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Inflation vs Inclusion: Stabilization Policy in the Wake of the Pandemic

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Inflation vs Inclusion: Stabilization Policy in the Wake of the Pandemic[*]

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Abstract

As the economy emerges from a crisis, macroeconomic policy confronts a dilemma: a protracted stimulus can foster a more inclusive labor market recovery, yet risks igniting inflation that ultimately undermines workers' welfare through real income erosion. This tension amplifies in the presence of the ZLB and aggregate capacity constraints. We embed this insight into a quantitative model of the US economy. We study how monetary and fiscal policies managed this inflation-inclusion trade-off after the pandemic, contrasting actual outcomes with counterfactual scenarios. Our experiments yield five findings: (i) the trade-off was unusually difficult because policy was squeezed between these two constraints; (ii) inflationary pressures arose from the joint deployment of prolonged monetary and fiscal stimulus; either policy alone would have produced milder price dynamics; (iii) either inclusive fiscal policy or inclusive monetary policy in isolation would have been sufficient to contain the negative labor market hysteresis at the bottom of the distribution; (iv) inclusive fiscal policy combined with a more traditionally inflation-focused central bank would have achieved higher welfare for the vast majority of households; (v) welfare effects reflect mostly corrections of incomplete-market inefficiencies rather than gains from aggregate stabilization.

JEL Codes: E21, E24, E31, E32, E52, J24, J64

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Under just about any theory that we have in economics, inflation at this moment was quite predictably an outcome of the policies that were being pursued [9/22] Larry Summers

Intentional polices focused on driving an inclusive recovery helped our economy withstand the challenges of the past two years [6/2023] *Strategies designed to fully suppress the post-pandemic inflationary surge would have required an unacceptably high level of unemployment* [1/2025] Janet Yellen

1 Introduction

In the aftermath of a contractionary shock that depresses aggregate output, fiscal and monetary authorities typically adopt an expansionary stance to reverse the downturn and steer the economy back to its trend. Traditionally, the success or failure of these policies has been evaluated by their ability to prevent a more severe downturn and to induce a swift recovery of *aggregate* real indicators, such as output or unemployment. Mounting micro-data evidence on the distributional effects of business cycles and recent insights from heterogeneous-agent incomplete-market models, however, are shifting the policy focus from aggregate stabilization toward achieving an inclusive recovery that alleviates individual hardship across the entire distribution.

The main reason for this shift in focus is the recognition that both the pace and the extent of recovery from a recession can vary markedly across the distribution, with participation, employment, and earnings outcomes for workers at the bottom of the distribution continuing to lag long after aggregate output and unemployment have returned to trend (see, e.g. Aaronson et al., 2019; Cajner et al., 2017; Hobijn and Şahin, 2021; Yagan, 2019). Reducing the entire distribution to its average can thus easily miss the mark.

Therefore, a stabilization strategy that seeks to foster an inclusive recovery—one in which no group is left behind—may need to sustain monetary and fiscal support beyond what is required to restore aggregate indicators. Yet, maintaining a hot economy for too long also entails significant risks. One is that the economy overheats and causes inflation to slip out of control, which erodes workers' real wages and can ultimately undo the policy's initial gains. Pursuing an inclusive recovery therefore entails a stark trade-off between *inflation and inclusion*.[1]

In this paper, we study the tension between inflation and inclusion intrinsic in stabilization policy. Our key insight is that this trade-off becomes particularly acute—and difficult to navigate for policymakers—in the presence of the zero lower bound (ZLB) and maximum capacity constraints in production. This challenge arises because both of these aggregate constraints act to magnify the costs associated with the two sides of

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[1] As Okun (1973) famously put it, "renouncing these gains to most disadvantaged groups should be carefully reckoned as a high cost of accepting slack as an insurance policy against inflation."

the inflation-inclusion trade-off. The ZLB on nominal interest rates limits the effectiveness of conventional monetary tools and exacerbates the long-lasting scarring effects of recessions, especially for lower-income workers. This scenario calls for protracted monetary and fiscal stimulus. However, a prolonged policy-driven demand stimulus makes productive capacity constraints more likely to bind, increasing the risk of an inflationary burst.

The U.S. recovery from the pandemic-induced recession is a stark example of this challenge because stabilization policy was—perhaps for the first time in history—squeezed between these two aggregate constraints. In fact, both fiscal and monetary authorities were openly and actively pursuing an inclusive recovery when the economy hit the ZLB early in 2020 and faced global supply chain disruptions, which undermined its productive capacity.

On the fiscal side, all major interventions were explicitly designed to reach lower-income households, the unemployed, and families with children, rather than functioning purely as aggregate demand stimulus. The three rounds of Economic Impact Payments (stimulus checks) were means-tested and phased out at higher incomes. The expanded unemployment insurance (UI) added a fixed weekly lump-sum of $600 to laid-off workers, and temporarily integrated gig and self-employed workers, groups traditionally excluded from UI, into the system via the Pandemic Unemployment Assistance program. The expansion of the Child Tax Credit (CTC) in 2021 made the credit fully refundable and paid monthly, more directly helping poor families with children.[2]

On the monetary side, policy was marked by an active pursuit of a strong labor market. This commitment was made explicit in the September 2020 FOMC meeting, when the Committee communicated that it would keep the federal funds rate at zero *until labor market conditions have reached levels consistent with the Committee's assessments of maximum employment, and inflation has risen to 2 percent and is on track to moderately exceed 2 percent for some time*. By doing so, the Fed made the achievement of maximum employment a precondition for the lift-off, regardless of what happened to inflation. This represented a substantial departure from the Fed's earlier "preemptive restraint" approach, under which it would raise nominal rates even in anticipation of higher future inflation.[3]

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[2] Furthermore, eviction moratoriums, food assistance, and emergency housing programs disproportionately benefited low-income households.

[3] This "preemptive restraint" approach was evident in 2015 when the Federal Reserve first started its hiking cycle following the Great Recession. Back then, the unemployment rate was already down at 5 percent and was expected to drop further, causing the Federal Reserve to project that inflation would run above its target. However, inflation remained firmly below 2 percent while unemployment continued falling, dropping to 3.7 percent in July 2019. At the time of the decision, there was notable disagreement within the Federal Open Market Committee (FOMC): while some members advocated for immediate hikes, others, including Chicago Fed President Charles Evans, recommended postponing rate increases. In hindsight, a growing consensus emerged among analysts and policymakers (e.g. Ozimek and Ferlez, 2015) that the

Looking at the labor market experience of low-wage workers during this period, these policies appeared to be successful. For instance, total labor earnings of the lower half of the income distribution grew by nearly 18% between 2019 and 2023, compared to roughly 5% for the upper half (Blanchet et al., 2022). This strong growth at the bottom contrasts with the past decade's weak relative wage growth, leading to what Autor et al. (2023) have labeled the "unexpected compression" of the wage distribution.[4]

At the same time, the economy underwent a sharp inflationary surge that lifted the price level to roughly 10 percentage points above trend, eroding much of the wage gains generated by the exceptionally strong labor market. Numerous analyzes link this episode of historically high inflation to the combination of unprecedented fiscal expansion and highly accommodating monetary policy, which were implemented precisely as post-pandemic supply disruptions severely constrained the economy's productive capacity (Eggertsson and Kohn, 2023; Levy et al., 2024).

Could a more restrained policy stance, in line with the traditional approach, have avoided capacity constraints to bind? What would have been the potential cost of these alternative tighter policies in terms of inclusive labor market outcomes? For example, according to Secretary Janet Yellen, the fiscal interventions were a success precisely because *the rapid decline in unemployment enabled the United States to avoid labor market scarring—the erosion of skills and reduced employability that can result from long periods of unemployment—and thus avoid an associated reduction in future potential output.*[5]

We address these questions through the lenses of a state-of-the-art Heterogeneous Agent New Keynesian model with a rich three-state representation of a frictional labor market, an extension of the framework originally developed in Alves and Violante (2025). The model accommodates heterogeneous sensitivity to aggregate shocks across the income distribution and incorporates labor market hysteresis via skill depreciation—forces that disproportionately affect households at the bottom and are further amplified at the ZLB. This provides a rationale for inclusive stabilization policies that extend the duration of recoveries. To capture the inflationary risk of inclusive stabilization policies, we extend the framework to incorporate time-varying capacity constraints in production, which—when binding—generate a surprise spike in inflation that erodes real wages and real returns. This real income erosion is the fundamental reason why inflation might ultimately harm workers in the model, cautioning against an overly prolonged monetary or fiscal stimulus.

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tightening was premature, as it interrupted the ongoing strong labor market recovery too early and prevented the recovery of low-wage workers still struggling to re-enter the labor force.

[4] These unusual wage dynamics are robust to changes in the composition of the workforce, as demonstrated by time-series earnings data for continuing workers constructed by the Atlanta Fed.

[5] Remarks by Secretary of the Treasury Janet L. Yellen Reflecting on the Biden-Harris Administration's Economic Record, January 15, 2025.

After calibrating the model to the pre-Covid period, we estimate the realizations of demand, cost-push, and labor supply shocks that exactly match inflation, unemployment, and labor force participation. With the realized aggregate shocks in hand, we run three policy counterfactuals. In the first counterfactual, we assume that both fiscal and monetary policy adopt a more traditional approach to stabilization: monetary policy follows a strict inflation targeting rule, and fiscal policy is more restrained, i.e., it does not protract its stimulus beyond the first round of interventions—the Coronavirus Aid, Relief, and Economic Security (CARES) Act of March 2020—meant to deal with the immediacy of the crisis. In the second counterfactual, we only change the stance of monetary policy from inclusive to traditional, and leave fiscal policy as expansionary as observed in the data. In the last one, we only change the stance of fiscal policy, while monetary policy follows a more inclusive strategy, as in the data.

We study the implications for a variety of labor-market outcomes, as well as for welfare, across the household distribution. Our analysis yields five main findings. First, navigating the inflation-inclusion trade-off was unusually difficult during this period because policy was squeezed between the ZLB and tight capacity constraints: implementing a large and prolonged stimulus to reduce the costs of the former increased the risk of hitting the latter. Second, the historic inflation surge—and the consequent real income erosion—stemmed from the joint deployment of inclusive monetary and fiscal stimulus. Either policy implemented in isolation would have produced a much less severe increase in prices. The lack of coordination between fiscal and monetary authorities was therefore at the heart of the inflationary episode. Third, an inclusive fiscal or monetary policy implemented on its own would have also been sufficient to contain labor-market hysteresis at the bottom of the distribution, albeit with different timing. An inflation-focused monetary policy would have stabilized labor-earnings dynamics throughout the recovery, whereas a more restrained fiscal policy would have produced a sharp earnings decline in 2021 (when fiscal transfers helped sustain demand) followed by a stronger rebound in 2022 (when the negative wealth effects of transfers on labor supply put downward pressure on participation).

Turning to welfare, we find that a more restrained fiscal policy coupled with an inclusive central bank would have entailed substantial welfare losses throughout the skill distribution, whereas a policy mix pairing an inflation-focused central bank with an inclusive fiscal authority would have yielded modest welfare gains for the vast majority of households. Thus, despite having similar effects on inflation and labor-market outcomes, inclusive monetary and inclusive fiscal policies, when implemented in isolation, have markedly different welfare implications. Interestingly, labor market outcomes play only a minor role in our welfare results, as wage and employment dynamics tend to offset each other—stronger real wages in the low-inflation counterfactuals are roughly balanced by less broad-based employment growth relative to the baseline. Welfare differences relative to the baseline are instead mainly driven by the behavior of fiscal transfers below the median of the distribution and by profits and capital gains at the top. Lastly, we observe that the sizable welfare gains associated with inclusive fiscal policy—especially for households at the bottom of the distribution—should be interpreted with caution. This is because the bulk of these welfare gains does not stem from the stabilization of aggregate shocks, but rather from the correction of steady-state inefficiencies arising from market incompleteness. In this sense, the gains we find are driven less by the policies' mitigation of pandemic-induced aggregate fluctuations and more by the lack of insurance and liquidity in the model's stationary equilibrium.

1.1 Related Literature and Contribution

Our paper belongs to the rapidly growing literature that leverages Heterogeneous Agent New Keynesian (HANK) models to study the macroeconomic and distributional impact of aggregate shocks and stabilization policies (see Auclert et al., 2024a, for a recent survey of this literature). Building on Alves and Violante (2025), we augment the canonical HANK model with nominal wage and price rigidities to include extensive margin of labor supply and participation decision, along the lines of Krusell et al. (2017) and Heathcote et al. (2020). In doing so, we join an emerging strand of papers calling for a more prominent role of labor supply in this class of models (Huo and Ríos-Rull, 2020; Bardóczy, 2022; Graves et al., 2023; Faia et al., 2025). The present paper adapts our previous framework to investigate the inflation-inclusion trade-off implicit in aggregate stabilization policy, with a particular focus on the U.S. post-pandemic recovery where supply chain disruptions impaired productive capacity in the short run.

