From Means-Tested Programs to Universal Basic Income - The Role of Endogenous Participation in Transfer Programs*

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Abstract

This paper studies the effects of replacing the Earned Income Tax Credit (EITC) with a Universal Basic Income (UBI) in an environment where EITC take-up is incomplete. In contrast, UBI ensures full participation by design, extending benefits to households who do not take up the EITC, at the cost of higher fiscal expenditures. I study this trade-off between expanded coverage and fiscal cost using a life-cycle model with an endogenous EITC participation decision that replicates the observed eligibility and take-up patterns. The results show that a generous UBI ($12,000 annually) reduces welfare due to the substantial fiscal burden it entails, whereas a modest UBI ($3,500 per year) improves welfare by reaching previously uncovered households at only a moderate fiscal cost. These findings highlight the importance of the program participation margin in evaluating policy reforms.

Keywords: Universal Basic Income, Incomplete Take-up, Labor Supply

JEL: E21, E62, H31, I38

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1. Introduction

Universal Basic Income (UBI), which provides unconditional cash transfers to all individuals, has drawn significant attention amid rising inequality. In contrast, existing transfer programs aim to reduce inequality through targeted redistribution, with eligibility and benefit levels tied to income. Yet many eligible households do not participate, and such incomplete take-up has long been a feature of many transfer programs across countries (Ko and Moffitt, 2022). For instance, the Earned Income Tax Credit (EITC)—the largest in-work cash transfer—reaches only about 78% of eligible households, leaving roughly five million low-income families uncovered (Crandall-Hollick et al., 2021; Goldin et al., 2022). This suggests that targeted welfare programs may be less beneficial than often thought.[1]

A key question is whether UBI's universal coverage can offset its well-known drawbacks, such as higher fiscal costs and potential disincentives to work. This paper addresses this question by combining empirical analysis of EITC take-up with a life-cycle model featuring an endogenous program participation margin. To my knowledge, this is the first paper that analyzes UBI reform within such a framework.

The existing macroeconomic literature on this topic mostly abstracts from this margin, assuming that all eligible households receive benefits for sure. However, this full-participation setup can overstate the effectiveness of transfer programs by assuming they assist all people in need. Moreover, it cannot capture the knock-on effects of changes in participation that arise from program reforms. Therefore, properly modeling the program participation margin is essential for analyzing policy reforms, as it governs how incomplete take-up shapes the effectiveness and distributional impact of transfer programs.

Using data from Annual Social and Economic Supplements of the Current Population Survey (ASEC-CPS), I construct a sample of EITC-eligible households and obtain an average take-up rate that is close to the official estimate reported by the Internal Revenue Service. Moreover, I document that EITC participation is incomplete across the entire eligible earning distribution.

[1] In the U.S., participation in other cash transfer programs is even lower. For example, it is only 23% for Temporary Assistance for Needy Families (TANF) in the fiscal year 2017, according to the Center on Budget and Policy Priorities. In addition, Marr et al. (2020) shows there were about 12 million individuals in the U.S. not receiving the fiscal stimulus benefits during the pandemic.

Even at the earning region that corresponds to the maximum benefit, the take-up rate remains below full participation.

Participation pattern also varies with household characteristics. Families with higher expected benefits or higher education are more likely to claim. Conversely, households with higher wages or investment income are less likely to participate. These empirical findings are used to discipline the modeling of program participation friction in the quantitative analysis.

The quantitative framework builds on a standard incomplete-market life-cycle heterogeneous-agent general equilibrium model with endogenous labor supply along both the intensive and extensive margins. The novel features of the model include a rich means-tested working-age transfer program that mimics the EITC, and a participation decision among eligible households.

The model is calibrated to the U.S. economy in the 2010s and replicates the observed EITC take-up patterns. The benchmark economy also generates realistic income, earnings, and wealth distributions, including the distribution of EITC eligibility, which is crucial for counterfactual analysis. To understand the role of the program participation margin, I also calibrate a version of the model with full participation—consistent with the standard assumption in the literature—to the same set of economic moments. Overall, both setups perform well in terms of targeted and untargeted moments, making them suitable laboratories for analyzing policy reforms and the role of program participation margin.

I conduct counterfactual policy reforms that replace the benchmark EITC program with UBI, assuming UBI has complete participation. Two levels of UBI are considered. The first provides an annual after-tax transfer of $12,000—a generous level that has been widely discussed in the literature. In the second reform, the level of UBI is chosen to maximize steady-state welfare, yielding a more modest transfer of approximately $3,500 per year.

Replacing the EITC with a generous UBI generates large distortionary effects. The sharp increase in taxes required to finance the transfer reduces aggregate efficiency, which outweighs the gains in redistribution and leads to welfare losses in both participation setups.

In contrast, the modest UBI imposes much smaller fiscal pressure, allowing the program participation margin to play a central role. In the incomplete-participation (IP) economy, the reform extends coverage to households who were eligible for the EITC but did not claim it. These newly covered households benefit substantially from the unconditional transfer, while the overall fiscal cost remains moderate. Consequently, welfare improves under IP. Under the full-participation (FP) setup, however, this additional redistributive channel is absent, as all eligible households already received EITC benefits in the benchmark, leading to a small welfare loss. When transitional dynamics are considered, the gain under IP becomes even larger, driven by higher consumption and leisure along the transition. In contrast, under the FP setup, consumption initially falls below its new steady-state level, resulting in an overall welfare loss.

Related literature.– This paper mainly contributes to the growing UBI literature.[2] Hoynes and Rothstein (2019) provided a comprehensive descriptive analysis of UBI. In the empirical literature, Jones and Marinescu (2018) analyzed Alaska Permanent Fund (APF)[3] and found no effect on employment along extensive margin but an increase in part-time work (intensive margin). Pilkauskas et al. (2022) analyzed the short-term unconditional Child Tax Credit and found improvement in economic well-being but no effects on labor supply.

There is a growing amount of work that quantitatively analyzes the effects of replacing existing schemes with UBI. These papers have different emphases from this paper, and none allows for endogenous program participation. Fabre et al. (2014) focus on comparing UBI and unemployment insurance. Conesa et al. (2023) and Ferriere et al. (2023) study the optimal financing scheme for the UBI, where the former focus on the consumption tax and the latter focus on the progressivity. Daruich and Fernández (2024) focus on the effect of UBI reform on human capital investment, and Santos and Rauh (2022) study how UBI reform affects the labor market using the search-matching framework. There are also many papers analyzing the macroeconomic effect of the UBI on aggregates and inequality (Lopez-Daneri (2016); Chang et al. (2021a); Jaimovich et al. (2022); Guner et al. (2023); Luduvice (2024)).

Some of these studies (e.g., Conesa et al. (2023)), Luduvice (2024)) find UBI can improve welfare, mostly when UBI is financed by less distortionary fiscal tools like consumption taxes. Hence, part of the gains from UBI in these analyses reflect changes in the tax mix. In contrast, studies using income-tax financing (e.g., Guner et al. (2023), Daruich and Fernández (2024)) typically find welfare loss of implementing UBI. In addition, Guner et al. (2023) also shows this pattern holds

[2]This paper mainly focuses on U.S.-related literature. There are also many empirical papers that analyzed similar programs in other countries: Hanna and Olken (2018); Banerjee et al. (2019); Boccanfuso et al. (2020)

[3]APF is financed through oil revenue, and the benefit is around $1,000 annually, which is far from the basic income level to live on.

even at the optimal UBI level. These findings are in line with my findings when assuming full participation in the benchmark. However, none of these papers considers the participation margin of the current programs, which this paper incorporates and highlights the difference it makes. In particular, the key welfare gains found in this paper arise from individuals who did not take EITC but are now covered by UBI, which is different from the mechanism in other papers.

In addition to the UBI literature, this paper also contributes to the literature on EITC's incomplete take-up. Most of the recent studies only focus on aggregate participation rates (Hoynes (2019); Crandall-Hollick et al. (2021); Chang et al. (2021b)). Two exceptions are Plueger (2009) and Jones (2013). They show participation rates by benefit region before and after the EITC reform in 2009. My paper updates their estimates into the 2010s and analyzes participation-related economic factors. In addition, the participation cost constructed in the quantitative model replicates well both the observed EITC eligibility distribution and the empirical participation pattern, providing a more realistic modeling way for analyzing tax-and-transfer programs.

The remainder of the paper is organized as follows: Section 2 contains an empirical analysis of EITC participation. Section 3 formulates the quantitative model, followed by calibration in section 4. In section 5, I assess the performance of the benchmark model by comparing untargeted moments and analyze counterfactual program reforms in section 6. Section 7 concludes.

2. Empirical Analysis

This section presents the empirical analysis of participation in the Earned Income Tax Credit, the main means-tested transfer program in the US. I first provide a brief background on the EITC, including its benefit design and application procedure. Then, I document the fact of incomplete participation of EITC and analyze the correlated economic factors, providing essential insights for subsequent program participation modeling.

