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Abstract

How costly are the imperfections of conditional welfare programs? Should we replace these programs with a Universal Basic Income (UBI)? We answer these questions using a general equilibrium model with incomplete markets, accounting for three overlooked imperfections of real-life conditional programs: incomplete take-up, illegitimate transfers, and administrative costs. We find that these imperfections, especially incomplete take-up, significantly reduce welfare. Also, diverting almost half of the current welfare expenditure to finance a UBI would maximize welfare by mitigating distortions and reaching those in the dead angle of conditional programs. Conditional programs and UBI are, then, complementary policy instruments, a finding unveiled by accounting for the imperfections of conditional programs.

Keywords: Universal Basic Income; Welfare System; Take-up; Illegitimate Transfers; Administrative Costs; Labor Market Flows.

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1 Introduction

Conditional, or means-tested, welfare programs aim at providing relief to eligible individuals, typically those in need. In practice, these programs work imperfectly. Despite their intent, they fail to reach all the eligible – take-up is incomplete (Moffitt, 1983; Finkelstein and Notowidigdo, 2019). Also, they inadvertently transfer to the ineligible in spite of costly screening and monitoring (Kleven and Kopczuk, 2011). On top of these imperfections, conditional welfare programs distort decisions, including those of savings and labor supply (Heathcote, Storesletten and Violante, 2017). In contrast, a universal basic income (UBI), i.e., a fixed, universal, and unconditional transfer, could reach everyone with minimal administrative costs.[1] Its unconditionality also mitigates distortions (Luduvice, 2024). However, unlike conditional programs, a UBI does not target transfers to the needy.

In this paper, we investigate the macroeconomic and welfare impact of the imperfections of conditional welfare programs. We also assess the consequences of replacing the extant imperfect programs, in whole or in part, with a UBI that is expenditure-neutral, i.e., that costs the same. These are novel and crucial questions. The macroeconomics literature, particularly that evaluating a UBI (e.g., Guner, Kaygusuz and Ventura, 2023; Daruich and Fernández, 2024), assumes that conditional programs are perfect – that they reach all and only the eligible at no cost. We show that this deviation from reality is quantitatively important: the imperfections of conditional programs substantially lower welfare. Also, accounting for them unveils a novel complementarity between conditional programs and UBI: conditional programs target the needy, while a UBI guarantees a safety net to all.

We reach these findings using a model with heterogeneous agents and incomplete markets built and disciplined to resemble the US economy. As in other contributions to the literature, our model accounts for the magnitude and incentive structure of the current welfare system. Yet, we also take up the challenge of modeling three imperfections of conditional welfare programs: incomplete take-up, illegitimate transfers, and administrative costs.

Incomplete take-up occurs when conditional programs do not reach all the eligible. It is a common and sizeable phenomenon. Focusing on US programs, the take-up rate is well below 100%, being closer to 80% for the *Earned-Income Tax Credit* (EITC) and the *Supplemental Nutrition Assistance Program* (SNAP), and as low as 60% for the *Supplemental Security Income* (SSI) and 45% for *Unemployment Insurance* (UI).[2] Take-up is especially low among the neediest (Finkelstein and No-

[1] In the literature, a UBI may refer to any universal income, as in this paper, or only to a universal income large enough to cover basic expenses. It may be seen as a substitute for existing welfare programs, completely or partially, or merely as a complement. For more details, see Van Parijs and Vanderborght (2017), Calsamiglia and Flamand (2019), and Hoynes and Rothstein (2019).

[2] We define take-up rate as the fraction of the eligible that receives the benefit. Claim rate, on the other hand, is the fraction of a group that, irrespective of eligibility, applies for a welfare benefit. See Section 4.2 for the sources of the estimates

towidigdo, 2019; Ko and Moffitt, 2022; Tempelman and Houkes-Hommes, 2016). We model take-up parsimoniously by assuming that claims follow a random process, and that claim rates are typically less than unity and differ with level of education.

Illegitimate transfers occur when conditional programs offer relief to those not entitled to it. They are a significant phenomenon too, reaching up to 10% of the value of SNAP and SSI transfers, and as much as 25% of the EITC's. We model illegitimate transfers by allowing a fraction of a program's total transfers to go to ineligible claimants and to overpay eligible recipients.

Finally, in addition to incomplete take-up and illegitimate transfers, conditional programs require resources for screening and monitoring. Administrative or overhead costs can be as little as 1% of the total spent on transfers, as in the EITC, but they can also be sizable, reaching more than 6% of spending on SNAP, 10% on UI, and 12% on SSI transfers. We model these costs by allowing a proportion of what the government spends on conditional programs to benefit no one.[3]

A UBI would be mostly free of those imperfections. Since it is a universal transfer, it is bound to achieve near complete take-up.[4] It therefore holds the promise of bringing relief to those whom conditional programs fail to reach. Illegitimate payments should also be several orders of magnitude smaller than in existing programs, mostly limited to duplicate payments or cases of identity theft. Finally, the trivial administrative costs of the EITC, a relatively complex tax credit, indicate that a UBI's administrative costs should be negligible. Still, a UBI would suffer from challenges of its own. Even though it promises to reach all those in the dead angle of conditional programs, it is a blunt instrument that does not discriminate rich from poor. Consequently, it would inefficiently transfer to those that value transfers relatively less. Its unconditionality would also make it useless for nudging behavior. Conditional and unconditional programs thus suffer from distinct, albeit significant, challenges.

To improve the model's fit to the US economy, enabling its use as a laboratory for policy experiments, it features consumers that are heterogeneous along five dimensions: accumulated assets, labor market state, benefit claimant status, fixed level of education, and stochastic human capital. Moreover, consumers are constrained by their success in matching with firms in a frictional labor market and by taxes and transfers set by the government. Reassuringly, the model performs well in our extensive

in this and the next two paragraphs.

[3] These three imperfections are not independent of each other. For instance, whilst the EITC has lower administrative or overhead costs than the SNAP or the SSI, a much greater proportion of the value of its transfers goes to ineligible recipients. In this paper, we are not concerned with perfecting the existing system or with the trade-offs involved in reforming it. For that, see Kleven and Kopczuk (2011) and Finkelstein and Notowidigdo (2019).

[4] Being unconditional, a UBI could be passively received and, being universal, no stigma should be attached to receiving it. Hence, a UBI addresses the important causes of incomplete take-up: application costs, stigma, and imperfect information (Moffitt, 1983; Finkelstein and Notowidigdo, 2019).

validation exercises.

In our first set of experiments, we quantify the welfare significance of the imperfections of conditional programs. We remove each imperfection separately and then all three together. We find that illegitimate payments have quantitatively negligible effects on welfare, while those of administrative costs are moderate. Incomplete take-up, on the other hand, is associated with a welfare loss of noteworthy magnitude vis-a-vis a perfect system. Its correction would be equivalent to a permanent increase of 1.9% in consumption, almost 9% for those with the lowest level of education. Those with less education tend to claim relief at a relatively low rate and are, simultaneously, poorly protected by their assets against fluctuations in income. They are therefore especially affected by the inability of conditional programs to reach all the eligible. Abstracting from the imperfections of conditional programs, especially incomplete take-up, risks overestimating their capacity to help the needy.

Next, we quantify the welfare impact and investigate other consequences of fully replacing the benchmark welfare system with an expenditure-neutral UBI. By redirecting all the expenditure on the conditional programs we model to finance a UBI, the universal transfer would amount to approximately 1500 USD per year per adult. This reflects a higher total amount of transfers than in the benchmark, made possible by savings on administrative costs. We find that replacing the benchmark system with a UBI would increase job search effort, capital accumulation, and, consequently, output. It would also lower wealth inequality. Indeed, transfers in the benchmark depend on consumers' idiosyncratic states, such as wealth or labor market state, disincentivizing work and wealth accumulation, especially among the poorest. As a UBI is less distortionary, economic activity rises. Further, since an expenditure-neutral UBI spreads the welfare budget across more recipients, the amount going to the worse off falls. For precautionary reasons, they are incentivized to save more than in the benchmark, whilst the better off are incentivized to save less, contributing to the fall in wealth inequality.

Still, despite promoting economic activity and curbing inequality, an expenditure-neutral UBI fully replacing the benchmark welfare system would lower welfare by an average of 0.7% of consumption-equivalent units. Mostly, this is due to the poor and nonemployed becoming less well-insured: while a UBI reaches everybody and increases total transfers, it reduces the amount directed to those in need. Yet, the least educated, who are disproportionately poor and nonemployed, are not the most adversely affected by a UBI. Although their average transfer decreases the most, a UBI partially compensates by providing relief to all, particularly to those in need who previously received no relief from conditional programs.

These findings would be substantially different if conditional programs were free of imperfections, as assumed in the literature. The welfare losses of fully replacing the extant welfare system with a

UBI would increase fivefold, reaching 3.5% of consumption-equivalent units. Also, the least educated would be the hardest hit, as perfect conditional programs reach all the needy. In other words, abstracting from the imperfections of conditional welfare programs risks overestimating the welfare losses of replacing the extant system with a UBI and misidentifying who would be most affected by the change.

Real-world conditional programs, then, provide higher average transfers to those in need but miss eligible, needy recipients and distort economic activity. In contrast, a UBI reaches everyone with fewer distortions but directs less resources to those who benefit most. These observations raise the question of whether the two kinds of programs are complementary, with their combination outperforming either alone. A combination could ensure universal support through a UBI while still primarily targeting those in need via conditional transfers. We investigate this by partially replacing the benchmark welfare system with an expenditure-neutral UBI. We find that the optimal share of expenditure on a UBI is significantly higher than zero – around 40% or about 600 USD yearly per adult. This optimal combination benefits approximately 80.6% of the population across all levels of education and is equivalent to a permanent increase in consumption of 0.3%. The imperfections of conditional programs also drive this result: without them, the optimal UBI share is essentially zero.[5]

Our work contributes to the literature assessing the introduction of a UBI. Among the contributions furthering this goal are those studying existing programs that, like a UBI, offer universal cash transfers. Noteworthy examples are the Alaska Permanent Fund Dividend (Berman, 2018, Jones and Marinescu, 2022, Kozminski and Baek, 2017, Watson, Guettabi and Reimer, 2020), or the universal cash transfer implemented in Iran (Salehi-Isfahani and Mostafavi-Dehzooei, 2018).[6] Other contributions result from the numerous trials and pilot projects across the world (e.g., Haushofer and Shapiro, 2016, Verho, Hämäläinen and Kanninen, 2022).[7] Still, despite generating relevant evidence, enlightening decision-makers and offering proofs-of-concept, there are important questions that the study of existing programs or of pilots cannot illuminate (Hoynes and Rothstein, 2019). Existing programs typically differ from a UBI in crucial details. For instance, the Alaska Permanent Fund Dividend is not tax-funded. Pilots, in turn, usually have a clear and relatively short duration and, therefore, are not intended to create a long-term expectation that transfers will endure. Some are not redistributive but

[5] Relatedly, we find that with a moderate increase in current welfare expenditure, directing all additional funds toward a UBI is preferable to expanding existing programs.

[6] Since 1982, the Alaska Permanent Fund has paid a yearly dividend, usually well above 1000 USD, to virtually every Alaska resident. As for Iran, in late 2010 it replaced several existing subsidies with a sizable, universal cash transfer worth more than a quarter of the median per capita household income. A smaller example is the dividend paid to all adult members of the Eastern Band of Cherokee Indians, distributing part of the profits from the operation of a casino inaugurated in 1997 (Akee et al., 2010, Akee et al., 2018). The number of beneficiaries is relatively small, in the hundreds, even though gross transfers have been as high as 6000 USD in a year.

[7] An example is that implemented by the Finnish authorities. In 2017 and 2018, about 2000 unemployed persons in Finland saw their conditional unemployment insurance replaced by an unconditional monthly transfer worth 631 USD.

instead create net inflows from the outside. Finally, the number of beneficiaries and the magnitude of average and total transfers are too small to induce sizable general equilibrium effects.

An approach like ours is better suited to address the questions we pose. Our work is closest to contributions using general equilibrium models to study tax and transfer systems (such as Boar and Midrigan, 2022, Dyrda and Pedroni, 2023, Ferriere et al., 2023, Heathcote, Storesletten and Violante, 2017, or McKay and Reis, 2016), especially to those looking specifically at UBI. There is a growing number of these, displaying increased diversity in emphases and modeling choices. Daruich and Fernández (2024), Ferreira, Peruffo and Cordeiro Valério (2021), Guner, Kaygusuz and Ventura (2023), and Luduvice (2024), for instance, are especially concerned with modeling family structure and family-level decision making. Like us, Fabre, Pallage and Zimmermann (2014), Jaimovich et al. (2024), and Rauh and Santos (2022) instead put a greater emphasis on the role of labor market frictions. In their turn, Conesa, Li and Li (2023) and Mukbaniani (2021) emphasize the hierarchical importance of different types of needs and the role of a UBI in covering basic consumption necessities.

We make two major contributions to this literature. First, and most importantly, we are the first to explicitly model incomplete take-up and illegitimate transfers.[8] This is consequential as failing to account for incomplete take-up overestimates the effectiveness of conditional welfare programs. Regarding UBI, the literature generally concludes that using it to fully replace existing conditional programs decreases welfare. As the literature abstracts from take-up, this conclusion turns on the trade-off between the distortions from conditionality and its effectiveness in targeting relief to those in need. The consensus is that, for a welfare system resembling that of the US, the distortions generated by conditional programs do not outweigh the redistributive bluntness of a UBI.[9] We find that factoring in imperfections does not change this conclusion, but reveals key complementarities between conditional programs and a UBI. A UBI reaches everyone but fails to exclude the better-off; conditional programs exclude the better-off, but miss some in need. These imperfections have noteworthy welfare consequences, leading to more nuanced results than those in the literature. In particular, the negative impact of a UBI on welfare is neither universal – as the most educated would

[8] A few papers address incomplete take-up by adjusting the calibration. For example, Heathcote, Storesletten and Violante (2017) and Rauh and Santos (2022) calibrate their tax and transfer functions accounting for incomplete take-up, but do not model it directly. They thus implicitly assume that all eligible individuals get the average transfer, overlooking those who get nothing. Within the UBI literature, there are two papers that do model imperfections, including administrative costs. Fabre, Pallage and Zimmermann (2014) contrast a UBI with unemployment insurance that suffers from moral hazard problems and incurs in administrative costs. They find that the optimal unemployment insurance (UI) is preferred to the optimal UBI because UBI does not distinguish the rich from the poor. Yet, in modeling unemployment insurance, they assume that all the unemployed receive UI if unemployed for no fault of their own. In a robustness check, Daruich and Fernández (2024) calculate the magnitude of administrative costs necessary to reverse their benchmark results and conclude that it is implausibly high.

[9] The published version of Luduvice (2024) is an exception. In his model, replacing all conditional welfare programs with a UBI would lead to an increase in output of almost 15% in the long run. This is enough to compensate for the redistributive shortcomings of a UBI.

benefit from a UBI in our benchmark – nor robust, as it hinges on whether a UBI fully replaces existing conditional welfare programs. Accounting for imperfections shows that there is a role for a UBI in the welfare system – not as a full replacement, but as a complementary safety net for all in need.

Second, we model flows across three labor market states: employed, unemployed, and out of the labor force (OLF). To the best of our knowledge, no other paper assessing the tax and transfer system does this.[10] Rauh and Santos (2022), for example, abstract from the OLF, while Jaimovich et al. (2024) allow newborn consumers to remain OLF, but no subsequent transitions into the labor market. By incorporating flows across all three states, we account for the risks of losing a job and leaving the labor force. We also account for the impact of transfers differentiated by labor market state, a common feature in real-life programs. Finally, if a labor market state were left out, the universal transfer in the model would be implicitly conditional to belonging to the modeled states.

We also contribute to another literature, which models and assesses the consequences of imperfections of conditional welfare programs, particularly incomplete take-up. Moffitt (1983) is the seminal contribution, while Chan (2013), Finkelstein and Notowidigdo (2019), Kleven and Kopczuk (2011), and Low et al. (2022) are more recent contributions. Our paper is closer to the few modeling take-up of unemployment insurance in a macroeconomic setting (Birinci and See, 2023; Kekre, 2023). Kekre proposes a parsimonious approach, as in our benchmark, while Birinci and See offer a model with endogenous take-up, similar to that in our extension. Neither studies the welfare consequences of incomplete take-up nor the benefits of a UBI vis-a-vis conditional welfare programs. Our paper is also close to those estimating structural models that endogenize the take-up of welfare programs. Some of these contributions also account for the distortions of welfare programs on savings and labor supply (e.g., Low and Pistaferri, 2015). This literature, however, does not address the questions we pose. Most studies assess particular welfare programs or the impact of the welfare system on a small subset of the population in partial equilibrium, while we assess the general-equilibrium and welfare consequences of the bulk of cash and near-cash US welfare programs for all working-age adults. Also, we compare existing conditional programs with a UBI, unveiling a novel complementarity between these two types of welfare programs that only arises when the imperfections of conditional programs are considered.

In Section 2, we examine a simple endowment economy, a stripped-down version of the model, which evinces the welfare consequences of the imperfections of conditional programs. In this section, we show that a UBI that fully replaces conditional programs can increase welfare even if average

[10] Our paper, therefore, relates to contributions outside the tax and transfer literature, such as Cairó, Fujita and Morales-Jiménez (2022), or Krusell et al. (2017; 2020), who also build models accounting for flows across the three labor market states.

transfers to the worse off fall. If the replacement is only partial, we also show that a UBI increases welfare for a wider range of parameters. We then lay out our full model in Section 3 and describe and explain our calibration strategy in Section 4. We present our experiments and measure the welfare costs associated with the imperfections of the benchmark welfare system in Section 5 and the impact of replacing it, fully or partially, with an expenditure-neutral UBI in Section 6. In Section 7, we explore two extensions of the model and show that conditional welfare programs and UBI remain complementary, even if claim rates or OLF flows are endogenous. We conclude in Section 8.

2 A Simple Endowment Model

2.1 Environment

Consider an endowment economy whose consumers have the same preferences, measured by a utility function $u(\cdot)$, but differ in their exogenously fixed endowment $y \in \{y_L, y_H\}$, $y_H > y_L$. To alleviate this inequality, a government runs a conditional welfare program transferring from those with endowment y_H to the rest. This conditional program suffers from three imperfections. First, take-up is incomplete: all consumers with y_L are eligible, but only a fraction $0 < \psi < 1$, the exogenously fixed take-up rate, does receive a transfer. Second, not all transfers are legitimate: some end up going back to those with endowment y_H. Third, there are administrative costs: screening claimants and monitoring recipients divert a fraction $\iota \geq 0$ of the amount collected from those with y_H.

2.2 The Costly Imperfections of Conditional Programs

Let T_L (T_H) denote the average transfer to those with low (high) endowment. Each low-endowment recipient gets T_L/ψ. The welfare burden of incomplete take-up may be measured by:

$$\Xi \equiv u(y_L + T_L) - \left[\psi u\left(y_L + T_L/\psi\right) + (1-\psi)u(y_L)\right]. \tag{1}$$

Proposition 1 *Let $u(\cdot)$ be a strictly increasing, strictly concave, continuously differentiable function with a strictly convex first-order derivative, $0 < \psi < 1$, y_L>0, and T_L>0. Then:*

i) $\Xi > 0$

ii) Ξ *decreases with* ψ

iii) Ξ *increases with* T_L

iv) Ξ *decreases with* y_L

Proof *See Appendix A.1.*

Proposition 1 shows that, under standard assumptions, the welfare outcome of a conditional welfare program is worse when take-up is incomplete. This is true among the eligible and, consequently, in the aggregate. The welfare loss is greater, the lower the take-up rate, as the consumption inequality among low-endowment consumers increases. Furthermore, more generous programs, i.e., with greater T_L, have, in this setting, better welfare outcomes among the eligible. They are also better in the aggregate as long as $y_L + T_L/\psi$ is less than the endowment of high-endowment consumers net of taxes and transfers, a further assumption we make throughout this section. Proposition 1, however, shows that the welfare burden due to incomplete take-up grows with the generosity of the program, as a higher T_L, for a given ψ, increases the consumption inequality among low-endowment consumers. As for y_L, it lessens the satisfaction that any given transfer brings to its recipients. Consequently, if it is higher, less is lost by those the program does not reach.

Turning to illegitimate transfers, the more trickles up to the high-endowment consumers, T_H, the lower the T_L, which diminishes the welfare effects of the conditional program. Finally, the more is diverted to the wasteful running of the conditional program, ι, the less actually reaches recipients.

2.3 UBI vs. Imperfect Conditional Programs

A UBI promises to reach those in the dead-angle of conditional programs at a negligible administrative cost. Yet, it is a blunt instrument that does not discriminate high-endowment from low. Consequently, barring implausibly high administrative costs, those with a low endowment would receive a lower average transfer with an expenditure-neutral UBI. This, however, need not imply that they would become, on average, worse off.