Given our focus on the pandemic business cycle, our work is also related to a recent literature examining inflation dynamics during this period. A number of papers have used VARs and local projections to estimate the contribution of various demand and supply shocks to inflation (e.g. Bai et al., 2024; Bergholt et al., 2024; Giannone and Primiceri, 2024). We perform a similar decomposition, but identify shocks by filtering the data through the lenses of a fully specified dynamic equilibrium model. In this sense, our approach is similar to Gagliardone and Gertler (2023).

To incorporate capacity constraints, we follow Comin et al. (2023), who model them as (time-varying) maximum productive capacity at the firm level. As they illustrate, binding constraints show up as inflationary cost-push shocks in the price Phillips curve. Rubbo (2024) and Guerrieri et al. (2021) also discuss how global supply chain disruptions and industry-specific disturbances (e.g., productivity declines in contact intensive services) that prevailed during the economy's recovery from Covid can manifest, in reduced form, as an aggregate cost-push shock. Consistent with this interpretation, Lorenzoni and Werning (2023) emphasize how such supply-chain constraints can propagate through wage-setting and generate persistent wage-price dynamics even after the underlying supply disruptions abate. Even though we do not explicitly model or microfound a nonlinear Phillips curve—as in Benigno and Eggertsson (2023), Harding et al. (2023), or Blanco et al. (2024)—the presence of capacity constraints nonetheless implies that demand shocks can cause a sudden surge in unexpected inflation through an upward shift in the Phillips curve.

The costs of inflation in our model operate mainly through the erosion of real income, in the form of both wages and interest income. This erosion is the primary channel through which households dislike inflation in the model. In practice, inflation also generates uneven costs across the distribution through several additional channels that we abstract from in our analysis, including nominal net positions (Del Canto et al., 2024; Pallotti et al., 2024), heterogeneity in consumption baskets (Jaravel, 2021; Olivi et al., 2023; Cavallo and Kryvtsov, 2024), and costly actions such as increased search and renegotiation efforts undertaken to keep nominal wages in line with inflation (Afrouzi et al., 2024; Guerreiro et al., 2024). Stantcheva (2024) provides survey-based evidence on households' perceptions of the costs of inflation during the most recent inflationary episode.

With respect to fiscal policy, our paper echoes the findings from Auclert et al. (2024b) and Angeletos et al. (2024) on the effect of fiscal transfers in HANK models and its dependence on the degree of debt-financing. Relative to their analysis, our model also features implications of the transfers on labor force participation, a margin that is important in capturing the response of the economy to the second round of stimulus checks of 2021. In addition, our exercise speaks to the role of fiscal stimulus in driving the accumulation of excess savings and their persistent effects on aggregate demand during the post-pandemic recovery, a point also raised and analyzed by Auclert et al. (2023b) and Bardóczy et al. (2024).

Relative to this body of literature, our contribution is to ask and assess whether alternative choices for monetary and fiscal policy would have led to better outcomes across the income distribution and, in particular, for low-wage workers, given that this was the stated intent of the policy rules in place.[6] Methodologically, we combine the insights of Holden (2016) and Hebden and Winkler (2024) on how deal with aggregate occasionally

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[6] Even though the interaction between health and the macroeconomy was a defining trait of this episode, we abstract from it here. A number of heterogeneous-agent models have incorporated this additional trade-off. See for example Glover et al. (2023) and Kaplan et al. (2020). We also abstract from specific features of post-Covid labor market dynamics, such as the rise in vacancies and job-to-job quits (Afrouzi et al., 2024; Bagga et al., 2025) because they are not central to our analysis.

binding constraints (ZLB and maximum capacity in our model) with the linearized solution computed using the popular sequence-space approach of Auclert et al. (2021).

The closest paper to ours is Kaplan and Miyahara (2025). Like us, they examine the macroeconomic effects of the monetary and fiscal responses to the pandemic contraction, and conduct counterfactual policy experiments within a HANK framework. Their model differs from ours in four main respects: (i) they generate the inflation surge through a microfounded model of state-dependent pricing rather than via binding capacity constraints; (ii) they abstract from the extensive margin of labor supply and from labor-market scarring effects of shocks; (iii) inflation is costly in their framework primarily through real wealth dilution, whereas in ours it operates mainly through real wage erosion; and (iv) they treat the fiscal shocks as fully unfunded (i.e., with an active fiscal stance), while in our experiments the government eventually raises taxes. Despite these differences, many of their qualitative conclusions on the inflation-inclusion trade-off align closely with ours. Finally, our decomposition of welfare effects into stabilization gains versus corrections of steady-state incomplete-markets inefficiencies is motivated by one of their exercises.

The rest of the paper is organized as follows. Section 2 outlines the model. Section 3 explains the sources of aggregate fluctuations in the model, and describes how we solve the model with the aggregate constraints. Section 4 describes how we calibrate the model to the pre-pandemic U.S. economy. Section 5 illustrates the role of ZLB and capacity constraint in the occurrence of a negative demand shock. Section 6 describes our filtering exercise, which recovers the realizations of the aggregate shocks, and our simulation of the pandemic business cycle. Section 7 presents our policy counterfactuals. Section 8 contains our welfare analysis. Section 9 concludes.

2 Model

Our model extends the HANK model with a three-state labor market (employed, unemployed, out of the labor force) developed in Alves and Violante (2025). Workers face uninsurable idiosyncratic risk which originates from shocks to their labor productivity ("skill") and from canonical labor market frictions—job-finding and job-separation—which are allowed to depend on workers' skill. Households are subject to Gabaix (2020) "cognitive discounting" and hold their wealth in firms' equity and government bonds. Firms face maximum capacity constraints to production following Comin et al. (2023). Nominal price and wage rigidities give rise to corresponding Phillips curves. Finally, the monetary authority sets the policy rate subject to a zero lower bound (ZLB) on nominal rates, while the fiscal authority finances spending and transfers by raising taxes and issuing debt.

We now lay out the full model structure. To ease the presentation, we first describe the model abstracting from aggregate shocks and production capacity constraints. We introduce both in Section 3, where we describe the sources of aggregate fluctuations and explain how capacity constraints change the price setting problem of firms.

2.1 Households

Demographics. Time is continuous and indexed by t. The economy is populated by a continuum of households (or individuals) with measure 1 who face mortality rate ϱ. The deceased are replaced by an inflow of newborn agents which keeps population constant.

Labor market status. At any date t, individuals can be in one of three labor market states s_t which are mutually exclusive: employed ($s_t = e$), unemployed and looking for a job ($s_t = u$), and non-participant ($s_t = n$). Among the unemployed, we distinguish between eligible ($u = u_1$) and ineligible ($u = u_0$) for unemployment insurance (UI) benefits. Workers gain eligibility when they enter the unemployment pool due to an exogenous separation, and they lose it at some constant rate. Among those out of the labor force, we distinguish between "passive"($n = n_0$) and "active ($n = n_1$) " non-participants. The former do not engage in any search and hence do not transition into employment. The latter, instead, still receive job offers and thus can transition back into employment, though at a lower rate than the unemployed.[7]

Labor productivity. Each individual is endowed with efficiency units of labor (or skills) z evolving according to a Ornstein-Uhlenbeck diffusion process which depends on labor market status s_t

$$d \log z_t = \Big\{ - \gamma_z \log z_t + \mathbb{I}_{\{s_t = e\}} \, \delta_z^+ - \mathbb{I}_{\{s_t \neq e\}} \, \delta_z^- \Big\} dt + \sigma_z d\mathcal{W}_t. \tag{1}$$

When workers are employed ($s_t = e$), skills drift up at rate $\delta_z^+ > 0$, and when they are not employed ($s_t = u, n$) they drift down at rate δ_z^-. The parameter $\gamma_z > 0$ measures the degree of mean reversion in skill dynamics, σ_z determines uncertainty about future realizations, and $\mathcal{W}_t$ is a Wiener process. Upon death, workers are replaced by an offspring with log skills drawn from a Normal distribution with mean $\bar{z}_0$ and variance $\sigma_{z_0}^2$.

Labor market transitions. Every period individuals can transition between employment states through a combination of exogenous Poisson rates and mobility decisions. Ta-

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[7] This differentiation is meant to capture the fact that the pool of non-participants is heterogeneous (Hall and Kudlyak, 2019) with some individuals able and willing to work, while others unable and not searching at all for a job (e.g., because unhealthy, involved in household care, or discouraged by the failure of previous job search).

	e	u_1	u_0	n_1	n_0
e	$\ddots$	λ^{eu}_{zt}	$\times$	▶	η^{en_0}
u_1	$\lambda^{ue}_{zt} \cdot \triangleright$	$\ddots$	$\lambda^{u_1u_0}_{z}$	▶	η^{un_0}
u_0	$\lambda^{ue}_{zt} \cdot \triangleright$	$\times$	$\ddots$	▶	η^{un_0}
n_1	$\lambda^{ne}_{zt} \cdot \triangleright$	$\times$	▶	$\ddots$	$\eta^{n_1n_0}$
n_0	$\times$	$\times$	$\times$	$\eta^{n_0n_1}$	$\ddots$

Table 1: Transition matrix across the 5 employment states. The × symbol means that transition cannot happen. The ▶ symbol means that an endogenous participation decision moves the individual in that state. The ▷ symbol means that an endogenous job acceptance decision moves the individual into employment. $\lambda^{ss'}_{zt}$ and $\eta^{ss'}$ are exogenous Poisson rates capturing labor market frictions and nonparticipation shocks, respectively. The diagonal dots stand for the negative of the sum of all the other entries on that line.

ble 1 describes all the possible transitions and their endogenous/exogenous nature. Employed and unemployed workers can choose to quit the labor force and enter active nonparticipation (rows 1, 2, 3 of Table 1). Similarly, an active non-participant can choose to re-enter the labor force as unemployed ineligible for UI (row 4). Employed workers who decide to remain attached can still be laid off, and thus move from e to u at an exogenous rate λ^{eu}_{zt} which depends on the worker's skill level z (row 1). Unemployed workers draw a job opportunity at an exogenous rate λ^{ue}_{zt} and choose whether to accept it (rows 2 and 3). Upon expiration of UI benefits, at rate $\lambda^{u_1u_0}_{z}$, eligible unemployed become ineligible (row 2). Active participants receive job opportunities at rate λ^{ne}_{zt} and decide whether to accept them or not (row 4). All workers can exogenously transition into passive nonparticipation at rate η^{sn_0} (rows 1, 2, 3, 4). At rate $\eta^{n_0n_1}$, passive nonparticipants become active again (row 5).

Employed individuals earn labor income $w_th_tz_t$, where w_t is the real wage per effective hour, and eligible unemployed receive benefits $b(z_t)$. We let UI benefits be a function of current worker productivity z_t, as a proxy for actual replacement rates. Both types of income are taxed at a proportional rate τ_t. Every household is entitled to a lump-sum transfer ϕ_t.

Saving instruments. Households can save by holding equity shares, and real and nominal government bonds. Because a no-arbitrage condition holds between all assets, we can summarize households' equity and bond holdings into a single combined asset a with (equalized) rate of return r_t. In Section 2.3 we discuss asset structure and returns in more detail. Household face a zero unsecured credit limit. Newborn workers enter the economy with zero wealth holdings. Perfect annuity markets insure workers against survival risk, so that the net wealth of the deceased is redistributed to surviving households in proportion to their own net wealth.[8]

Preferences. Households discount the future at rate ρ, the sum of the rate of time preference $\tilde{\rho}$ and the mortality rate ϱ. They derive utility from consumption c_t, suffer disutility from the effort cost κ^s associated to being in labor market status s (the extensive margin) and, if employed, from the effort cost of working h_t hours (the intensive margin). We specify the following functional form for period utility

$$u^s(c_t, h_t; z_t) = \log\left(c_t - \psi z_t \frac{h_t^{1+\frac{1}{\sigma}}}{1+\frac{1}{\sigma}}\right) - \kappa^s \tag{2}$$

where $\sigma > 0$ is the Frisch elasticity of labor supply, and $\kappa^e > \kappa^u > \kappa^n \geq 0$. Note that these preferences induce wealth effects on the extensive margin (labor force participation), but not on the intensive margin (hours worked) of labor supply of employed workers. In addition, because the disutility of hours is scaled by individual productivity z_t, optimal hours worked are the same for every employed individual.