2.1. Earned Income Tax Credit (EITC)

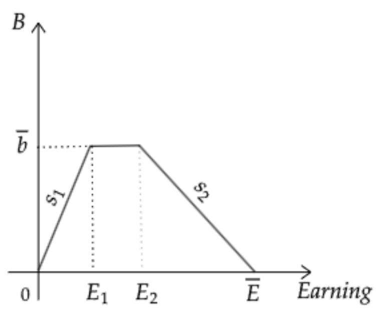
EITC is an annual refundable tax credit and is the largest non-medical/pension cash transfer program in the U.S.[4] In addition to the sizable benefit, EITC also features i) a flexible benefit scheme

[4]For 2018 (i.e., 2018 tax returns filed in 2019), 26.5 million taxpayers (17% of all taxpayers) received a total of \$64.9 billion from the EITC (Crandall-Hollick et al., 2021)

containing both phase-in and phase-out design and ii) means-tested eligibility requirements similar to the other transfer programs.

The eligibility requirements consist of both economic and demographic restrictions. In terms of the economic requirements, both investment income and earned income have to be less than some limits.[5] The investment income limit is the same across demographic status, but the earned income limit depends on some demographic factors, such as the applicant's age, marital status, and the number of eligible child(ren). Eligible individual or family then faces a trapezoid benefit scheme based on earned income (e.g., Figure 1): the benefit entitlement increases with the earned income in the *phase-in* region and is fixed at a maximum level in the *flat* region. As earned income keeps rising, the benefit decreases in the *phase-out* region.

Figure 1: Stylized EITC Scheme



Note: Figure shows a stylized EITC schedule as a function of earnings (horizontal axis). Vertical axis B denotes the entitled benefit. $\bar{b}$ is the maximum benefit. E_1 and E_2 indicate the start and end of the flat benefit region, respectively, and $\bar{E}$ is the earning eligibility cutoff. s_1 and s_2 are the phase-in and phase-out rates.

To receive the EITC benefit, the applicant needs to i) file the tax form 1040 and schedule EIC form using the information on the W-2 tax form, and ii) check the EITC claiming box in the form 1040. Thus, the reason for not taking up the benefit can be either not filing tax forms or not claiming the benefit. As Goldin et al. (2022) pointed out, almost two-thirds of the eligible non-participants of EITC are non-filers.[6] Overall, only 78% of the eligible take up the EITC benefit, and the remaining 22% eligible non-participants account for 5 million low-income people (Goldin

[5]Investment income consists of Interest, dividends, rental income, and capital gain, while earned income consists of wage/salary and self-employment income(business or farm).

[6]The literature suggests the main reason for not filing tax forms is due to filing cost instead of information friction (Chetty and Saez (2013); Guyton et al. (2016); Linos et al. (2020). Goodman et al. (2022) estimates the average filing cost is around 387$ for nonfilers without filing obligation and 1528$ for nonfilers with filing obligation. Given the average EITC benefit is around 2,500$, the cost is significant.

et al., 2022).

2.2. Sample Description

To investigate who the eligible participants are, and study the participation pattern, I used the 2013 - 2016 Annual Social and Economic Supplements of Current Population Survey (ASEC-CPS). The dataset provides detailed information on demographics, income, EITC receipt status and benefits. To build the correct tax units, I first construct the sample at the family level by marital status, family relationship, and age. Economic variables (e.g., earnings) and program participation are then aggregated or calculated within the family.

I apply the following sample selection criteria, which are standard in literature and customized to EITC's universe: i) working-age (aged 25-64) families with or without children, and young (aged 20-24) families with children; ii) hourly wage rate is higher than half of the federal minimum wage (3.625$/hour); iii) work at least 260 hours annually. After the sample selection, I have a total of 36,329 eligible observations for the EITC program.

The dataset provides the EITC benefits amount for participants only, but it lacks information on the potential eligibility for EITC among non-participants and the qualified EITC benefit level of the eligible non-participants, both of which are essential for the analysis. To fill this gap, I impute eligibility based on income and demographic characteristics. I then calculate the potential benefit of each eligible family, regardless of their recorded participation status, following closely the official guidelines.

To examine the imputation's quality, I check whether the imputed eligible group contains all participating families, whose EITC benefits are positive in the raw data. In terms of the imputed benefits (B^{imp}), I regress it on the counterpart from the raw data (B^{raw}) among recorded participants. The closer the estimated coefficient is to one, the better the imputation. The imputed eligible group indeed includes all recorded participants. Moreover, the correlation between B^{imp} and B^{raw} is close to one (1.005 with standard error of 0.001) with a high R^2 of 0.95, confirming the validity of the imputed benefits.

2.3. Incomplete Participation along Benefit Scheme

Using the sample described above, I calculate the participation rates (PR) across the three regions of the EITC benefit scheme to assess the incompleteness of program participation. $PR_i, (i \in$

{Overall, Phase-in, Flat, Phase-out}) measures the share of eligible families that claim the credit at benefit region i, ranging from zero (no participation) to one (full participation). A lower PR indicates greater incompleteness of participation.

Table 1: Participation Rates across Benefit Scheme

Benefit Region	Overall	Phase-in	Flat	Phase-out
PR	0.83	0.91	0.86	0.81

Notes: Table shows the participation rate (PR), share of eligible families participating in EITC, by benefit region. "Overall" includes all eligible families, while "Phase-in," "Flat," and "Phase-out" correspond to the respective segments of the EITC schedule. Source: ASEC-CPS 2013-2016.

As seen in Table 1, the overall participation rate of EITC is 83%, suggesting that 83% of the eligible families in the survey claim their benefits. This estimate is close to the official rate of approximately 79.5%.[7]

The last three columns of Table 1 present the participation rate by benefit regions. Program participation is incomplete across the entire scheme, as all PR_i values are below one. In addition, the incompleteness of the participation exhibits an increasing trend as we move along the benefit scheme (phase-in →flat→phase-out). This trend can be partially attributed to a decreasing benefit in the phase-out region. However, the participation rate is still far from 1 in the flat region, where the benefit is maximized for a given demographic group. Therefore, benefit size alone cannot fully explain the incomplete participation.

2.4. What Drives (Non)Participation?

To better understand what factors correlate with the (non)participation, I estimate the following Probit model among eligible families:

$$Pr(\mathbb{P}_{it} = 1 | ra_{it}, w_{it}, edu_{it}, B_{it}, X_{it}) = \Phi(\beta_1 ra_{it} + \beta_2 w_{it} + +\beta_3 edu_{it} + \beta_4 B_{it} + X'_{it}\gamma) \quad (1)$$

[7] To further validate the empirical method, I apply the imputation and PR computation to the 2006 ASEC-CPS, and get close results as Plueger (2009) and Jones (2013). The four PR levels (as in Table 1) in their papers are {0.75(±2%),0.65(±3%), 0.8(±3%), 0.79(±2%)}, while my corresponding estimates are {0.74,0.59, 0.84, 0.8}.

where the dependent variable $\mathbb{P}_{it} \in \{0, 1\}$ indicates whether the eligible family i in year t participate in EITC. Key regressors $\{ra, w, edu, B\}$ refer to the investment income, wage rate, years of schooling, and potential benefit respectively. The control set (X) includes: i) benefit-related variables: marital status, the number of eligible children; ii) demographic variables: age, state of residence; and iii) economic variables: other transfer programs' receipt status, other income.

Table 2: Program Participation Pattern

Variable	Average elasticity		
Hourly Wage	-0.076	-0.051	-0.058
	(0.007)	(0.008)	(0.008)
Investment Income	-0.003	-0.004	-0.005
	(0.001)	(0.001)	(0.001)
Education	0.056	0.066	0.097
	(0.016)	(0.018)	(0.018)
Benefit	0.036	0.08	0.072
	(0.003)	(0.005)	(0.005)
Benefit-factor control	N	Y	Y
Other controls	N	N	Y
Obs	36,329	36,329	36,329
Pseudo R^2	0.029	0.128	0.161

Note: Table shows the average elasticity of EITC participation with respect to selected variables, estimated from a Probit model. Robust standard errors in parentheses. Source: ASEC-CPS 2013-2016.

Table 2 shows the estimated average elasticity of participation to variables of interest. Eligible families with higher investment income or hourly wage rates are less likely to participate. For example, if hourly wage increases by 1%, then the likelihood of participating in EITC decreases by around 0.06%. Such negative effects can be due to a higher opportunity cost for those wealthier or more productive people, given the potential hassle cost associated with the document preparation and application process. In contrast, the likelihood of participation is higher for families who are entitled to a higher benefit or are more educated. The former entails a benefit-seeking motive since a larger benefit compared to the hassle cost makes participation more attractive. The latter implies that the participation cost is lower for educated people as it is easier for them to handle the application process.