To see this, let ξ_1 measure by how much average transfers could be reduced without welfare loss if take-up were complete, i.e., to be such that:

$$u(y_L + (1-\xi_1)T_L) = \psi u\left(y_L + T_L/\psi\right) + (1-\psi)u(y_L). \tag{2}$$

Proposition 2 *Under the assumptions of Prop. 1:*

i) $\Xi > 0$ *iff* $\xi_1 > 0$

ii) $0 < \xi_1 < 1$

iii) ξ_1 *decreases with* ψ

iv) $\xi_1 . T_L$ *increases with* T_L*. If the utility function displays constant absolute or relative risk aversion, then* ξ_1 *increases with* T_L

v) If the utility function displays constant absolute risk aversion, then ξ_1 does not vary with y_L. If it displays constant relative risk aversion, then ξ_1 falls with y_L

Proof *See Appendix A.2.*

ξ_1 is a strictly positive magnitude. Consequently, if the introduction of an expenditure-neutral UBI lowers average transfers to low-endowment consumers by less than ξ_1, i.e., if $UBI > (1-\xi_1)T_L$, then these consumers would benefit, on average, from the unconditional program. In this case, the welfare gains of the eligible, but formerly non-recipient, consumers would more than compensate the welfare loss of the eligible, and formerly recipient, consumers resulting from the reduction in the average value of transfers.

Proposition 2 establishes that a UBI's welfare performance, relative to the existing program, is better when take-up is low, when the size of the existing welfare program is greater, and when those in the dead-angle of conditional programs have less.

The performance of a UBI also rises with T_H and ι. A higher T_H means that the conditional program, like the UBI, also transfers to those that do not need, while saving on administrative costs associated with conditionality allows a higher average transfer.

In the literature, the imperfections of conditional welfare programs are mostly neglected. Under the assumption of a perfect welfare system ($\psi = 1$, $T_H = 0$, $\iota = 0$), an expenditure-neutral UBI stands little chance of increasing the welfare of low-endowment consumers. To see this, notice that, in a perfect system, $UBI < T_L + T_H = T_L$, as the UBI also reaches high-endowment consumers. Consequently $u(y_L + UBI) < u(y_L + T_L)$. Only if the introduction of a UBI were associated with a substantial increase in y_L would low-endowment consumers benefit. A rise in y_L is expected insofar as conditional welfare programs tend to be more distortionary. Yet, most of the extant literature and the results of the full model suggest that the order of magnitude of such distortions is too low.

2.4 UBI as a Complement to Imperfect Conditional Programs

Conditional programs fail to reach all low-endowment consumers, but limit wasteful transfers to the better-off. In contrast, a UBI reaches everybody, but distributes aid to those that do not need it. A combination of both captures the strengths of each.

To see this, suppose that a proportion $0 < a < 1$ of T_L is now allocated to a UBI. In other words, the conditional transfer to eligible consumers that take-up the conditional program falls to $(1-a)T_L/\psi$, while all consumers now receive a UBI. Low-endowment consumers receive a lower transfer on average, since high-endowment consumers now benefit equally from the UBI. Yet, no low-endowment consumer is left out. Define ξ_2, analogously to ξ_1, as the share of the UBI benefiting high-endowment consumers that leaves low-endowment consumers on average indifferent, i.e., to be such that:

$$\psi u\left(y_L + (1-a)T_L/\psi + a(1-\xi_2)T_L\right) + (1-\psi)u\left(y_L + a(1-\xi_2)T_L\right) = \psi u\left(y_L + T_L/\psi\right) + (1-\psi)u(y_L) \quad (3)$$

Proposition 3 *Under the assumptions of Proposition 1:*

i) $0 < \xi_2 < 1$

ii) $\xi_1 < \xi_2$

Proof *See Appendix A.3.*

In the previous section, we demonstrated that a UBI fully replacing the conditional program cannot reduce average transfers to low-endowment consumers by more than ξ_1 without making them worse-off. However, part (ii) of Proposition 3 shows that, with a partial replacement, these consumers tolerate a larger proportional reduction in transfer ($\xi_2 > \xi_1$) without welfare loss. This is because the remaining conditional program ensures their average transfers stay higher than under a full replacement. In other words, even if a full replacement lowers welfare, a partial replacement might increase it, pointing towards a possible complementarity between conditional and unconditional welfare programs. This complementarity is what we observe in the full model.

2.5 Conclusion

The findings in this section hinge on assumptions ubiquitous in macroeconomic models.[11] They are relevant to all models that shed light on the advantages and disadvantages of a UBI relative to extant conditional welfare programs. They highlight that whether an expenditure-neutral UBI increases welfare depends on how programs function in practice, warts and all. Hence, since existing estimates of the welfare losses of a UBI abstract from the imperfections of extant programs, they offer upper bounds for that loss. It also shows that a combination of an imperfect conditional program and a UBI leverages the strengths of each. In the next section, we develop a much richer model of an economy as a laboratory to quantify the welfare and macroeconomic effects of introducing an expenditure-neutral UBI. A key message from this richer model is that the results in this section are not only qualitatively but also quantitatively relevant: neglecting the imperfections of the welfare system implies a sizable overestimation of the welfare losses of a UBI. This neglect also hides the complementary and welfare-enhancing role that a UBI can play as a universal safety net within real world welfare systems.

[11] Assumed, for example, by any model with constant relative risk aversion or exponential utility.

3 Model

We build an artificial economy in continuous time with incomplete markets and without aggregate uncertainty (such as Aiyagari, 1994; Bewley, 1986; Huggett, 1993). As in the economy of Krusell, Mukoyama and Şahin (2010), heterogeneous consumers meet and bargain with firms in a labor market characterized by matching frictions. The government collects taxes on consumption and on capital and labor incomes to finance spending and transfers. We study the economy's stationary general equilibrium.

3.1 Consumers

The economy is populated by a measure one continuum of infinitely-lived, risk-averse, dynastic consumers perpetually in working age.[12] They are heterogeneous along five dimensions: accumulated assets, a; labor market state, n; benefit claimant status, b; exogenously-given fixed level of education, z; and stochastic human capital resembling work experience, ζ.

3.1.1 Objective Function

Consumers choose consumption, c_t, and, if nonemployed, job search effort, s_t, to maximize lifetime utility:

$$\mathbb{E}_0 \int_0^\infty e^{-\rho_z t} u(c_t, s_t) \mathrm{d}t, \tag{4}$$

where $\mathbb{E}$ is the expectation operator, t denotes time, $u(\cdot)$ is instantaneous utility (such that $u_c(\cdot) > 0$, $u_{cc}(\cdot) < 0$, $u_s(\cdot) < 0$, $u_{ss}(\cdot) \leq 0$), and ρ_z is a discount rate dependent on consumers' level of education.[13]

3.1.2 Budget Constraint and Asset Holdings

A consumer's choices are constrained by a budget:

$$\dot{a}_t = \bar{w}_t(a,n,b,z,\zeta) + T_t(a,n,b,z,\zeta) + (1-\tau_a)(r_t - \delta)a_t - (1+\tau_c)c_t, \tag{5}$$

[12] As discussed by Hubmer, Krusell and Smith. (2021), the choice of dynastic consumers implicitly defines a bequest function. As there are no clear microeconomic estimates of such functions, our assumption conveniently introduces the bequest motive, which is typically disregarded in other papers studying the effects of a UBI.

[13] Assuming heterogeneous discount rates allows us to better capture the wealth differences among workers of different levels of education. Other papers in the literature also allow for them: e.g., Krusell and Smith (1998), Krueger, Mitman and Perri (2016), Hubmer, Krusell and Smith. (2021), and Rauh and Santos (2022). See also Falk et al. (2018) for experimental evidence.

where r_t and δ refer to the gross return and depreciation rate of capital, τ_a is the capital income tax, and τ_c is the consumption tax. $\bar{w}_t$ is net labor income, which refers to after-tax wages in the case of employed consumers or, in that of the nonemployed, to home production in the amount $h(z,\zeta)$ (as in Boerma and Karabarbounis, 2021).[14] T_t are transfers received. Taxation and transfers are discussed in Section 3.2.

The assets accumulated by a consumer, a, are claims on the total assets in the economy. These, as in Krusell, Mukoyama and Şahin (2010), are composed of aggregate capital, K, and the value of firms, Ω, both with an equal equilibrium return of $r-\delta$, due to arbitrage.[15] Asset holdings observe a lower-bound, or borrowing limit, dependent on the level of education:

$$a_t \geq \underline{a}_z. \tag{6}$$

3.1.3 Labor Market State

The labor market is segmented by level of education and stochastic human capital (z,ζ). In each segment, consumers can be employed (e), unemployed (u), or out of the labor force (OLF, o). The indicator function n^x, $x \in \{e,u,o\}$, denotes labor market state.

Job-search effort affects the likelihood of finding a job. Its intensity is given by $s(a,n^x,b,z,\zeta)f(z,\zeta)$. $s(a,n^x,b,z,\zeta)$ denotes the search effort of the unemployed $(x=u)$ or the OLF $(x=o)$, while $f(z,\zeta)$ is the job-finding rate per unit of search effort in the segment (endogenized in Section 3.4.1). Since OLF consumers do, in fact, find jobs without actively looking, we distinguish them from unemployed consumers by assuming that they search passively if moving to employment would increase lifetime utility. Hence, $s(a,n^o,b,z,\zeta) \in \{s_o^z,0\}$, where $s_o^z>0$ measures passive search effort and depends on the level of education z.

Finally, we assume that a constant exogenous fraction, m_{eu}^z, of employed consumers with level of education z become unemployed. Similarly, there are exogenous flows from employment and unemployment to out of the labor force and from out of the labor force to unemployment. We denote their intensities by m_{eo}^z, m_{uo}^z, and m_{ou}^z, all varying with z.

[14] Home production is a perfect substitute for the market good. The evidence in Boerma and Karabarbounis suggests that it significantly affects inequality.

[15] Consumers are not allowed to own equity of an individual firm. Also, assuming that arbitrage holds frees us from tracking portfolio compositions.

3.1.4 Stochastic Human Capital

Consumers are further constrained by the stochastic processes for human capital. As in the literature (Ljungqvist and Sargent, 1998; Kehoe, Midrigan and Pastorino, 2019), they tend to accumulate human capital when employed and lose it when nonemployed. To capture this, we use bounded Ornstein-Uhlenbeck processes for stochastic human capital, ζ:

$$d\zeta = \theta_\zeta(\zeta_e - \zeta(t))dt + \sigma_\zeta d\mathtt{W}(t), \tag{7}$$

$$d\zeta = \theta_\zeta(\zeta_o - \zeta(t))dt + \sigma_\zeta d\mathtt{W}(t), \tag{8}$$

where Eq. (7) applies to employed consumers and Eq. (8) to the nonemployed. These stochastic processes observe exogenously-imposed upper and lower bounds, $\bar{\zeta}$ and $\underline{\zeta}$. θ_ζ is the rate of mean reversion, σ_ζ denotes volatility, and $\mathtt{W}(t)$ is a standard Brownian motion. ζ_e and $\zeta_o < \zeta_e$ are the long-term means of the respective (unbounded) process.

3.2 Government

Consumers' budgets depend on taxes and transfers set by the government. These are detailed in this section.

3.2.1 Revenues

The government obtains revenues by collecting flat taxes on consumption and capital income, and progressive taxes on labor income. In particular, we follow Benabou (2002) and Heathcote, Storesletten and Violante (2017) and assume that labor income taxes are

$$w(a,b,z,\zeta) - (1-\tau_n)\,w(a,b,z,\zeta)^{1-\lambda_n},$$

which implies that net labor income for employed consumers is

$$\bar{w}(a,n^e,b,z,\zeta) \equiv (1-\tau_n)\,w(a,b,z,\zeta)^{1-\lambda_n}, \tag{9}$$

where λ_n governs the degree of progressivity, while τ_n governs the level.[16] Home production ($\bar{w}(a,n^u,b,z,\zeta) = \bar{w}(a,n^o,b,z,\zeta) = h(z,\zeta)$) is not taxed.

[16]If tax rates are flat ($\lambda_n = 0$), then τ_n is the labor income tax rate.

3.2.2 Expenses

These revenues are spent on unproductive government spending, G, and on transfers and ancillary administrative costs.

There are four conditional programs in the model, mimicking, in a stylized way, various real-world counterparts (Table B1 in Appendix B.7 summarizes the four programs). First, there are employed benefits subsidizing the labor supply of consumers whose labor income is not too high. Second, there is standard unemployment insurance (UI) for consumers that become unemployed after a long enough period of employment and that have not received UI for too long. Third, there are other unemployed benefits for the unemployed poor who do not receive UI. Finally, there are OLF benefits directed at poor OLF consumers. We use b_l^j as an indicator function denoting benefit-claiming status, where the superscript $j \in \{e, ui, u, o, \varnothing\}$ corresponds to employed benefits, e, unemployment insurance, ui, other unemployed benefits, u, out of the labor force benefits, o, and no benefits, $\varnothing$; the subscript $l \in \{ui, \varnothing\}$ only applies to employed benefits to denote eligibility for UI. We denote the corresponding value of transfers by $B(a, n, b_l^j, z, \zeta)$.

Real-life conditional benefit programs are characterized by incomplete, and sometimes very low, take-up: only a fraction of the eligible do receive a transfer. We model incomplete take-up in a parsimonious way, abstracting from its causes.[17] Regarding employment, other unemployment, and OLF benefits, we assume that claims follow a random process. Only a proportion ψ_x^z of those that move to any labor market state $x \in \{e, u, o\}$ or lose eligibility for UI claim the respective benefits. The claim rate is then ψ_x^z, dependent on the level of education. Besides claiming, to receive benefits consumers must also fulfill categorical or means-testing conditions on income or wealth. For instance, those entitled to unemployment insurance are not entitled to other unemployed benefits.

The take-up rate of each type of benefit is then given by the proportion of those that are eligible and that do receive it. Insofar as the claim rate is less than one ($\psi_x^z < 1$), then so is the take-up rate. These two rates are, however, different: claimants have the incentive to behave in a way that grants them eligibility, e.g., by choosing not to search for jobs or by not accumulating assets.

Regarding UI, employed consumers with level of education z become eligible at rate $p_{ui}^{e,z}$, capturing incomplete take-up and that eligibility requires a sufficiently long period of employment as well as the satisfaction of an earnings test. If eligible consumers become unemployed, they always claim, and get, UI transfers. Consumers receiving these transfers lose eligibility at rate p_{ui}^{u}, which only

[17] In Section 7.1, we offer a version of our model with endogenous take-up. We choose the parsimonious model as our benchmark because our goal is not to explain incomplete take-up, but to understand its macroeconomic and welfare implications in the benchmark system. Additionally, the simpler version is computationally less demanding and offers greater flexibility for considering extensions, such as accounting for endogenous OLF flows.

depends on the duration of unemployment.

Besides incomplete take-up, real-life programs suffer from two additional imperfections: illegitimate transfers and administrative costs. Illegitimate transfers include over-payments to eligible consumers and payments to ineligible consumers. We model this phenomenon by assuming that all claimants receive some payment, however small, that they are not entitled to. As for administrative costs, they are simply modeled as a fraction, ι_j where $j \in \{e, ui, u, o\}$, of the total value of transfers in the program.

Finally, in addition to the four conditional benefits, the model includes an unconditional transfer directed at all consumers, a universal basic income, UBI. All consumers receive the same UBI transfer, i.e., there is complete take-up. We also assume that there are no illegitimate transfers or administrative costs.

The transfers a consumer receives are, then, given by $T(a, n, b_l^j, z, \zeta) = UBI + B(a, n, b_l^j, z, \zeta)$.

3.2.3 The Balanced Budget

The government runs a balanced budget:

$$\begin{aligned} &\sum_z \sum_b \int_{\underline{\zeta}}^{\bar{\zeta}} \int_{\underline{a}}^{\infty} \left[w(a,b,z,\zeta) - (1-\tau_n) w(a,b,z,\zeta)^{1-\lambda_n} \right] g(a, n^e, b, z, \zeta) \mathrm{d}a\mathrm{d}\zeta \\ +\tau_c &\sum_z \sum_b \sum_n \int_{\underline{\zeta}}^{\bar{\zeta}} \int_{\underline{a}}^{\infty} \left[c(a,n,b,z,\zeta) - h(n,z,\zeta) \right] g(a,n,b,z,\zeta) \mathrm{d}a\mathrm{d}\zeta + \tau_a (r-\delta)(K+\Omega) = \\ &(1+\iota_e)\left(\bar{B}^e_{e,ui} + \bar{B}^e_{e,\varnothing}\right) + (1+\iota_{ui})\bar{B}^u_{ui} + (1+\iota_u)\bar{B}^u_u + (1+\iota_o)\bar{B}^o_o + UBI + G, \end{aligned} \tag{10}$$

where $g(\cdot)$ is the density function of the consumers' distribution detailed in Section 3.6.1, and $\bar{B}^x_{j,l} \equiv \sum_z \int_{\underline{a}}^{\infty} B(a, n^x, b_l^j, z, \zeta) g(a, n^x, b_l^j, \zeta, t) \mathrm{d}a$ are transfers to consumers in labor market state n^x and benefit status b_l^j. The left-hand side of Eq. (10) sums government revenues from labor income, consumption, and capital income taxes. Since home production is consumed but not taxed, we subtract it from consumption. The right-hand side of Eq. (10) sums government transfers and related administrative costs, as well as unproductive government expenditures. Transfers include employed benefits, which depend on wages and thus on whether consumers are eligible for UI. Transfers also include those related to UI, other unemployed benefits, OLF benefits, and UBI.

3.3 Firms

Consumers rely on firms for employment and production. There are two types of firms in the model. Intermediate producers, or labor firms, hire consumers to produce labor services. These are, in turn, sold to final-good producers to produce the final good that is consumed or invested.

3.3.1 Labor Firms

Labor firms open vacancies in a segment of the labor market of their choice, and a free-entry condition is satisfied in each segment. Each labor firm employs at most one consumer (worker). When vacant, it pays the flow cost κ_z, which varies with the level of education of the consumers in the segment. When matched with a consumer characterized by level of education z and stochastic human capital ζ, the firm produces $y_z e^{\zeta}$ units of labor services, where y_z is a productivity factor varying with education. It also pays a wage, $w(a,b,z,\zeta)$, that is bargained as described in Section 3.4.2 and depends on the consumer's idiosyncratic state.

Labor services are sold to final-good producers at the competitive price p_L. Labor firms are homogeneous, but their profits depend on the consumer (worker) they are matched with, since this affects both production and wages. Consequently, the labor firm's value, J, depends on the state (a,b,z,ζ) of the consumer. Labor firms discount future profits at rate $r-\delta$, and are worthless in equilibrium if the match breaks.

For illustration, we present the case of a firm employing a consumer receiving employed benefits but not yet eligible for unemployment insurance. In this case, the value of the firm is given by the following Hamilton-Jacobi-Bellman (HJB) equation:

$$\begin{aligned}(r-\delta+m_{eu}^{z}+m_{eo}^{z})J(a,b_{\varnothing}^{e},z,\zeta) &= y_z e^{\zeta} p_L - w(a,b_{\varnothing}^{e},z,\zeta) + \partial_a J(a,b_{\varnothing}^{e},z,\zeta)\,\dot{a}(a,n^{e},b_{\varnothing}^{e},z,\zeta) \\ &+\theta_{\zeta}(\zeta_e-\zeta)\partial_{\zeta}J(a,b_{\varnothing}^{e},z,\zeta) + \frac{\sigma_{\zeta}^{2}}{2}\partial_{\zeta\zeta}^{2}J(a,b_{\varnothing}^{e},z,\zeta) + p_{ui}^{e,z}\left[J(a,b_{ui}^{e},z,\zeta)-J(a,b_{\varnothing}^{e},z,\zeta)\right].\end{aligned} \tag{11}$$

The left-hand side accounts for the possibility that the match breaks up if the consumer becomes unemployed (m_{eu}^{z}) or OLF (m_{eo}^{z}). On the right-hand side, the first two terms correspond to flow profit, while the third term accounts for the impact that a change in the consumer's asset holdings would have on the bargaining solution and, consequently, on the value of the firm. The subsequent two terms account for changes in human capital, while the last term accounts for changes in benefit status, as eligibility for unemployment insurance tends to increase wages. This last term differentiates the HJB of a labor firm employing a consumer ineligible for unemployment insurance from that of the others (see Appendix B.2 for all possible HJB equations giving labor firm values).

3.3.2 Final-good Producers

Final-good producers rent capital, K, from consumers and buy labor services, L, from labor firms to produce the final good, Y. Their production function is $Y = AF(K,L)$, where A is total-factor productivity. We assume perfect competition, which implies that:

$$r = AF_K,$$
$$p_L = AF_L.$$

where F_K and F_L are the marginal products of K and L.

3.4 Labor Market

Consumers and labor firms meet in a frictional labor market segmented by level of education and stochastic human capital, (z,ζ).