Cognitive discounting. We assume that households are subject to a cognitive discounting (CD) friction when forming expectations, following Gabaix (2020).[9] Specifically, households' expectation of the h-period ahead deviation from the steady-state in an aggregate variable X, denoted by $\mathbb{E}_t^{CD}[X_{t+h} - X^*]$, is a fraction $\exp(-\chi h)$ of the full-information rational expectation $\mathbb{E}[X_{t+h} - X^*]$, where χ governs the degree of cognitive discounting ($\chi = 0$ corresponds to the rational expectation benchmark). In this formulation, expectations about future aggregate outcomes are progressively pulled toward their steady-state values, with the degree of discounting increasing as outcomes occur further into the future.

2.1.1 Household problem

Let $v_t(s, a, z)$ be the value at date t of an individual with employment state s, wealth a, and productivity z. The dynamic problem solved by the household at time t is a mix of an optimal control problem, the choice of $c_t > 0$, and two optimal stopping problems: a continuous one, the participation decision $\mathfrak{p}_t^s \in \{0, 1\}$, and one arising at random Poisson jump times (the arrival of job offers), the job acceptance decision $\mathfrak{j}_t^s \in \{0, 1\}$. The stochastic

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[8] We fold this adjustment directly into the real rate of return r_t, which should therefore be interpreted as inclusive of the rate of return ϱ from annuity contracts.

[9] See **?** for a discussion of the interaction between unequal exposure with cognitive discounting in a HANK framework.

nature of the problem is due to both the Poisson arrival rates that determine transitions across labor market states, and the diffusion that determines the evolution of skills z_t. Conditional on these realizations, wealth evolves deterministically.

Consider, for example, the problem of an active non-participant (n_1):

$$
\begin{aligned}
v_0\left(n_1, a_0, z_0\right) = \max_{\{c_t\}_{t\geq 0}, \mathfrak{t}^*} \quad \mathbb{E}_0^{CD} \Bigg[& \int_0^{\mathfrak{t}^{\min}} e^{-\rho t} \mathfrak{u}^n\left(c_t, 0\right) dt \\
& + \mathbb{I}_{\{\mathfrak{t}^{\min} = \mathfrak{t}^e\}} e^{-\rho \mathfrak{t}^e} \max\left\{ v_{\mathfrak{t}^e}\left(e, a_{\mathfrak{t}^e}, z_{\mathfrak{t}^e}\right), v_{\mathfrak{t}^e}\left(n_1, a_{\mathfrak{t}^e}, z_{\mathfrak{t}^e}\right)\right\} \\
& + \mathbb{I}_{\{\mathfrak{t}^{\min} = \mathfrak{t}^*\}} e^{-\rho \mathfrak{t}^*} \left(v_{\mathfrak{t}^*}\left(u_0, a_{\mathfrak{t}^*}, z_{\mathfrak{t}^*}\right) - \xi \right) \\
& + \mathbb{I}_{\{\mathfrak{t}^{\min} = \mathfrak{t}^{n_0}\}} e^{-\rho \mathfrak{t}^{n_0}} v_{\mathfrak{t}^{n_0}}\left(n_0, a_{\mathfrak{t}^{n_0}}, z_{\mathfrak{t}^{n_0}}\right) \Bigg]
\end{aligned}
$$

$$
\begin{aligned}
s.t.\ c_t + \dot{a}_t &= r_t a_t + \phi_t \\
a_t &\geq 0
\end{aligned} \tag{3}
$$

where the conditional expectation $\mathbb{E}^{CD}$ coincides with the full-information expectation over individual-specific (idiosyncratic) risk, but incorporates cognitive discounting with respect to the evolution of aggregate variables relevant to the household's problem (such as the real rate r_t or the job-finding rate from out of the labor force λ_{zt}^{ne}). Active non-participants receive job opportunities at rate λ_{zt}^{ne}, with $\mathfrak{t}^e$ being the arrival time of this event. Conditional on receiving this job offer, they decide whether to accept it or not. At every instant, the non-participant chooses whether to remain unattached $\left(\mathfrak{p}_t^{n_1} = 0\right)$ or re-enter the labor force $\left(\mathfrak{p}_t^{n_1} = 1\right)$, in which case they become unemployed, but are not eligible for UI benefits ($u = u_0$). We assume that re-entering the labor force involves a small fixed switching cost ξ.[10] The optimal stopping time $\mathfrak{t}^*$ represents the first instant in which the choice $\mathfrak{p}_t^{n_1}$ switches from 0 to 1. Finally, at rate $\eta^{n_1 n_0}$ (with $\mathfrak{t}^{n_0}$ being the arrival time of this shock) active non-participants become passive non-participants. Finally, we let $\mathfrak{t}^{\min}$ denote the time at which the first of these events occurs and the worker switches out from its current state.

We present the other four cases in Appendix A. Each of these five problems can be expressed recursively as a Hamilton-Jacobi-Bellman Quasi-Variational Inequality (HJBQVI) which can, in turn, be appropriately discretized to numerically solve the household problem (see Alves and Violante, 2025, for details).

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[10] The presence of a small switching cost is mostly a technical assumption to avoid "chattering," i.e., infinitely fast switching between n_1 and u_0, in the optimal solution of the problem.

2.1.2 Fluctuations in Job Finding and Separation Rates

Because employment and hours per worker are tightly correlated in the data, we posit that job offer arrival rate $\lambda_{zt}^{ue}, \lambda_{zt}^{ne}$ and separation rate λ_{zt}^{eu} shift with fluctuations in average hours per worker h_t. Specifically, we assume that

$$\log\left(\lambda_{zt}^{ss'}\right) = \log\left(\lambda_{z}^{*\ ss'}\right) + \vartheta^{ss'} \log\left(\frac{h_t}{h^*}\right), \quad \text{for } ss' \in \{eu, ue, ne\} \tag{4}$$

where $\vartheta^{ss'}$ determines the elasticity with respect to hours.

2.2 Production, price and wage setting

Final-goods producers. A competitive representative final-good producer aggregates a continuum of intermediate inputs indexed by $j \in [0,1]$ into aggregate output Y_t using a constant returns to scale (CRS) technology with constant elasticity of substitution across inputs $\varepsilon > 0$. Let $P_t = \left[\int_0^1 p_{jt}^{1-\varepsilon} dk\right]^{\frac{1}{1-\varepsilon}}$ be the price of the final good and the numeraire of the economy, and let $\pi_t = \dot{P}_t / P_t$ denote the inflation rate.

Intermediate goods producers and price setting. A continuum of measure one of monopolistically competitive firms produce the intermediate goods from a continuum of labor tasks indexed by $k \in [0,1]$. Production proceeds in two stages. First, firm j combines task–specific labor inputs ℓ_{jkt}, hired at the task wage w_{kt}, into efficiency–weighted hours ℓ_{jt} through a Dixit–Stiglitz aggregator with elasticity of substitution ε^{ω}:

$$\ell_{jt} = \left[\int_0^1 \ell_{jkt}^{\frac{\varepsilon^{\omega}-1}{\varepsilon^{\omega}}} dk\right]^{\frac{\varepsilon^{\omega}}{\varepsilon^{\omega}-1}}, \qquad w_t = \left[\int_0^1 w_{kt}^{1-\varepsilon^{\omega}} dk\right]^{\frac{1}{1-\varepsilon^{\omega}}},$$

where w_t denotes the real hourly wage index per efficiency unit.[11] Second, given ℓ_{jt}, the firm produces with the decreasing-returns technology

$$y_{jt} = \Gamma\, \ell_{jt}^{1-\alpha}$$

subject to a per-period fixed operating cost Ω. Firms also face a Rotemberg-style quadratic cost of price adjustment $\Theta/2\left(\pi_{jt} - \pi_t^*\right)^2 Y_t$, where $\pi_t^* = \gamma\pi_{t-1} + (1-\gamma)\pi^*$ is a convex combination of past inflation π_{t-1} and the central bank's inflation target π^*. The weight

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[11] We allow the government to subsidize labor hired by these firms at rate τ_ℓ, with the subsidy partially financed by a lump sum tax ϕ^{ℓ} levied on the same firms, in order to offset the steady-state monopolistic distortion to the quantity produced.

on past inflation γ creates inflation persistence even in the presence of transitory shocks to inflation, a useful feature to reproduce the inflationary dynamics during Covid.[12] In a symmetric equilibrium, the optimal price setting decisions of firms yields the price Phillips curve

$$(\rho + \chi)(\pi_t - \pi_t^*) - \left(\dot{\pi}_t - \dot{\pi}_t^*\right) = \frac{\varepsilon(1 - \tau^{\ell})}{\Theta}\left(\frac{w_t}{(1-\alpha)\Gamma \ell_t^{-\alpha}} - 1\right). \tag{5}$$

Labor unions and wage setting. This block of the model adapts the wage setting mechanism of Erceg et al. (2000) —i.e., the standard New Keynesian *sticky wage* model—to an heterogeneous-agent economy. We follow closely the approach of Auclert et al. (2024b, 2023a), with the necessary modifications due to our continuous time formulation and the presence of the extensive margin in labor supply.[13]

There is a continuum of unions, each representing all employed workers on a single task k. By adhering to the union, workers agree to supply the as many hours h_{kt} are demanded by intermediate good producers. This equals the total amount of task k effective hours demanded, ℓ_{kt}, at real wage w_{kt} per effective hour, divided uniformly across all employees' efficiency units, or $h_{kt}\int_{s_{it}=e} z_{it}di = \ell_{kt}$. The *nominal* wage ω_{kt} is set by the union in order to maximize the welfare of its current members (all individuals employed at date t) subject to a Rotemberg-style quadratic costs of adjusting the nominal wage, in utility terms, given by $\Theta_\omega/2(\pi_t^\omega - \pi^*)^2$, where π^* is the central bank's inflation target. The solution to this problem yields the wage inflation $\pi_{\omega t}$ Phillips curve

$$(\rho + \chi)(\pi_t^{\omega} - \pi^*) - \dot{\pi}_{\omega t} = \frac{\epsilon^{\omega}}{\Theta^{\omega}}\left[h_t \int_{s_{it}=e} \partial_c u^e(c_{it}, h_t; z_{it}) z_{it} di\right]\left(\psi h_t^{\frac{1}{\sigma}} - (1-\tau_t)w_t\right). \tag{6}$$

The right hand side of equation (6) implies that unions have an incentive to raise their nominal wage whenever the marginal disutility of supplying an additional hour of labor exceeds the marginal utility of an additional unit of after-tax real wage income.[14]

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[12] We assume that these price adjustment costs are virtual and do not reduce profits. Quantitatively, they are tiny at the observed inflation levels (at most 0.2% of output) so they do not affect any of our conclusions on the dynamics of aggregates and welfare.

[13] See Alves and Violante (2025) for a detailed derivation of the union problem.

[14] Note that the steady-state hours per worker implied by (6), $h^* \equiv \psi^{-1}[(1-\tau^*)w^*]^{\sigma}$, correspond to the labor supply that each employed worker would choose under competitive wage-setting. Thus, the union's imposition that all workers supply the same number of hours is consistent with individual optimization, different from the case with separable preferences where the equal-hours constraint introduces an additional distributional distortion relative to the representative agent benchmark. The downside of this specification is that the complementarity between hours and consumption implies a high contemporaneous MPC out of intensive-margin income. However, the importance of this complementarity in the model is limited, relative to canonical HANK models, because in our model with extensive margin of labor supply only 1/3 of fluctuations in total hours arise from hours per employed worker.

2.3 Asset Holdings

Households wealth is invested in three different assets classes: (i) equity shares of the intermediate good firms; (ii) real debt issued by the government; (iii) and a nominal bond in zero net supply. At any time t, an equity share of intermediate good producers pays a flow of Π_t in dividends (or profits) and is valued at price q_t. Holding real bonds yields a real return r_t^b. If we let i_t denote the nominal interest rate, a standard Fisher equation establishes that nominal bonds pay a real return $r_t^m = i_t - \pi_t$. Both real and nominal bonds also carry a liquidity premium (or convenience yield) $\bar{\iota}$.

A no-arbitrage condition equalizes the rate of return on all assets

$$\tilde{r}_t = \frac{\Pi_t + \dot{q}_t}{q_t} = r_t^b + \bar{\iota} = r_t^m + \bar{\iota}. \tag{7}$$

This common rate of return $\tilde{r}_t$ holds at every t, except when an aggregate shock hits the economy, in which case the price q_t can jump, and equities pay a different return from bonds. In those instances, the price jump causes a revaluation of household wealth in proportion to the equity share held in their portfolio. When solving the model, we treat the individuals' position in equity as exogenous, and allow it to vary with skill levels z. As we explain in Section 4, we calibrate these equity shares to match the empirical evidence on households portfolio.

