(a, e, z)$ is shown for the benchmark (black line), for the economy where UBI is 20% without UI (dashed dark gray) and for the economy where a UBI of 20% is pared with UI (light gray). Bottom left panel shows $J(a, e, z)$ when a is high. The bottom right panel shows the percentage change in the distribution of z compared to the benchmark. Education group: 1=less than high school, 2=high school, 3=some college, and 4=college graduate.

nance UBI, the increased action in hiring makes up for the associated welfare losses, and it is a key channel through which less-educated groups improve with the reform despite their sizable fall in wages and an overall rise in wage inequality. Moreover, although distributing the same amount to everyone, including the very rich, the UBI reform can still result in redistribution to the poor since it is financed through progressive taxation.

Figure 9: The impact of different levels of UBI without UI



Notes: The figure shows the shares of total wages and wealth (top) going to each quintile in the benchmark (black) and when UBI is 15% (dark gray), 20% (gray), and 25% (light gray) of mean benchmark income. Similarly, the remaining panels show the unemployment rate, job finding probability, change in mean search intensity, and change in CEV for each education group (1 is less than high school, 2 is high school, 3 is some college, and 4 is college graduate).

Table 4: Decomposition - UBI 20% without UI

Variable	Benchmark	UBI 20%	Keeping at the benchmark: Taxes	θ_e	r
Aggregate output Y	100	+0.54%	+4.95	-7.06%	+2.71
Aggregate capital A	100	-1.89%	+12.63	-20.81%	+5.52
Consumption	100	-1.00%	+19.55%	-17.37%	+1.74%
$Labor$	100	+1.62%	+1.79	-0.66%	+1.51
Mean human capital	100	+0.39%	+0.42%	-0.13%	+0.37%
Unemployment rate u	5.03%	3.65%	3.51%	5.45%	3.75%
Mean job finding prob.	45.06%	62.44%	65.09%	40.40%	60.66%
Mean search intensity	100	+0.16%	+1.73	-6.28%	-0.98
Mean wage	100	-2.82%	+6.97%	-15.77%	+0.12%
Mean income	100	-0.55%	+3.42%	-9.84%	+1.81%
Interest rate r	0.65%	0.70%	0.54%	0.95%	0.65%
τ_w	22.36%	41.90%	22.36%	45.87%	40.24%
B_{UBI}/Y	—	8.47%	8.12%	10.07%	8.29%
			Gini		
Gross income	0.495	0.515	0.504	0.590	0.499
Net income	0.398	0.377	0.378	0.412	0.367
Consumption	0.329	0.326	0.325	0.350	0.320
Assets	0.779	0.743	0.728	0.820	0.720
			Welfare		
CEV	—	0.68%	19.92%	-21.38%	4.44%
CEV employed	—	0.85%	19.46%	-22.11%	3.73%
CEV unemployed	—	-1.50%	7.88%	-15.59%	2.10%

Notes: The table presents changes to the economy when eliminating transfers, EITC, and UI, while introducing UBI of 20% of mean benchmark income. In the column 'Taxes' we keep taxes, in 'θ_e' labor market tightness, and 'r' the interest rate at the benchmark level. Marked with '+/-' are relative changes to the benchmark economy set to 100 for outcomes for which levels do not have an obvious interpretation. For outcomes for which levels have a clear interpretation, we present actual levels indicated by the level in the benchmark column.

Conclusions

Transfers to poorer households help buffer shocks but can disincentivize precautionary savings and work. The US, and many other developed countries, spend a considerable amount of money on transfers. In this paper, we look at how transfers and the EITC affect the US economy, inequality, and welfare. To do so, we calibrate a rich heterogeneous agent search-and-matching model with incomplete markets to the US economy while incorporating transfer functions estimated using microdata.

When we shut down the EITC in a counterfactual exercise, we find benign negative effects on the economy and welfare. On the other hand, removing transfers boosts the economy but leaves the average person worse off due to the extremely low consumption associated with unemployment.

Universal basic income has become a much discussed policy option with little real-world evidence to draw from. We fill this gap by simulating an economy in which we withdraw all transfer programs and replace them with different levels of UBI. Within these experiments, we also investigate the differential impact when pairing UBI with unemployment insurance versus UBI without unemployment insurance.

When paired with unemployment insurance, we find that economic activity across all dimensions drops rapidly as the level of UBI increases. The reason is that unemployment is a relatively comfortable state with both unemployment insurance and a higher level of UBI and precautionary savings cease to be necessary. We find that at 20% of mean benchmark income, a world with UBI paired with unemployment insurance dominates the benchmark economy for almost three-quarters of individuals. However, these welfare gains are heavily concentrated amongst the less educated and the unemployed. When also removing unemployment insurance, political support in a referendum compared to the benchmark economy would be equally high, but gains would be much less concentrated. While the college-educated would still on average be unhappy with such a policy given that they are financing most of the handouts through increased taxes, the majority would prefer the assured inflow of cash. Moreover, overall economic output would actually be higher than in the benchmark.