3.4.1 Matching Function

Within each segment, a standard Cobb-Douglas matching function, $M(U, v) \equiv \chi_z v(z,\zeta)^{1-\eta} U(z,\zeta)^{\eta}$, determines the number of matches as a function of total job search effort, U, and vacancies, v, in the segment. Here, η is the elasticity of the matching function with respect to U, while χ_z is the matching efficiency, which depends on z. Hence, the vacancy-filling rate is $q(z,\zeta) \equiv \chi_z \theta(z,\zeta)^{-\eta}$ and the job-finding rate of a unit of search effort is $f(z,\zeta) \equiv \chi_z \theta(z,\zeta)^{1-\eta}$, where $\theta(z,\zeta) \equiv \frac{v(z,\zeta)}{U(z,\zeta)}$ measures labor market tightness as the ratio of vacancies to total search effort in the segment. Total search effort is $U(z,\zeta) \equiv \sum_{n\in\{n^u,n^o\}} \sum_b \int_{\underline{a}}^{\infty} s(a,n,b,z,\zeta) g(a,n,b,z,\zeta) \mathrm{d}a$.

3.4.2 Wage Bargaining

Matched consumers and labor firms bargain over wages according to Kalai's (1977) bargaining, i.e., until

$$(1-\phi)\Big[W(a,n^e,b,z,\zeta) - \tilde{W}(a,n^u,b,z,\zeta)\Big] = \phi J(a,b,z,\zeta),$$

where ϕ represents consumers' bargaining power, the share of the total surplus of the match accruing to them. This equation also solves the Nash bargaining problem under risk neutrality, which is common in the literature. $W(a,n,b,z,\zeta)$ stands for the lifetime utility of a consumer in state (a,n,b,z,ζ), while $\tilde{W}(a,n^u,b,z,\zeta)$ stands for the consumers' outside option. The latter is either $W(a,n^u,b^{ui},z,\zeta)$ for consumers entitled to unemployment insurance, since they always claim it, or $\psi_u W(a,n^u,b^u,z,\zeta)+(1-\psi_u)W(a,n^u,b^{\varnothing},z,\zeta)$ for the others, as only a fraction ψ_u claim other unemployed benefits.[18] The closed-form wage equations are found in Appendix B.3.

[18] The latter outside option also applies to consumers that find jobs when out of the labor force to avoid unnecessarily complicating the model.

3.5 Consumers' Problem

The consumer's maximization problem can be summarized by HJB equations corresponding to each of the nine labor-benefit states. As presented above, these states are the combination of n^x and b^j_l where $x \in \{e, u, o\}$, $j \in \{e, ui, u, o, \varnothing\}$, and $l \in \{ui, \varnothing\}$, the latter only relevant to the employed ($x = e$). When convenient, we use $X^x_{j,l}$ as shorthand for any function X depending on the entire vector of idiosyncratic states, $(a, n^x, b^j_l, z, \zeta)$.

We illustrate the consumers' maximization problem with the case of an unemployed consumer receiving unemployment insurance and leave the other cases to Appendix B.1. The HJB of this consumer is

$$\rho_z W^u_{ui} = \max_{c,s} \Big\{ u(c,s) + \partial_a W^u_{ui} \Big[h(z,\zeta) + B^u_{ui} + UBI + (1-\tau_a)(r-\delta)a - (1+\tau_c)c \Big] + sf(z,\zeta) \Big[\psi^z_e W^e_{e,ui} + (1-\psi^z_e) W^e_{\varnothing,ui} - W^u_{ui} \Big] + p^u_{ui} \left[\psi^z_u W^u_u + (1-\psi^z_u) W^u_{\varnothing} - W^u_{ui} \right] + m^z_{uo} \Big[\psi^z_o W^o_o + (1-\psi^z_o) W^o_{\varnothing} - W^u_{ui} \Big] + \theta_\zeta(\zeta_o - \zeta)\partial_\zeta W^u_{ui} + \frac{\sigma^2_\zeta}{2} \partial^2_{\zeta\zeta} W^u_{ui} \Big\}. \tag{12}$$

The HJB shows that the flow value depends on instantaneous utility, changes in asset holdings, the possibility of finding jobs, the risk of losing UI eligibility, the risk of moving out of the labor force, and the risk of changes in stochastic human capital. In the cases of changes in labor market state and loss of UI eligibility, there is the additional risk of benefit claiming. In light of all these risks, the consumption-saving decision is determined by the First-Order condition (FOC) with respect to c:

$$u_c(c^x_{j,l}, s^x_{j,l}) = (1+\tau_c)\partial_a W^x_{j,l}, \tag{13}$$

which is the same for all consumer types. This equation implies that the marginal value of consumption must be as high as the marginal value of saving. Moving to the job search effort decision, the FOC is:

$$u_s(c^u_{ui}, s^u_{ui}) = f(z,\zeta) \Big[\psi^z_e W^e_{e,ui} + (1-\psi^z_e) W^e_{\varnothing,ui} - W^u_{ui} \Big]. \tag{14}$$

This equation implies that the marginal disutility of searching must equal the marginal expected gain of searching. It takes a similar form for unemployed consumers who do not receive UI. OLF consumers, however, as referred above, do not choose the intensive margin of job search effort: their job search effort is positive (and fixed) if $\psi^z_e W^e_{e,\varnothing} + (1-\psi^z_e) W^e_{\varnothing,\varnothing} > W^o_j$ for $j \in \{o, \varnothing\}$. *Ceteris paribus,* OLF consumers that receive benefits tend to enjoy higher lifetime utility than those not receiving them ($W^o_o > W^o_{\varnothing}$). This, in turn, lowers incentives to passively search for jobs, increasing the chances they remain OLF.

3.6 Stationary Equilibrium

3.6.1 Kolmogorov Forward Equations

The Kolmogorov Forward (Fokker-Planck) equations describe the evolution of the joint density function $g^x_{j,l} \equiv g(a, n^x, b^j_l, z, \zeta)$. Like the consumers' HJB, it is also a system of nine equations, detailed in Appendix B.4. The Kolmogorov Forward equations in the state (n^u, b^{ui}), for instance, is:

$$\begin{aligned} \partial_t g^u_{ui} &= -\partial_a \left[\dot{a}^u_{ui} g^u_{ui}\right] - \left[s^u_{ui} f(z,\zeta) + p^u_{ui} + m^z_{uo}\right] g^u_{ui} \\ &+ m^z_{eu}\left(g^e_{e,ui} + g^e_{\varnothing,ui}\right) - \partial_\zeta \left[\theta_\zeta(\zeta_o - \zeta) g^u_{ui}\right] + \frac{1}{2}\partial^2_{\zeta\zeta}\left[\sigma^2_\zeta g^u_{ui}\right], \end{aligned} \tag{15}$$

This equation highlights movements along the asset dimension, labor market state, benefit status, and stochastic human capital. The density function aligns with the population size normalization, $\sum_z \sum_n \sum_b \int_{\underline{\zeta}}^{\bar{\zeta}} \int_{\underline{a}}^{\infty} g(a,n,b,z,\zeta) \mathrm{d}a \mathrm{d}\zeta = 1$. In the stationary equilibrium, it satisfies $\partial_t g(\cdot) = 0$ for all (a,n,b,z,ζ).

3.6.2 Market Clearing

The asset market clears continuously in the model because the sum of all the assets owned by consumers equals the sum of aggregate capital, K, and the value of firms, Ω:

$$\sum_z \sum_b \sum_n \int_{\underline{\zeta}}^{\bar{\zeta}} \int_{\underline{a}}^{\infty} a g(a,n,b,z,\zeta) \mathrm{d}a \mathrm{d}\zeta = K + \Omega. \tag{16}$$

As only labor firms obtain profits in equilibrium, their value is

$$\Omega \equiv \sum_z \sum_b \int_{\underline{\zeta}}^{\bar{\zeta}} \int_{\underline{a}}^{\infty} J(a,b,z,\zeta) g(a,n^e,b,z,\zeta) \mathrm{d}a \mathrm{d}\zeta, \tag{17}$$

where we use the fact that the density of labor firms equals that of employed consumers, as each firm employs a single consumer.[19]

Each segment of the labor market converges to equilibrium as labor firms open vacancies until the free-entry condition is satisfied:

$$\kappa_z = \frac{q(z,\zeta)}{U(z,\zeta)} \sum_{j\in\{e,\varnothing\}} \psi^z_j \int_{\underline{a}}^{\infty} \left[J(a,b^j_{ui},z,\zeta) s^u_{ui} g^u_{ui} + J(a,b^j_{\varnothing},z,\zeta)\left(s^u_u g^u_u + s^u_{\varnothing} g^u_{\varnothing} + s^o_o g^o_o + s^o_{\varnothing} g^o_{\varnothing}\right)\right] \mathrm{d}a, \tag{18}$$

[19] In equilibrium, Ω also equals $\frac{d}{r-\delta}$, where dividends, d, equal the difference between the sum of profits and the sum of hiring costs, $\sum_z \sum_b \int_{\underline{\zeta}}^{\bar{\zeta}} \int_{\underline{a}}^{\infty} (y_z e^{\zeta} p_L - w(a,b,z,\zeta)) g(a,n^e,b,z,\zeta) \mathrm{d}a \mathrm{d}\zeta - \sum_z \int_{\underline{\zeta}}^{\bar{\zeta}} \kappa_z v(z,\zeta) \mathrm{d}\zeta$.

where $\psi_j^z = \psi_e^z$ if $j = e$ and $\psi_j^z = 1 - \psi_e^z$ if $j = \varnothing$. This equation posits that the flow cost of an open vacancy, κ_z, equals the expected flow value. The latter, in turn, depends on the vacancy-filling rate and the expected value of a filled vacancy. This expectation relies on the density function g and on the variation in search intensity among consumers. Furthermore, this expectation accounts for the changing value of the matched firm across consumers' idiosyncratic states.

Finally, the market for labor services also clears:

$$L \equiv \sum_z \sum_b \int_{\underline{\zeta}}^{\bar{\zeta}} \int_{\underline{a}}^{\infty} y_z e^{\zeta} g(a, n^e, b, z, \zeta) \mathrm{d}a \mathrm{d}\zeta. \tag{19}$$

The formal definition of the stationary equilibrium is in Appendix B.5.

4 Calibration

To calibrate the model, we looked at monthly US data for the population aged 25-64. We used data from the *Current Population Survey* (CPS), *Survey of Income and Program Participation* (SIPP), and others, as well as information from reports by accredited bodies and other papers. All values are in 2018 dollars. The calibrated model performs well in internal and external validation exercises.

4.1 Consumers and Firms

Table 1 lists the calibration choices related to consumers and firms.

Consumers' utility function is $u(c, s) = \log(c) - \pi_u^z \frac{s^2}{2}$, where the second term only applies to the unemployed.[20] Consumers can have one of four fixed and exogenous levels of education: less than high school (LHS), high school (HS), some college (SC), and college or more (C). The proportion of each was calibrated to equal the equivalents in CPS data (2010-2019). Regarding stochastic human capital, we normalize its lower bound to $\underline{\zeta} = 0$ and set its upper bound to $\bar{\zeta} = 4$ to be arbitrarily large. We also impose that the long-term mean of the (unbounded) stochastic human capital process for the nonemployed converges to the lower bound, i.e., $\zeta_o = \underline{\zeta}$. We adapt the calibration in Jaimovich et al. (2024) of a discrete-time auto-regressive process for stochastic human capital to our continuous-time setting to calibrate σ_ζ and θ_ζ. We then use ζ_e to approximate the earnings distribution in SIPP data (2019).[21] Finally, we allow small amounts of debt to capture the empirical fact that there are individuals with negative net worth. Maximum borrowing increases with the level of education in

[20] We assume that the passive job search effort of OLF consumers has no utility relevance.

[21] These parameters are calibrated internally together with others, as detailed below. In most instances, no single parameter reaches a target. But, in describing our calibration choices, we relate the parameter with the intended target.

Table 1: Benchmark Calibration: Consumers and Firms

Description	LHS	HS	SC	C	Source/Target
	Parameters				
Preferences & Borrowing					
Discount rate ($100\rho_z$):	1.01	0.93	0.89	0.53	Return on K; education wealth
Minimum assets (a_z):	-1.00	-1.39	-1.61	-2.69	Small Debt Levels Allowed
Production					
Capital Share (α):		0.30			Standard
Capital depreciation rate (δ):		0.01			Investment-Output ratio
Skill efficiency units (y_z):	1	1.04	1.03	1.45	Skill premium CPS
Home production (h_v):		0.17			Fall Consumption UI Recipients
Size of each group (%):	8.00	29.68	27.76	34.56	CPS Averages
Total-Factor Productivity (A):		0.15			Normalize mean wages
Experience					
Maximum log experience ($\bar{\zeta}$):		4.00			Exogenous
Minimum log experience ($\underline{\zeta}$):		0.00			Exogenous
Rate of mean reversion ($100\theta_\zeta$):		0.95			Jaimovich et al.
Volatility (σ_ζ):		0.11			Jaimovich et al.
Long term ζ of employed (ζ_e):		1.65			Earnings Distribution SIPP
Long term ζ of nonemployed (ζ_o):		0.00			Exogenous
Matching & Bargaining					
Matching function elasticity (η):		0.72			Petrongolo and Pissarides
Bargaining Power (ϕ):		0.72			Standard
Matching efficiency (χ_z):	0.24	0.25	0.26	0.27	Job-finding probability CPS
Vacancy-posting costs (κ_z):	0.93	1.22	1.24	1.36	Normalize market tightness
Labor Market Flows					
Job-destruction probability ($100m^z_{eu}$):	2.26	1.33	1.06	0.62	Flows CPS
Flows from E to OLF ($100m^z_{eo}$):	3.82	2.27	2.00	1.61	Flows CPS
Flows from U to OLF ($100m^z_{uo}$):	22.60	18.90	17.90	15.80	Flows CPS
Flows from OLF to U ($100m^z_{ou}$):	1.36	1.77	2.15	1.71	Flows CPS
JSE disutility (π^z_u)	2.19	3.01	3.06	3.31	Normalize JSE
Passive JSE of OLF (s^z_o)	0.12	0.14	0.17	0.20	Flows CPS

proportion to skill premiums.[22]

We assume that final-good producers combine capital and labor services using a Cobb-Douglas production function: $Y = AK^\alpha L^{1-\alpha}$. As is common in the literature (e.g., Krusell, Mukoyama and Şahin, 2010), we target a capital share of 30%, an investment-output ratio of 23%, and an annual real rate of return on capital of 4%. We also target the ratios of mean wealth among consumers of each level of education in 2019 (US Federal Reserve Board, 2020). All these targets imply $\alpha = 0.3$, a depreciation rate of capital $\delta = 0.012$, and discount rates $\rho_1 = 0.0101$, $\rho_2 = 0.0092$, $\rho_3 = 0.0089$, and $\rho_4 = 0.0053$, which agree with Falk et al. (2018) in that patience increases with education. To calibrate total-factor productivity, A, we normalize the average wage (57500 USD in 2018 CPS) to one. For the labor productivity factor, y_z, we target skill premiums in CPS data (2010-2019).

We use CPS data (1978-2012) to discipline labor market flows. We follow Shimer (2012) and Krusell et al. (2017) to obtain average gross worker flows for each level of education and use them to calibrate exogenous flows (m^z_{eu}, m^z_{eo}, m^z_{uo}, and m^z_{ou}). We also use these average gross flows to calibrate the matching efficiency, χ_z, and OLF passive job search effort, s^z_o, such that the model matches average

[22] In Appendix D.2, we show that excluding borrowing from the model does not change our main results.

unemployed and OLF job-finding rates. The average job search effort of the unemployed and average labor market tightness are normalized to one for each level of education by calibrating the scale of the disutility of job search effort, π_u^z, and vacancy-posting costs, κ_z. The elasticity of the matching function is $\eta = 0.72$, which agrees with the evidence in Petrongolo and Pissarides (2001). Consumers' bargaining power is also $\phi = 0.72$ as it commonly equals η in the calibration of matching models (e.g., Shimer, 2005).

Finally, we use home production to capture the average 8.2% fall in consumption observed in the first month of recipiency among UI recipients (Ganong and Noel, 2019). We assume $h(z,\zeta) = h_v(y_z e^{\zeta})p_L$, consistent with the evidence in Boerma and Karabarbounis (2021) that home productivity increases with market productivity, and set $h_v = 0.165$ to meet that target.

4.2 Government

Table 2 lists the calibration choices related to taxes, benefit programs, and government spending.

We assume that the consumption tax rate is 5.5% and the capital income tax rate is 30% (similar to those in McKay and Reis, 2016). We use the estimates in Guner, Kaygusuz and Ventura (2014) to calibrate the labor income tax function. Specifically, we focus on the case without tax credits for any household, since we include tax credits in benefit programs. We thus set $\tau_n = 0.088$ and $\lambda_n = 0.031$.[23]

We calibrate the four conditional benefit programs in the model by using information for six US cash or near-cash programs: the *Earned Income Tax Credit* (EITC), the *Advanced Child Tax Credit* (ACTC), the *Child Tax Credit* (CTC), *Unemployment Insurance* (UI), *Supplemental Nutrition Assistance Program* (SNAP), and *Supplemental Security Income* (SSI).[24] These programs have motley categorical and means-testing requirements, differing among them and often by State. It is beyond the scope to capture the idiosyncrasies of each of those programs. Our stylized surrogates merely aim to approximate real-world counterparts.

The EITC, ACTC, and CTC are tax credits. They are, implicitly, employment subsidies, creating pro-work incentives (Hoynes and Rothstein, 2019). Since taxes in the model are calculated on a monthly basis and paid instantaneously while employed, we look at these tax credits to calibrate employed benefits, b^e.[25] Figure C1 in Appendix C illustrates the schedule of b^e. It is modeled in line with the

[23] As the estimates in Guner, Kaygusuz and Ventura (2014) rely on normalized household income, we rescale labor income in the model assuming that mean household income is 75000.

[24] We exclude programs with transfers in kind, such as Medicaid. Our selection covers the lion's share of cash or near-cash welfare programs in the US (Hoynes and Rothstein, 2019). In a robustness check found in Appendix D.2, we consider a scenario that includes the *Temporary Assistance for Needy Families* (TANF) program.

[25] In practice, these programs also have nonemployed beneficiaries. This can happen if, for instance, a household member obtained earnings in a previous tax year. We abstract from these complications. See Guner, Kaygusuz and Ventura (2023) or Luduvice (2024) for contributions modeling such details.

Table 2: Benchmark Calibration: Government

Description	LHS	HS	SC	C	Source/Target
		Parameters			
Employed Benefits					
Guaranteed Benefit:		0.03			Total CTC & ACTC transfers
Subsidy Rate:		0.34			EITC Single 1 child
Tax Rate:		0.16			EITC Single 1 child
Phase-out point:		0.32			EITC Single 1 child
Maximum Legitimate Transfer:		0.08			Total EITC transfers
Maximum Assets:		18.26			EITC Single 1 child
Illegitimate Transfer (if $a = 0$; 100x):		0.96			Taxpayer Advocate
Claim Rate (ψ_e^z):	0.60	0.42	0.46	0.41	EITC Recipients PSID
Administrative Costs (ι_{be}):		0.01			Taxpayer Advocate
Unemployment Insurance					
Replacement Rate:		0.50			Standard
Cap (% bench. wage):		0.57			Average UI transfers
Illegitimate Transfer (if $a = 0$; 100x):		4.13			US Department of Labor
Entitlement ($p_{ui}^{e,z}$):	0.03	0.05	0.05	0.33	% of Unemployed receiving UI
Expiration (p_{ui}^{u}):		0.17			Average Duration
Administrative Costs (ι_{bui}):		0.10			Whittaker, Isaacs and Overbay
Other Unemployed Benefits					
Guaranteed Benefit:		0.11			Unemp. Share SSI & SNAP in PSID
Maximum Assets:		0.63			SSI & SNAP Rules
Illegitimate Transfer (if $a = 0$; 100x):		0.49			Taxpayer Advocate
Claim Rate (ψ_u^z):	0.39	0.49	0.65	0.86	SSI & SNAP Unemp. Recip. PSID
Administrative Costs (ι_{bu}):		0.09			Social Security Admin.; Dep. of Agriculture
OLF Benefits					
Guaranteed Benefit:		0.08			OLF Share SSI & SNAP in PSID
Maximum Assets:		0.63			SSI & SNAP Rules
Illegitimate Transfer (if $a = 0$; 100x):		0.45			Taxpayer Advocate
Claim Rate (ψ_o^z):	0.36	0.47	0.46	0.43	SSI & SNAP OLF Recip. PSID
Administrative Costs (ι_{bo}):		0.09			Social Security Admin.; Dep. of Agriculture
Taxes & Government Spending					
Labor income tax level ($100\tau_n$):		8.80			Guner, Kaygusuz and Ventura
Labor income tax progressivity ($100\lambda_n$):		3.10			Guner, Kaygusuz and Ventura
Capital income tax ($100\tau_a$):		30.00			Standard
Consumption tax rate ($100\tau_c$):		5.50			Standard
Government Spending ($100g_y$):		8.97			Balanced Budget

workings of the EITC: it increases with earned income according to a subsidy rate until it reaches a maximum transfer. This value is received until earnings reach a phase-out point. For earnings higher than this point, the benefit falls with earned income according to a tax rate until it reaches zero for earnings high enough.

In calibrating b^e, we rely on the EITC schedule for a household with one adult and one dependent. In this case, the subsidy rate is 34%, the tax rate 15.98%, and the phase-out annual income 18661.7 USD (0.32 in model units). We further impose that eligible claimants must have less than 3500 USD (0.06 in model units) in annual capital income. We calibrate the maximum transfer so that total transfers match 69.4 Bn USD of average real yearly spending on EITC (calculated based on the IRS's SOI Bulletins for 2009-2019). Further, since the ACTC and CTC have high income and wealth limits, we assume that the 71 Bn USD of average yearly spending (2009-2017) on these credits are transferred evenly to all claimants of b^e, whether eligible for the EITC or not.