2.4 Fiscal Authority

The fiscal authority faces the following intertemporal budget constraint:

$$G + \Psi_t^\ell + \phi_t + \int_{s_{it}=u^1} b_t(z_{it})di + r_t^b B_t^g = \tau_t \mathcal{I}_t + \dot{B}_t^g \tag{8}$$

where $\mathcal{I}_t = \int_{s_{it}=u^1} b(z_{it})di + w_t h_t \int_{s_{it}=e} z_{it} di$ is aggregate taxable income , and where $\Psi_t^\ell = \tau^\ell w_t \ell_t - \phi^\ell$ is the net subsidy which undoes the monopolistic distortions of intermediate producers. Outside of steady-state the fiscal authority passively reacts to deviations of debt from its steady-state level B^* by adjusting the tax rate τ_t according to the policy rule:

$$\tau_t = \tau^* + \mathbb{1}\{t \geq t^*\}\beta_\tau \left(\frac{B_t^g - B^*}{\mathcal{I}_t} \right), \quad \beta_\tau > 0. \tag{9}$$

where t^* disciplines the timing of the fiscal adjustment. Following a shock at date $t = 0$, the government abstains from any fiscal adjustment for the first t^* periods, before adjusting taxes to bring government debt back to steady state.

2.5 Monetary Authority

In our baseline, the monetary authority sets the nominal interest rate according to an Inflation Targeting (IT) rule that reacts to deviations of inflation and unemployment rate from their targets with some inertia. If we let i_t denote the policy rate and i^* denote the steady-state nominal rate, then the IT rule is defined as

$$\frac{di_t}{dt} = \begin{cases} -\beta_i(i_t - i^* - \mathcal{R}_t) & \text{if } i_t > 0 \\ \\ \max\Big\{ -\beta_i(i_t - i^* - \mathcal{R}_t),\ 0\Big\} & \text{if } i_t = 0 \end{cases} \tag{10}$$

where the reaction function to inflation and unemployment is

$$\mathcal{R}_t = \beta_\pi(\pi_t - \pi^*) + \beta_u(u_t - u^*). \tag{11}$$

The coefficients $\beta_\pi > 1$ and $\beta_u \leq 0$ capture the strength of the policy response to deviations of inflation from target π^* and of unemployment from its steady-state value u^*, while $\beta_i > 0$ measures the degree of interest rate smoothing. The monetary authority is constrained by a ZLB on nominal rates which forces i_t to be weakly above zero at all times.

3 Sources of Aggregate Shocks and Numerical Solution

We introduce four aggregate shocks to the model, denoted by ζ_t^k, where $k = d$ denotes a demand shock, $k = \ell$ a labor supply shock, $k = m$ denotes a markup shock, and $k = \bar{Y}$ a shock to firms' maximum capacity. We also model the fiscal stimulus enacted in response to Covid as a policy shock at the time of implementation. We discuss how we model it in detail in Section 6.1. Appendix E plots the model's impulse response to these three aggregate shocks in the absence of binding aggregate constraints (ZLB and maximum capacity).

Demand shock. As in Alves and Violante (2025), we model the demand shock ζ_t^d as a perturbation to the bonds' liquidity premium $\bar{\iota}$. This premium enters as a time-varying wedge in the no-arbitrage equation (7) linking the rate of return on equity and the return on bonds:

$$\tilde{r}_t = \frac{\Pi_t + \dot{q}_t}{q_t} = r_t^b + \bar{\iota} + \zeta_t^d = r_t^m + \bar{\iota} + \zeta_t^d. \tag{12}$$

A surprise increase in ζ_t^d lowers q_t, the value of equity, relative to bonds and increases the rate of return of wealth going forward. These two forces depress household consumption expenditures and firms' demand for labor. This shock captures the collapse in aggregate demand caused by the diffusion of the virus and the restrictions to social and economic activity, as well as the subsequent rebound once those constraints were lifted.

Labor supply shock. The labor supply shock ζ_t^ℓ enters additively in utility, as the fixed participation cost, shifting both κ^e and κ^u. This shock allows to capture the rise in the disutility of working while the virus was circulating and, possibly, the reduction in the cost of working (e.g., in terms of lower commuting costs and higher flexibility) owing to the widespread adoption of remote work after the pandemic (Barrero et al., 2023).

Mark-up shock. The price markup shock ζ_t^m captures fluctuations in the intermediate producers' desired markup through changes to the elasticity of substitution across goods.[15] As usual, the shock enters the price Phillips curve (5) as a cost-push disturbance, which allows the model to generate aggregate fluctuations featuring a negative comovement between output and inflation. As nominal wages are also sticky, the increase in price inflation leads to a persistent reduction in real wages.

3.1 Capacity Constraints

To model the capacity constraint, we build on the insight of Comin et al. (2023) by imposing that production by intermediate producers Y_t cannot exceed a time-varying maximum capacity, $\bar{Y}_t = \bar{Y}\exp(\zeta_t^{\bar{Y}})$. Solving the firms' pricing problem with this additional constraint leads to a price Phillips curve, where the multiplier associated with firms' capacity constraint, ζ_t^{cc}, enters as a (non-negative) cost-push shock.[16] As such, the multiplier ζ_t^{cc} is isomorphic to the price markup shock ζ_t^m, with only their sum $\zeta_t^p \equiv \zeta_t^m + \zeta_t^{cc}$ appearing in the linearized price Phillips curve

$$(\rho+\chi)(\pi_t-\pi_t^*)-\left(\dot{\pi}_t-\dot{\pi}_t^*\right)=\theta(\log w_t+\alpha\log\ell_t)+\zeta_t^p. \tag{13}$$

Intuitively, when the constraint is (and is expected to remain) slack, the multiplier ζ_t^{cc} is zero and firms set their prices optimally to trade-off their desire to maintain markups at

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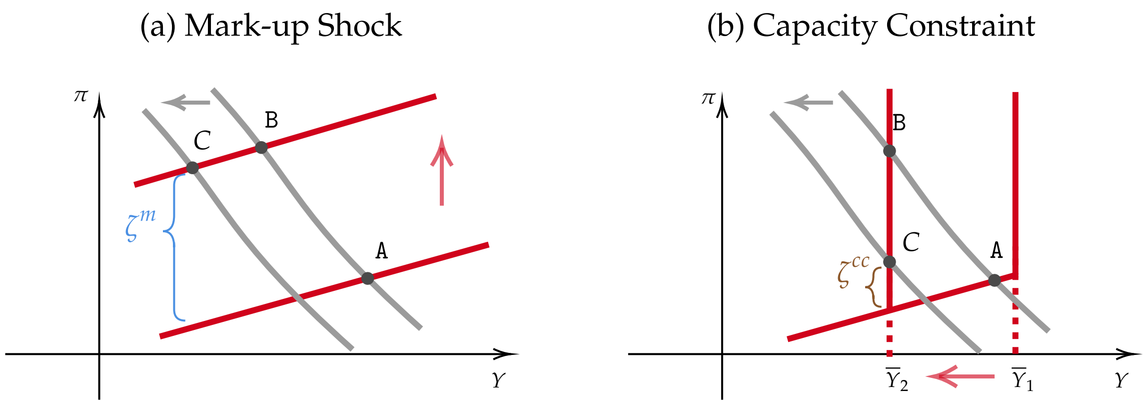
[15] We assume a shock to price and not wage markups following the view that most of the inflation surge from 2021 onward was not driven by wage-pressures, but by shocks to prices given wages (Bernanke and Blanchard, 2025; Lorenzoni and Werning, 2023).

[16] Appendix B contains the full statement of the optimization problem of the intermediate good producers with exogenously capacity constraints based on the setup of Comin et al. (2023).



(a) Mark-up Shock

(b) Capacity Constraint

Figure 1: **A simple aggregate demand–aggregate supply diagram.** The vertical axis shows inflation π and the horizontal axis economic activity (output). In both panels, the gray downward-sloping curves represent aggregate demand, while the red upward-sloping schedules represent aggregate supply (a Phillips-curve-type relation). **Panel (a) Mark-up shock:** an adverse mark-up disturbance ζ^m shifts the aggregate supply curve up, moving the economy from `A` to `B` (higher inflation and lower activity). **Panel (b) Capacity constraint:** a tighter capacity constraint $\bar{Y}_2 < \bar{Y}_1$ causes a leftward shift of the vertical capacity limit, generating an equilibrium movement from `A` to `B` that is observationally similar in (π, Y) space.

the optimal level with the cost of adjusting their prices. In periods where capacity constraints bind—either because demand for a firm's output surges or because its productive capacity is curtailed by input disruptions—the multiplier ζ_t^{cc} turns positive, leading firms to to hike their prices to ensure that the demand for their product does not exceed their maximum production capacity.[17]

Despite their isomorphism, the two shocks have starkly different implications for our policy counterfactuals. When cost-push shocks ζ_t^p come from markup shocks ζ_t^m alone, they are fully exogenous. Therefore, the only way to mitigate their inflationary impact is by inducing a contraction in the labor market, i.e., by moving the economy along a (possibly flat) Phillips curve. When cost-push shocks ζ_t^p arise from binding capacity constraints $\zeta_t^{cc} \geq 0$, however, they are endogenous and depend on the extent to which firms' capacity constraints are more or less binding. In this case, a small reduction to demand—as caused, for instance, by a more restrictive monetary or fiscal policy—leads to reduction ζ_t^{cc}—and thus on inflation—with no impact on the labor market.

Figure 1 illustrates this distinction using a stylized aggregate demand–aggregate supply (AD–AS) diagram. The gray curve represents aggregate demand, while the red curve

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[17] In formulating the problem in this way, we implicitly assume that firms always satisfy demand. That is, all intermediate good markets clear. In absence of this assumption, in some cases (e.g., when price adjustment costs are large) firms might find it optimal to set a price at which the quantity demanded exceeds the amount produced. In this more general model with rationing, for the same parameterization, prices would rise less when the constraint binds, and capacity constraints would explain less of the inflation surge.

represents the short-run aggregate supply relationship—a Phillips-curve-type link between inflation and activity. The left panel shows an economy with no capacity constraints on production, while the right panel displays an economy with (initial) maximum capacity constraint $\bar{Y}_1$. Notice that the capacity constraint makes the AS schedule vertical at the maximum capacity. Suppose that the two economies start at the same point A. In the left panel, a markup shock shifts the AS curve upward, moving the economy from point A to point B. In the right panel, a tightening of the constraint from $\bar{Y}_1$ to $\bar{Y}_2$ also moves the economy from A to B. This exemplifies why the two shocks are isomorphic. Notwithstanding this equivalence, the two scenarios imply markedly different policy trade-offs around point B. Under the markup shock interpretation, reducing inflation requires moving leftward along the AS curve, so a given disinflation comes with a large decline in employment and output. Under the capacity constraint case, by contrast, contracting demand at the margin mainly relaxes the constraint and lowers inflation with little change in employment and output. This latter scenario will be the one at play in our policy counterfactuals.

3.2 Numerical Solution and Implementation of Aggregate Constraints

The perfect-foresight equilibrium of the model is defined in Appendix C. We solve globally for the stationary equilibrium of our model using standard continuous-time finite-difference methods as described in Achdou et al. (2021). We then compute the economy's perfect-foresight linearized response to aggregate shocks using the sequence-space approach of Auclert et al. (2021). The outcome of this step is a set of general-equilibrium Jacobians $\mathbf{G}^{X,s}$ that give the impulse response of the variable X to a (arbitrary) path for the aggregate shocks $\{\zeta^s_{t+h}\}_{h\geq 0}$, for $s \in \{d, \ell, p\}$. Naturally, the linearized response obtained by the sequence-space approach fails to take into account the ZLB or the maximum capacity constraint. We impose these aggregate constraints by following the strategy of Holden (2016) and Hebden and Winkler (2024), which relies on adding (current and anticipated news) shocks to the constrained equilibrium equation whenever the unconstrained linear solution would otherwise violate them.