In summary, the empirical analysis presents evidence of incomplete EITC participation by computing the participation rate across the benefit scheme. In addition, Probit analysis suggests some economic factors that correlate with (non)participation, whose qualitative patterns are incorporated while constructing participation friction in the next model section.

3. The Model

To analyze the quantitative effect of replacing EITC with UBI and study the role of program participation margin, I build an incomplete market heterogenous-agent life-cycle dynamic general equilibrium model (Aiyagari (1994); İmrohoroglu et al. (1995)) with endogenous EITC participation decision, and labor supply adjustment along both intensive and extensive margins.[8] The model economy contains three agents: households, a representative firm, and a government.

3.1. Household Problem

The economy consists of a continuum of agents that are heterogeneous in age (j), wealth (a), skill (η), and productivity(ϵ). Agents are born with zero assets ($a_{j=1} = 0$) and a permanent skill level (η). The time endowment in each period is one, from which agents choose hours of work and leisure. Agents work until the mandatory retirement age J_r and live until age J.

During working age ($j = 1 \dots J_r - 1$), agents face an uninsurable idiosyncratic labor productivity shock every period, which follows a finite-state Markov-Chain $\Pi(\epsilon'|\epsilon)$. With the realized productivity and other endowments, agents can have a pre-tax income as a sum of salary and investment income ($y = w\eta\epsilon\tilde{h} + ra$), where w is the market wage rate per efficiency labor, and r is the market interest rate. $\tilde{h}$ denotes the hours of work, which is a kinked function of non-leisure hours (h) (Prescott et al. (2009); Chang et al. (2019)):

$$\tilde{h} = \max\{0, h - \zeta\}, h \in [0, 1] \tag{2}$$

where ζ denotes the time commuting cost. This kinked mapping gives rise to labor supply adjustment along both intensive and extensive margins: larger ζ raises marginal cost and lowers the marginal benefit of working simultaneously, which undermines the value of working. Both labor

[8] It is important to have a comprehensive endogenous labor supply for analyzing the reform as Kleven (2019) shows EITC has significant effects on encouraging work, especially along the extensive margin. In contrast, one of the critical concerns of UBI is lowering working incentives or labor force participation due to the income effect.

income and investment income are subject to a progressive income tax, and I use the log-linear approximation for the post-tax disposable income y^d (Heathcote et al., 2017).

Another component of the disposable income is the non-taxable EITC benefit $B(ra, w\eta\epsilon\tilde{h})$. Based on the income type and level, agents decide whether to participate ($\mathbb{P} \in \{0, 1\}$) if eligible. Agents then allocate the disposable resources to consumption (c) and savings (a').

The program participation decision involves a trade-off between the utility gain from EITC benefit and the utility participation cost $\kappa(\eta)$. I set the utility participation cost as a decreasing function of skill (η), which is disciplined by the positive effect of education on program participation from the empirical analysis. The justification for this setting is that it is relatively easier for a more educated individual to file tax forms or learn the application process, which translates into lower participation friction.:

$$\kappa(\eta) = \frac{\nu_1}{1 + exp(\nu_2 \eta - \nu_3)}, \quad \kappa'(\eta) < 0; \quad \nu_i > 0, i \in \{1, 2, 3\}. \tag{3}$$

In addition, this utility-cost specification, combined with the well-defined value function, reproduces the key empirical correlations. Given a skill level, the participation cost is constant along other dimensions. On the one hand, by monotonicity, the value function rises with a higher EITC benefit, which makes participation more attractive.[9] On the other hand, by the concavity of value function, the net participation benefit is decreasing along the wealth and productivity for a given benefit level, which in turn lowers the likelihood of participation for wealthy and more productive households.

In summary, working-age households ($j < J_r$) value consumption, dislike working, and discount future utility using a discount factor $\beta \in (0, 1)$. Taking the tax scheme, market prices (w, r), and the aggregate distribution (Γ) as given, agents maximize the expected discounted utility by choosing how much to consume(c), save(a'), non-leisure hours (h) and whether to participate in the transfer program ($\mathbb{P}$). The formulation of the working-age households' problem is as follows:

[9] Although the participation cost κ depends only on the permanent income component, the potential benefit amount still affects the participation decision through its impact on the value of take-up. This mechanism generates the positive relationship between benefit generosity and participation observed in the data.

$$
\begin{aligned}
V(j,a,\eta_i,\epsilon_k) &= \max_{c,a',h,\mathbb{P}} \frac{c^{1-\sigma}}{1-\sigma} - \theta\frac{h^{1+\psi}}{1+\psi} - \kappa(\eta_i)\mathbb{P} + \beta\sum_{l=1}^{N_\epsilon}\pi_{kl}V(j+1,a',\eta_i,\epsilon_l) \\
s.t. \quad & c + a' \leq a + y^d(w\eta_i\epsilon_k\tilde{h} + ra) + B(ra, w\eta_i\epsilon_k\tilde{h})\mathbb{P}; \\
\tilde{h} \quad & = \max\{0, h-\zeta\}, h \in [0,1] \\
a' \quad & \geq 0; \quad c \geq 0; \quad \mathbb{P} \in \{0,1\}
\end{aligned} \tag{4}
$$

where π_{kl} is the transition probability of productivity $Pr(\epsilon' = \epsilon_l | \epsilon = \epsilon_k)$ and $y^d(.)$ denotes disposable income. In addition, at the last working age ($J_r - 1$), the agent's problem becomes a bit different since there is no uncertainty in productivity next period due to retirement. With the same constraint set, the Bellman equation becomes:

$$
V(j,a,\eta_i,\epsilon_k) = \max_{c,a',h,\mathbb{P}} \frac{c^{1-\sigma}}{1-\sigma} - \theta\frac{h^{1+\psi}}{1+\psi} - \kappa(\eta_i)\mathbb{P} + \beta V^R(j+1,a',\eta_i,\epsilon_k). \tag{5}
$$

After agents retire ($j \geq J_r$), the taxable income consists of investment income and a fixed amount of pension payment ($pen = pw\eta\epsilon^{J_r-1}\bar{h}$). I assume pension payment depends on i) fixed replacement rate p, ii) labor efficiency level at one year before retirement ($\eta\epsilon^{J_r-1}$), and iii) average hours of work $\bar{h}$. The transfer program is not available for retirees, which mimics the age limits of the EITC. Therefore, retirees decide on consumption and savings under a deterministic setting. The formulation of the retirees' problem is:

$$
\begin{aligned}
V^R(j,a,\eta_i,\epsilon_k) &= \max_{c,a'} \frac{c^{1-\sigma}}{1-\sigma} + \beta V^R(j+1,a',\eta_i,\epsilon_k) \\
& s.t. \quad c + a' \leq a + y^d(ra + pw\eta_i\epsilon_k\bar{h}); \quad c \geq 0; \quad a' \geq 0
\end{aligned} \tag{6}
$$

At the last age ($j = J$), agents consume everything on hand and do not save($a'_{j=J} = 0$).

3.2. Government

The government levies a progressive income tax on households, and uses the tax revenue to pay i) autonomous expenditure, which is modeled as a fixed proportion of output ($G = gY$); ii) EITC transfer payments for the working-age participants, and iii) pensions for all retirees. I employ the log-linear tax function (Benabou (2002);Heathcote et al. (2017)) to represent the U.S. progressive tax system. Denote y, y^d as the taxable income and disposable income respectively. Total tax revenue ($\mathcal{T}$) is:

$$\begin{aligned}\mathcal{T}(\lambda,\tau) &= \int_{s\in\mathcal{S}} \left[y(s) - y^d(s)\right] d\Gamma(s) = \int_{s\in\mathcal{S}} \left[y(s) - \lambda y(s)^{1-\tau}\right] d\Gamma(s) \qquad (7)\\ \text{where } y &= \begin{cases} w\eta\epsilon\tilde{h} + ra & if\ j \leq Jr - 1 \\ pw\eta\epsilon^{J_r-1}\bar{h} + ra & if\ j \geq Jr \end{cases}\end{aligned}$$

where $(j, a, \eta, \epsilon) = s \in \mathcal{S}$ denotes a state bundle and $\Gamma(s)$ is the distribution mass at state s. The parameter $\tau \in (0, 1]$ governs the progressivity of the tax system, and λ controls the average tax rate.

The transfer program in the model mimics the average EITC benefit scheme closely in terms of means-tested requirements and benefit scheme. Similar to the EITC in the real world, the eligibility requirement consists of age, earning ($\bar{E}$), and investment income limit ($\bar{d}$). Thus, the eligibility region ($\mathcal{E}$) becomes: $\mathcal{E}(s) = \{s = (j, \eta, \epsilon, a)|j < J_r;\ w\eta\epsilon\tilde{h} \leq \bar{E};\ ra \leq \bar{d}\}$.