To calibrate illegitimate transfers, we take a leaf from Taxpayer Advocate (2019) who estimate that about 25% of the total value of EITC transfers is not distributed in accordance with the program's rules. We assume that this amount is distributed among all claimants, regardless of eligibility, according to the decay rule $e^{-0.02a}$. In other words, those with fewer assets tend to obtain higher illegitimate transfers as wealthier consumers are more easily screened out. We also assume that the administrative costs of employed benefits are 1% of the total value of transfers, the estimate for the EITC (Taxpayer Advocate, 2019).

Finally, about 28 million taxpayers benefited from the EITC yearly in 2010-19, of which 22.22% were couples. Hence, we scale the claim rates, ψ_e^z, to reach 33.8 million recipients in the model. To distinguish the claim rates of consumers with different levels of education, we use SIPP data (2017-2019) to estimate the share of EITC beneficiaries of each level of education among employed individuals.

Unemployment insurance has the clearest empirical counterpart. We impose $p_{ui}^u = 1/6$, so that receiving unemployment insurance lasts approximately six months on average. We set $p_{ui}^{e,z}$, the rate at which employed consumers become eligible for unemployment insurance, by targeting the respective recipiency rate (the share of unemployed consumers of each level of education receiving unemployment insurance). We obtain these estimates by rescaling those in Forsythe and Yang (2021) until we reach the average recipiency rate of 28% reported by the BLS. We also follow a calibration strategy for calculating benefits that is common in the literature. We set a replacement rate of 50% but impose a ceiling calibrated to match average total transfers of 24.4 Bn USD during 2017-2019.[26] Finally, every worker receiving unemployment insurance gets an extra amount, also decaying with assets according to $e^{-0.02a}$. This amount is calibrated to capture the 8.5% of total transfers misaligned with program rules, as per the US Department of Labor's estimates. Administrative costs are set at 10%, the proportion of total transfers equivalent to the average yearly federal funding for the administration of this program in 2014-2019 (Whittaker, Isaacs and Overbay, 2022).

SSI and SNAP offer recipients a guaranteed benefit and tax earnings heavily (at 50% and 30%). We use information on these programs to calibrate other unemployed benefits and OLF benefits.[27] We impose two eligibility requirements: consumers must be in the appropriate labor market state and, like the real SNAP and SSI, their assets cannot exceed 3000 USD (0.05 in model units). To calibrate claim rates, we target the recipiency rates of unemployed and OLF consumers per level of education receiving SNAP, SSI, or both in SIPP data (2017-2019).[28] Consumers with the lowest levels of education are

[26] Average transfers in this period were 28.2 Bn USD, but almost 14% of recipients were either younger than 25 or older than 64.

[27] In the model, all nonemployed consumers have zero earned income, so the transfer is always the maximum.

[28] SIPP identifies the household members that benefit from a program. We use these data to calculate the recipiency rates. Moreover, as, in practice, employed individuals can also be beneficiaries, we reweight the shares of the unemployed and OLF such that the share of beneficiaries in the model is the one we calculate using SIPP data (2017-2019). In calculating

the most likely to receive these benefits (see Data column in Table C2 in Appendix C). Importantly, we find that many consumers with almost no assets or very little earnings do not receive SNAP or SSI while unemployed or OLF. These consumers stand to gain substantially from the introduction of a UBI.[29]

To calibrate the guaranteed benefit of other unemployed and OLF benefits, we target the average real total transfers of SSI and SNAP (70.5 Bn USD) from 2011 to 2019 to those aged 25-64. We split them between the two benefits in the model to match the average share of the value of SSI and SNAP transfers directed at the unemployed (91.6%) and OLF (8.4%) in SIPP data (2017-2019). Finally, we assume that illegitimate transfers (again decaying with assets) amount to 8% of the value of all transfers (Taxpayer Advocate, 2019) and administrative costs to 8.7% (US Social Security Administration, 2022, US Department of Agriculture, 2022).

Total spending in benefit schemes is 2.55% of the average wage, i.e., 1470 USD per year. Government spending is the residual that balances the budget: it is a share $g_y = 8.97\%$ of output.

4.3 Internal & External Validation

The calibrated model matches empirical targets well. Tables C1and C2 in Appendix C show this for the job-finding rates of unemployed and OLF consumers, for skill premiums, for wealth differences in skill, for investment-related targets, and for benefit-related targets. The two leftmost columns of Table 3 compare the earnings distribution in SIPP data (2019) with that delivered by our model. The differences are small.

Table 3: Earnings and Wealth Inequality

	Earnings		Wealth	
	Data	Model	Data	Model
Q1	0.00	1.30	-0.50	-0.79
Q2	2.70	4.74	0.80	0.76
Q3	13.52	10.47	3.40	5.31
Q4	24.10	21.39	9.00	16.63
Q5	59.60	62.11	87.40	78.09

Note: This table contrasts the five quintiles of the earnings distribution in 2019 SIPP data and the wealth distribution in the Survey of Consumer Finances 2018 with those in the model.

Table 3 also offers a measure of external validation. The two rightmost columns contrast the share of each quintile of the wealth distribution in the Survey of Consumer Finances (2019) with that in the model. The model offers a good approximation.

these shares, we rule out those with net worth (excluding net holdings in housing and automobiles) higher than 3000 USD and those with yearly earnings exceeding 12000 USD.

[29] There are concerns that SIPP data might underestimate recipiency. Celhay, Meyer and Mittag (2024) argue that 20% of recipients fail to report in the SIPP. Throughout the paper, we use their estimate as a robustness check. When we do this, we recalibrate the parameters to still reach the internal targets.

The Alaska Permanent Fund Dividend (APFD) is another source of external validation. It is a transfer to all Alaska residents, with few exceptions (see Jones and Marinescu, 2022 for a detailed discussion). It is, therefore, close to the UBI in the model, albeit not tax-financed.[30] According to Jones and Marinescu, the APFD slightly increases employment, but it increases the share of part-time work by 1.8pp. This indicates a small reduction in hours worked. To judge how close our model is to the estimates in Jones and Marinescu, we introduce a UBI worth 2.5% of mean wages (1430 USD per year; close to the average APFD in real terms since 1982) without adjusting taxes. Our model implies a 0.58pp reduction in employment, close to the findings in Jones and Marinescu and in line with other papers that perform a similar experiment (Jaimovich et al., 2024).

The evidence in Elsby and Shapiro (2012) and Ortego-Marti (2016, 2017) supports our calibration strategy for the stochastic processes of human capital accumulation and, in particular, our choice of ζ^e. Elsby and Shapiro report a difference in log earnings between an experienced and an inexperienced full-time, full-year worker to have been, in 2001-07, approximately 1.02 for LHS workers and 1.2 for workers with College or more. In our model, consumers are ageless and experienced. We produce a counterpart to their estimates by simulating ζ over a 12-month period for two types of consumer employed throughout: one starting with $\zeta = \underline{\zeta}$ and another with the average ζ of the employed with the respective level of education. The model counterparts are very close to the estimates in Elsby and Shapiro. We obtain 0.98 for LHS consumers and 1.24 for those with College or more, the difference between these two magnitudes being explained by the higher average ζ of the latter. Additionally, Ortego-Marti offers evidence that, upon nonemployment, each month without a job lowers subsequent earnings by about 0.0122 log points on average, with a higher loss for more educated consumers. In our model, spending a month nonemployed implies that ζ falls by 0.0132 on average for those with College and 0.0107 for those with LHS, in line with the evidence.

As presented above, we target the average fall in consumption of unemployment insurance recipients in the first month of recipiency estimated in Ganong and Noel (2019). Yet, Ganong and Noel also offers the path of consumption for those that remain nonemployed up to ten months after the first month of recipiency. We use this evidence to externally validate our calibration. We simulate the path of consumption for those who become unemployed and recipients of UI. Then, we restrict our attention to those who remain recipients of UI for six months and lose recipiency immediately after. Figure D1 in Appendix D shows that our model broadly agrees with the path estimated in Ganong and Noel. Moreover, the consumption paths of the relatively rich (at the time of losing the job) and the rest agree with the variation reported in Ganong and Noel as those relatively rich are better able to smooth consumption.

[30] Also, the transfer value varies yearly, even if it has usually been higher than 1000 current USD since 1996.

Finally, we further validate our model by studying the claim rates of consumers with different levels of education. Empirically, the recipiency rate of a given program falls with the level of education, as conditional programs usually target the worse off. Matching these rates for SSI and SNAP, our model estimates that the claim rates and, consequently, the take-up rates of LHS consumers are the lowest.[31] Since a relatively high proportion of LHS consumers is eligible, take-up rates similar to those of more educated consumers would entail much higher recipiency rates than we find in the data. This implication of our model dovetails with the evidence in Tempelman and Houkes-Hommes (2016) and Finkelstein and Notowidigdo (2019), who find that the poorest do not display the highest take-up rates. Poverty is associated with multifaceted burdens, such as poorer health, limited social integration, or lower educational attainment, all of which complicate the application process (Tempelman and Houkes-Hommes). Additionally, evidence suggests that the poorest often underestimate the benefits of applying for welfare programs (Finkelstein and Notowidigdo). Poverty is linked with cognitive burdens that can impair performance and reasoning (Bertrand, Mullainathan and Shafir, 2004; Mani et al., 2013). All these burdens are compounded by practical barriers, such as additional costs or mobility limitations, which disproportionately affect the poorest (Kuka and Stuart, 2022; Dupas and Jain, 2024).

5 The Burdensome Imperfections of Conditional Programs

A major contribution of our paper is to explicitly model key imperfections of current welfare programs: incomplete take-up, illegitimate transfers, and administrative costs. In Proposition 1, we showed that, under typical assumptions, they are associated with welfare losses vis-a-vis a perfect welfare system. In this section, we quantify these losses. We run a set of experiments in which we remove each imperfection separately and then all three together.[32] The latter case is that of a near-perfect welfare system, the one assumed by almost all contributions in the related literature. In these experiments, the total expenditure on welfare programs remains the same.[33]

Table 4 shows that the three imperfections are not equally consequential in terms of welfare.[34] Re-

[31]The same is not true for the EITC because our model abstracts from a few of the categorical restrictions that apply in practice. For example, the asset limit for couples equals that of singles, which penalizes eligibility for the most educated, who are more likely to be married.

[32]To conduct our experiments, we use the finite-difference method described in Achdou et al. (2021) to solve for two deterministic steady-states of the model: the benchmark and the counterfactual.

[33] To ensure this, we rescale employed benefits, other unemployed benefits, and OLF benefits by adjusting the maximum transfer until expenditures on each program equal their respective new target. For unemployment insurance, we rescale expenditures by adjusting both the replacement rate (capped at 90%) and the maximum transfer. Regarding complete take-up, we set $\psi_e^z = \psi_u^z = \psi_o^z = 1$ for all z. In the case of unemployment insurance, we approximate complete take-up by dividing the benchmark $p_{ui}^{e,z}$ by 0.45, an estimate of the take-up rate of this program (Lachowska, Sorkin and Woodbury, 2022). In the cases with complete take-up, we also rescale illegitimate transfers so that their total remains approximately the same. This implies lower average transfers with complete take-up and higher transfers without administrative costs.

[34]See Appendix B.6 for details on the welfare measure.

moving illegitimate transfers has a negligible effect. Removing administrative costs is more significant, especially for consumers with less than high school, but the overall effect is moderate. The most significant imperfection is clearly incomplete take-up. Solving this imperfection would be equivalent to a permanent increase in consumption of 1.93%.

Table 4 also shows that the worse off, here the least educated, bear the brunt of these imperfections. Moving to a perfect welfare system would generate an aggregate consumption-equivalent variation (CEV) of 2.58%. Yet, echoing Proposition 1, this figure rises to 10.99% for consumers with less than high school. As for the better-off, i.e., those with at least a college degree, a perfect welfare system would be equivalent to a relatively small permanent increase in consumption of 0.44%.

Table 4: Welfare impact of conditional programs' imperfections

	No Illeg. Transfers	No Admin	100% Take-up	Perfect
CEV Aggregate	0.00	0.38	1.93	2.58
CEV LHS	0.12	1.22	8.86	10.99
CEV HS	-0.06	0.62	3.91	5.02
CEV SC	-0.02	0.45	1.79	2.61
CEV C	0.04	0.14	0.24	0.44

Note: This table shows the consumption-equivalent variation (CEV, welfare change) of ameliorating the extant welfare system by eliminating each of the three imperfections (first three columns) and all three together (fourth). The first line reports the average CEV, while the other lines decompose it by level of education.

Despite its imperfections, the current welfare system substantially increases welfare. Indeed, eliminating it completely generates a CEV of -7.2%. If the recipiency rates of other unemployed and OLF benefits were 25% larger (Celhay, Meyer and Mittag, 2024), then the current system would work even better: eliminating it would generate a CEV of -8.1%. Yet, if the welfare system were perfect, eliminating it would be equivalent to a reduction in lifetime consumption of 10.2%. As discussed, a UBI would be mostly free of these imperfections. Yet, its unconditionality brings problems of its own, including the fact that the worse off would get less relief on average. In the next section, we throw light on the welfare and macroeconomic consequences of introducing a UBI.

6 The Effects of Introducing an Expenditure-Neutral UBI

What are the effects of lowering expenditure on a suite of conditional programs to finance a UBI? To answer this, we solve for several deterministic steady-states of our model: one with conditional benefit programs and without UBI transfers, another with the converse, and several intermediate scenarios with varying proportions of total expenditure allocated between the conditional and unconditional programs. In all our experiments, we impose that the government spends the same amount on the welfare system and on other spending in every steady-state.[35]

In the next section, we discuss the full replacement of the benchmark conditional welfare system with a UBI. Then, we investigate intermediate scenarios by reallocating varying proportions of the expenditure on conditional programs to finance a UBI. In Appendix D, we complement these experiments by showing that alternative calibrations and the inclusion of the transitional dynamics between steady-states barely affect our findings.

Finally, motivated by recent calls for a more generous social safety net, we pose a related question: is it better to use additional resources to expand current programs or to finance a UBI? We increase the welfare budget by 20% and compare the resulting welfare outcomes.

6.1 Full Replacement: Output Increases, while Inequality and Welfare Fall

Table 5 summarizes the aggregate effects of fully replacing the four conditional welfare programs with an expenditure-neutral UBI, while Table 6 expands these results and discriminates them by level of education.

Table 5: Effects on economic activity, inequality, and welfare

	Change (%)
Output	1.12
Capital	2.87
Labor Services	0.38
Average Wage	0.50
Wealth Gini	-4.83
CEV	-0.73
Change in Transfers	
Average	0.10
Average among Poor	-1.15

Note: This table shows key effects of replacing the benchmark welfare system with an expenditure-neutral UBI. The first five lines report indicators of economic activity and of wealth inequality. These are followed by the consumption-equivalent variation, a measure of welfare change. The last two lines report the change in average transfers and in average transfers to the poor (i.e., those with less than 10000 USD in assets).

The replacement substantially boosts the capital stock and labor services, resulting in an increase in output of 1.12%. Average wages also increase. Conditional welfare programs thus prove to be more distortionary than a UBI, a result in line with the literature (e.g., Guner, Kaygusuz and Ventura, 2023, Conesa, Li and Li, 2023, and Luduvice, 2024). In our model, the most generous conditional benefits are only available to nonemployed consumers. This distorts job search effort, as a substantial fraction of OLF consumers with less than a high school education reject any job offers, opting to claim

[35] Expenditures may be the same, but differences in economic activity, such as changes in capital income, may affect tax revenues. If so, the government adjusts τ_n to balance the budget.

benefits instead.[36] Moreover, the most generous benefits also require virtually no asset holdings. There arises the semblance of a poverty trap, as consumers with limited prospects for high wages prefer not to accumulate assets to foster eligibility. Consequently, removing such limits increases the capital stock and the asset holdings of the lowest quintiles of the wealth distribution.

Indeed, both wealth and earnings inequalities fall. The wealth Gini coefficient, for instance, drops from 0.764 to 0.727.[37] This substantial reduction in wealth inequality is further explained by precautionary savings as in Luduvice (2024) and Rauh and Santos (2022). Since the average transfers received while poor are lower with a UBI (last line in Table 5), consumers seek to increase their asset holdings to smooth consumption. They also tend to search more intensively for jobs. The opposite tends to be true for college-educated consumers. With a UBI they have fewer incentives to accumulate assets, also lowering wealth inequality.

Still, despite these advantages, introducing an expenditure-neutral UBI is equivalent to a permanent loss of 0.73% of consumption. In other words, it lowers welfare, in line with the literature (e.g., Guner, Kaygusuz and Ventura, 2023; Conesa, Li and Li, 2023). This loss is therefore robust to taking the imperfections of conditional programs into account.[38] Again, the last line in Table 5 helps explain these seemingly conflicting results. Average transfers to the poorest consumers (those with net worth below 10000 USD) fall by 1.15% of the benchmark average wage, i.e., by more than 30% of their original value. As the poorest consumers value a dollar relatively more, the fact that they get smaller transfers significantly impacts welfare. In other words, a UBI's better economic performance is insufficient to compensate for its poorer job at alleviating need.[39]

Table 6, however, reminds us that conditional programs are also far from perfect in alleviating need. Less educated consumers lose with a UBI as they become less well-insured in the worst idiosyncratic states. Yet, they are not those losing the most, even considering that they enjoy the largest average transfers in the benchmark. The reason is twofold. The least educated are those with the lowest claim rates, especially for the two programs that bring the most relief to the poor: other unemployed and OLF benefits. Moreover, they have the lowest endowments, which magnifies the losses of incomplete take-up. Echoing Proposition 2, then, a UBI partly compensates for the fall in average transfers to the needy by reaching all of them. As for college-educated consumers, they prefer a UBI because of the imperfections and also because their wealth or earnings are usually too high for them to be

[36] Table 6 shows a high increase in passive OLF job search effort with the introduction of a UBI, which indicates that more consumers with LHS search passively for jobs.

[37] Table D3 in Appendix D offers the breakdown per quintile of wealth and earnings.

[38] In a world with 25% higher recipiency rates of other unemployed and OLF benefits (Celhay, Meyer and Mittag, 2024), the loss would be of 1.39%. In a world without the three imperfections of conditional programs, the loss would be 3.51% (see Table D4 in Appendix D).

[39] Another finding, in line with Guner, Kaygusuz and Ventura (2023), is that despite reducing overall welfare, a majority (54.6%) of the population would still be better off with a UBI.

eligible for conditional benefits. Table D4 in Appendix D corroborates this reasoning. If conditional programs worked perfectly – by transferring to all and only the eligible at no cost – then all education groups would lose with a UBI. The losses would be especially large for the least educated (a CEV of -11.73% compared with -1.35% when accounting for imperfections) as they would be well insured in that counterfactual world.

Table 6: Breakdown by level of education

	LHS	HS	SC	C
CEV	-1.35	-1.38	-1.83	0.20
Employment	4.27	0.15	0.15	0.07
Unemployment	-0.66	-0.06	-0.06	-0.03
Average Wage	-3.32	0.89	0.85	0.89
Job-finding rate	-0.22	0.20	0.26	0.08
Unemployed JSE	-0.72	1.41	1.66	1.50
OLF JSE	30.15	–	–	–
Change in Transfers				
Average	-0.94	-0.13	-0.15	0.74
Average among Poor	-1.70	-1.04	-1.13	-0.93

Note: This table decomposes the effects of replacing the benchmark welfare system with an expenditure-neutral UBI by levels of education. The first line reports the consumption-equivalent variation (welfare change). The following six lines report changes in labor market outcomes and job search effort (JSE). The last two lines report the change in average transfers and in average transfers to the poor (i.e., those with less than 10000 USD in assets).

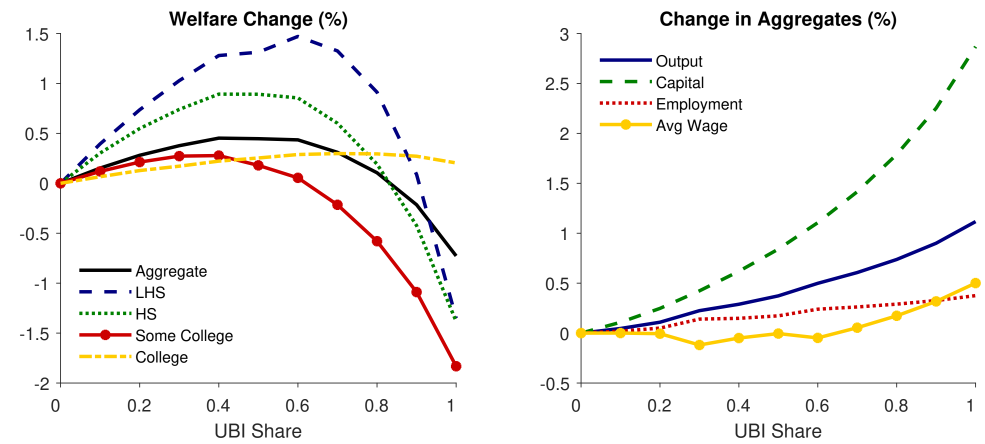
In sum, this experiment suggests that fully replacing the benchmark welfare system with a UBI fosters economic activity and lowers inequality. Yet, welfare falls, as it also results in a significant reduction in the average transfer to the needy. This reduction outweighs the main advantages of a UBI's unconditional nature, namely (i) its boost to economic activity and employment, (ii) the increase in total transfers from savings in administrative costs, and (iii) its inclusion of poor consumers that receive no conditional benefits due to incomplete take-up. Further experiments show that the boost to economic activity always accompanies the introduction of a UBI. Yet, as shown in the next section, the negative welfare impact of an expenditure-neutral UBI hinges on whether it is treated as a full or partial substitute of conditional programs, i.e., as a complement.