To illustrate how we implement this numerical method, consider the case of the maximum capacity constraint. Start from the sequence-space representation of the price Phillips curve at a given time t

$$\Pi \mathbf{X}_{(t)} - \mathbf{Z}^{cc}_{(t)} = \mathbf{0}$$

where Π is the linear map summarizing (13), the vector $\mathbf{X}_{(t)} \equiv (X_t, \mathbb{E}_t[X_{t+1}], \ldots, \mathbb{E}_t[X_{t+T}])'$ collects the expected time paths of inflation $\{\pi_{t+h}\}_{h\geq 0}$, wages $\{w_{t+h}\}_{h\geq 0}$, efficiency units of labor $\{\ell_{t+h}\}_{h\geq 0}$, and markup shocks $\{\zeta^m_{t+h}\}_{h\geq 0}$. The term $\mathbf{Z}^{cc}_{(t)} \equiv \left\{\mathbb{E}_t[\zeta^{cc}_{t+h}]\right\}_{h\geq 0}$ is the vector of current and anticipated Lagrange multipliers on the capacity constraint that firms' production, $\mathbf{Y}_{(t)} \equiv \{\mathbb{E}_t[Y_{t+h}]\}_{h\geq 0}$, cannot exceed a time-varying maximum capacity, $\bar{\mathbf{Y}}_{(t)} \equiv \{\mathbb{E}_t[\bar{Y}_{t+h}]\}_{h\geq 0}$.

Suppose that the capacity constraint becomes binding following a demand shock that pushes output above the constraint under the linear solution. While the linear solution abstracts from the constraint, we can impose it by adding positive shocks to the current and expected multipliers. Formally, we have to find the path of multipliers $\mathbf{Z}^{cc}_{(t)} \geq 0$ that satisfy the complementarity slackness conditions

$$\bar{\mathbf{Y}}_{(t)} - \mathbf{Y}_{(t)} \geq 0, \qquad \mathbf{Z}^{cc}_{(t)} \geq 0, \qquad \left(\bar{\mathbf{Y}}_{(t)} - \mathbf{Y}_{(t)}\right) \perp \mathbf{Z}^{cc}_{(t)}, \tag{14}$$

where the forecasted path of output is given by

$$\mathbf{Y}_{(t)} = \mathcal{F}\mathbf{Y}_{(t-1)} + d\mathbf{Y}_{(t)} + \mathbf{G}^{Y,p}\left(\mathbf{Z}^{cc}_{(t)} - \mathcal{F}\mathbf{Z}^{cc}_{(t-1)}\right). \tag{15}$$

The forecasted path of output $\mathbf{Y}_{(t)}$ equals to the sum of three components: (1) the previous period forecasts, $\mathcal{F}\mathbf{Y}_{(t-1)}$, (2) the (linear) response to time-t shock(s), $d\mathbf{Y}_{(t)}$, (3) the response to "news" on the value of the multipliers, $\mathbf{G}^{Y,p}\left(\mathbf{Z}^{cc}_{(t)} - \mathcal{F}\mathbf{Z}^{cc}_{(t-1)}\right)$.[18] Notice that the isomorphism between markup and the capacity constraints multipliers means that we can use the general-equilibrium Jacobian with respect to cost-push shocks $\mathbf{G}^{Y,p}$ to evaluate the effect of time-t surprises in the multiplier on the path of output. Substituting (15) into the complementary slackness (14), we arrive at a linear complementarity problem (LCP) in terms of $\mathbf{Z}^{cc}_{(t)}$ only

$$Q\mathbf{Z}^{cc}_{(t)} + q \geq 0, \quad \mathbf{Z}^{cc}_{(t)} \geq 0, \quad \left(Q\mathbf{Z}^{cc}_{(t)} + q\right) \perp \mathbf{Z}^{cc}_{(t)}, \tag{16}$$

with

$$Q \equiv -\mathbf{G}^{Y,p}, \qquad q \equiv \bar{\mathbf{Y}}_{(t)} - \left(\mathcal{F}\mathbf{Y}_{(t-1)} + d\mathbf{Y}_{(t)} - \mathbf{G}^{Y,p}\mathcal{F}\mathbf{Z}^{cc}_{(t-1)}\right)$$

which can be solved with a standard LCP solver.[19]

4 Parameterization

Our model calibration closely follows Alves and Violante (2025). Accordingly, this section provides only a brief overview of the key empirical moments used to discipline the model parameters. Table D1 summarizes the model parameter values, which are all expressed

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[18] We use $\mathcal{F}$ to represent the forward-shift operator, i.e., applying $\mathcal{F}$ to $\mathbf{X}_{(t)}$ delivers $\mathcal{F}\mathbf{X}_{(t)} = (\mathbb{E}_t[X_{t+1}], \ldots, \mathbb{E}_t[X_{t+T+1}])'$.

[19] The ZLB constraint can be similarly imposed with shocks to the monetary policy rule (11).

in monthly frequency.

Demographics and Preferences. We set the monthly mortality rate ϱ so that workers' average careers are 36 years (25 to 60). The Frisch elasticity on the intensive margin of labor supply is set to $\sigma = 1$. Working entails a variable and a fixed cost. The variable disutility parameter ψ is set so that $h^* = 1$ satisfies (6) in steady state. The flow utility of non-participation κ^n is normalized to zero.

The effective discount rate ρ is set to target a ratio of mean wealth to annual earnings of 0.56 under a real annual interest rate r^* of 3%. This corresponds to the amount of liquid wealth immediately available for consumption smoothing among US households (Kaplan and Violante, 2022).

The average quarterly marginal propensity to consume in the model is close to 0.10. In addition, our parameterization is consistent with recent U.S. micro evidence on the impact of lottery wins on workers' labor supply with an annual marginal propensity to earn (the dollar reduction in earnings for an additional dollar of non-earned income) around -0.02 (Golosov et al., 2023).

Aggregate and individual asset portfolios. In equilibrium, aggregate household savings $A_t = \int a_{it} di$ must be equal to the combined value of government bonds and firm equity, $B_t^g + q_t$. We set government debt B^g to be 1/4 of total equity, following the 2019 Flow of Funds (Table B.101.h, Balance Sheet of Households), and adjust the net firm subsidy Ψ^ℓ so that the value of equity equals the residual of aggregate savings. This determines the share of equity in total assets. Consistently with the data, we allow individuals of different skill levels z to hold different shares of their wealth in equity. We calibrate these shares to match the equity fraction of liquid wealth across the earnings distribution in the 2019 SCF. In the data, equity holdings are nearly zero for the bottom half of the distribution and rise sharply with earnings until reaching around 1/3 at the very top.

Skill Dynamics. The initial skill distribution is calibrated so that: (i) its mean $\bar{z}_0$ matches the average wage of ages 23-27 relative to the wage of all workers in the 2019 CPS (Heathcote et al., 2023); (ii) its dispersion σ_{z_0} matches the group's P90-P50 hourly wage ratio of 2.00. As for the parameters in the skill diffusion process (1), we set σ_z to match the P90-P50 wage ratio for the 2019 CPS, set the mean-reversion parameter $\gamma_z = 0.0017$ so that $\exp(-12\gamma_z) = 0.98$ annually, and choose (δ_z^+, δ_z^-) to match average earnings growth from age 25 to age 60, and the ten-year post-displacement earnings losses as computed in Davis and Von Wachter (2011).

Labor Market Frictions, Nonparticipation Shocks, and Participation Costs. Search frictions, passive nonparticipation shocks, and participation costs are disciplined using data on labor market flows—both in the aggregate and across the weekly earnings distribution (our proxy for worker skill)—constructed from the Basic Monthly CPS. Overall, the model matches the average flows reasonably well (see Alves and Violante, 2025, for a comparison between flows in model and data).[20]

Steady-state Fiscal Instruments. We assume that unemployment benefits are given by $b_t(z_{it}) = \bar{b}\ w_t h_t z_{it}$, and set the UI replacement rate $\bar{b}$ to 0.5 of individual earnings. We make the rate at which UI benefits expire $\lambda_z^{u_1 u_0}$ constant across skill z and equal to 0.167 to reflect an average UI benefits duration of 6 months. In steady-state, the proportional tax rate τ^* is set to 0.2 and the lump-sum transfer ϕ^* is calibrated to match a value equal to 6% of average earnings in steady-state.[21] Government consumption expenditures are set residually to satisfy the government budget constraint in steady state.

Technology. The elasticities of substitution across labor types (ε^{ω}) and across intermediate goods (ε) are set to 10, a value which implies wage and price markups around 10 percent. Firms' decreasing returns to scale parameter α is set to 0.20, productivity Γ is used to normalize the after-tax hourly wage per efficiency units $(1-\tau)w^*$ to 1 in steady state, and the fixed cost Ω is chosen to match the profit share of income. Finally, we set the "liquidity premium" of holding bonds ι to 10bp so that the steady-state nominal (annual) interest rate $i^* = r^m + \pi^*$ is equal to 1%.

The parameter χ which measures the degree of cognitive discounting is set to 0.14. This value, admittedly on the high end among those considered by Gabaix (2020), avoids the otherwise counterfactually strong effects from forward-guidance on inflation and unemployment.

Monetary and Fiscal Policy Rule. We assume a steady-state (trend) inflation rate π^* of 2% and set the interest rate smoothing parameter to $\beta_i = 0.07$, corresponding to a quarterly persistence of 0.81. Values for the coefficient on inflation $\beta_\pi = 2.25$ and the coefficient on the unemployment gap $\beta_u = -0.10$ are consistent with estimates from Bayer et al. (2024). In our fiscal rule (9), we set β_τ to 0.008 and assume that taxes adjust with a delay of t^*=10 years. This choice is consistent with the view that taxes have not yet risen to finance the escalation in debt, and are not projected to in the near term.

Slope of the Price and Wage Phillips curve. The slope of the linearized price Phillips curve is set to 0.05, while the slope of the wage PC is set to 0.005 reflecting that wages take on average 3 times longer to adjust than prices (Grigsby et al., 2021). The indexation to past inflation is set to 0.95, reflecting the high persistence of inflation.

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[20] In Alves and Violante (2025), we have shown that our model generates impulse responses of labor flows to monetary policy surprises that are qualitatively consistent with empirical evidence.

[21] This number is obtained by dividing a broad aggregate measure of government social benefits by wages and salaries, both obtained from NIPA. See Alves and Violante (2025) for details.

Elasticity of Frictions to Aggregate Hours. As in Alves and Violante (2025), the elasticities of job separation and job finding rates to hours ($\vartheta^{eu}, \vartheta^{ue}$) are chosen to replicate the share of the variance in total hours coming from fluctuations in the extensive margin of employment (70%) and the relative volatility of *eu* and *ue* flows (1.15) in the US over the period of 1989-2019.[22]

We postpone the description of fiscal and monetary policy during the pandemic recession and recovery, as well as the results of our filtering exercise—which recovers the realizations of all aggregate shocks—to Section 6.

5 Aggregate Stabilization Policy under Aggregate Constraints

We now examine how the two aggregate constraints—the ZLB and maximum capacity—shape aggregate and distributional dynamics in response to a large negative demand shock that perturbs the economy out of steady state.

Zero Lower Bound. We begin with the case where the monetary authority follows an IT rule (11) and there are no binding capacity constraints (Figure 2). Aggregate variables behave as expected in response to a negative demand shock: unemployment increases, inflation falls, and nominal rates fall to the ZLB. Because prices are more flexible than wages and because the marginal product of labor rises under decreasing returns to scale, real wages increase. The two bottom-right panels report total labor earnings in the first (T1) and top (T3) terciles of the skill distribution. The combination of differential exposure to shocks, endogenous participation margin, and skill erosion during nonemployment amplifies the impact of the shock on the bottom-tier and makes its effects more persistent. In the first few quarters after the shock, earnings at the bottom fall roughly 2–3 times more than at the top. In addition, by the time nominal rates exit the ZLB—about 8 quarters after the shock—earnings at the top have already fully recovered, whereas earnings at the bottom are still significantly below trend. From the perspective of low-wage workers, the IT rule ends the recovery prematurely, preventing them from recouping lost earnings and leaving them persistently scarred by the recession.

We next turn to a policy that deliberately extends the duration of the ZLB to engineer a stronger and prolonged recovery. We call this rule Lower-for-Longer (LfL). As we argue below, a LfL rule mirrors the approach taken by monetary authorities during the Covid recovery.[23] Shifting from IT to LfL stabilizes unemployment and inflation, while

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[22] Keeping with the steady-state calibration strategy, we set the elasticity of λ^{ne}_{zt} with respect to hours equal to the elasticity of λ^{ue}_{zt}, or $\vartheta^{ne} = \vartheta^{ue}$.