Since I abstract from differences in marital status and the number of children, I use one trapezoid scheme to represent the average EITC benefit, where the average is taken over the number of children and marital status. Figure 1 visualizes the benefit scheme as a trapezoid mapping of the earnings ($e = w\eta\epsilon\tilde{h}$), and is modeled as:

$$B(s) = \begin{cases} s_1 e & e \in [0, E_1), s \in \mathcal{E} \\ \bar{b} = s_1 E_1 & e \in [E_1, E_2), s \in \mathcal{E} \\ s_2(\bar{E} - e) & e \in [E_2, \bar{E}], s \in \mathcal{E} \\ 0 & s \notin \mathcal{E} \end{cases} \qquad (8)$$

where $s_1, s_2 > 0$ corresponds to the phase-in and phase-out rate respectively. The earning thresholds E_1 and E_2 split benefit scheme into three regions: Benefit first increases with earning at rate s_1 until E_1, where phase-in region ends and the maximum benefit $\bar{b}$ is achieved. Productive households with earnings larger than E_2 get lower benefit decaying with earnings at rate s_2. Ineligible households ($s \notin \mathcal{E}$) entitled zero benefit.

Overall, government adjusts the tax parameter λ to balance the following budget:

$$G + \int_{s \in \mathcal{S}} \left[\underbrace{\mathbb{1}(j \geq Jr) pen(s)}_{Pension} + \underbrace{\mathbb{1}(j < Jr) B(s) \mathbb{P}(s)}_{EITC} \right] d\Gamma(s) = \mathcal{T}(\lambda, \tau) \tag{9}$$

3.3. Firm

A representative firm produces a consumption good with Cobb-Douglas technology ($F(K, L) = K^{\alpha} L^{1-\alpha}$) in a competitive market, where α denotes capital elasticity. Taking the production factor prices (w, r) as given, the firm optimize upon the production inputs of efficient labor (L) and capital (K):

$$\max_{K,L} F(K, L) - \delta K - rK - wL; \; where \; F(K, L) = K^{\alpha} L^{1-\alpha} \tag{10}$$

The first order conditions of the firm are:

$$F_K(K, L) = \alpha \left(\frac{K}{L} \right)^{\alpha - 1} = r + \delta; \;\; F_L(K, L) = (1 - \alpha) \left(\frac{K}{L} \right)^{\alpha} = w. \tag{11}$$

3.4. Stationary Equilibrium

Denote $s = (j, a, \eta, \epsilon) \in \mathcal{S}$ as a generic state bundle. The stationary equilibrium of the economy consists of value function $\{V(s), V^R(s)\}$, consumption function $c(s)$, saving function $a'(s)$, labor supply $h(s)$, EITC-participation decision $\mathbb{P}(s)$ (if under IP setup), wage rate w, an interest rate r, tax policy λ and a distribution of agents over state space $\Gamma(s)$ such that:

1. Given prices, value function and policy functions solve households' problem.
2. Given prices, the firm maximizes profit.
3. Factor market clear: $K = \int_s a(s) d\Gamma(s) \quad L = \int_s \eta \epsilon \tilde{h} d\Gamma_{j<J_r}(s)$
4. Government budget is balanced (equation 9)
5. $\Gamma(s)$ is consistent with policy functions and stationary

3.5. Measurements for Evaluating Reform

Redistribution Effect. To quantify the extent to which a fiscal system reduces income inequality, I measure redistribution using both an overall index – Mean Log Deviation (MLD)– and complementary percentile ratios. For each economy $i \in 0, 1$ (pre- and post-reform), the redistribution effect (RE^i) is defined as the percentage change in MLD of income before and after taxes and transfers.[10]

To assess which parts of the distribution are mostly affected, I compare percentile ratios before and after the fiscal policy. Changes in the p50/p10 ratio capture redistribution at the lower end, while changes in the p90/p50 ratio capture redistribution at the upper end. A negative value indicates that fiscal policy narrows the corresponding income gap.

Steady-state Welfare ($\mathcal{W}^{ss}$). The evaluation of policy reform uses the *consumption equivalent variation* (*CEV*), defined as the percentage change in consumption in the initial economy that makes agents indifferent between the benchmark and post-reform economy.[11] Following Bakış et al. (2015) and Conesa et al. (2009), I calculate *CEV* along consumption, labor, and participation cost (if IP setup) for each state $s \in \mathcal{S}$. The steady-state welfare change, $\mathcal{W}^{ss}$, is computed as the weighted average of CEV based on the post-reform distribution, and is useful for analyzing heterogeneity in welfare changes and the role of program participation margin.

$$\mathcal{W}^{ss} = \int_{s \in \mathcal{S}} \left(CEV^c(s) + CEV^h(s) + CEV^\kappa(s) \right) d\Gamma^{ss}(s) \tag{12}$$

Transitional dynamic welfare ($\mathcal{W}^{td}$). Following Kindermann and Krueger (2022), I incorporate the transitional dynamics into the aggregate welfare as:

$$\mathcal{W}^{td} = \underbrace{\int CEV_1(s_{j>1}) d\Gamma_0(s_{j>1})}_{old\ generation} + \gamma_{j=1} \sum_{t=1}^{\infty} \left(\frac{1}{1+r_0} \right)^{t-1} CEV_t(s_{j=1}) \tag{13}$$

where $CEV_t(s)$ refers to the consumption equivalence variation at state s in period t. The first term of equation (13) corresponds to the average welfare of households born before the reform (hereafter referred to as the *old generation*), computed using the stationary distribution (Γ_0) from the initial steady state. The second term captures the discounted welfare of future generations, where the discount rate is set to the initial steady-state interest rate and $\gamma_{j=1}$ denotes the share of newborns in

[10] Because a lower MLD reflects less inequality, a more negative value of RE^i corresponds to a stronger redistributive effect of the fiscal system.

[11] Full derivations of CEV are provided in Appendix A

each period. This measure complements steady-state welfare by accounting for adjustment along the transition, highlighting how participation margins influence current and future households.

4. Calibration

The model is calibrated to the U.S. economy in the 2010s. To assess the role of program participation, I formulate another version of the model without participation friction that generates full EITC participation. Calibrating both versions to the same moments ensures that they start from an identical benchmark, making their responses to the UBI reform directly comparable.

4.1. Demographics and Preferences.

The model period is one year. Agents born at age 21, retire at age 65 and live until age 90. The preference parameter set includes a discount factor (β), inverse of elasticity of intertemporal substitution (σ), the inverse Frisch elasticity of labor supply (ψ), the disutility of work (θ), time commuting cost (ζ) and three utility program participation cost ($\nu_{1,2,3}$).

I set the σ equal to 1.5, which is a standard level in the literature (De Nardi and Yang, 2016). The curvature parameter of labor utility ψ is set to 1.2, which implies a Frisch elasticity of 0.83 (Blundell et al., 2016). After anchoring the utility curvature, I then calibrate participation friction parameters (ν_is) to match the participation rates computed in the empirical analysis (Table 1). The remaining preference parameters (θ, ζ, β) are jointly calibrated to match average hours of work, labor force participation, and the annual risk-free interest rate, respectively (See Table 3).

4.2. Productivity Process.

I assume that the total labor efficiency (ω) consists of both permanent (η) and temporary (ϵ) elements. The temporary component follows a first-order autoregressive process with persistence parameter ρ and a white noise shock ξ, follows a standard normal distribution with the standard deviation of σ_ξ.

$$\ln \omega = \ln \eta + \ln \epsilon; \quad where \ \ln \epsilon \sim AR(1, \rho, \sigma_\xi) \tag{14}$$

I use the panel data on the hourly wage from the 2011-2019 Panel Study of Income Dynamics (PSID) to estimate the productivity parameters. I estimate the following regression to decompose the permanent and stochastic components:

$$\ln w_{it} = \gamma_t + f(3, edu_{it}) + \epsilon_{it}$$

where γ_t denotes the year fixed effect and $f_{it} = f(3, edu_{it})$ is the cubic polynomial of the years of schooling for individual i at time t. The predicted $\hat{f}_{it}$ captures the permanent component of labor efficiency ($\ln \eta$), and I use its quartile levels as the grid for permanent skill in the model.

Residual ϵ_{it} represents the stochastic component of labor efficiency. Following the minimum distance method in Kim (2022), the estimated persistence and the variance are 0.93 and 0.08, respectively. I then employed the Tauchen algorithm to discretize the stochastic productivity space and get the transition matrix $\Pi(\epsilon'|\epsilon)$. I follow Kaymak and Poschke (2016) and augment the ordinary productivity state with a super-earner state $\bar{\epsilon}$[12] with entry and exit probabilities of λ^{in} and λ^{out}, respectively.The three parameters are calibrated to match wealth Gini, 90-95% income share and wealth share.

4.3. Production, Tax, Transfer.

According to the National Income and Product Account (NIPA), I set the capital income share (α) to 0.35, and calibrate the deprecation rate (δ) to match the capital-output ratio around 3.