6.2 Partial Replacement: Welfare Increases

Conditional welfare programs and a UBI have complementary strengths and weaknesses. Conditional programs, for a given level of total expenditure, deliver a higher average transfer to those in need but fail to reach all the eligible and substantially distort economic activity. In contrast, a UBI reaches everyone with fewer distortions, but it allocates a larger share of resources to those who benefit less. Such considerations beg the question of whether a combination of both kinds of programs might be preferable to the benchmark system and, consequently, to its substitution by a UBI. In this section, we study this conjecture by investigating the effects of partially replacing the benchmark conditional welfare system with an expenditure-neutral UBI. We conduct several experiments, redirecting different proportions of the total expenditure on welfare programs to finance a UBI.[40]

The left-hand panel of Figure 1 shows the welfare performance of systems with equal overall expenditure, but differing in the share dedicated to a UBI. As discussed in the previous section, the extreme case of allocating 100% of expenditure to a UBI reduces welfare. It is, however, now clear that the welfare maximizing share of expenditure on a UBI is also much greater than zero. In fact, it is almost half: the optimal share exceeds 40%, or about 600 USD per year, echoing Proposition 3. The CEV would be 0.3%, and nearly 80.6% of the population benefits from this optimal combination, as do all levels of education, including the lowest. This dovetails with earlier findings: many of the needy, often among the least educated, fail to receive conditional relief and would be better off with a UBI.

Figure 1: Partial and Full Replacement of the Benchmark Welfare System with a UBI



Note: This figure plots the effects of replacing the benchmark welfare system with alternatives that maintain the same overall expenditure but allocate different shares to a UBI. The left panel reports the average consumption-equivalent variation for all consumers and consumers grouped by education. The right panel reports changes in indicators of economic activity and in the average gross wage.

The right-hand panel in Figure 1 generalizes the findings of the previous section regarding the distortions of conditionality. Replacing the benchmark welfare system with an expenditure-neutral UBI enhances economic activity, an effect that grows stronger with the share dedicated to a UBI. In other words, the positive impact of a UBI on job search effort, the accumulation of assets, and, consequently, on output increases with its share in the welfare system.

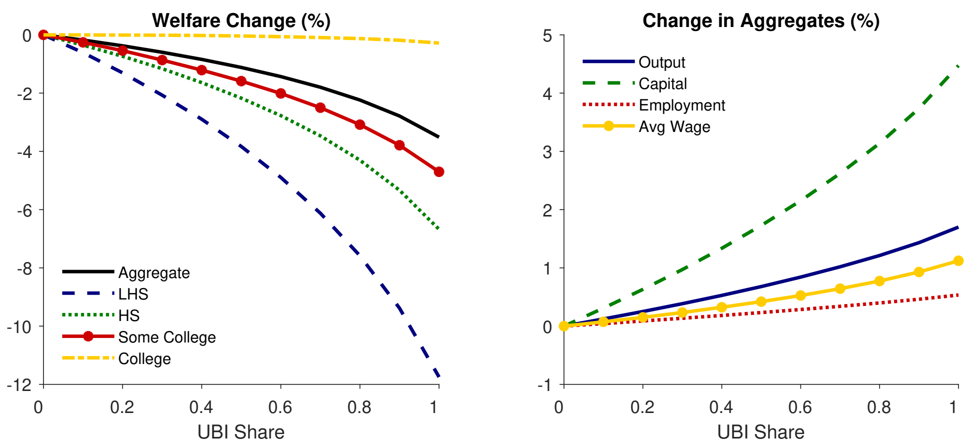
Yet, our finding that a UBI can increase welfare is not explained by its reduced distortions. In fact, a 100% UBI share maximizes both economic activity and welfare losses. Instead, the imperfections of conditional programs are key. Figure 2 shows the results of a similar exercise, only now assuming that conditional programs are free of incomplete take-up, illegitimate transfers, and administrative costs.

[40] We do this by proportionately reducing the budget of each conditional program through adjustments to the maximum transfer. In the case of unemployment insurance, we adjust both the replacement rate and cap.

In this unrealistic world, any share of expenditure deviated to finance a UBI lowers welfare. Also, no level of education is better off with the introduction of an expenditure-neutral UBI, with the costs falling overwhelmingly on the least educated. Crucially, such a welfare system better insures consumers against the worst idiosyncratic states, such as leaving the labor force or suffering a negative human capital shock, an effect that trumps its distortionary effects and explains its superior welfare outcomes.

Contrasting Figures 1 and 2 shows how abstracting from the imperfections of conditional programs – the standard in the literature – biases the assessment of a UBI. Without imperfections, the optimal UBI share is zero. With imperfections, the optimal UBI share is positive, sizable, but far from 100%.[41] As discussed above, conditional programs are better than a UBI at directing relief, ensuring a larger average transfer to the needy. But conditional programs, unlike a UBI, fail to reach all the needy. Conditional and unconditional programs are, thus, complementary. Introducing a UBI alleviates distortions. But, more importantly, their combination guarantees that no consumer is without support, as a UBI reaches everyone, while conditional transfers ensure that transfers remain primarily targeted to those in need.

Figure 2: Partial and Full Replacement of the Welfare System Free of Imperfections with a UBI



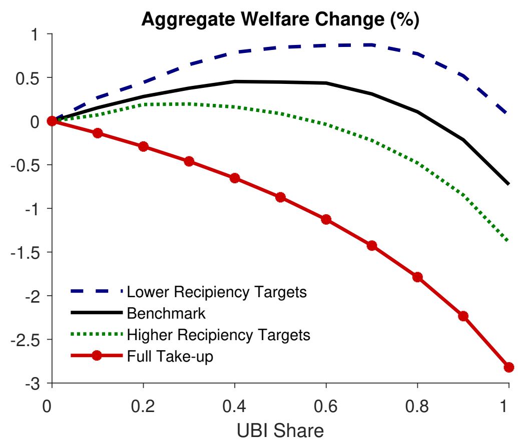
Note: This figure shows the results of repeating the experiments in Figure 1, only now abstracting from incomplete take-up, illegitimate transfers, and administrative costs. The left panel reports the average consumption-equivalent variation for all consumers and consumers grouped by education. The right panel reports changes in indicators of economic activity and in the average gross wage.

Among the three imperfections, incomplete take-up is the main driver of the complementarity between conditional programs and UBI. Figure 3 shows that if take-up for all welfare programs were

[41] Failing to account for the imperfections also leads to an overestimation of the distortions caused by conditional programs and, consequently, of the advantages to economic activity of replacing them with a UBI. If there are no imperfections, a UBI has an even greater positive impact on economic activity, as the less imperfect conditional welfare system demotivates job search effort and asset accumulation even more. A conditional welfare system without imperfections is also more vulnerable to the threat of poverty traps.

complete, the introduction of a UBI would lower welfare, even in the presence of illegitimate transfers and administrative costs. Still, as Figure 3 shows, within a realistic range of claim rates, partially replacing conditional programs with an expenditure-neutral UBI enhances welfare. This finding is reassuring, as there is evidence that survey data, like that used in our calibration, tends to underestimate participation in welfare programs. According to Celhay, Meyer and Mittag (2024), the SIPP – the one we use – suffers less from this issue than other surveys, like the CPS. Nevertheless, there is evidence that using the SIPP to calculate the recipiency of SNAP may still result in an underestimation of up to 25% when compared to administrative data (Celhay, Meyer and Mittag, 2024).[42] When we recalibrate the model to target a 25% larger recipiency rate of other unemployed and OLF benefits than in the benchmark, we find that the optimal share of a UBI remains sizable, but closer to 30% (Figure 3).

Figure 3: Partial and Full Replacement of the Welfare System under Different Degrees of Incomplete Take-up



Note: This figure shows the results of repeating the experiments in Figure 1, only now comparing economies with alternative recipiency rates and focusing on aggregate welfare changes. For the blue dashed line, we recalibrate the model targetting a 25% lower recipiency rate of other unemployed and OLF benefits. For the green dotted line, we recalibrate the model targeting a 25% higher recipiency rate of the same two benefits. For the red solid dotted line, we assume that all programs have full take-up as in Section 5.

6.3 Expanding the Welfare System: Use a UBI

The deviation of any sizable share of current expenditures on conditional transfers to finance a UBI would face, we speculate, considerable political opposition, despite leaving the vast majority better off. In recent years, however, there have been calls to make the social safety net more generous. These calls have been accompanied by action: expenditure on the welfare programs we model is now larger than in the 2010-19 decade used in our calibration.[43] This suggests the following exercise: if the total

[42] These errors are not random. Evidence suggests that underreporting welfare recipiency in survey data is more pronounced among those with higher income and education (Meyer, Mittag and Goerge, 2022).

[43] Real spending on the SNAP, for instance, has grown by about 50%, while that on the SSI has hardly changed in real terms. Tax credits have also become more generous, especially the ACTC.

expenditure on transfers were increased, what share of the increase should be allocated to the existing conditional programs and what to a UBI? To execute it, we change the budget of each program proportionately by adjusting the maximum transfer, and we update the level of labor income taxes, τ_n, to balance the government budget.[44]

We find that for welfare systems spending 20% more on transfers than the benchmark, the optimal share allocated to a UBI would be even greater (in line with Propositions 2 and 3). This indicates that all the increase in spending should be allocated towards a UBI, providing a safety net to all those in the dead-angle of conditional programs. Such a policy would be equivalent to an aggregate CEV of 0.93%, 3.3% for the LHS. Part of these welfare gains result from the increase in the scale of the welfare system: a 20% increase in expenditure on existing programs is equivalent to an aggregate CEV of 0.72%, 2.88% for the LHS.[45] The remaining gains, however, stem from the introduction of a UBI.

7 Extensions & Alternative Setups

7.1 Accounting for Endogenous Claim Rates

In our benchmark model, claim rates differ by welfare program and consumers' level of education. Yet, they are exogenous and do not change with other consumer characteristics. Additionally, claims are costless, in line with the literature that assumes complete take-up. In reality, however, take-up is incomplete in part due to the substantial administrative burdens and other sources of disutility (e.g., stigma or cognitive costs), associated with claiming welfare programs (Currie, 2006; Ko and Moffitt, 2022; Wu and Meyer, 2023). Costly take-up is a direct drag on utility, reducing the net benefit of being a welfare claimant. On the other hand, claiming costs deter some of the better-off from applying for welfare programs, fostering welfare-enhancing self-selection. In this section, we illuminate the effects of accounting for costly take-up by examining a version of our model in which claim rates are endogenous.

In this version, claims are modeled as a two-step process that aims at capturing the main causes of incomplete take-up: imperfect information, stigma, and application costs.[46] The ψ_x^z are now inter-

[44] We do not do this for unemployment insurance because, except for temporary measures during the pandemic, it has not changed much. Yet, the results would be similar if we expanded it as well.

[45] Almost all the papers in the literature analyze a UBI that replaces the extant welfare system. There are, however, a few exceptions. For example, Daruich and Fernández (2024) and Guner, Kaygusuz and Ventura (2023) look at the welfare change of adding a UBI of about 8000 or 12000 USD to existing welfare programs. This results in a substantial increase in the size of the welfare system, much larger than any we consider, and a change in the relative importance of conditional and unconditional transfers. Both contributions find that introducing a UBI would result in substantial welfare losses, a conclusion that dovetails with ours insofar as both abstract from the imperfections of conditional programs.

[46] We adapt the claim rate process only for employed, other unemployed, and OLF benefits, but not for UI for three reasons. First, unlike the other programs, in our benchmark model, employed workers eligible for UI always claim it upon becoming unemployed. Second, the size of UI is relatively small. Third, and most importantly, replacing all welfare programs

preted as the proportion of those that, upon moving to any labor market state ($x \in \{e, u, o\}$) or losing eligibility for UI, *could* claim the respective benefits. This captures imperfect information as well as other eligibility constraints not considered in the model. The potential claimants that choose to claim a benefit are then subject to a cost c drawn from a distribution $\varsigma_x(\mathsf{c})$. This cost captures the disutility of stigma and application costs. In this version of the model, consumers only claim a benefit if it is indeed worth their while. For example, consumers that move out of the labor force would claim OLF benefits if $W(a, n^o, b^o, z, \zeta) - \mathsf{c} > W(a, n^o, b^{\varnothing}, z, \zeta)$, which, conditional on z, depends on standard wealth, income, and substitution effects. All else remains the same.

We model $\varsigma_x(\mathsf{c})$ by assuming that, with probability ϑ, consumers draw a cost of $\mathsf{c} = 0$ as in the benchmark model or, with probability $1 - \vartheta$, they draw c from a log-normal distribution with mean zero and standard deviation σ_x. If $\vartheta = 1$, this model is equal to the benchmark. To illustrate this extension, let $\vartheta = 1/2$ and $\sigma_x = 1$ for all x.[47] Also, we calibrate ψ_x^z by following the same calibration strategy as in Section 4.2. Note that because potential claimants drawing a sufficiently high c do not claim, ψ_x^z is higher than in our benchmark for all programs and education groups.

Our findings are summarized in Figure 4. We highlight two. First, accounting for endogenous and costly claim rates substantially favors UBI. In this case, an expenditure-neutral UBI that fully replaces extant conditional programs would reduce welfare by 0.3%, less than half the loss in the benchmark. Second, a combination of conditional and unconditional welfare programs remains optimal, highlighting the complementarity of the two. The UBI's optimal share increases from about 40% in the benchmark model to about 60%. We also find that, as in the benchmark, increases in welfare spending would be optimally allocated towards a UBI.

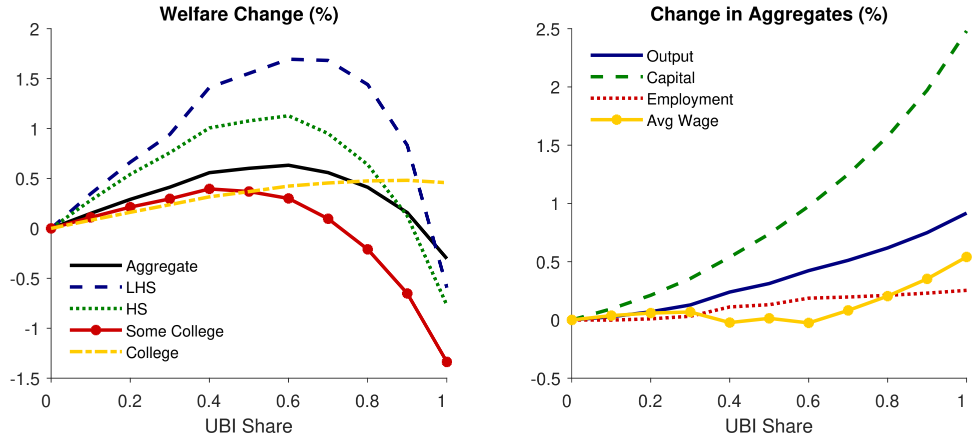
In this version of our model, conditional programs are even more effective at targeting the neediest, as take-up costs reinforce self-selection through income and wealth effects. Yet, claiming conditional welfare programs directly lowers utility. In our experiment, this direct negative effect outweighs the advantages of self-selection.[48]

except UI with a UBI has a negligible impact on our conclusions regarding the optimal UBI share in both this extension and the benchmark model.

[47] Our calibration ensures that the claim rates of employed benefits increase 2.6 pp with a 1000 USD annual increase in generosity, dovetailing with the estimates in Plueger (2009) for the EITC.

[48] We also considered alternative calibrations, but in all of them, a UBI was favored by endogenous take-up. For example, if all potential claimants draw their take-up cost from a log-normal distribution, all ψ_x^z are higher, so more consumers can take up a program. Consequently, aggregate take-up costs are also higher. This, again, favors a UBI. Indeed, in this case, a UBI that fully replaces conditional welfare programs would increase welfare, and the optimal UBI share would be 70%.

Figure 4: Model with Endogenous Claim Rates



Note: This figure shows the results of repeating the experiments in Figure 1, only now with endogenous and costly claim rates.

7.2 Accounting for Endogenous OLF flows

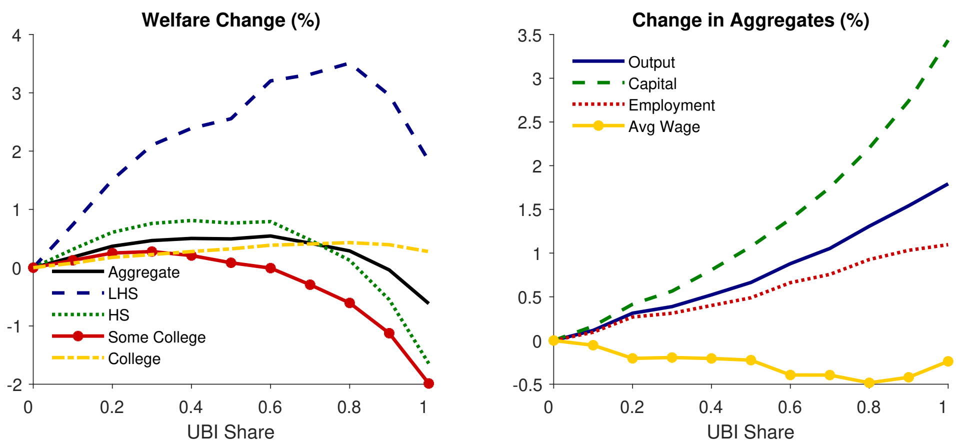
In our benchmark model, labor force participation flows are mostly driven by exogenous shocks. OLF consumers decide whether to passively look for jobs, but the flows from out of the labor force to unemployment as well as those into the OLF state are driven by Poisson processes. This begs the question of whether our benchmark model fully captures the distortions caused by welfare programs on the labor supply. Hence, in this section, we investigate a version of our model in which all the flows to and from out of the labor force are endogenous.

The shocks bringing consumers out of the labor force, m^z_{eo} and m^z_{uo}, can be interpreted as the result of a cost of participating in the labor market that is large enough to compel them to leave. Symmetrically, the shock m^z_{ou} can be interpreted as the result of a cost compelling all nonparticipants to actively look for jobs. We model this interpretation in a simple way. When agents face the shocks m^z_{eo} and m^z_{uo}, they draw a cost of remaining in the labor force, denoted by c_p, from the probability density functions $\varphi^z_e(c_p)$ and $\varphi^z_u(c_p)$. Similarly, when agents face the shock m^z_{ou}, they draw a cost of remaining out of the labor force, c_o, from $\varphi^z_o(c_o)$. Moreover, we assume that when consumers draw c_p or c_o they become aware of whether they will be welfare claimants conditional on the change in their labor market state. With probability ψ^z_x, they become claimants if they move. Optimal decision making, therefore, requires that consumers only leave or enter the labor force if it is worth their while. For example, unemployed consumers drawing c_p move out of the labor force if $W(a,n^u,b,z,\zeta) - c_p < W(a,n^o,b^o,z,\zeta)$ when they are claimants of OLF benefits and if $W(a,n^u,b,z,\zeta) - c_p < W(a,n^o,b^{\varnothing},z,\zeta)$ when they are not.

To illustrate this extension, we assume that $\varphi^z_e(\cdot)$, $\varphi^z_u(\cdot)$, and $\varphi^z_o(\cdot)$ are discrete probability distributions in which there is 1/2 chance of drawing one of two possible outcomes, $\{0, \infty\}$. All consumers that draw ∞ move, but of those that draw 0, only those that are better off in the alternative labor market state will move. We recalibrate the model using m^z_{eo}, m^z_{uo}, and m^z_{ou} to match the respective flows in the data.

Figure 5 summarizes the results. As expected, the distortions to the labor supply in this extension are larger than in the benchmark model. Fully replacing the conditional welfare programs with an expenditure-neutral UBI would increase labor supply three times more than in the benchmark. The changes to capital and output are also more substantial. Looking at welfare, however, there are only small changes in the aggregate. This said, we find a substantial change for the least educated, whose CEV increases by 1.83%, contrasting with the loss of 1.35% in the benchmark. If the greater distortions in this extension contribute to this result, the main reason for the fall is the greater persistence in being a welfare claimant, especially when OLF. In our benchmark model, many LHS consumers claiming OLF benefits would prefer to remain OLF. In this extension, consumers have more agency to remain OLF. Consequently, outflows from this state are smaller in this extension. Given the recipiency rates in the data, this necessitates a correlative fall in the claim rate of OLF benefits, ψ^z_o (0.145 in this extension and 0.361 in the benchmark), to reduce the inflows. In other words, in the status quo, few of those with an LHS education that leave the labor force benefit from OLF benefits.