[23] The exact specification of the LfL rule is not central for the results in this section, provided it produces

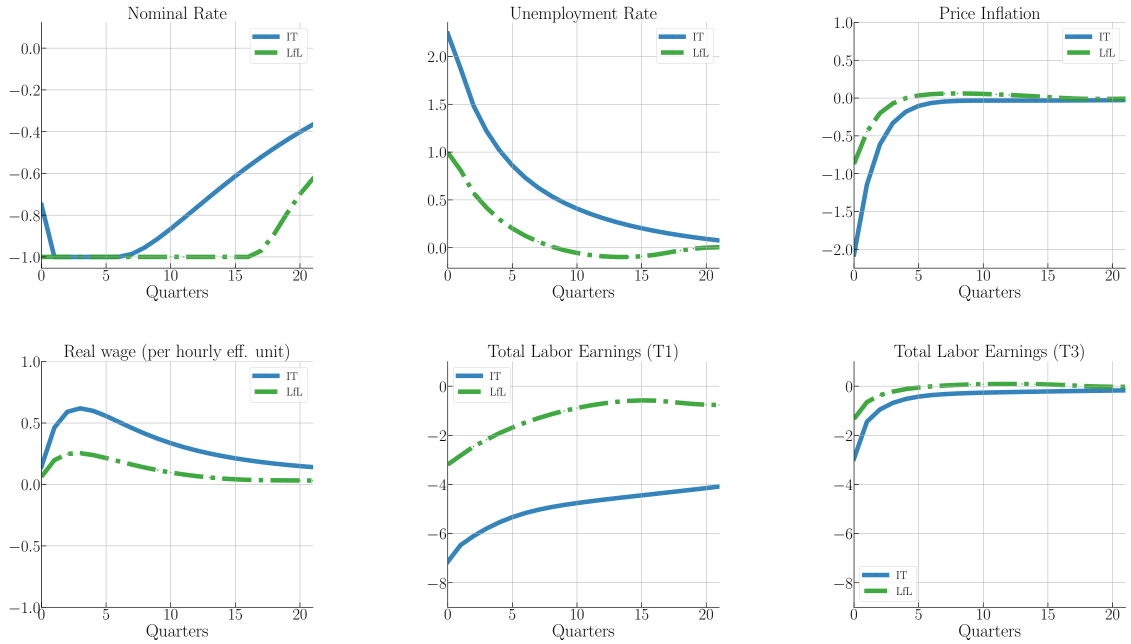

Figure 2: Aggregate and distributional dynamics under an traditional Inflation Targeting (IT) regime and under an inclusive Lower-for-Longer (LfL) regime in the presence of the ZLB, but in absence of binding capacity constraints.

substantially reducing both shock amplification and the negative earnings hysteresis at the bottom of the distribution. Overall, these results suggest that LfL promotes a more inclusive labor-market recovery by acting as an effective "antidote" to the ZLB.[24]

Maximum capacity. We now turn to a scenario in which the negative demand shock is accompanied by a reduction in firms' maximum production capacity, $\bar{Y}_t$. As discussed earlier, this is meant to capture the post-Covid supply chain disruptions and health-motivated restrictions that limited, or placed severe strain on, the economy's production capabilities. If firms' maximum capacity declines as the economy is hit with the negative demand shock, adopting a LfL policy with the intent of pursuing a stronger and longer recovery risks throwing the economy against its maximum productive capacity.

Figure 3 illustrates the dynamics of the economy in a scenario where this is the case. The capacity constraint does not bind under IT (and the economy follows the same path

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a nominal-rate path that extends the time at the ZLB beyond that under IT. Section 6.1 outlines the exact formulation used in our simulations.

[24] The finding that LfL is able to foster more inclusion is consistent with the our earlier findings in Alves and Violante (2025), where we quantify the negative hysteresis induced by the ZLB under an IT and LfL rules simulating the economy subject to demand and supply shocks over a long horizon. Similar to our conclusions here, there we find that (i) the ZLB can lead to a significant and systematic negative earnings bias for low-wage workers under IT, and (ii) switching to LfL largely eliminates this bias and, in some parameterizations, can even reverse it.

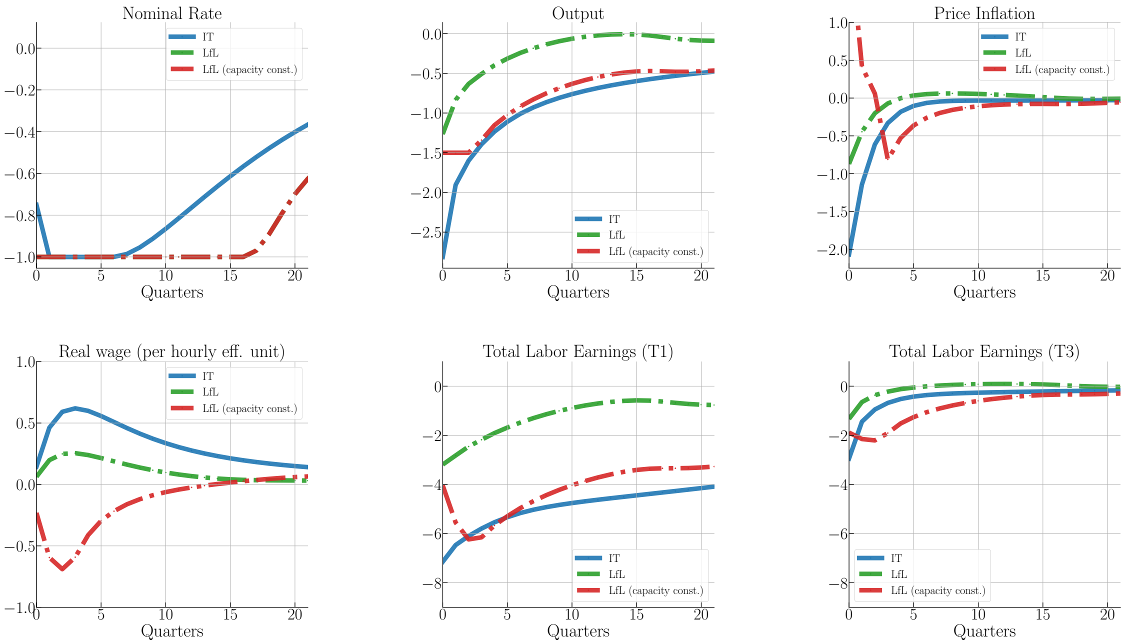

Figure 3: Aggregate and distributional dynamics under a traditional Inflation Targeting (IT) regime and under an inclusive Lower-for-Longer (LfL) regime in the presence of the ZLB, with and without binding capacity constraints.

as in Figure 2), but it binds for three quarters under LfL.[25] As long as constraints bind, firms raise their prices which leads to a bout in inflation and a sharp erosion of real wages. This wage erosion wipes out much of the earning gains arising from adopting a LfL rule which, ordinarily, would successfully engineer a hot labor market for longer during the recovery. While earnings in the bottom skill tercile are still just above their IT counterpart—because the LfL rule somewhat reduces the size of the recession and the ensuing hysteresis—earnings in the top tercile, where workers are more sensitive to movements in real wages than to changes in aggregate unemployment, remain depressed for longer. Therefore, when the economy operates near capacity, attempts to strengthen the labor market are largely ineffective—and, if real wage erosion offsets the earnings gains, may even be counterproductive.

Obviously, the effects of binding capacity constraints are not limited to the labor market. As we show in Figure 4, the inflation surge also increases firm profits and drives a sharp reduction to real rates as nominal rates remain stuck at the ZLB. As with wages and employment, these shifts generate heterogeneous effects across the skill distribution—for example, higher profits disproportionately benefit high-skilled households, who hold a

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[25] For completeness we also plot the dynamics under LfL without a binding capacity constraint, as in Figure 2.

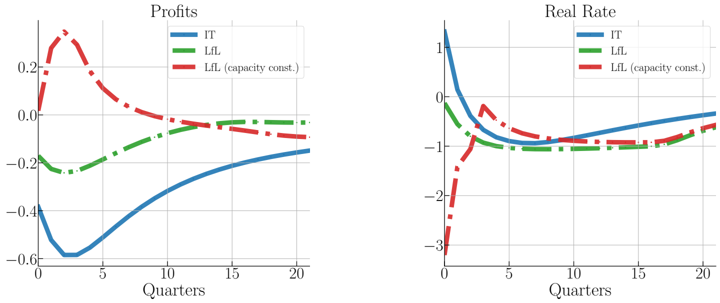

Figure 4: Profits and real rates under a traditional Inflation Targeting (IT) regime and under an inclusive Lower-for-Longer (LfL) regime in the presence of the ZLB, with and without binding capacity constraints.

larger share of their wealth in equity. Our welfare analysis in Section 8 accounts for all these policy effects on workers' well being.

"Between a Rock and a Hard Place." Overall, this example illustrates how the ZLB and capacity constraints in production can make stabilization policy in the wake of recessions particularly challenging. The ZLB exacerbates the long-term negative consequences of recessions, especially for low-wage workers, and thus calls for a more protracted and larger stimulus. The presence of binding capacity constraints, instead, heightens the risk of an inflationary spike and real wage erosion, which can ultimately undermine the benefits of a policy that pursues a stronger recovery. When both are binding, policy becomes squeezed between the constraints, making it hard to navigate the inflation-inclusion trade-off.

In the rest of the paper, we turn our attention to the post-Covid experience—an especially interesting historical episode because both of these constraints were salient. We study how well fiscal and monetary policy dealt with this trade-off and ask how different the recovery would have been under alternative policy counterfactuals.

6 Simulation of the Pandemic and the Policy Response

To simulate the US economy around the pandemic, we need two ingredients. First, we must estimate the aggregate shocks that hit the US economy over this period. Second, we need to model the fiscal and monetary policy interventions that were put in place in response to the recession. We start by discussing the latter.

6.1 Fiscal and Monetary Response

Fiscal Response. The pandemic prompted a massive fiscal response from the US government. Six Covid-19 relief laws enacted in 2020 and 2021 provided $4.6 trillion of funding for pandemic response and recovery. Nearly $2 trillion was allocated in the form of direct transfers to households. These measures included three main types of income-support interventions: payments to households, expansions of unemployment insurance (UI) benefits, and tax credits.[26]

To model the effect of these policies in a parsimonious way, but also roughly in line with actual events, we assume that fiscal relief occurs as two separate surprise policy shocks: one in 2020Q2 and a second in 2021Q1. The 2020Q2 package comprises: (i) an immediate uniform stimulus check of $1,200, (ii) additional UI benefits of $600 per week from 2020Q2 until mid 2020Q3, and (iii) a doubling of the UI benefit eligibility period. The 2021Q1 package includes: (i) two economic impact payments to households for $600 and $1,400, (ii) $300 per week from 2021Q1 until 2021Q3 (to capture the child-tax credit expansion), and (iii) another doubling of UI duration. We assume that the policy is funded with an increase in the labor tax beginning in 2030, following the fiscal rule in (9).[27] This set of interventions raises the debt-output ratio by 6 ppts at the end of the recovery, roughly half of the observed rise.[28]

Monetary Response. Until 2020, the Federal Reserve had followed a "balanced approach" to promote price stability and maximum employment. This strategy, summarized in our Taylor rule (11)—which minimizes deviations of inflation from the 2% target and of unemployment from its steady-state level—faced key challenges in the aftermath of the 2008 financial crisis, when the economy experienced a prolonged period at the zero lower bound (ZLB), weak labor-market conditions, and inflation below 2%. Motivated by this experience, in August 2020 the Fed announced a new monetary policy framework that featured two major departures from its earlier framework. First, it aban-

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[26] For a comprehensive summary, see `https://home.treasury.gov/policy-issues/coronavirus/assistance-for-American-families-and-workers`.

[27] Around steady state, this debt financing policy leads to a fiscal multiplier of 0.28 on impact, with the cumulative output effect reaching 1.04 after two years. **?** estimates an impact multiplier around 0.4 from the 2001 and 2008 economic impact payments episodes.

[28] The rise in debt-output ratio is larger for two reasons. First, we abstract from the rise in government consumption because the bulk of such spending was targeted to the health emergency (i.e., hospital equipment, testing, vaccines purchase and administration, etc). Second, we abstract from forgivable loans to firms (the Paycheck Protection Program, PPP). While large in fiscal terms, PPP operated primarily as a firm-side employment subsidy, channeled through employers and conditional on payroll retention, rather than as a direct transfer to households. As such, its incidence across households is difficult to map, and its macroeconomic effects are more naturally interpreted through firm survival channels than through the consumption and liquidity channels that are the focus of this paper.

doned strict inflation targeting regime in favor of an average inflation targeting approach under which, following periods when inflation has run persistently below target, policy would, for some time, aim for inflation moderately above 2 percent. Second, it explicitly redefined its maximum employment mandate as a “broad-based and inclusive goal” and stated that policy would focus on mitigating shortfalls, rather than deviations, of employment from its maximum level.