The pension replacement rate (p) is set to 0.4. The government expenditure ratio (g) is calibrated to match the income-weighted average tax rate of 0.34 as in Heathcote et al. (2017). The tax progressivity is estimated based on the following regression using PSID data from 2000 to 2015:

$$\ln y^d = \hat{\alpha} + 0.863 \ln y + X'\hat{\beta}; \; R^2 = 0.9$$

where X includes time and state dummies. Disposable (y^d) is constructed by adding transfer benefit and deducting tax obligation, both of which are simulated from TAXSIM, from the gross income (y). In particular, the EITC benefit is excluded when constructing disposable income to avoid double-counting the progressivity introduced by EITC in the quantitative model. The implied value of τ is 0.137 (s.d. 0.0023). The eligibility thresholds are calibrated to the average EITC benefit scheme plotted in Appendix B, where I explain the details on EITC calibration.

Table 3 summarizes the endogenously calibrated parameter values for two versions of the

[12] I assume that these people are not captured in the PSID.

Table 3: Endogenous Calibrated Parameters

Parameter	Description	Value(IP)	Value(FP)	Targeted moment	Data	IP	FP
β	discount rate	0.9502	0.9507	r^*	4%	4.01%	4.02%
θ	labor disutility	8.25	7.85	Average Hours	0.33	0.33	0.33
ζ	time commuting cost	0.315	0.326	Employment Rate	0.8	0.82	0.82
g	G / Y	0.1	0.095	Average Tax Rate	0.34	0.32	0.32
δ	depreciation	0.076	0.076	Capital-output ratio	3	3.01	3
$\bar{\epsilon}$	super-earner state	56	56	wealth Gini	0.8	0.79	0.79
λ^{in}	entry rate to $\bar{\epsilon}$	0.001	0.001	90-95% wealth share	0.12	0.13	0.13
$\pi_{\bar{\epsilon},\bar{\epsilon}}$	stay rate at $\bar{\epsilon}$	0.924	0.924	90-95% income share	0.11	0.1	0.1
ν_1, ν_2, ν_3	participation cost	0.985,7.25,3.15	-	$PR_{\{in,flat,all\}}$	{0.91,0.86,0.81}	{0.93,0.83,0.78}	-

Note: Table shows calibrated parameter values and corresponding targeted moments for the incomplete (IP) and full participation (FP) setups. Column *'Value'* lists the calibrated parameter values, while the columns to the right of *'Targeted moment'* compare the model-generated moments with the empirical targets from the data and literature.

model, which differ in the participation setup of the EITC. The difference between the two sets of calibrated parameters is relatively small. In addition, the models match well the same set of the moments under both incomplete (IP) and full participation(FP) setups, as shown in the last three columns of Table 3. Therefore, both setups have similar starting points of the benchmark economy so that the reforms' effects are comparable.

5. Benchmark Economy

In this section, I check the model's performance by comparing some model-generated moments to their empirical counterparts. The comparison mainly focuses on distributional measures and labor supply behavior. Ensuring consistency between the benchmark model economy and the data is essential for the credibility of the counterfactual analysis.

5.1. Distributions

The benchmark transfer program (EITC) features complex means-tested schemes to screen eligible households and redistribute resources toward people in need. Thus, the untargeted earnings and wealth distributions are important as they capture the mass of people in need and likely to be eligible for the EITC. In addition, as we balance the fiscal budget with progressive income tax, a realistic income distribution is necessary to ensure the redistribution and tax burden are valid.

Panel A of Table 4 compares the quintiles and Gini coefficient of income, earnings, and wealth distributions in the model with their empirical counterparts from Kuhn and Ríos-Rull (2016).

While the 90–95% wealth and income share are targeted in the calibration, the remaining quintile shares also closely align with the data.

Table 4: Distributions

	0-20	20-40	40-60	60-80	80-100	Gini
Panel A. Distribution						
wealth						
model(IP)	0.00	0.01	0.05	0.13	0.82	0.79
model(FP)	0.00	0.01	0.04	0.13	0.82	0.79
data	-0.01	0.01	0.03	0.10	0.87	0.85
income						
model(IP)	0.03	0.06	0.09	0.16	0.58	0.59
model(FP)	0.03	0.06	0.09	0.16	0.58	0.59
data	0.03	0.07	0.11	0.18	0.61	0.58
earnings						
model(IP)	0.01	0.05	0.09	0.17	0.68	0.67
model(FP)	0.01	0.05	0.08	0.17	0.69	0.67
data	0.00	0.03	0.10	0.20	0.67	0.67

Panel B. Eligibility distribution				
	$E < \bar{E}, ra < \bar{d}$	$E > \bar{E}, ra < \bar{d}$	$E < \bar{E}, ra > \bar{d}$	$E > \bar{E}, ra > \bar{d}$
model(IP)	0.49	0.27	0.03	0.21
model(FP)	0.51	0.265	0.02	0.205
data	0.53	0.34	0.03	0.1

Note: Panel A shows the quintiles and Gini coefficient of wealth, income, and earnings distribution. The data counterparts are from Kuhn and Ríos-Rull (2016). Panel B shows the (in)eligibility distribution of EITC based on labor earnings (E) and capital income (ra); $\bar{E}$ and $\bar{d}$ correspond to the means-tested eligibility limit of earnings and investment income, respectively. Source: ASEC-CPS 2013-2016.

Another important moment to examine is the distribution of eligibility for benchmark EITC. The overall participation rate among the eligible population is targeted in the calibration stage; however, this alone may be insufficient for the counterfactual analysis. In particular, the share of ineligible individuals also matters, as it can influence the reform's effect through general equilibrium (e.g., the extent of tax increase).

By the nature of EITC, which provides benefits to working-age individuals with positive salary, I construct four mutually exclusive (in)eligible regions based on the investment income (ra) and positive earnings ($E > 0$). Panel B of Table 4 shows the distribution across these four groups. The first column corresponds to the eligible share, which consists of households that pass the means test in terms of both earnings and investment income. This share is very close to its data counterpart in both participation setups. This is essential to ensure that the model provides a realistic assessment of the tax burden generated by a UBI.[13] The other three columns present the share of ineligible individuals due to either high earnings, investment income, or both.

The detailed earnings makeup of the population exceeding the earnings threshold matches the data a bit less well. The model overstates the share of those with high capital income in this group. This arises although the calibration targets several aspects of the wealth distribution. A potential reason for the disconnect between the wealth and capital income distributions could be heterogeneity in rates of return. Since this discrepancy arises among the group that is ineligible for the EITC due to high earnings, I believe that it does not affect simulation results materially.

5.2. More on Labor Supply

I also examine several additional measures of labor supply behavior. The model-generated coefficient of variation in hours worked (CV_H) is 0.20 under the incomplete participation (IP) setup and 0.19 under the full participation (FP) setup, close to the empirical estimate of 0.27 in Kaymak and Poschke (2016). This close match, together with the targeted moments, indicates that the model captures both the level and dispersion of labor supply reasonably well.

I further check the untargeted labor supply elasticity (beyond calibrated Frisch elasticity), which governs the extent of the distortions on labor. Using model-generated data, I run an OLS regression of log hours worked on wealth (a), hourly efficiency (ω), and age, where the coefficients on a and ω are converted to approximate the non-labor income elasticity (IE) and substitution elasticity (SE), respectively.[14] The estimated elasticities are $SE = 0.186$ (IP) and 0.183 (FP), and $IE = -0.08$ (IP) and -0.07 (FP). These estimates fall within the empirical ranges $SE \in [0.1, 0.3]$ and $IE \in [-0.1, 0]$ reported in McClelland and Mok (2012), confirming that model-generated labor elasticities are both qualitatively and quantitatively consistent with empirical studies.

In summary, the calibrated models under two participation setups perform well in terms of both targeted and untargeted moments, making them suitable labs for analyzing the policy reform in the next section. In particular, the patterns of untargeted moments are similar across the two setups, suggesting the comparability of the counterfactual reform's effect. Moreover, this similarity also

[13]Recall that the calibration also matches the participation rate in this eligible group.

[14]Both substitution and income elasticity matter for the potential effects of transfer programs on labor supply. For instance, EITC's phase-in/out alters participants' behavior mainly through the substitution effect, while the UBI program has a large income effect.

enables us to study the role of program participation margin by contrasting the reform's effect between them.

6. Policy Reform

This section investigates the effects of reforms that replace EITC with UBI.[15] The role of the program participation margin is analyzed by comparing two calibrated versions of the model that differ in the existence of participation friction in the benchmark EITC.[16]

The analysis begins with a generous UBI of \$12,000 per year — a level often discussed in public debate — which leads to welfare losses in both participation setups due to large fiscal cost it entails (Section 6.1).[17] In contrast, a modest UBI of about \$3,500 per year (Section 6.2), which maximizes steady-state welfare, yields welfare gains but only under the IP setup, highlighting the importance of the participation margin. Section 6.3 and 6.4 then examine in detail the mechanisms generated by this margin and the resulting equity–efficiency implications of the modest reform.