One reason the overall economy does not contract is that, because of the universal nature of lump-sum transfers, the disincentives to (search for) work are reduced. Therefore a positive side effect of UBI, which is mostly overlooked in other models, is that vacancy creation is also more attractive given the reduced frictions. In a decomposition exercise, we find that the increase in labor market tightness is the key driver of the gains.

This project brings us a step closer to understanding the overall impact the introduction of UBI would have. However, other proposals of UBI include even replacing social security. This sort of interesting question is left to future research.

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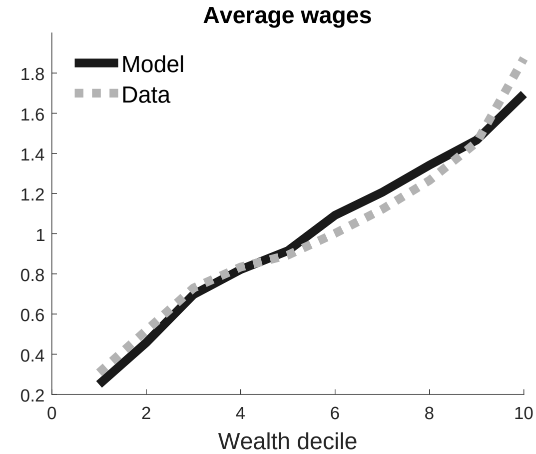
A Additional tables and figures

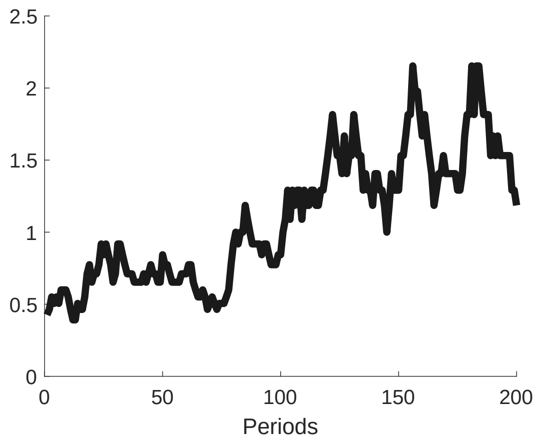
Figure A.1: Average wages



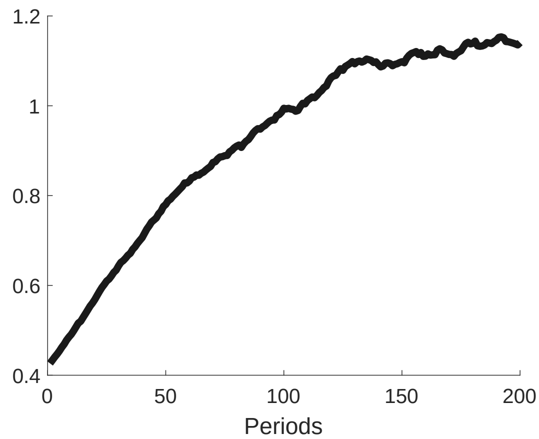
Notes: Average wages are normalized to 1 both in the data and in the model.

Figure A.2: Life-cycle profile of human capital

(a) Human capital of a random agent

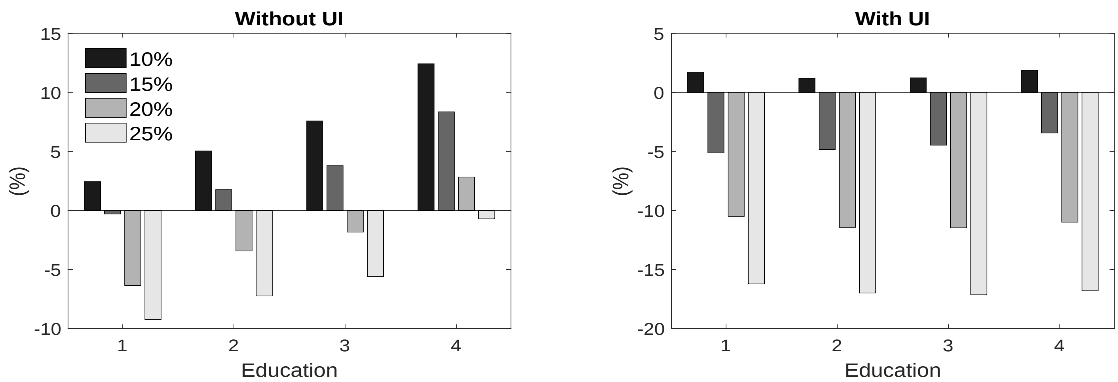


(b) Mean human capital



Notes: One model period on the x-axis is equivalent to 1.5 months. Panel a) shows the human capital, e^z, for a single random agent who enters the market with mean human capital. Panel b) shows the average human capital of a sample of newborns who enters the market with mean human capital.