These shifts in the Fed’s approach were evident in the statement following the September 2020 FOMC meeting, when the Committee communicated that it would keep the Federal Funds rate unchanged at zero *until labor market conditions have reached levels consistent with the Committee’s assessments of maximum employment, and inflation has risen to 2 percent and is on track to moderately exceed 2 percent for some time*. As emphasized by Romer and Romer (2024), what is especially striking in the statement is the use of the word *“and”* when discussing the conditions required for the lift-off—namely, the fact that the Fed promised to keep rates at zero until conditions for both inflation and employment were fully met. This marked a significant departure from the Fed’s traditional approach, which would trade off the goals of price stabilization and maximum employment if one of them threatened to be far away from its target. Moreover, the statement also appeared to abandon the Fed’s principle of “preemptive restraint,” by which it sought to head off projected future inflation by tightening policy at the first signs of a strong labor market. Under the new framework, by contrast, the Fed promised not to begin raising rates until it had actually observed a strong labor market alongside at least some realized inflation.

To model this radical shift in the Fed’s strategy, we assume that in 2020Q4 the monetary autority unexpectedly announced that it would abide by a new policy rule going forward. We label this policy rule *Lower for Longer* (LfL) to capture the framework’s implicit promise that nominal interest rates would be kept lower for longer during the recovery. Nominal rate dynamics are still described by (10), but in this regime the reaction function $\mathcal{R}_t$ is instead given by

$$\mathcal{R}_t = \beta_\pi(\pi_t - \pi^*) - \beta_u(u_t - u^*) + \beta_{LfL}\min\{\mathcal{U}_t, \Pi_t, 0\} \tag{17}$$

with

$$\dot{\mathcal{U}}_t = -\nu\mathcal{U}_t - (u_t - u^*), \qquad \dot{\Pi}_t = -\nu\Pi_t + (1-\nu)(\pi_t - \pi^*),$$

The terms $\mathcal{U}$ and Π are weighted averages of past deviations of unemployment and inflation rates from their respective targets, accumulated over a horizon of length $1/\nu$. The final term in (17) is activated whenever at least one of these averages is negative, i.e., whenever there is either an employment or an inflation shortfall. In such cases, this term adds downward pressure on nominal rates until both the inflation and employment shortfalls

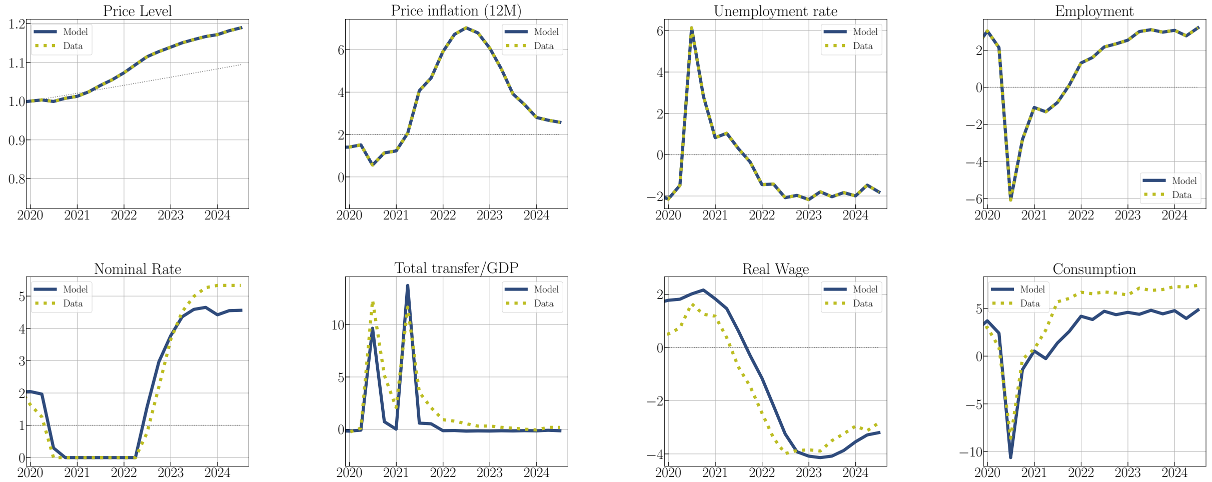

Figure 5: Model vs data during the pandemic recession and recovery.

Note. Price-level gap relative to trend (percentage points), inflation (PCE deflator), unemployment rate, employment, real wages (Atlanta Fed Wage Growth Tracker — 12-month MA of weighted median hourly wage growth), federal fund rate, government transfers, real wage, and private consumption. Solid lines are model-implied series; dashed lines are the corresponding data.

accumulated during the crisis have fully dissipated.

To understand the difference between (17) and (11), consider an economy recovering from a demand-driven recession that resulted in elevated unemployment and below-target inflation. Under (11), nominal interest rates would begin to rise as soon as either unemployment or inflation returned close to target. By contrast, under (17), nominal rates would only begin to increase once both employment and inflation had not only reached but exceeded their targets for a sustained period, thereby offsetting the earlier shortfalls. Unlike IT, the LfL rule requires that both inflation and employment conditions be satisfied before liftoff, hence delaying the exit from the ZLB—consistent with the Fed's September 2020 announcement.

In our simulations, we set ν to $(1/48)$, corresponding to a half life of 2.5 years. The initial conditions are set to $\mathcal{U}_0 = -10$ and $\Pi_0 = -0.50$. As we show below, these calibrated values match (i) the expected duration of the ZLB given the economic conditions at the outset of the recession, and (ii) the actual timing of interest rates liftoff given that the economy recovered faster than initially expected (see Figure 5).[29]

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[29] In FOMC Summary of Economic Projections of June 2020, the federal funds rate was projected to remain at the effective lower bound at least until end of 2022.

6.2 Filtering and Shock Decomposition

Filtering. We filter the aggregate time series for inflation, unemployment, and employment from 2005Q1 to 2024Q4 to recover the three aggregate disturbances (demand, labor supply, and the combined cost-push shocks). Our algorithm proceeds iteratively from 2005Q1. At each time t we search for the innovations to the shocks ζ_t^k for $k \in \{d, \ell, p\}$ that account for the "surprise" movements in the filtered series, i.e., the difference between the one-step-ahead projections based on information available at $t-1$ and the realized values at t.[30] Starting in 2020Q1, we make two adjustments to the filtering procedure in order to to capture the dynamics of the Covid recession and the stabilization policies that followed. First, we lower the persistence of the shocks ζ_t^k for $k \in \{d, \ell, p\}$ to reflect more transitory disturbances; this change is important to capture the fast movements in labor-market variables during the pandemic and its subsequent fast recovery. Second, we incorporate the effects of the monetary and fiscal policies discussed in Section 6.1, i.e., we filter the data for the shocks that rationalize the observed aggregate dynamics given the fiscal and monetary policies that were enacted as a response to the Covid recession.

Figure 5 compares several key aggregate variables in the model and in the data. By construction, the model matches inflation (measured as the growth rate of the PCE deflator in the data), unemployment, and employment exactly over the sample. As in the (detrended) data, the model's price level is approximately 10 ppts above trend by the end of the sample. Our calibration of the new monetary regime (17) captures both the timing of liftoff from the ZLB as well as the subsequent tightening of policy rates. Likewise, the model's fiscal policy response reproduces the two peaks in transfers observed in 2020Q2 and 2021Q1.[31] Lastly, the model also depicts well the degree of the real wage erosion observed during the 2021-22 inflationary spike as well as consumption's initial drop, while it somewhat underestimates its post-pandemic rebound.

Our filtered series of cost-push shocks, ζ_t^p, captures the joint effect of markup and binding capacity constraints shocks. However, as noted in Section 3, distinguishing exogenous markup shocks, ζ_t^m, from the endogenously binding capacity-constraint component, ζ_t^{cc}, is essential for the monetary and fiscal counterfactuals we study in Section 7. Accordingly, for the purposes of these counterfactual exercises, we make two assumptions: (i) capacity constraints bind only over the period 2020-2022; (ii) 75% of the esti-

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[30] Note that the asymmetries induced by the ZLB and by our monetary policy rule make this filtering problem highly nonlinear—a shock that triggers the ZLB will, in turn, also affect the realization of the model series we use to filter the aggregate shocks in the first place. In practice, a standard nonlinear solver is able to recover the shocks that match the observed dynamics under the constraints.

[31] As in the data, the large transfers and weak consumption led to a substantial increase in household savings relative to pre-pandemic trend. In the model, these "excess savings" peak at 6 ppts relative to steady-state annual GDP, which accounts for roughly 2/3 of the increase in the data as estimated by Aladangady et al. (2022).

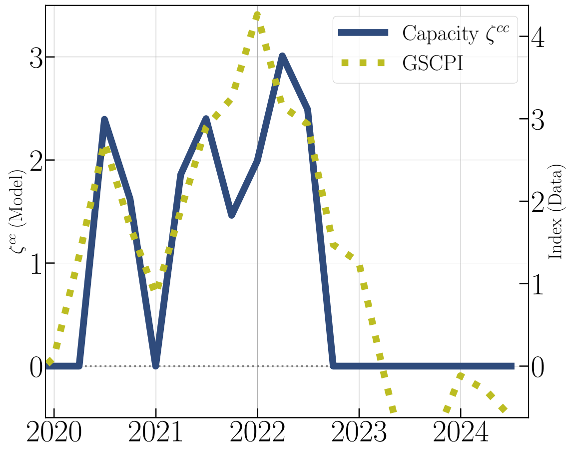

Figure 6: Path for the capacity constraints multiplier ζ_t^{cc} in the model and the empirical Global Supply Chain Pressure Index (GSCPI) constructed by the Federal Reserve Bank of New York.

Note: A detailed overview of how the GSCPI is constructed is available in Benigno et al. (2022).

mated combined cost-push shock ζ_t^p is attributed to ζ_t^{cc} and the remaining 25% to ζ_t^m.[32]

These two assumptions are motivated by two pieces of evidence. First, 2020-2022 includes the two peaks in the Global Supply Chain Pressure Index (GSCPI).[33] As shown in Figure 6, ζ_t^{cc} correlates tightly with the Global Supply Chain Pressure Index (GSCPI). As for the 75/25 split, this ratio generates a contribution of capacity constraints to inflation which falls in the range of external decompositions. Liu and Nguyen (2023), for instance, attribute roughly one-half of inflation over this period to supply-chain disruptions (see their 12-month inflation decomposition in Figure 7). This is close to what we find in our decompositions below.

Shock Decomposition. At this point we are able to decompose aggregate dynamics into contributions from the demand, labor supply, markup shocks, capacity constraints, as well as fiscal and monetary policies. Figure 7 plots the decomposition for some key

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[32] Given our assumed ζ_t^{cc}, we can (partially) recover the series of shocks to the maximum capacity $\zeta_t^{\bar{Y}}$ by noticing that output is constrained $Y_t = \bar{Y}\exp(\zeta_t^{\bar{Y}})$ during periods where $\zeta_t^{cc} > 0$. For periods where $\zeta_t^{cc} = 0$, we assume that shocks to the capacity constraint are zero.

[33] The GSCPI is composite measure of global supply chain disruptions, developed by the Federal Reserve Bank of New York. It combines 27 indicators of supply chain stress, a mix of global transportation costs indexes (e.g., Baltic Dry Index, air freight rates, shipping costs) and country-level manufacturing Purchasing Managers' Index (PMI) data such as backlogs, delivery times, inventories. Each series is standardized, and then aggregated into a single index.