6.1. Generous UBI

Columns 3 and 4 of Table 5 show the aggregate effects of replacing the EITC with a generous UBI of \$12,000. The average tax rate(*ATR*) rises by about 11 percentage points (IP: 11.5pp; FP: 10pp) to balance the fiscal budget, reflecting the universality and large scale of the transfer. This significant increase in taxation strengthens intertemporal distortions, and aggregate capital (K) declines by roughly 11%(IP: –12.3%, FP: –10.8%).

Labor supply also contracts. Hours of work (H) decline by roughly 4.5 percentage points (IP: –4.9pp, FP: –4.3pp), and the employment rate (ER) is about six percentage points lower compared to the benchmark. These declines arise from both the strong income effect of UBI and the removal of the EITC's incentivizing design (e.g., phase-in), which previously encouraged labor

[15] Due to EITC's age requirement, only working-age people receive the UBI benefit.

[16] The assumption of complete participation of UBI may seem ideal, but it is not impossible. EITC non-participation is largely driven by the complex application and screening processes. In addition, EITC requires yearly filing and is subject to changes in rules and documentation; people need to stay updated and adjust their filings accordingly, which can further increase costs. However, a well-designed UBI - being unconditional - can leverage existing administrative infrastructure (e.g., Social Security numbers) to distribute benefits automatically. Households may only need to register once or verify minimal demographic information, making the process more accessible and less costly.

[17] The generous UBI benefit is considerably larger than the EITC: the maximum EITC benefit averages about \$3,600, while the mean benefit is around \$2,500. Thus, a \$12,000 UBI is roughly five times the average EITC benefit, equal to about 29% of average disposable income, and close to the federal poverty threshold.

force participation. As a result of these distortions in the efficiency terms, output and aggregate consumption each fall by approximately 9% compared to the benchmark steady state. Consistent with the larger decline in capital relative to labor input, the interest rate rises by 0.4 percentage points, while the equilibrium wage is about two percentage points lower.

Table 5: Reform Effects

	Baseline	12,000		3,500	
		IP	FP	IP	FP
ATR	0.320	0.435	0.420	0.336	0.332
H	0.300	0.251	0.258	0.294	0.302
ER	0.82	0.764	0.757	0.808	0.802
K	100	87.706	89.205	97.980	99.645
C	100	91.003	91.693	98.424	99.233
Y	100	91.141	91.927	98.401	99.419
w	1.182	1.158	1.162	1.179	1.183
r	0.039	0.044	0.043	0.040	0.039

Note: Table shows steady-state aggregate outcomes under the baseline EITC system and two UBI reforms: a generous UBI of $12,000 and a modest UBI of $3,500, each evaluated under the incomplete participation (IP) and full participation (FP) setups. Notation: ATR denotes the average tax rate; H hours worked; ER employment rate; K aggregate capital; C aggregate consumption; Y output; w wage rate; and r interest rate. All variables are reported in levels, except for the stock variables K, C and Y, which are expressed relative to the baseline (normalized to 100).

Redistribution strengthens relative to the benchmark EITC—the MLD-based redistribution effect (RE^i) improves by about 14 percentage points (IP: 14.8pp; FP: 14pp)—yet aggregate steady-state welfare $\mathcal{W}^{ss}$ still declines in both setups (-0.3% under IP and -1.96% under FP), as fiscal costs and efficiency losses outweigh redistributive gains.

Overall, the generous UBI leads to sizable contractions in aggregate efficiency with lower welfare despite stronger redistribution. These findings are consistent with the results in the existing literature (e.g., Guner et al. (2023), Daruich and Fernández (2024)), suggesting that the generous UBI operates primarily through fiscal and efficiency channels, with the program participation margin playing only a limited role.

6.2. *Modest UBI*

Having established that a generous UBI entails substantial fiscal and efficiency costs and a limited role of program participation margin, I now turn to a more modest reform that maximizes $\mathcal{W}^{ss}$. The resulting benefit is about \$3,500 annually, slightly below the maximum EITC benefits. The last two columns of Table 5 report the aggregate effects of this modest UBI.

The average tax rate (ATR) rises modestly, by 1.6pp under IP and 1.2pp under FP. Such contained fiscal cost limits efficiency loss. Aggregate capital (K) falls by 2.0% under IP and 0.4% under FP, while the aggregate consumption (C) declines by 1.6% and 0.8%, respectively. Aggregate output (Y) exhibits similarly small reductions.

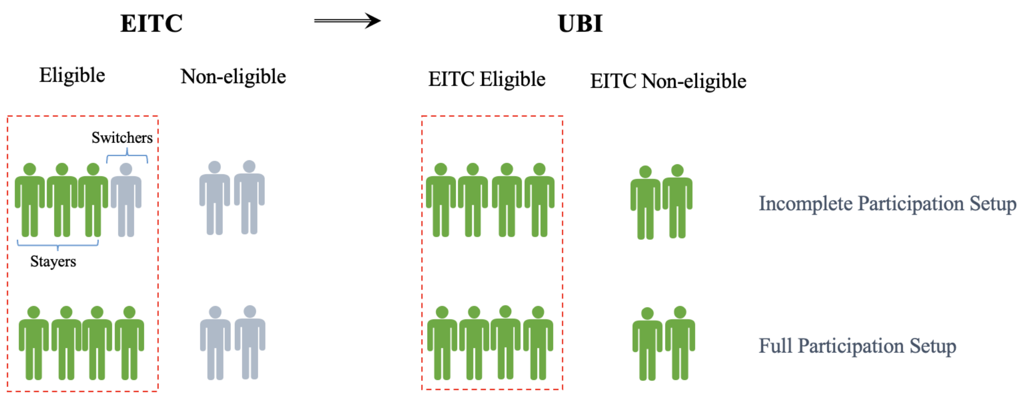
Labor supply responses are also modest but display interesting qualitative differences. Employment falls by about 1.5 percentage points in both setups (IP: –1.1pp, FP: –1.8pp), while hours of work move in opposite directions—declining by 0.6pp under IP but rising slightly (0.2pp) under FP. Price adjustments are modest but also in opposite directions across two setups. For instance, the wage rate decreases by 0.3 pp under IP but increases slightly under FP setup. These qualitative differences signal the non-trivial role of program participation margin in shaping aggregate outcomes. The following subsection, therefore, provides a more detailed analysis of the mechanisms underlying these differences.

6.3. *Distributional and Mechanism Analysis*

The aggregate responses in the previous section reveal opposite patterns across the two participation setups, suggesting that the program participation margin plays a decisive role. This section goes beyond aggregate metrics to uncover the mechanisms underlying these differences, focusing on how heterogeneity in participation status—induced by the program participation margin—shapes the overall outcomes.

Figure 2 illustrates the key compositional differences between the two setups in the benchmark economy. The red dashed box divides the population into EITC-eligible households (inside the box) and ineligible ones (outside). Within the eligible group, green indicates participants and gray denotes nonparticipants. In the IP setup (upper-left panel), both green and gray cells appear inside the eligible box, indicating that a sizable fraction of the eligible households do not take up benefits. In the FP setup (lower-left panel), by contrast, the eligible region is entirely green, reflecting full

Figure 2: Compositional Difference between Setups



Note: Figure illustrates the composition of participants under EITC and UBI for two model setups. Green indicates participants, while gray figures represent non-participants. The red dashed box outlines the group eligible for the EITC. Under the incomplete participation setup, eligible individuals are divided into "stayers" (who continue participation) and "switchers" (who enter under UBI but were non-participants under EITC).

participation. After the UBI reform, universality ensures that all eligible households receive the transfer. For clarity, I refer to benchmark EITC participants as *stayers*, while previously eligible nonparticipants who begin receiving UBI are labeled *switchers*.

To better illustrate how the program participation margin generates opposite patterns under the modest UBI, I decompose behavioral responses within the benchmark-eligible group, where the key compositional differences across setups arise, as shown above. Table 6 shows outcomes separately for stayers and switchers in the IP setup, along with the aggregated eligible group in both IP and FP setups.

Stayers in the IP setup respond similarly to the eligible group in FP. Savings increase by about 2.8% under IP and 6.2% under FP, reflecting both life-cycle motives of receiving an unconditional transfer and the effect of removing the investment-income cap. Hours of work rise slightly—by 0.04pp in IP and nearly one percentage point in FP — as the elimination of the phase-out reduces the implicit tax on earnings. At the same time, employment falls in both setups due to the removal of EITC's incentivizing (phase-in) design. Overall, the magnitudes of these responses are smaller in the IP setup, consistent with the attenuation mechanism of the program participation margin: since only a subset of eligible households participate in the benchmark under IP, fewer are exposed to the means-tested scheme, whereas under FP the entire eligible group is subject to it.