Figure 5: Model with Endogenous OLF Flows



Note: This figure shows the results of repeating the experiments in Figure 1, only now with endogenous OLF flows.

We also find that the optimal share of a UBI remains high, close to 60%. This important result is, therefore, quantitatively robust.

8 Concluding Remarks

In this paper, we take up the challenge of modeling three real-world imperfections of extant conditional programs: incomplete take-up, illegitimate transfers, and administrative costs. These imperfections have been mostly neglected in the literature. Yet, they – especially incomplete take-up – impose a heavy welfare burden: we estimate that moving to a world of perfect welfare programs would increase welfare by as much as a permanent 2.6% increase in lifetime consumption, 11% for the least educated.

The imperfections of conditional programs are also consequential for assessing a UBI. The welfare loss of fully replacing extant programs with an expenditure-neutral UBI would be five times larger if we abstracted from their imperfections.[49] More importantly, accounting for incomplete take-up evinces a complementarity between conditional and unconditional welfare programs. While conditional programs target transfers to the needy but fail to reach them all, a UBI does not discriminate rich from poor but also leaves no one behind.

We find a combination of the two to be optimal. Our results suggest that replacing a sizable fraction (optimally, about 40%) of the extant conditional programs with a UBI would increase welfare (CEV of 0.3%) and would make the vast majority better off at no extra cost. Alternatively, a politically feasible option might be to supplement the current welfare system with a relatively small UBI. Offering a UBI worth about 20% of current expenditure on cash or near-cash welfare programs (or 300 USD per year for each working-age adult) would increase welfare according to all the versions of our model.[50]

Finally, our findings remind us that a policy option may seem best in a perfect setting, but that practical implementation often raises issues with first-order importance. Indeed, conditional programs with complete take-up and no illegitimate transfers would be much preferred to a simple UBI, as they would reach perfectly all those and just those they target. But this is not so in practice. Such a deviation from the ideal could well reverse the preferable policy choice.

[49] Accounting for imperfections does not qualitatively change the result in the literature that a UBI that replaces conditional programs increases economic activity, curbs inequality, and lowers welfare.

[50] There are alternative modeling choices that we did not consider, for instance, that of explicitly modeling overlapping generations or household composition. Propositions 1 through 3 indicate that our central results should be robust. This warrants further research, but unless it finds that conditional programs work much better in directing transfers, then our results should stand. Moreover, our findings in Section 7 reinforce the robustness of our conclusion that combining conditional and unconditional payments could improve the welfare system.

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Appendix

A Proofs Endowment Economy

A.1 Proof of Proposition 1:

i) Follows directly from the strict concavity of $u(\cdot)$, $0 < \psi < 1$, and T_L>0.

ii)
$$\frac{\delta \Xi}{\delta \psi} = -u(y_L + T_L/\psi) + \psi.\frac{T_L}{\psi^2}.u'(y_L + T_L/\psi) + u(y_L) =$$
$$u(y_L) - u(y_L + T_L/\psi) - u'(y_L + T_L/\psi)[y_L - (y_L + T_L/\psi)] < 0,$$

since $0 < \psi < 1$, T_L>0, and $u(\cdot)$strictly concave.

iii)
$$\frac{\delta \Xi}{\delta T_L} = u'(y_L + T_L) - \frac{\psi}{\psi}.u'(y_L + T_L/\psi) = u'(y_L + T_L) - u'(y_L + T_L/\psi) > 0,$$

since $y_L + T_L < y + T_L/\psi$, as $0 < \psi < 1$ and $T_L > 0$, and $u(\cdot)$ strictly concave.

iv)
$$\frac{\delta \Xi}{\delta y_L} = u'(y_L + T_L) - \psi.u'(y_L + T_L/\psi) - u'(y_L) + \psi.u'(y_L) =$$
$$u'(y_L + T_L) - [\psi.u'(y_L + T_L/\psi) + (1-\psi).u'(y_L)] < 0,$$

since $0 < \psi < 1$, T_L>0, and $u'(\cdot)$ strictly convex.

A.2 Proof of Proposition 2:

i) Let $x \in \mathbb{R}$ be such that

$u(y_L + T_L - x) = \psi u\left(y_L + T_L/\psi\right) + (1-\psi)u(y_L)$

Since $u(\cdot)$ is continuous, x exists. Since $u(\cdot)$ is strictly increasing, x is unique. Without loss of generality, $x = \xi_1 T_L$, for some $\xi_1 \in \mathbb{R}$.

$\Xi > 0 \iff u(y_L + T_L) > u(y_L + T_L - x) \iff y_L + T_L > y_L + T_L - x$, since $u(\cdot)$ strictly increasing.

But $y_L + T_L > y_L + T_L - x \iff x > 0 \iff \xi_1 > 0$, since $T_L > 0$.

ii) $\xi_1 > 0$ follows trivially from Prop. 1 (i) and Prop. 2 (i). Suppose $\xi_1 \geq 1$. Then $u(y_L + (1-\xi_1)T_L) \leq u(y_L) \implies u(y_L + T_L/\psi) \leq u(y_L)$, which contradicts $u(\cdot)$ strictly increasing, $T_L > 0$ or $0 < \psi < 1$.

iii) Let $\psi' > \psi$. From Prop. 1 (ii) follows that

$u(y_L + T_L) - \left[\psi' u\left(y_L + T_L/\psi'\right) + (1-\psi')u(y_L)\right] < u(y_L + T_L) - \left[\psi u\left(y_L + T_L/\psi\right) + (1-\psi)u(y_L)\right] \iff$

$\left[\psi' u\left(y_L + T_L/\psi'\right) + (1-\psi')u(y_L)\right] > \left[\psi u\left(y_L + T_L/\psi\right) + (1-\psi)u(y_L)\right] \iff u(y_L + (1-\xi_1')T_L) > u(y_L + (1-\xi_1)T_L) \iff y_L + (1-\xi_1')T_L > y_L + (1-\xi_1)T_L \iff 1-\xi_1' > 1-\xi_1 \iff \xi_1 > \xi_1'$.

iv) Let $T_L' > T_L$. Since $u(\cdot)$ strictly increasing, $u(y_L + T_L'/\psi) > u(y_L + T_L/\psi) \iff \psi u(y_L + T_L'/\psi) + (1-\psi)u(y_L) > \psi u(y_L + T_L/\psi) + (1-\psi)u(y_L) \iff u(y_L + (1-\xi_1')T_L') > u(y_L + (1-\xi_1)T_L)$. Then, $y_L + (1-\xi_1')T_L' > y_L + (1-\xi_1)T_L$. Consequently, $y_L + T_L' > y_L + T_L \iff (y_L + T_L') - (y_L + (1-\xi_1)T_L) > (y_L + T_L) - (y_L + (1-\xi_1')T_L') \iff \xi_1' T_L' > \xi_1 T_L$.

To prove the second claim in (iv) and to prove (v), take a second-order Taylor approximation of each side of Eq. 2:

$$\begin{aligned}
u(y_L + T_L) - u'(y_L + T_L)\xi_1 T_L + \frac{1}{2}u''(y_L + T_L)\xi_1^2 T_L^2 &= u\left(y_L + T_L\right) + \frac{1}{2}u''(y_L + T_L)T_L^2(1/\psi - 1) \Leftrightarrow \\
-u'(y_L + T_L)\xi_1 T_L + \frac{1}{2}u''(y_L + T_L)\xi_1^2 T_L^2 &= \frac{1}{2}u''(y_L + T_L)T_L^2(1/\psi - 1) \Leftrightarrow \\
-u'(y_L + T_L)\xi_1 + \frac{1}{2}u''(y_L + T_L)\xi_1^2 T_L &= \frac{1}{2}u''(y_L + T_L)T_L(1/\psi - 1) \Leftrightarrow
\end{aligned}$$

$$\xi_1 - \frac{1}{2}\frac{u''(y_L + T_L)}{u'(y_L + T_L)}\xi_1^2 T_L = -\frac{1}{2}\frac{u''(y_L + T_L)}{u'(y_L + T_L)}T_L\left(\frac{1}{\psi} - 1\right). \tag{A1}$$

Assume that the utility function displays constant absolute risk aversion (CARA). Let $\theta \equiv -\frac{u''(y_L+T_L)}{u'(y_L+T_L)} > 0$. In this shorthand, Eq. A1 becomes:

$$\begin{aligned}
\xi_1 + \frac{1}{2}\theta\xi_1^2 T_L &= \frac{1}{2}\theta T_L\left(\frac{1}{\psi} - 1\right) \Leftrightarrow \\
\xi_1 &= \frac{1}{2}\theta T_L\left(\frac{1}{\psi} - 1 - \xi_1^2\right).
\end{aligned}$$

Taking the derivative of both sides with respect to T_L, noticing that, given CARA, $\frac{\partial\theta}{\partial T_L} = 0$, yields:

$$\begin{aligned}
\frac{\partial\xi_1}{\partial T_L} &= \frac{1}{2}\theta\left(\frac{1}{\psi} - 1 - \xi_1^2\right) - \theta T_L \xi_1 \frac{\partial\xi_1}{\partial T_L} \Leftrightarrow \\
\frac{\partial\xi_1}{\partial T_L}(1 + \theta\xi_1 T_L) &= \frac{1}{2}\theta\left(\frac{1}{\psi} - 1 - \xi_1^2\right).
\end{aligned}$$

As $0 < \xi_1 < 1$ (Prop. 2 (ii)), $T_L > 0$, and $\theta > 0$, $\frac{1}{\psi} - 1 - \xi_1^2$ and $1 + \theta\xi_1 T_L$ are both positive magnitudes. Consequently, $\frac{\partial\xi_1}{\partial T_L} > 0$ (iv). Taking the derivative of Eq. A1 with respect to y_L makes it straightforward to see that $\frac{\partial\xi_1}{\partial y_L} = 0$ (v).

Assume that the utility function displays constant relative risk aversion (CRRA). Let $\theta \equiv -\frac{u''(y_L+T_L)}{u'(y_L+T_L)}(y_L +$

T_L). In this shorthand, Eq. A1 becomes:

$$\xi_1 = \frac{1}{2}\theta\frac{T_L}{y_L+T_L}\left(\frac{1}{\psi}-1-\xi_1^2\right).$$

Taking the derivative of both sides with respect to T_L, noticing that, given CRRA, $\frac{\partial\theta}{\partial T_L}=0$, yields

$$\frac{\partial\xi_1}{\partial T_L}\left(1+\theta\xi_1\frac{T_L}{y_L+T_L}\right)=\frac{1}{2}\theta\frac{\partial\frac{T_L}{y_L+T_L}}{\partial T_L}\left(\frac{1}{\psi}-1-\xi_1^2\right).$$

Since $0<\xi_1<1$, $y_L>0$, $T_L>0$, and $\theta>0$, $\frac{\partial\xi_1}{\partial T_L}$ must be positive (iv). Taking the derivative of Eq. A1 with respect to y_L makes it straightforward to see that $\frac{\partial\xi_1}{\partial y_L}<0$ (v).

A.3 Proof of Proposition 3:

i) Suppose $\xi_2=1$, then $y_L+(1-a)T_L/\psi+a(1-\xi_2)T_L<y_L+T_L/\psi$ and $y_L+a(1-\xi_2)T_L=y_L$. Since $u(\cdot)$ is strictly increasing then $\psi u\left(y_L+(1-a)T_L/\psi+a(1-\xi_2)T_L\right)+(1-\psi)u\left(y_L+a(1-\xi_2)T_L\right)<\psi u\left(y_L+T_L/\psi\right)+(1-\psi)u(y_L)$, which contradicts the definition of ξ_2. So $\xi_2\neq 1$.

Suppose $\xi_2=0$, then $y_L+(1-a)T_L/\psi+a(1-\xi_2)T_L-(y_L+T_L/\psi)=-aT_L[(1-\psi)/\psi-\xi_2]=-aT_L[(1-\psi)/\psi]$ and $y_L+a(1-\xi_2)T_L-y_L=a(1-\xi_2)T_L=aT_L$. From here follows that

$$\begin{aligned}\psi u\left(y_L+(1-a)T_L/\psi+a(1-\xi_2)T_L\right)-\psi u\left(y_L+T_L/\psi\right)+(1-\psi)u\left(y_L+a(1-\xi_2)T_L\right)-(1-\psi)u(y_L)\approx\\ \psi u'(y_L+T_L/(1-\psi))[-aT_L[(1-\psi)/\psi]]+(1-\psi)u'(y_L)aT_L=\\ -u'(y_L+T_L/(1-\psi))aT_L(1-\psi)+u'(y_L)aT_L(1-\psi)>0,\end{aligned}$$

since, by strict concavity, $u'(y_L+T_L/(1-\psi))<u'(y_L)$. $\xi_2=0$, then, contradicts the definition of ξ_2.

Since $u(\cdot)$ is continuous and strictly increasing, from the above then follows that there is exactly one $0<\xi_2<1$ that satisfies $\psi u\left(y_L+(1-a)T_L/\psi+a(1-\xi_2)T_L\right)+(1-\psi)u\left(y_L+a(1-\xi_2)T_L\right)=\psi u\left(y_L+T_L/\psi\right)+(1-\psi)u(y_L)$.

ii) Define:

$$\begin{aligned}s&=y_L+T_L,\\ \delta_1&=\left(y_L+\frac{T_L}{\psi}\right)-(y_L+T_L)=T_L\left(\frac{1}{\psi}-1\right)=T_L\left(\frac{1-\psi}{\psi}\right),\\ \delta_2&=y_L-(y_L+T_L)=-T_L.\end{aligned}$$

We do a second-order Taylor expansion of the following equation in the neighborhood of $s = y_L + T_L$:

$$\psi\, u\left(y_L + \frac{T_L}{\psi}\right) + (1-\psi)\, u(y_L) = \psi\, u\left(y_L + a\frac{T_L}{\psi} + (1-a)(1-\xi_2)\,T_L\right) + (1-\psi)\, u\big(y_L + (1-a)(1-\xi_2)\,T_L\big).$$

After rearranging yields:

$$u'(s)\xi_2 - \frac{1}{2}u''(s)\,T_L a\xi_2^2 = -\frac{1}{2}u''(s)\,T_L\frac{1-\psi}{\psi}(2-a).$$

Rearranging, yields

$$\xi_2 = -\frac{1}{2}\frac{u''(s)}{u'(s)}\,T_L\left[\frac{1-\psi}{\psi}(2-a) - a\xi_2^2\right]. \tag{A2}$$

Recall Equation A1:

$$\xi_1 = -\frac{1}{2}\frac{u''(s)}{u'(s)}\,T_L\left(\frac{1-\psi}{\psi} - \xi_1^2\right).$$

Subtracting ξ_2 and rearranging we conclude:

$$(\xi_1 - \xi_2) - \frac{1}{2}\frac{u''(s)}{u'(s)}\,T_L(\xi_1^2 - \xi_2^2) = -\frac{1}{2}\frac{u''(s)}{u'(s)}\,T_L\left[(1-a)\left(-\frac{1-\psi}{\psi} - \xi_2^2\right)\right]. \tag{A3}$$

Given that $-\frac{1}{2}\frac{u''(s)}{u'(s)}T_L > 0$ due to the strict concavity of u, the left-hand side has the same sign as $\xi_1 - \xi_2$. Also, on the right-hand sign, $(1-a)\left(\frac{1-\psi}{\psi} - \xi_2^2\right)$ is negative given that $0 < \psi < 1$ and $0 < \xi_2$ and $0 < a < 1$. Hence, $\xi_2 > \xi_1$.

Online Appendix

B Further Details of the Model

Throughout this appendix, we use $X^{x}_{j,l}$ as shorthand for any function X depending on the entire vector of idiosyncratic states, $(a, n^{x}, b^{j}_{l}, z, \zeta)$, where $x \in \{e, u, o\}$, $j \in \{e, ui, u, o, \varnothing\}$, and $l \in \{ui, \varnothing\}$, the latter only relevant to the employed ($x = e$). In the case of wages, $w(a, b^{j}_{l}, z, \zeta)$, and the value of firms, $J(a, b, z, \zeta)$, we use the shorthand w^{j}_{l} and J^{j}_{l}.

B.1 Consumers' HJB Equations

Here we present all possible HJB equations describing a consumer's problem.

The HJB of an employed consumer claiming employed benefits and eligible for unemployment insurance is given by:

$$\begin{aligned}\rho_z W^{e}_{e,ui} &= u(c^{e}_{e,ui}, 0) + \partial_a W^{e}_{e,ui}\left[(1-\tau_n)(w^{e}_{ui})^{1-\lambda_n} + B^{e}_{ui} + UBI + (1-\tau_a)(r-\delta)a - (1+\tau_c)c^{e}_{e,ui}\right] \\ &+ m^{z}_{eu}\left[W^{u}_{ui} - W^{e}_{e,ui}\right] + m^{z}_{eo}\left[\psi^{z}_{o} W^{o}_{o} + (1-\psi^{z}_{o})W^{o}_{\varnothing} - W^{e}_{e,ui}\right] + \theta_\zeta(\zeta_e - \zeta)\partial_\zeta W^{e}_{e,ui} + \frac{\sigma^2_\zeta}{2}\partial^2_{\zeta\zeta} W^{e}_{e,ui}.\end{aligned} \tag{B1}$$

The HJB shows that the flow value depends on instantaneous utility, which is only a function of consumption because consumers only search for jobs when nonemployed. The flow value also depends on changes in asset holdings (i.e., on the budget constraint). Note that the benefits B^{e}_{ui} depend on whether the consumer is eligible for unemployment insurance because it affects the wage. Moreover, the flow value depends on the risk of moving to unemployment and receiving unemployment insurance, on the risk of moving out of the labor force and, if moving, whether OLF benefits are claimed. Finally, the flow value depends on stochastic changes in human capital.

The HJB of an employed consumer claiming employed benefits and ineligible for unemployment insurance is:

$$\begin{aligned}\rho_z W^{e}_{e,\varnothing} &= u(c^{e}_{e,\varnothing}, 0) + \partial_a W^{e}_{e,\varnothing}\left[(1-\tau_n)(w^{e}_{\varnothing})^{1-\lambda_n} + B^{e}_{\varnothing} + UBI + (1-\tau_a)(r-\delta)a - (1+\tau_c)c^{e}_{e,\varnothing}\right] \\ &+ p^{e,z}_{ui}\left[W^{e}_{e,ui} - W^{e}_{e,\varnothing}\right] + m^{z}_{eu}\left[\psi^{z}_{u} W^{u}_{u} + (1-\psi^{z}_{u})W^{u}_{\varnothing} - W^{e}_{e,\varnothing}\right] + m^{z}_{eo}\left[\psi^{z}_{o} W^{o}_{o} + (1-\psi^{z}_{o})W^{o}_{\varnothing} - W^{e}_{e,\varnothing}\right] \\ &+ \theta_\zeta(\zeta_e - \zeta)\partial_\zeta W^{e}_{e,\varnothing} + \frac{\sigma^2_\zeta}{2}\partial^2_{\zeta\zeta} W^{e}_{e,\varnothing}.\end{aligned} \tag{B2}$$

There are two major differences relative to Eq. (B1). One is the additional term accounting for the impact of becoming eligible for unemployment insurance (UI) on the flow value. Another is the term to account for the claiming risk when moving to unemployment without being eligible for UI.

The HJBs of an employed consumer not earning employed benefits are:

$$\rho_z W^e_{\varnothing,ui} = u(c^e_{\varnothing,ui},0) + \partial_a W^e_{\varnothing,ui}\left[(1-\tau_n)(w^{\varnothing}_{ui})^{1-\lambda_n} + UBI + (1-\tau_a)(r-\delta)a - (1+\tau_c)c^e_{\varnothing,ui}\right]$$
$$+m^z_{eu}\left[W^u_{ui} - W^e_{\varnothing,ui}\right] + m^z_{eo}\left[\psi^z_o W^o_o + (1-\psi^z_o)W^o_{\varnothing} - W^e_{\varnothing,ui}\right] + \theta_\zeta(\zeta_e - \zeta)\partial_\zeta W^e_{\varnothing,ui} + \frac{\sigma^2_\zeta}{2}\partial^2_{\zeta\zeta}W^e_{\varnothing,ui}, \tag{B3}$$

$$\rho_z W^e_{\varnothing,\varnothing} = u(c^e_{\varnothing,\varnothing},0) + \partial_a W^e_{\varnothing,\varnothing}\left[(1-\tau_n)(w^{\varnothing}_{\varnothing})^{1-\lambda_n} + UBI + (1-\tau_a)(r-\delta)a - (1+\tau_c)c^e_{\varnothing,\varnothing}\right]$$
$$+p^{e,z}_{ui}\left[W^e_{\varnothing,ui} - W^e_{\varnothing,\varnothing}\right] + m^z_{eu}\left[\psi^z_u W^u_u + (1-\psi^z_u)W^u_{\varnothing} - W^e_{\varnothing,\varnothing}\right] + m^z_{eo}\left[\psi^z_o W^o_o + (1-\psi^z_o)W^o_{\varnothing} - W^e_{\varnothing,\varnothing}\right]$$
$$+\theta_\zeta(\zeta_e - \zeta)\partial_\zeta W^e_{\varnothing,\varnothing} + \frac{\sigma^2_\zeta}{2}\partial^2_{\zeta\zeta}W^e_{\varnothing,\varnothing}. \tag{B4}$$

The main difference relative to Eqs. (B1) and (B2) (respectively) is that these consumers do not claim employed benefits, which affects their budget constraints.