Figure A.3: Change in average wage by education



Notes: The figure shows the change in average wages by education groups relative to the benchmark. The left panel shows the case where when all programs are replaced by UBI, while the right panel shows the results when UI is kept in place. The change when UBI is 10% is represented by the black bar, 15% by the dark gray bar, 20% by the gray bar, and 25% by the light gray bar.

Table A.1: Universal basic income with unemployment insurance

		Fraction of average income at the baseline			
Variable	Benchmark	10%	15%	20%	25%
Aggregate output Y	100	+1.27%	-2.38%	-6.16%	-9.86%
Aggregate capital A	100	+2.89%	-7.10%	-16.83%	-24.53%
Consumption	100	+0.97%	-2.82%	-2.44%	-10.14%
$Labor$	100	+0.58%	-0.26%	-1.10%	-2.62%
Mean human capital	100	+0.06%	-0.09%	-0.23%	-0.60%
Unemployment rate $u\%$	5.03	4.48%	5.16%	5.83%	7.11%
Mean job finding prob.	45.06%	51.07%	43.58%	38.29%	30.98%
Mean search intensity	100	+7.59%	-2.85%	-10.60	-20.19%
Mean wage	100	+1.50%	-4.22%	-11.17%	-16.82%
Mean income	100	+1.17%	-1.55%	-5.39%	-9.34%
Interest rate r	0.65%	0.63%	0.74%	0.88%	0.99%
τ_w	22.36%	28.76%	37.63%	44.88%	59.70%
B_{UBI}/Y	—	4.21%	6.55%	9.08%	11.82%
			Gini		
Gross income	0.495	0.484	0.493	0.523	0.533
Net income	0.398	0.395	0.379	0.378	0.361
Consumption	0.329	0.344	0.326	0.324	0.302
Assets	0.779	0.730	0.769	0.807	0.827
			Welfare		
CEV	—	-5.83%	-2.55%	0.01%	-3.29%
CEV employed	—	-4.94%	-2.75%	-0.78%	-4.79%
CEV unemployed	—	-12.02%	3.21%	16.67%	23.85%
Political support	—	57.38%	72.15%	75.96%	58.18%

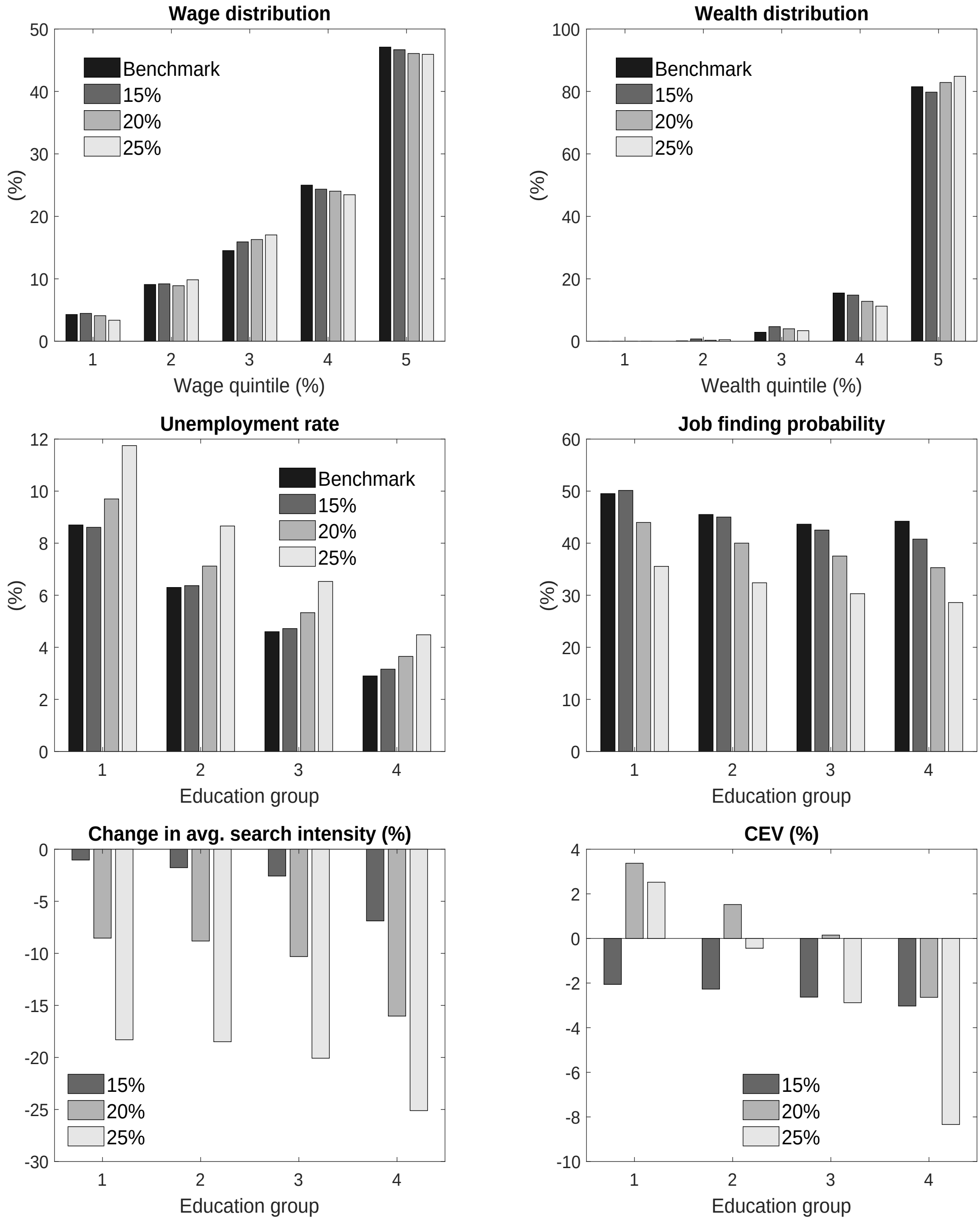
Notes: The table presents changes to the economy when eliminating transfers and EITC, while introducing UBI of 10%, 15%, 20%, and 25% of mean benchmark income. Marked with '+/-' are relative changes to the benchmark economy set to 100 for outcomes for which levels do not have an obvious interpretation. For outcomes for which levels have a clear interpretation, we present actual levels indicated by the level in the benchmark column.