The other channel through which the participation margin operates is the distinct group present

Table 6: Behaviour Response within Benchmark Eligible Group

	IP			FP
	Stayer	Switcher	Eligible	Eligible
K(%)	2.79	1.48	2.20	6.24
H(pp)	0.04	-3.02	-0.77	0.96
ER(pp)	-2.22	-1.1	-1.93	-2.24

Note: Table shows behavioral responses within the benchmark EITC-eligible group under the modest UBI reform. Columns 1–3 show outcomes for stayers, switchers, and the aggregated eligible group in the incomplete participation (IP) setup, while the last column shows the eligible group under the full participation (FP) setup. Changes in wealth (K) are reported as percent deviations relative to the benchmark, whereas changes in hours of work (H) and employment rate (ER) are expressed in percentage points.

only under the IP setup—*switchers*. These households were not subject to the EITC's means-tested distortions in the benchmark, and their behavioral responses mainly reflect the income effect of receiving a new unconditional transfer. For instance, savings increase by about 1.5%, driven by the lifecycle motive, while hours of work and employment fall by 3pp and 1.1pp, respectively, as a result of the income effect from non-work-related benefits.

The fourth column reports the response of the benchmark-eligible group under the IP setup, which is a weighted average of the reactions of stayers and switchers. Because switchers are unaffected by the removal of the means-tested scheme, their responses in savings and employment are muted along this channel relative to their FP counterparts. At the same time, the strong income effect among switchers dominates the eligible group's hour responses under IP, in contrast to an increase observed in the FP setup.

In summary, this decomposition highlights how the participation margin shapes aggregate responses, leading to different outcomes than in the FP setup. With these mechanisms established, the next step is to examine how they translate into redistribution and welfare under the modest UBI reform.

6.4. Redistribution and Welfare

This section examines the redistributive effect of the reform and how redistribution, alongside efficiency, determines the overall change in welfare.

Replacing the EITC with a modest UBI strengthens redistribution overall. UBI reduces the Mean Log Deviation (MLD) of income—a measure of inequality—from 0.645 before tax and transfer to 0.42 after, a 35% reduction compared with 32% under the EITC. Accordingly, the MLD-based redistribution effect (RE) indicates that inequality declines by about 2.5 percentage points more under the UBI than under the benchmark (IP: –3pp; FP: –2pp).

The stronger redistribution effect is concentrated at the lower end of the distribution: UBI lowers the p50/p10 ratio by roughly 2.5 percentage points more than the benchmark, narrowing the gap between middle- and low-income households. At the upper end, however, the two setups diverge. In the IP setup, UBI reduces p90/p50 ratio by an additional 1.4 percentage points compared to the benchmark, indicating stronger redistribution among higher-income households. In the FP setup, by contrast, the p90/p50 ratio still decreases after UBI, but by about nine percentage points less than in the benchmark, implying slightly weaker redistribution at the top.

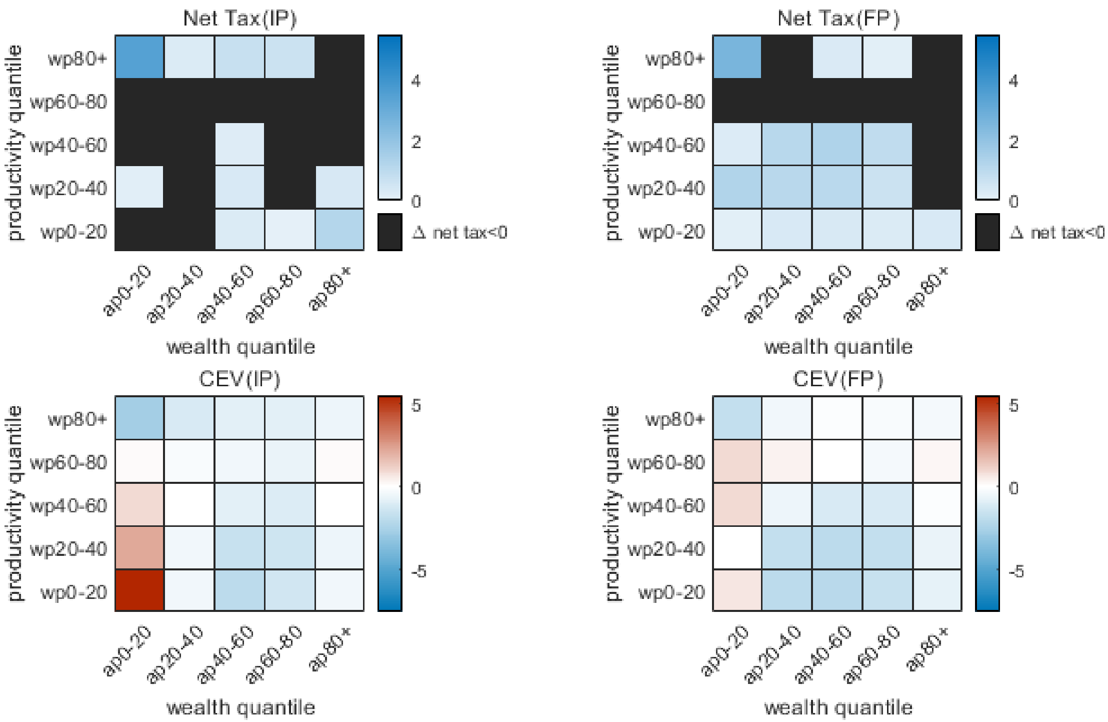
Aggregate steady-state welfare exhibits an opposite pattern across the two setups, where $\mathcal{W}^{ss}$ increases by 0.02% under IP setup but it declines by about -0.5% under FP setup. To better understand how redistribution and welfare differ across participation setups, and how the program participation margin drives these differences, I next decompose the changes in net taxes (taxes minus transfers) and welfare along the joint distribution of wealth and productivity, as shown in Figure 3.

In all panels, the horizontal axis represents wealth quintiles and the vertical axis represents productivity quintiles, both defined using the benchmark distribution. The diagrams in the top row display changes in net tax liabilities, where darker blue indicates higher net tax payments and black cells represent reductions relative to the benchmark. The bottom row shows the welfare ($\mathcal{W}^{ss}$) change, with red denoting welfare gains and blue denoting losses.

The changes in net tax across the two setups help clarify the redistribution patterns observed in the aggregate metrics, with the participation margin playing a central role. As shown in the first row of Figure 3, the most pronounced differences occur in the low-middle regions of the wealth–productivity distribution, corresponding to areas where benchmark EITC-eligible households are concentrated.

Under the IP setup, many households in this region experience a decline in net taxes relative to the benchmark. This pattern reflects the role of switchers, whose benefit receipts rise substantially,

Figure 3: Decomposition of Net Tax and Steady-state Welfare



Note: The upper panels show the change in net tax payments between the pre- and post-reform steady states along the joint distribution of wealth and productivity. Cells are defined by percentiles of the benchmark distribution. Black cells indicate a reduction in net tax payments, while darker blue shades indicate larger increases. Lower panels display the welfare change, with red denoting welfare gains and blue denoting welfare losses. Results are presented separately for the incomplete participation (IP) and full participation (FP) setups.

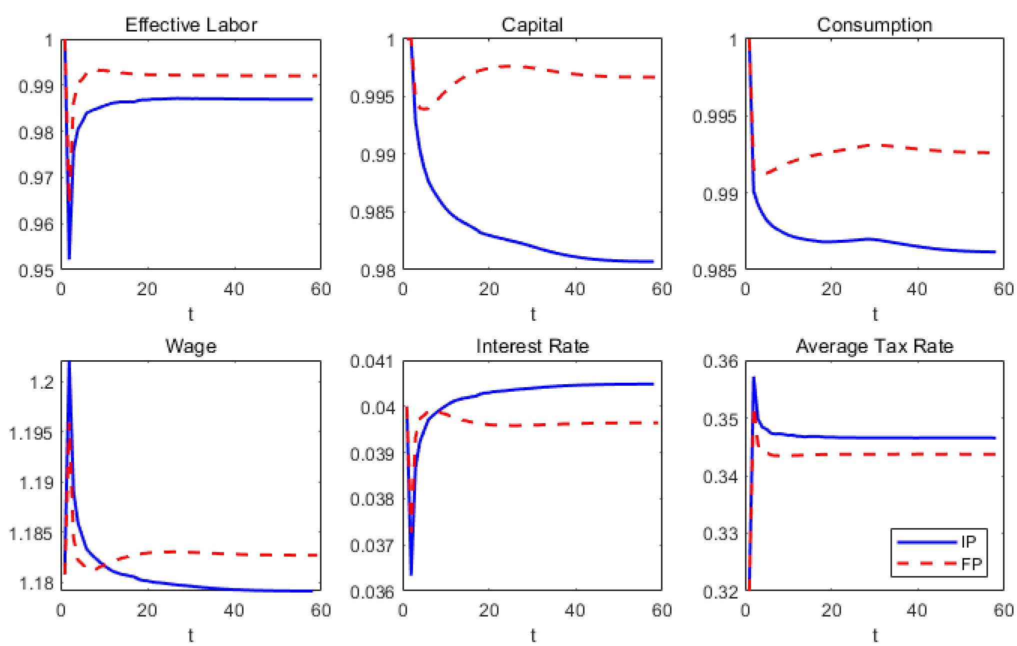
reducing their net tax burden. Consequently, a larger share of the fiscal financing burden shifts toward higher-productivity households (shown as darker blue cells), thereby strengthening redistribution at the top. In contrast, under the FP setup, switchers are absent, and some low-income households face higher net tax payments because the modest UBI is smaller than the maximum EITC benefit. This alleviates part of the financing pressure on high-income households, explaining why redistribution at the top is weaker under FP.