The HJB of an unemployed consumer claiming other unemployed benefits is:

$$\rho_z W^u_u = u(c^u_u, s^u_u) + \partial_a W^u_u\left[h(z,\zeta) + B^u + UBI + (1-\tau_a)(r-\delta)a - (1+\tau_c)c^u_u\right]$$
$$+s^u_u f(z,\zeta)\left[\psi^z_e W^e_{e,\varnothing} + (1-\psi^z_e)W^e_{\varnothing,\varnothing} - W^u_u\right] + m^z_{uo}\left[\psi^z_o W^o_o + (1-\psi^z_o)W^o_{\varnothing} - W^u_u\right]$$
$$+\theta_\zeta(\zeta_o - \zeta)\partial_\zeta W^u_u + \frac{\sigma^2_\zeta}{2}\partial^2_{\zeta\zeta}W^u_u. \tag{B5}$$

Compared with Eq. (12), this equation has one less term as, contrary to those earning unemployment insurance, consumers receiving other unemployed benefits do not lose eligibility while unemployed. The same applies to the HJB of an unemployed consumer claiming no conditional benefits:

$$\rho_z W^u_{\varnothing} = u(c^u_{\varnothing}, s^u_{\varnothing}) + \partial_a W^u_{\varnothing}\left[h(z,\zeta) + UBI + (1-\tau_a)(r-\delta)a - (1+\tau_c)c^u_{\varnothing}\right]$$
$$+s^u_{\varnothing} f(z,\zeta)\left[\psi^z_e W^e_{e,\varnothing} + (1-\psi^z_e)W^e_{\varnothing,\varnothing} - W^u_{\varnothing}\right] + m^z_{uo}\left[\psi^z_o W^o_o + (1-\psi^z_o)W^o_{\varnothing} - W^u_{\varnothing}\right]$$
$$+\theta_\zeta(\zeta_o - \zeta)\partial_\zeta W^u_{\varnothing} + \frac{\sigma^2_\zeta}{2}\partial^2_{\zeta\zeta}W^u_{\varnothing}, \tag{B6}$$

which also has a simpler budget constraint.

Finally, the HJBs for consumers out of the labor force (OLF) are:

$$\rho_z W^o_o = u(c^o_o,0) + \partial_a W^o_o\left[h(z,\zeta) + B^o + UBI + (1-\tau_a)(r-\delta)a - (1+\tau_c)c^o_o\right]$$
$$+s^o_o f(z,\zeta)\left[\psi^z_e W^e_{e,\varnothing} + (1-\psi^z_e)W^e_{\varnothing,\varnothing} - W^o_o\right] + m^z_{ou}\left[\psi^z_u W^u_u + (1-\psi^z_u)W^u_{\varnothing} - W^o_o\right]$$
$$+\theta_\zeta(\zeta_o - \zeta)\partial_\zeta W^o_o + \frac{\sigma^2_\zeta}{2}\partial^2_{\zeta\zeta}W^o_o, \tag{B7}$$

$$\rho_z W^o_\varnothing = u(c^o_\varnothing, 0) + \partial_a W^o_\varnothing \Big[h(z,\zeta) + UBI + (1-\tau_a)(r-\delta)a - (1+\tau_c)c^o_\varnothing\Big]$$
$$+ s^o_\varnothing f(z,\zeta) \left[\psi^z_e W^e_{e,\varnothing} + (1-\psi^z_e) W^e_{\varnothing,\varnothing} - W^o_\varnothing\right] + m^z_{ou}\Big[\psi^z_u W^u_u + (1-\psi^z_u) W^u_\varnothing - W^o_\varnothing\Big] \tag{B8}$$
$$+ \theta_\zeta(\zeta_o - \zeta)\partial_\zeta W^o_\varnothing + \frac{\sigma^2_\zeta}{2}\partial^2_{\zeta\zeta} W^o_\varnothing,$$

Even though OLF consumers choose whether to search for jobs, they only choose on the extensive margin and searching for jobs does not affect their utility since we assume that the search happens passively. Other than this, all other changes relative to Eqs. (B5) and (B6) are to account for the fact that the flows between the two labor market states reverse direction.

For completeness, we reproduce the HJB of an unemployed consumer receiving unemployment insurance found in the main text:

$$\rho_z W^u_{ui} = u(c^u_{ui}, s^u_{ui}) + \partial_a W^u_{ui}\Big[h(z,\zeta) + B^u_{ui} + UBI + (1-\tau_a)(r-\delta)a - (1+\tau_c)c^u_{ui}\Big]$$
$$+ s^u_{ui} f(z,\zeta)\Big[\psi^z_e W^e_{e,ui} + (1-\psi^z_e) W^e_{\varnothing,ui} - W^u_{ui}\Big] + p^u_{ui}\left[\psi^z_u W^u_u + (1-\psi^z_u) W^u_\varnothing - W^u_{ui}\right] \tag{B9}$$
$$+ m^z_{uo}\Big[\psi^z_o W^o_o + (1-\psi^z_o) W^o_\varnothing - W^u_{ui}\Big] + \theta_\zeta(\zeta_o - \zeta)\partial_\zeta W^u_{ui} + \frac{\sigma^2_\zeta}{2}\partial^2_{\zeta\zeta} W^u_{ui}\Big\}.$$

B.2 Labor Firms' HJB

The HJB of a firm employing a consumer eligible for unemployment insurance is:

$$(r - \delta + m^z_{eu} + m^z_{eo}) J^e_{ui} = z e^\zeta p_L - w^e_{ui} + \partial_a J^e_{ui}\dot{a}^e_{e,ui} + \theta_\zeta(\zeta_e - \zeta)\partial_\zeta J^e_{ui} + \frac{\sigma^2_\zeta}{2}\partial^2_{\zeta\zeta} J^e_{ui}, \tag{B10}$$

which mainly differs from Eq. (11) because it does not include the last term. The two HJBs remaining, of firms employing consumers not claiming employed benefits, are, respectively, the same as (B10) and (11) except that the consumer's claimant status is either $b^\varnothing_{ui}$ and $b^\varnothing_0$.

B.3 Wage Equations

Using the consumers' HJB equations in Appendix B.1 and $J(a,b,z,\zeta)$ in Section 3.3, the wage of an employed consumer claiming employed benefits and entitled to unemployment insurance satisfies:

$$
\begin{aligned}
& w_{ui}^{e}\left[(1-\phi)\frac{\partial_a W_{e,ui}^{e}(1-\tau_n)(w_{ui}^{e})^{-\lambda_n}}{\rho_z+m_{uo}^{z}+m_{eo}^{z}}+\phi\frac{1-\partial_a J_{ui}^{e}(1-\tau_n)(w_{ui}^{e})^{-\lambda_n}}{r-\delta+m_{uo}^{z}+m_{eo}^{z}}\right] \\
&=(\phi-1)\frac{u(c_{e,ui}^{e},0)+\partial_a W_{e,ui}^{e}\left[B_{ui}^{e}+UBI+(1-\tau_a)(r-\delta)a-(1+\tau_c)c_{e,ui}^{e}\right]}{\rho_z+m_{uo}^{z}+m_{eo}^{z}} \\
&+(\phi-1)\frac{-(\rho_z+m_{eo}^{z})W_{ui}^{u}+m_{eo}^{z}\left[\psi_o W_o^{o}+(1-\psi_o)W_{\varnothing}^{o}\right]}{\rho_z+m_{uo}^{z}+m_{eo}^{z}}+(\phi-1)\frac{\theta_\zeta(\zeta_e-\zeta)\partial_\zeta W_{e,ui}^{e}+\frac{\sigma_\zeta^2}{2}\partial_{\zeta\zeta}^2 W_{e,ui}^{e}}{\rho_z+m_{uo}^{z}+m_{eo}^{z}} \\
&+\phi\frac{p_L z e^{\zeta}+\partial_a J_{ui}^{e}\left[B_{ui}^{e}+UBI+(1-\tau_a)(r-\delta)a-(1+\tau_c)c_{e,ui}^{e}\right]}{r-\delta+m_{uo}^{z}+m_{eo}^{z}}+\phi\frac{\theta_\zeta(\zeta_e-\zeta)\partial_\zeta J_{ui}^{e}+\frac{\sigma_\zeta^2}{2}\partial_{\zeta\zeta}^2 J_{ui}^{e}}{r-\delta+m_{uo}^{z}+m_{eo}^{z}}.
\end{aligned}
\tag{B11}
$$

The wage of a consumer claiming employed benefits but ineligible for unemployment insurance is:

$$
\begin{aligned}
& w_{\varnothing}^{e}\left[(1-\phi)\frac{\partial_a W_{e,\varnothing}^{e}(1-\tau_n)(w_{\varnothing}^{e})^{-\lambda_n}}{\rho_z+m_{uo}^{z}+m_{eo}^{z}+p_{ui}^{e,z}}+\phi\frac{1-\partial_a J_{\varnothing}^{e}(1-\tau_n)(w_{\varnothing}^{e})^{-\lambda_n}}{r-\delta+m_{uo}^{z}+m_{eo}^{z}+p_{ui}^{e,z}}\right] \\
&=(\phi-1)\frac{u(c_{e,\varnothing}^{e},0)+\partial_a W_{e,\varnothing}^{e}\left[B_{\varnothing}^{e}+UBI+(1-\tau_a)(r-\delta)a-(1+\tau_c)c_{e,\varnothing}^{e}\right]+p_{ui}^{e,z}W_{e,ui}^{e}}{\rho_z+m_{uo}^{z}+m_{eo}^{z}+p_{ui}^{e,z}} \\
&+(\phi-1)\frac{-(\rho_z+m_{eo}^{z}+p_{ui}^{e,z})\left[\psi_u W_u^{u}+(1-\psi_u)W_{\varnothing}^{u}\right]+m_{eo}^{z}\left[\psi_o W_o^{o}+(1-\psi_o)W_{\varnothing}^{o}\right]}{\rho_z+m_{uo}^{z}+m_{eo}^{z}+p_{ui}^{e,z}} \\
&+(\phi-1)\frac{\theta_\zeta(\zeta_e-\zeta)\partial_\zeta W_{e,\varnothing}^{e}+\frac{\sigma_\zeta^2}{2}\partial_{\zeta\zeta}^2 W_{e,\varnothing}^{e}}{\rho_z+m_{uo}^{z}+m_{eo}^{z}+p_{ui}^{e,z}} \\
&+\phi\frac{p_L z e^{\zeta}+\partial_a J_{\varnothing}^{e}\left[B_{\varnothing}^{e}+UBI+(1-\tau_a)(r-\delta)a-(1+\tau_c)c_{e,\varnothing}^{e}\right]+p_{ui}^{e,z}J_{ui}^{e}}{r-\delta+m_{uo}^{z}+m_{eo}^{z}+p_{ui}^{e,z}}+\phi\frac{\theta_\zeta(\zeta_e-\zeta)\partial_\zeta J_{\varnothing}^{e}+\frac{\sigma_\zeta^2}{2}\partial_{\zeta\zeta}^2 J_{\varnothing}^{e}}{r-\delta+m_{uo}^{z}+m_{eo}^{z}+p_{ui}^{e,z}}.
\end{aligned}
\tag{B12}
$$

The wage of a consumer not claiming employed benefits and eligible or ineligible for unemployment insurance are, respectively:

$$w_{ui}^{\varnothing}\left[(1-\phi)\frac{\partial_a W_{\varnothing,ui}^{e}(1-\tau_n)(w_{ui}^{\varnothing})^{-\lambda_n}}{\rho_z+m_{uo}^z+m_{eo}^z}+\phi\frac{1-\partial_a J_{ui}^{\varnothing}(1-\tau_n)(w_{ui}^{\varnothing})^{-\lambda_n}}{r-\delta+m_{uo}^z+m_{eo}^z}\right]$$
$$=(\phi-1)\frac{u(c_{\varnothing,ui}^{e},0)+\partial_a W_{\varnothing,ui}^{e}\left[UBI+(1-\tau_a)(r-\delta)a-(1+\tau_c)c_{\varnothing,ui}^{e}\right]}{\rho_z+m_{uo}^z+m_{eo}^z}$$
$$+(\phi-1)\frac{-(\rho_z+m_{eo}^z)W_{ui}^{u}+m_{eo}^z\left[\psi_o W_o^o+(1-\psi_o)W_{\varnothing}^{o}\right]}{\rho_z+m_{uo}^z+m_{eo}^z}+(\phi-1)\frac{\theta_\zeta(\zeta_e-\zeta)\partial_\zeta W_{\varnothing,ui}^{e}+\frac{\sigma_\zeta^2}{2}\partial_{\zeta\zeta}^2 W_{\varnothing,ui}^{e}}{\rho_z+m_{uo}^z+m_{eo}^z}$$
$$+\phi\frac{p_L z e^{\zeta}+\partial_a J_{ui}^{\varnothing}\left[UBI+(1-\tau_a)(r-\delta)a-(1+\tau_c)c_{\varnothing,ui}^{e}\right]}{r-\delta+m_{uo}^z+m_{eo}^z}+\phi\frac{\theta_\zeta(\zeta_e-\zeta)\partial_\zeta J_{ui}^{\varnothing}+\frac{\sigma_\zeta^2}{2}\partial_{\zeta\zeta}^2 J_{ui}^{\varnothing}}{r-\delta+m_{uo}^z+m_{eo}^z}, \tag{B13}$$

$$w_{\varnothing}^{\varnothing}\left[(1-\phi)\frac{\partial_a W_{\varnothing,\varnothing}^{e}(1-\tau_n)(w_{\varnothing}^{\varnothing})^{-\lambda_n}}{\rho_z+m_{uo}^z+m_{eo}^z+p_{ui}^{e,z}}+\phi\frac{1-\partial_a J(a,b_{\varnothing}^{\varnothing},z,\zeta)(1-\tau_n)(w_{\varnothing}^{\varnothing})^{-\lambda_n}}{r-\delta+m_{uo}^z+m_{eo}^z+p_{ui}^{e,z}}\right]$$
$$=(\phi-1)\frac{u(c_{\varnothing,\varnothing}^{e},0)+\partial_a W_{\varnothing,\varnothing}^{e}\left[UBI+(1-\tau_a)(r-\delta)a-(1+\tau_c)c_{\varnothing,\varnothing}^{e}\right]+p_{ui}^{e,z}W_{\varnothing,ui}^{e}}{\rho_z+m_{uo}^z+m_{eo}^z+p_{ui}^{e,z}}$$
$$+(\phi-1)\frac{-(\rho_z+m_{eo}^z+p_{ui}^{e,z})\left[\psi_u W_u^u+(1-\psi_u)W_{\varnothing}^{u}\right]+m_{eo}^z\left[\psi_o W_o^o+(1-\psi_o)W_{\varnothing}^{o}\right]}{\rho_z+m_{uo}^z+m_{eo}^z+p_{ui}^{e,z}}$$
$$+(\phi-1)\frac{\theta_\zeta(\zeta_e-\zeta)\partial_\zeta W_{\varnothing,\varnothing}^{e}+\frac{\sigma_\zeta^2}{2}\partial_{\zeta\zeta}^2 W_{\varnothing,\varnothing}^{e}}{\rho_z+m_{uo}^z+m_{eo}^z+p_{ui}^{e,z}}$$
$$+\phi\frac{p_L z e^{\zeta}+\partial_a J_{\varnothing}^{\varnothing}\left[UBI+(1-\tau_a)(r-\delta)a-(1+\tau_c)c_{\varnothing,\varnothing}^{e}\right]+p_{ui}^{e,z}J_{ui}^{\varnothing}}{r-\delta+m_{uo}^z+m_{eo}^z+p_{ui}^{e,z}}+\phi\frac{\theta_\zeta(\zeta_e-\zeta)\partial_\zeta J_{\varnothing}^{\varnothing}+\frac{\sigma_\zeta^2}{2}\partial_{\zeta\zeta}^2 J(a,b_{\varnothing}^{\varnothing},z,\zeta)}{r-\delta+m_{uo}^z+m_{eo}^z+p_{ui}^{e,z}}. \tag{B14}$$

B.4 Density Functions

The density of employed consumers claiming employed benefits and eligible for unemployment insurance evolves according to the Kolmogorov forward equation (KFE):

$$\partial_t g_{e,ui}^{e}=-\partial_a\left[\dot{a}_{e,ui}^{e}g_{e,ui}^{e}\right]-\left[m_{eu}^z+m_{eo}^z\right]g_{e,ui}^{e}+s_{ui}^{u}f(z,\zeta)\psi_e g_{ui}^{u}$$
$$+p_{ui}^{e}g_{e,\varnothing}^{e}-\partial_\zeta\left[\theta_\zeta(\zeta_e-\zeta)g_{e,ui}^{e}\right]+\frac{1}{2}\partial_{\zeta\zeta}^2\left[\sigma_\zeta^2 g_{e,ui}^{e}\right]. \tag{B15}$$

Looking at the left-hand side, this equation shows the effect of savings, flows out of employment, flows from those earning unemployment insurance who find jobs, and changes in stochastic human capital.

The KFE of an employed consumer claiming employed benefits but not eligible for unemployment insurance is:

$$
\begin{aligned}
\partial_t g^e_{e,\varnothing} = -\partial_a \left[\dot{a}^e_{e,\varnothing} g^e_{e,\varnothing}\right] - \left[m^z_{eu} + m^z_{eo} + p^e_{ui}\right] g^e_{e,\varnothing} \\
+\psi_e f(z,\zeta) \left(s^u_u g^u_u + s^u_\varnothing g^u_\varnothing + s^o_o g^o_o + s^o_\varnothing g^o_\varnothing\right) \\
-\partial_\zeta \left[\theta_\zeta(\zeta_e - \zeta) g^e_{e,\varnothing}\right] + \frac{1}{2}\partial^2_{\zeta\zeta}\left[\sigma^2_\zeta g^e_{e,\varnothing}\right].
\end{aligned}
\tag{B16}
$$

There are mainly three differences between Eqs. (B15) and (B16). One is that the flows of those that become eligible for unemployment insurance are reversed. The other two are related to flows from nonemployment. Whereas those claiming unemployment insurance (UI) remain eligible for UI as soon as they find jobs, the unemployed that do not claim UI must start employment without that eligibility. A fraction ψ_e of the latter group move to the state $(a, n^e, b^e_\varnothing, z, \zeta)$ when they find jobs. Finally, those OLF that find jobs are never eligible for UI and, again, a fraction ψ_e of them move to the state $(a, n^e, b^e_\varnothing, z, \zeta)$ when they do.

The last two KFEs for employed consumers are for those that do not claim employed benefits whether or not eligible for UI. The KFEs are, respectively:

$$
\begin{aligned}
\partial_t g^e_{\varnothing,ui} = -\partial_a \left[\dot{a}^e_{\varnothing,ui} g^e_{\varnothing,ui}\right] - \left[m^z_{eu} + m^z_{eo}\right] g^e_{\varnothing,ui} \\
+s^u_{ui} f(z,\zeta)(1-\psi_e) g^u_{ui} + p^e_{ui} g^e_{\varnothing,\varnothing} \\
-\partial_\zeta \left[\theta_\zeta(\zeta_e - \zeta) g^e_{\varnothing,ui}\right] + \frac{1}{2}\partial^2_{\zeta\zeta}\left[\sigma^2_\zeta g^e_{\varnothing,ui}\right],
\end{aligned}
\tag{B17}
$$

$$
\begin{aligned}
\partial_t g^e_{\varnothing,\varnothing} = -\partial_a \left[\dot{a}^e_{\varnothing,\varnothing} g^e_{e,\varnothing}\right] - \left[m^z_{eu} + m^z_{eo} + p^e_{ui}\right] g^e_{\varnothing,\varnothing} \\
+(1-\psi_e) f(z,\zeta) \left(s^u_u g^u_u + s^u_\varnothing g^u_\varnothing + s^o_o g^o_o + s^o_\varnothing g^o_\varnothing\right) \\
-\partial_\zeta \left[\theta_\zeta(\zeta_e - \zeta) g^e_{\varnothing,\varnothing}\right] + \frac{1}{2}\partial^2_{\zeta\zeta}\left[\sigma^2_\zeta g^e_{\varnothing,\varnothing}\right].
\end{aligned}
\tag{B18}
$$

The only relevant difference between these last two equations and Eqs. (B15) and (B16) is the separation between those who claim and those who do not claim employed benefits.