Table A.2: Universal basic income without unemployment insurance

		Fraction of average income at the baseline			
Variable	Benchmark	10%	15%	20%	25%
Aggregate output Y	100	+5.73%	+4.20%	+0.54%	-4.08%
Aggregate capital A	100	+14.46%	+9.54%	-1.89%	-15.55%
Consumption	100	+2.61%	+2.25%	-1.00%	-6.31%
$Labor$	100	+2.15%	+1.96%	+1.62%	+1.21%
Mean human capital	100	+0.48%	+0.45%	+0.39%	+0.34%
Unemployment rate u	5.03%	3.20%	3.37%	3.65%	3.98%
Mean job finding prob.	45.06%	71.80%	68.05%	62.44%	56.58%
Mean search intensity	100	+12.86%	+7.67%	+0.16%	-9.49%
Mean wage	100	+8.34%	+4.67%	-2.82%	-6.25%
Mean income	100	+4.43%	+2.69%	-0.55%	-1.23%
Interest rate r	0.66%	0.52%	0.57%	0.70%	0.89%
τ_w	22.36%	26.19%	33.00%	41.90%	51.75%
B_{UBI}/Y	—	4.03%	6.13%	8.47%	11.10 %
		Gini			
Gross income	0.495	0.492	0.487	0.515	0.515
Net income	0.398	0.410	0.381	0.377	0.355
Consumption	0.329	0.364	0.334	0.326	0.298
Assets	0.779	0.697	0.700	0.743	0.766
		Welfare			
CEV	—	-9.01%	-0.19%	0.68%	-0.74%
CEV employed	—	-8.14%	-0.21%	0.85%	-1.82%
CEV unemployed	—	-30.64%	-11.67%	-1.50%	2.22%
Political support	—	40.63%	52.15%	74.91%	68.38%

Notes: The table presents changes to the economy when eliminating transfers, EITC, and UI, while introducing UBI of 10%, 15%, 20%, and 25% of mean benchmark income. Marked with '+/-' are relative changes to the benchmark economy set to 100 for outcomes for which levels do not have an obvious interpretation. For outcomes for which levels have a clear interpretation, we present actual levels indicated by the level in the benchmark column.

Figure A.4: The impact of different levels of UBI with UI



Notes: UBI substitutes for the welfare programs but UI is kept in place. The figure shows the shares of total wages and wealth (top) going to each quintile in the benchmark (black) and when UBI is 15% (dark gray), 20% (gray), and 25% (light gray) of mean benchmark income. Similarly, the remaining panels show the unemployment rate, job finding probability, change in mean search intensity, and change in CEV for each education group (1 is less than high school, 2 is high school, 3 is some college, and 4 is college graduate).