The decomposition of $\mathcal{W}^{ss}$ in the second row of Figure 3 clarifies why steady-state welfare differs qualitatively across the two setups. Under the IP setup, welfare gains are concentrated among low-income households, as the UBI extends coverage to all of them at only a modest fiscal cost—especially to those who did not participate in the benchmark EITC. These gains outweigh the relatively small welfare losses associated with higher fiscal costs elsewhere, leading to an overall improvement in $\mathcal{W}^{ss}$. In contrast, under the FP setup, most low-income households were already covered under the benchmark, so the additional welfare gains among these households are limited, while the fiscal costs remain. As a result, aggregate welfare declines.

6.4.1. Transitional Dynamic

The analysis so far focuses on steady-state comparisons and has not taken into account the transitional dynamics. This section examines whether the program participation margin continues to matter during the transition. Specifically, do the aggregate paths differ across the two setups, and how do welfare outcomes change once transitional adjustments are taken into account? To address these questions, I computed the transitional dynamics for both participation setups with the following timing. The economy starts from the initial steady state at $t = 0$, and the modest UBI replacement reform is introduced unexpectedly and permanently at $t = 1$. In each subsequent period, markets clear through adjustments in factor prices, and the government budget is balanced.

Figure 4: Aggregates and Prices along the Transitional Path



Note: Top row shows the transitional dynamics of selected aggregate variables under the incomplete participation (IP) and full participation (FP) setups. All series are normalized to their respective pre-reform steady-state values. Bottom row shows the price adjustments along the transition, shown in levels. The blue solid line corresponds to the IP setup, and the red dashed line corresponds to the FP setup.

The top row of Figure 4 plots the aggregate changes under incomplete (blue solid) and full (red dashed) participation setups. Each series is normalized by its initial steady-state level, shown as unity at $t = 0$. The most striking change at $t = 1$ is in effective labor. Unlike capital, which is predetermined and adjusts gradually in the short run, labor supply responds immediately to the UBI reform. Due to the large income effect arising from the benefit scheme change and the high level of wealth holding, the effective labor drops significantly in both setups, which in turn drives down the aggregate output and consumption. The changes in wage and interest rates are consistent with the larger decline in effective labor, and the average tax rate increases to balance the fiscal budget.

Although the response pattern at the enactment date ($t = 1$) is similar across the two setups, the magnitudes are larger under the IP setup. This amplification reflects the role of the program participation margin. For instance, the drop in effective labor is amplified by switchers, who experience mostly the income effect of the modest UBI without any offsetting incentive effects from the removal of the EITC's means-tested structure. As a result, the smaller tax base under the IP setup necessitates higher taxes to balance the fiscal budget, which further distorts the response.

The dynamic path exhibits some differences between the two setups in the medium run, driven by the re-optimized savings of those alive at the reform period under the FP setup. Two opposite forces are taking effect. On the one hand, higher taxes distort savings. This effect is stronger under the IP setup because the presence of switchers raises the fiscal burden. On the other hand, the removal of the EITC's asset constraint encourages additional saving. This pro-saving effect is stronger under FP, where all participants were previously subject to the means test, whereas it is attenuated by incomplete take-up under IP. The interaction of these forces produces distinct dynamics across two setups: under IP, capital falls monotonically toward its new steady state, whereas under FP it first drops—reflecting the immediate tax distortion—but then recovers as the tax rate stabilizes, temporarily overshooting its new steady-state level. Consumption mirrors these patterns: it declines gradually to the new steady-state level under IP but falls more sharply under FP before partially recovering toward the new steady state.

Having established how the transitional paths differ across the two setups, we now examine how these dynamic patterns translate into differences in welfare $\mathcal{W}^{td}$. The resulting welfare changes ($\mathcal{W}^{td}$) are 0.77% and -0.34% under the IP and FP setups, respectively. This opposite pattern is consistent with what we had in steady-state ($\mathcal{W}^{ss}$), but the welfare gain is now more substantial under IP, reflecting the transitional adjustments discussed above. Under the IP setup, consumption declines only gradually toward its new steady-state level, remaining above it for an extended period. This higher transitional consumption, together with a reduction in labor supply, raises welfare along the transition relative to the new steady state. However, under FP setup, although the labor supply follows a similar pattern, consumption initially undershoots its new steady-state level as households increase saving, making them relatively worse off during the transition.

The aggregate measure $\mathcal{W}^{td}$ provides a useful summary but masks the heterogeneity across cohorts. As shown in equation (13), the transitional welfare can be decomposed into the contribution of the old generation and future newborns. The old generation experiences welfare losses of 0.1% under IP and 0.63% under FP. The smaller loss in the IP case reflects a mechanism similar to the steady-state results, where redistribution is strengthened as UBI extends coverage to households that did not take up the EITC in the benchmark. These losses arise mainly from the sharp increase in taxes at the onset of the reform. This particularly harms retirees and those close to retirement. Recall that the reform replaces the EITC—a program targeted only at working-age individuals—with a universal transfer. As a result, retirees face higher taxes without receiving UBI benefits. This reduces their remaining lifetime resources, thereby lowering their welfare.[18]

Contrasting the old generation's welfare losses with the overall $\mathcal{W}^{td}$ indicates that future newborns experience substantial welfare gains–0.87% under IP and 0.3% under FP setups. The difference in magnitude between the two setups reflects their compositional differences.

Under the IP setup, the expansion of benefit coverage to individuals who did not participate in the EITC under the benchmark generates stronger income effects, encouraging greater leisure and reducing the need for precautionary savings. By contrast, this margin of extended participation is absent in the FP setup, where all eligible households are already assumed to participate. Moreover, in the FP setup, the larger response to the removal of EITC's means-tested design has more pronounced counteracting effects. As a result, the welfare gain of future newborns is larger under the IP setup. Most importantly, these gains more than offset the welfare losses of the old generation, reinforcing the qualitative difference in welfare outcomes across the two setups.

[18] This welfare loss pattern is also present in the steady-state comparison, though weaker, since the tax increase is smaller in the new steady state than at the beginning of the transition.

7. Conclusion

In this paper, I documented the incomplete take-up of the EITC, which is the largest non-medical/pension cash transfer program in the U.S., and investigated the incompleteness and the relevant factors of the program participation using ASEC-CPS data. I then rationalized the empirical findings into a standard incomplete market life-cycle dynamic general equilibrium model (Aiyagari (1994); İmrohoroglu et al. (1995)). I calibrated the benchmark models of two setups, which differ in the means-tested program take-up (incomplete or full), to the U.S. economy and conducted two UBI-replacement reforms.

In the case of generous UBI ($12,000 annually), the reform significantly reduces inequality but results in a welfare loss under both participation setups. This mainly stems from the large fiscal cost, which distorts the aggregate efficiency and leaves little scope for program participation to play a meaningful role.

In contrast, the modest UBI reform ($3,500 annually) generates different behavioral responses across the two setups and yields a welfare gain, but only under the IP setup. The participation margin is central to this difference: under IP, UBI extends coverage to low-income households who were eligible for the EITC but did not claim it, while this redistributive channel is absent under full participation (FP). Consequently, redistribution toward low-productivity individuals is strengthened under IP but weakened under FP, where net tax payments rise for households in the lower-middle range of the wealth–productivity distribution. When transitional dynamics are considered, the welfare gain under IP becomes even larger. This improvement is primarily driven by higher consumption and more leisure along the transition. In contrast, under FP, consumption initially falls below its steady-state level, leading to an overall welfare loss.

Therefore, considering the program participation margin makes both qualitative and quantitative differences in terms of evaluating UBI-replacement reform. To summarize, replacing a means-tested program with a generous UBI is not a good idea, as it is expensive and distorts behavior. However, a properly sized UBI program may be beneficial, and the key is in extending benefits to those who do not take up benefits in the benchmark at a moderately high tax burden.

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