The KFEs of unemployed consumers that claim other unemployed benefits or claim no benefits are:

$$
\begin{aligned}
\partial_t g^u_u = -\partial_a \left[\dot{a}^u_u g^u_u\right] - \left[s^u_u f(z,\zeta) + m^z_{uo}\right] g^u_u \\
+\psi_u \left[p^u_{ui} g^u_{ui} + m^z_{eu}\left(g^e_{e,\varnothing} + g^e_{\varnothing,\varnothing}\right) + m^z_{ou}\left(g^o_o + g^o_\varnothing\right)\right] \\
-\partial_\zeta \left[\theta_\zeta(\zeta_o - \zeta) g^u_u\right] + \frac{1}{2}\partial^2_{\zeta\zeta}\left[\sigma^2_\zeta g^u_u\right],
\end{aligned}
\tag{B19}
$$

$$
\begin{aligned}
\partial_t g^u_\varnothing = -\partial_a \left[\dot{a}^u_\varnothing g^u_\varnothing\right] - \left[s^u_\varnothing f(z,\zeta) + m^z_{uo}\right] g^u_\varnothing \\
+(1-\psi_u) \left[p^u_{ui} g^u_{ui} + m^z_{eu}\left(g^e_{e,\varnothing} + g^e_{\varnothing,\varnothing}\right) + m^z_{ou}\left(g^o_o + g^o_\varnothing\right)\right] \\
-\partial_\zeta \left[\theta_\zeta(\zeta_o - \zeta) g^u_\varnothing\right] + \frac{1}{2}\partial^2_{\zeta\zeta}\left[\sigma^2_\zeta g^u_\varnothing\right].
\end{aligned}
\tag{B20}
$$

These two equations only differentiate between those who claim and those who do not claim other unemployed benefits. They are both affected by savings, flows to other labor market states, flows from those who lose eligibility for UI, flows from other labor market states, and changes in stochastic human capital.

Finally, the KFE for OLF consumers are

$$\begin{aligned}\partial_t g_o^o = -\partial_a\left[\dot{a}_o^o g_o^o\right] - \left[s_o^o f(z,\zeta) + m_{ou}^z\right] g_o^o \\ +\psi_o\left[m_{eo}^z\left(g_{e,ui}^e + g_{\varnothing,ui}^e + g_{e,\varnothing}^e + g_{\varnothing,\varnothing}^e\right) + m_{uo}^z\left(g_{ui}^u + g_u^u + g_{\varnothing}^u\right)\right] \\ -\partial_\zeta\left[\theta_\zeta(\zeta_o - \zeta) g_o^o\right] + \frac{1}{2}\partial_{\zeta\zeta}^2\left[\sigma_\zeta^2 g_o^o\right],\end{aligned} \tag{B21}$$

$$\begin{aligned}\partial_t g_\varnothing^o = -\partial_a\left[\dot{a}_\varnothing^o g_\varnothing^o\right] - \left[s_\varnothing^o f(z,\zeta) + m_{ou}^z\right] g_\varnothing^o \\ +(1-\psi_o)\left[m_{eo}^z\left(g_{e,ui}^e + g_{\varnothing,ui}^e + g_{e,\varnothing}^e + g_{\varnothing,\varnothing}^e\right) + m_{uo}^z\left(g_{ui}^u + g_u^u + g_{\varnothing}^u\right)\right] \\ -\partial_\zeta\left[\theta_\zeta(\zeta_o - \zeta) g_\varnothing^o\right] + \frac{1}{2}\partial_{\zeta\zeta}^2\left[\sigma_\zeta^2 g_\varnothing^o\right].\end{aligned} \tag{B22}$$

These two equations only differentiate between those who claim and those who do not claim OLF benefits. They are both affected by savings, flows to other labor market states, flows from other labor market states, and changes in stochastic human capital.

For completeness, we reproduce the density function of unemployed consumers receiving unemployment insurance found in the main text:

$$\begin{aligned}\partial_t g_{ui}^u = -\partial_a\left[\dot{a}_{ui}^u g_{ui}^u\right] - \left[s_{ui}^u f(z,\zeta) + p_{ui}^u + m_{uo}^z\right] g_{ui}^u \\ +m_{eu}^z\left(g_{e,ui}^e + g_{\varnothing,ui}^e\right) - \partial_\zeta\left[\theta_\zeta(\zeta_o - \zeta) g_{ui}^u\right] + \frac{1}{2}\partial_{\zeta\zeta}^2\left[\sigma_\zeta^2 g_{ui}^u\right],\end{aligned} \tag{B23}$$

B.5 Stationary Equilibrium: Definition

The stationary equilibrium is composed of a set of prices $\{r,\ p_L,\ w(a,b,z,\zeta)\}$, controls $\{c(a,n,b,z,\zeta),\ s(a,n,b,z,\zeta)\}$, value functions $\{W(a,n,b,z,\zeta),\ J(a,b,z,\zeta)\}$, quantities $\{K,\ L,\ \Omega,\ U(z,\zeta),\ f(z,\zeta),\ q(z,\zeta)\}$, labor market tightness $\theta(z,\zeta)$, and density function $g(a,n,b,z,\zeta)$ such that:

1. The value function $W(a,n,b,z,\zeta)$ and the controls satisfy the maximization problems in Eqs. (12) and (B1-B8).

2. The value function $J(a,b,z,\zeta)$ satisfies Eqs. (11) and (B10).

3. Factor prices r and p_L equal the marginal products of capital and labor for final-good producers.

4. The wage function agrees with the solutions to Kalai's bargaining in Eqs. (B11-B14).

5. The density function satisfies Eqs. (15), (B15-B22) and $\partial_t g(a,n,b,z,\zeta) = 0$.

6. The value of firms Ω satisfies Eq. (17).

7. The markets for assets, labor services, and vacancies clear, i.e., Eqs. (16), (18), and (19) are satisfied.

8. (a) In the benchmark, government spending G guarantees a balanced budget in line with Eq. (10).

   (b) In the experiments, the level of labor income taxes τ_n guarantees a balanced budget in line with Eq. (10).

B.6 Welfare Measure

We measure the welfare change if the economy is reformed from benchmark regime B to an alternative regime A by computing the required variation in lifetime consumption that would be just enough for each consumer to prefer regime A to B. In particular, we define

$$W^B(a,n,b,z,\zeta,\lambda) \equiv \mathbb{E}_0 \int_0^\infty e^{-\rho_z t} u((1+\lambda)c(a,n,b,z,\zeta))\mathrm{d}t,$$

where λ is a permanent relative change to consumption. Then, we find λ for each consumer such that

$$W^B(a,n,b,z,\zeta,\lambda) = W^A(a,n,b,z,\zeta) \tag{B24}$$

If $\lambda > 0$, the policy increases the consumer's welfare. Accordingly, we compute the aggregate consumption-equivalent variation (CEV) using:

$$\begin{aligned} &\sum_z \sum_b \sum_n \int_{\underline{\zeta}}^{\bar{\zeta}} \int_{\underline{a}}^{\infty} W^B(a,n,b,z,\zeta,\lambda) g^B(a,n,b,z,\zeta)\mathrm{d}a\mathrm{d}\zeta = \\ &\quad \sum_z \sum_b \sum_n \int_{\underline{\zeta}}^{\bar{\zeta}} \int_{\underline{a}}^{\infty} W^A(a,n,b,z,\zeta) g^B(a,n,b,z,\zeta)\mathrm{d}a\mathrm{d}\zeta, \end{aligned} \tag{B25}$$

where $g^B(\cdot)$ corresponds to the equilibrium density function in the benchmark and λ measures the CEV that equals both sides.

When accounting for the transition between steady-states (Appendix D.3), we replace $W^A(a,n,b,z,\zeta)$ with the value function upon impact. There is little difference between the value function with a UBI upon impact and in the long run. So, our measure of CEV for the steady-state is very close to that of the transition in Appendix D.3.

B.7 Summary of Welfare Programs

Table B1: Welfare Programs: Summary

Program	Who Claims it?	When is eligibility lost?	Transfer
Employed Benefits	A fraction ψ_e^z of job-finders.	Movements out of employment.	$B(a, n^e, b_u^e i, z, \zeta)$ if eligible for UI; $B(a, n^e, b_\varnothing^e, z, \zeta)$ otherwise.
Unemployment Insurance	Employed workers gain eligibility at rate $p_{ui}^{e,z}$ and always claim UI if they become unemployed.	Recipients lose eligibility at rate p_{ui}^u while unemployed. They also lose eligibility if they move to out of the labor force.	$B(a, n^u, b^u i, z, \zeta)$
Other Unemployed Benefits	A fraction ψ_u^z of those who move to unemployment and are ineligible for UI. A fraction ψ_u^z of those whose UI transfers expire also claim these benefits.	Movements out of unemployment.	$B(a, n^u, b^u, z, \zeta)$
OLF Benefits	A fraction ψ_o^z of those who move to OLF.	Movements into the labor force.	$B(a, n^o, b^o, z, \zeta)$

C Internal Validation

This Appendix offers insight into how well our model matches the empirical targets.

Table C1: Summary of Internal Validation I

	Data/Target	Model
Unemployed Job-finding rate		
College	27.00	27.09
Some College	25.90	26.00
High School	24.80	24.95
Less than High School	23.90	23.94
OLF Job-finding rate		
College	5.38	5.37
Some College	4.42	4.40
High School	3.38	3.36
Less than High School	2.23	2.23
Skill Premium		
College Vs Some College	1.67	1.67
Some College Vs High School	1.14	1.14
High School Vs Less High School	1.40	1.40
Mean Wealth Ratio		
Mean Wealth Ratio C-SC	4.04	4.04
Mean Wealth Ratio C-HS	4.98	4.98
Mean Wealth Ratio C-LHS	11.03	11.03
Investment		
I/Y	23.00	23.00
Annualized return on capital	4.00	4.00

Table C2: Summary of Internal Validation II

	Data	Model
Employed benefits		
Total Transfers	1.46	1.46
Illeg. Transfers	0.20	0.20
Recipients (%)	20.24	20.24
Share Recipients LHS	39.80	39.80
Share Recipients HS	24.86	24.86
Share Recipients SC	25.08	25.08
Unemployment Insurance		
Total Transfers	0.25	0.25
Illeg. Transfers	0.02	0.02
Recipiency Rate LHS	13.25	13.25
Recipiency Rate HS	23.19	23.19
Recipiency Rate SC	24.85	24.85
Recipiency Rate C	38.10	38.10
Other Unemployed Benefits		
Total Transfers	0.06	0.06
Illeg. Transfers	0.00	0.00
Recipiency Rate LHS	24.64	24.64
Recipiency Rate HS	20.87	20.87
Recipiency Rate SC	23.67	23.67
Recipiency Rate C	8.92	8.92
OLF Benefits		
Total Transfers	0.67	0.67
Illeg. Transfers	0.05	0.05
Recipiency Rate LHS	37.05	37.05
Recipiency Rate HS	27.25	27.25
Recipiency Rate SC	23.84	23.84
Recipiency Rate C	8.80	8.80

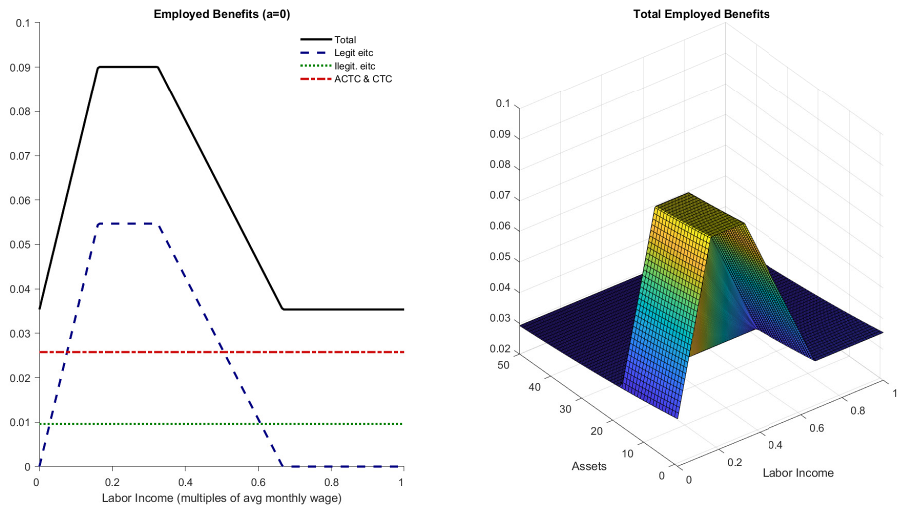
Note: This table contrasts moments in the data with the equivalents in the model. Recipiency rates are expressed as a fraction of those in the respective labor market state. The share of recipients of employed benefits is the recipiency rate of employed benefits of consumers of a given level of education divided by the recipiency rates for all levels of education.

D Further Results

D.1 External Validation: Comparison with Ganong and Noel (2019)

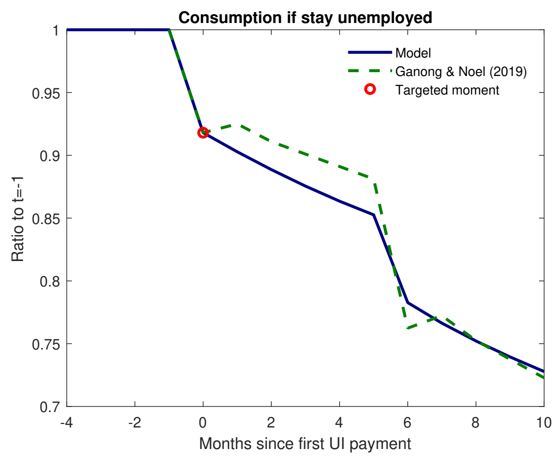
We use home production to target the fall in consumption of UI recipients observed on the month of the first UI payment, as estimated in Ganong and Noel (2019). Their data, however, offers a detailed pattern of the consumption behavior of UI recipients throughout the unemployment spell. We produce a model counterpart by (i) simulating the path of consumption for those who become unemployed and recipients of UI and (ii) restricting our attention to those who remain recipients of UI for six months and lose recipiency immediately after. We compare the two in Figure D1.

Figure C1: Employed Benefits Structure



Note: The left panel shows how the total and the three components of employed benefits change with labor income for consumers with zero assets. The right panel shows how total employed benefits change with assets and labor income. The fall of illegitimate transfers with assets drives the curvature seen on the right panel for given income.

Figure D1: Comparison of model with estimates in Ganong and Noel (2019)



D.2 Robustness to Alternative Calibrations

To gauge the robustness of our main results, we studied several alternative calibration choices, that we discuss below. We summarize the findings in Table D1. This table shows the CEV for a UBI that fully replaces conditional welfare programs in the upper panel and the optimal UBI share in the lower panel. The results are remarkably robust: welfare falls with a full replacement but conditional and unconditional programs are complementary. Quantitatively, there are only slight changes.

Table D1: Summary of Robustness Checks

	CEV Full UBI				
	Agg.	LHS	HS	SC	C
Benchmark Calibration	-0.73	-1.35	-1.38	-1.83	0.20
Fixed Home Production	-0.76	-1.93	-1.48	-1.78	0.25
High Asset Limit B_u&B_o	-0.67	-2.01	-1.16	-1.62	0.18
Low Asset Limit B_e	-0.75	-1.26	-1.33	-1.81	0.11
Benchmark Cal.+TANF	-0.62	-0.85	-1.15	-1.74	0.22
No Debt ($\underline{a}_z = 0$)	-1.25	-1.73	-2.23	-2.71	-0.03
	Optimal UBI Share				
	Agg.	LHS	HS	SC	C
Benchmark Calibration	0.4	0.6	0.4	0.4	0.7
Fixed Home Production	0.4	0.6	0.4	0.3	0.8
High Asset Limit B_u&B_o	0.5	0.5	0.5	0.3	0.7
Low Asset Limit B_e	0.4	0.6	0.5	0.4	0.7
Benchmark Cal.+TANF	0.5	0.6	0.5	0.3	0.7
No Debt ($\underline{a}_z = 0$)	0.4	0.6	0.4	0.3	0.6

- In the benchmark calibration, we assume that the home production function is $h(z,\zeta) = h_v(y_z e^{\zeta})p_L$, i.e., that home production is proportionate to market production. We now posit instead that $h(z,\zeta) = h_f + h_v(y_z e^{\zeta})p_L$, where $h^f = 0.025$ measures fixed home production, while h^v remains calibrated to match the fall in consumption of UI recipients ($h^v = 0.113$, contrasting with $h^v = 0.173$ in the benchmark calibration). This alternative calibration leads to higher home production for the least productive (typically less educated), and lower for the rest. Proposition 2 of Section 2 indicates that replacing the conditional welfare system with a UBI should be less appealing to those with higher home production, as a higher endowment protects against the imperfections of conditional programs. This is what we report in Table D1: the CEV of a UBI fully replacing conditional welfare programs falls for those with high school or less, and rises for the rest. The optimal UBI share barely changes.
- SNAP and SSI eligibility typically requires that recipients have less than 3000 USD in assets. Yet, such restrictions vary by state and have numerous exceptions. As an alternative calibration, we increase the asset limit of other unemployed and OLF benefits to 10000 USD. We also restrict our attention to a wider group of households in SIPP data, which implies that our claim rates ψ_u^z and ψ_o^z target higher recipiency rates. We find that the least educated are the most sensitive to this change. The effects are overall small, especially in the aggregate. But this calibration leads to a larger optimal UBI share of 50%.
- The maximum return on capital compatible with EITC eligibility is 3500 USD, which we target in our benchmark calibration. Yet, this maximum is set for the household, irrespective of

composition. We therefore consider an alternative in which we limit the maximum return on capital to 2625. We find that this increases the claim rates of all education groups, but especially of those with a college education, the most likely to be married in the data. This alternative has little effect in the aggregate. In the benchmark system, it benefits those with a college education at the expense of everyone else.

- In our benchmark calibration, we do not consider the *Temporary Assistance for Needy Families* (TANF). This program offers training and other forms of assistance to needy families, including transfers. It is intended to promote employment. As an alternative calibration, we increase employed benefits by 8 Bn USD. This change slightly increases the benefit of introducing a UBI for all education groups, with a disproportionate effect on the least educated.
- In our benchmark calibration, we allow for small debt levels, which increases the need for welfare assistance, as these consumers have less disposable income. Consequently, if we do not allow debt, a UBI reaching those without support in the benchmark becomes less desirable, further increasing the welfare loss of fully replacing conditional programs with a UBI. Yet, the optimal share of a UBI, again, barely changes.

D.3 Robustness to Transitional Dynamics

In this section, we look at the transitional dynamics from the moment that the expenditure-neutral UBI is unexpectedly introduced. To do so, we must consider that prices, $\{r_t,\ p_{L,t},\ w_t(a,b,z,\zeta)\}$, and quantities, $\{K_t,\ L_t,\ \Omega_t,\ U_t(z,\zeta),\ f_t(z,\zeta),\ q_t(z,\zeta)\}$, change over time. Moreover, the value functions, $W(\cdot)$ and $J(\cdot)$ also change over time, which implies that we must add the terms $\partial_t W_t(a,n,b,z,\zeta)$ and $\partial_t J_t(a,b,z,\zeta)$ to the respective equations for all (a,n,b,z,ζ). Again, we follow Achdou et al. (2021) in building the algorithm. However, we face the additional challenge that the value of firms jumps as the change is introduced. We handle this by using interpolation and adjusting the density functions of those with assets close to the maximum so that the aggregate capital stock is unchanged when the UBI is introduced.

Table D2 shows that accounting for the transition between steady-states has a negligible effect on our conclusions. The welfare effects of the policy upon impact and in the long-run are almost indistinguishable.

D.4 Other Tables and Figures

Table D2: Welfare Impact: Transition vs Long Run

	Aggregate	LHS	HS	SC	C
CEV Steady-state	-0.73	-1.35	-1.38	-1.83	0.20
CEV Transition	-0.72	-1.39	-1.38	-1.81	0.22

Note: This table reports the consumption-equivalent variation (welfare change, CEV) in the aggregate and decomposed by levels of education of our UBI experiment. The first line reports the CEV when we only compare the long-run values in both welfare systems. The second line reports the CEV when we compare the long-run values in the benchmark system with those immediately upon the introduction of a UBI.

Table D3: Inequality

	Earnings		Wealth	
	Benchmark	UBI	Benchmark	UBI
Q1	1.30	1.43	-0.79	-0.69
Q2	4.74	4.88	0.76	1.92
Q3	10.47	10.54	5.31	6.90
Q4	21.39	21.32	16.63	17.59
Q5	62.11	61.83	78.09	74.30

Note: This table contrasts the five quintiles of the earnings and wealth distributions implied by the model with the benchmark welfare system and the model with an expenditure-neutral UBI.

Table D4: Welfare impact of fully replacing improved welfare systems with a UBI

	Benchmark	No Illeg. Transfers	No Admin	100% Take-up	Perfect
CEV Aggregate	-0.73	-0.74	-1.12	-2.83	-3.51
CEV LHS	-1.35	-1.48	-2.55	-9.87	-11.73
CEV HS	-1.38	-1.33	-2.01	-5.55	-6.67
CEV SC	-1.83	-1.81	-2.29	-3.84	-4.69
CEV C	0.20	0.17	0.06	-0.07	-0.28

Note: This table shows the consumption-equivalent variation (welfare change) of fully replacing different welfare systems with an expenditure-neutral UBI. The first column repeats the benchmark results for convenience. The next three columns report the welfare consequences of replacing a system that transfers the same total amount but is free of one kind of imperfection. The last column that of replacing a welfare system without any such imperfections. The first line reports the average CEV, while the other lines decompose it by level of education.