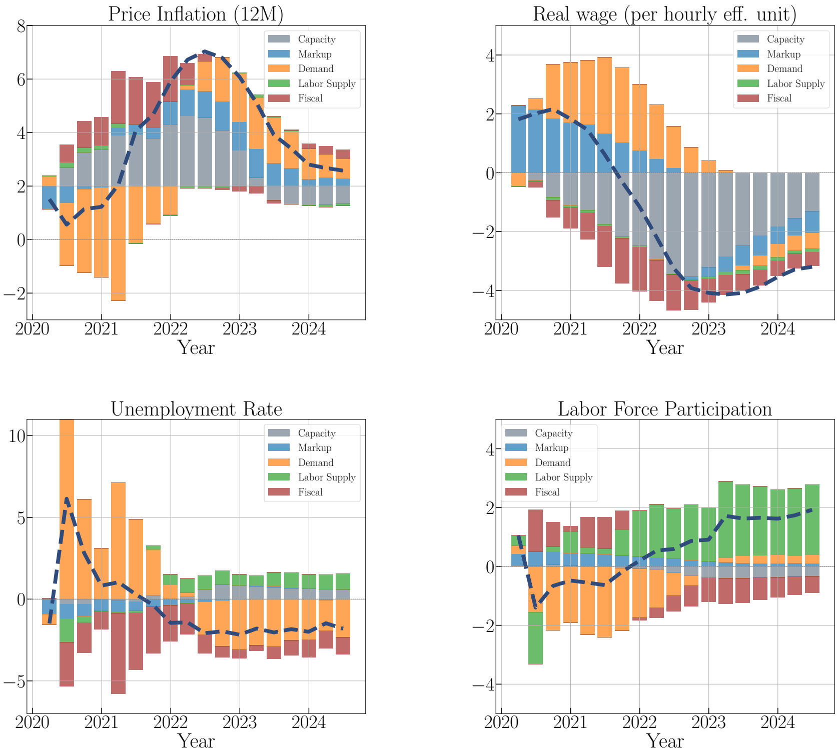

Figure 7: Shock decomposition during the pandemic recession and recovery.

Note. The figure shows the contributions of demand, labor-supply, markup, fiscal and monetary policy reactions, and binding capacity constraints to several macroeconomic aggregates. These values are obtained by feeding the shocks from the filtering exercise and the policy paths described in Section 6 into the model (see footnote 33 on our choice for the ordering of the shocks).

macro aggregates.[34]

Viewed through the lenses of the model, Covid-period inflation dynamics arise from the interplay of demand and supply forces. The initial, pronounced adverse demand shock exerts strong downward pressure on inflation, which is partially offset by inflationary pressures from the fiscal stimulus and from binding capacity constraints. By early 2022, however, all shocks contribute positively to inflation, with the ensuing decline in inflation largely attributed to the unwinding of the inflationary pressures from capacity constraints. Real wage dynamics are mostly driven by binding capacity constraints, which raise prices more than nominal wages, leading to a strong and lasting erosion of real wages.

Unemployment dynamics are largely driven by demand and fiscal shocks, which offset each other early on, but complement each other later in the recovery. In contrast, labor

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[34] Since the model is nonlinear, there is no unique way to attribute the dynamics of a given variable to individual shocks. Here we report contributions computed by feeding shocks, policies, and constraints into the model in the following order: demand, labor supply, markup, fiscal and monetary policy reactions, and finally the capacity constraints.

force participation dynamics reflect both labor-supply and demand shocks. Early in the crisis, demand and labor supply shocks push down participation, while later both contribute positively to the recovery of participation.[35] Likewise, fiscal policy's contribution reverses over time: it first stimulates participation through labor demand, then dampens it via wealth effects on labor supply. We revisit this last observation in Section 7 when we analyze counterfactuals with a more restrained fiscal policy.

7 Policy Counterfactuals

To isolate the role played by inclusive monetary and fiscal policies in the post-pandemic recovery, we now study three policy counterfactuals relative to the baseline (the 'Both Inclusive' line in all figures).

The first counterfactual considers what would have happened if both monetary and fiscal authorities had adopted a more restrained stance. Specifically, this scenario assumes that (i) the Fed maintains the inflation-targeting rule (11), and (ii) fiscal support is limited to the 2020Q2 package only, i.e., the first round only. We denote this counterfactual as 'Both Traditional' to contrast it to the 'Both Inclusive' baseline. This experiment is intended to capture the potential outcomes had both fiscal and monetary policy acted with preemptive restraint and focused solely on stabilization of aggregates, as opposed to actively trying to promote an inclusive recovery. The second counterfactual examines the case in which the fiscal authority implements both rounds (2020Q2 and 2021Q1) of stimulus packages, as in the baseline, while the Fed continues to follow its old strict inflation-targeting rule. Since this scenario combines protracted fiscal activism with (counterfactual) traditional monetary policy, we label it 'Traditional Monetary'. This simulation is designed to address the criticism that monetary policy was excessively loose, and thereby contributed to the surge in inflation. The last counterfactual asks what would have happened had the Fed switched to the Lower-for-Longer rule (17) in 2020Q4, as in the baseline, while fiscal support had been (counterfactually) limited to the 2020Q2 package only. We denote this scenario by 'Traditional Fiscal'. This simulation serves to assess the objection that it was fiscal policy that, by pursuing a broad-based recovery, overreacted to the crisis, particularly with the second round of support measures in early 2021.

We report the results of these three counterfactuals in two steps. First, we examine the effects of fiscal and monetary policies on the dynamics of inflation and labor market outcomes (e.g., real labor earnings) for low- and high-skilled workers. This allows us to

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[35] The demand-driven drag on participation is considerably more persistent than on unemployment. This pattern is in line with the slow-moving dynamics of the participation cycle described by Hobijn and Şahin (2021), in which a spike to unemployment leads workers to exit the labor force.

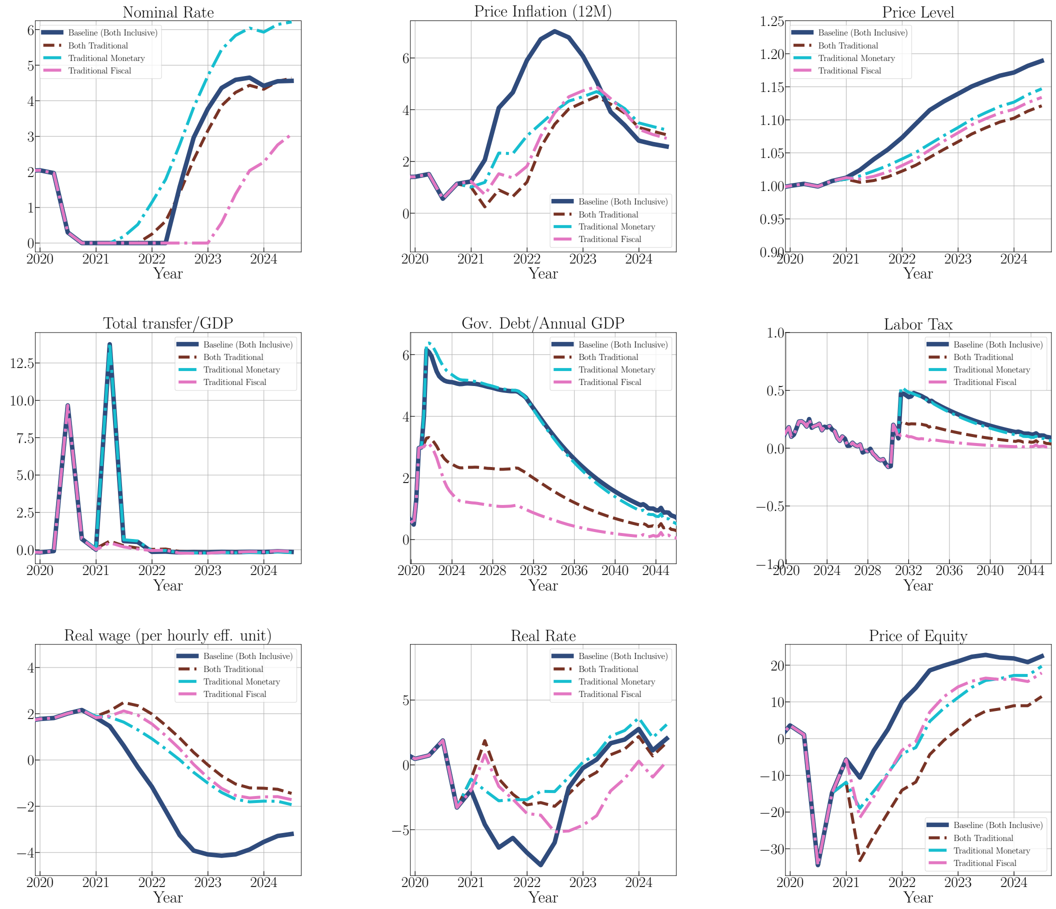

Figure 8: Nominal rate, inflation, price level, fiscal transfers, government debt, labor tax, the real hourly wage rate (per efficiency unit), real rate, and equity prices in the baseline and the three counterfactuals.

Both Traditional: monetary and fiscal policy both restrained (Fed maintains IT and fiscal support is limited to the first 2020Q2 package only). Traditional Monetary: restrained monetary and inclusive fiscal policy (fiscal authority enacts both 2020Q2 and 2021Q1 stimulus rounds, but the Fed sticks with IT). Traditional Fiscal: inclusive monetary and restrained fiscal policy (Fed adopts the LfL rule in 2020Q4, while fiscal support is curtailed to the initial 2020Q2 package only).

assess the inflationary impact of these policies against their stated goal of fostering an inclusive labor market recovery. Second, we present welfare calculations for each counterfactual that summarize, in a single metric, the effects of every component of income over and above labor earnings (e.g., taxes, transfers, interest income, dividends, etc) on households' consumption and leisure.

7.1 Counterfactual Economy Under Traditional Monetary and Fiscal Policy

Figure 8 shows that policies are markedly more restrained under the 'Both Traditional' counterfactual compared to the 'Both Inclusive' baseline. The interest rate lifts off earlier,

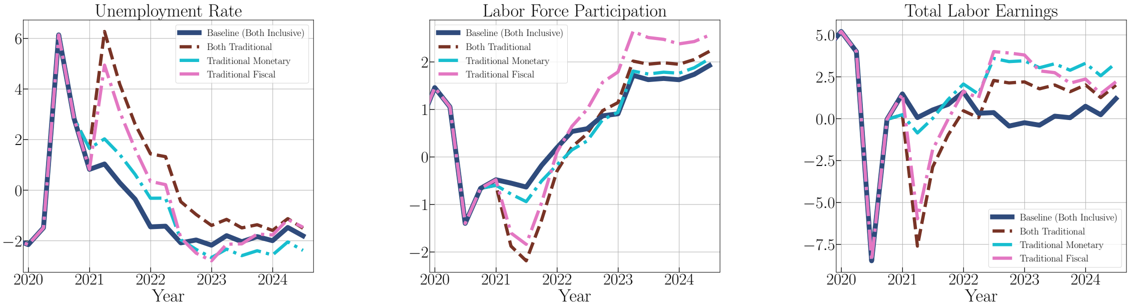

Figure 9: Unemployment rate, participation rate, and total labor income in the baseline and the three counterfactuals.

Both Traditional: monetary and fiscal policy both restrained (Fed maintains IT and fiscal support is limited to the first 2020Q2 package only). Traditional Monetary: restrained monetary and inclusive fiscal policy (fiscal authority enacts both 2020Q2 and 2021Q1 stimulus rounds, but the Fed sticks with IT). Traditional Fiscal: inclusive monetary and restrained fiscal policy (Fed adopts the LfL rule in 2020Q4, while fiscal support is curtailed to the initial 2020Q2 package only).

in 2021 instead of 2022, and there is no second round of fiscal transfers. As a result, government debt rises by only 3 percentage points of annual (steady-state) GDP, compared with 6 points in the baseline. The increase in labor taxes necessary to bring down the debt to its steady-state level (which by assumption only starts in 2030) is also smaller.

Consistent with this more restrained policy stance, the economy would have steered clear of the capacity constraints in 2020-2022. As a result, inflation would have peaked later, and only at 4 percent rather than at 7 percent, while the cumulative increase in the price level would have been about 11 percentage points instead of 19. By avoiding the inflation surge, this tighter fiscal and monetary policy regime would have also limited the decline in real wages—e.g, the real hourly wage would have declined by only 2 ppts relative to peak by 2022 compared to 6 ppts in the baseline. Similarly, real rates would have fallen to -3 percent, while they fall to -7 percent in the baseline. Lower profit margins—the counterpart of higher wages—and higher real rates would have dragged down the equity price even further.

Figure 9 illustrates that the weaker support to aggregate demand implicit in this counterfactual policy scenario results in a much weaker labor market throughout 2022. Under this counterfactual, in mid 2021 unemployment would have been 5 ppts higher, labor force participation nearly 3 ppts lower, and earnings 7 percent lower than the baseline.[36]

Since the objective of the sustained fiscal and monetary stimulus was to promote a more inclusive labor market recovery, Figure 10 depicts how labor market outcomes at the bottom (T1) and the top (T3) tercile of the skill distribution would have developed in

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[36] In our quarterly model equity prices drop by 33 percent in 2020Q2. In the data, the trough in the SP500 was 34 percent below its February 2020 peak, but quarter-to-quarter it was smaller, around 20 percent. Because this drop is common across all experiments, it does not affect our comparison across counterfactuals nor the welfare calculations.

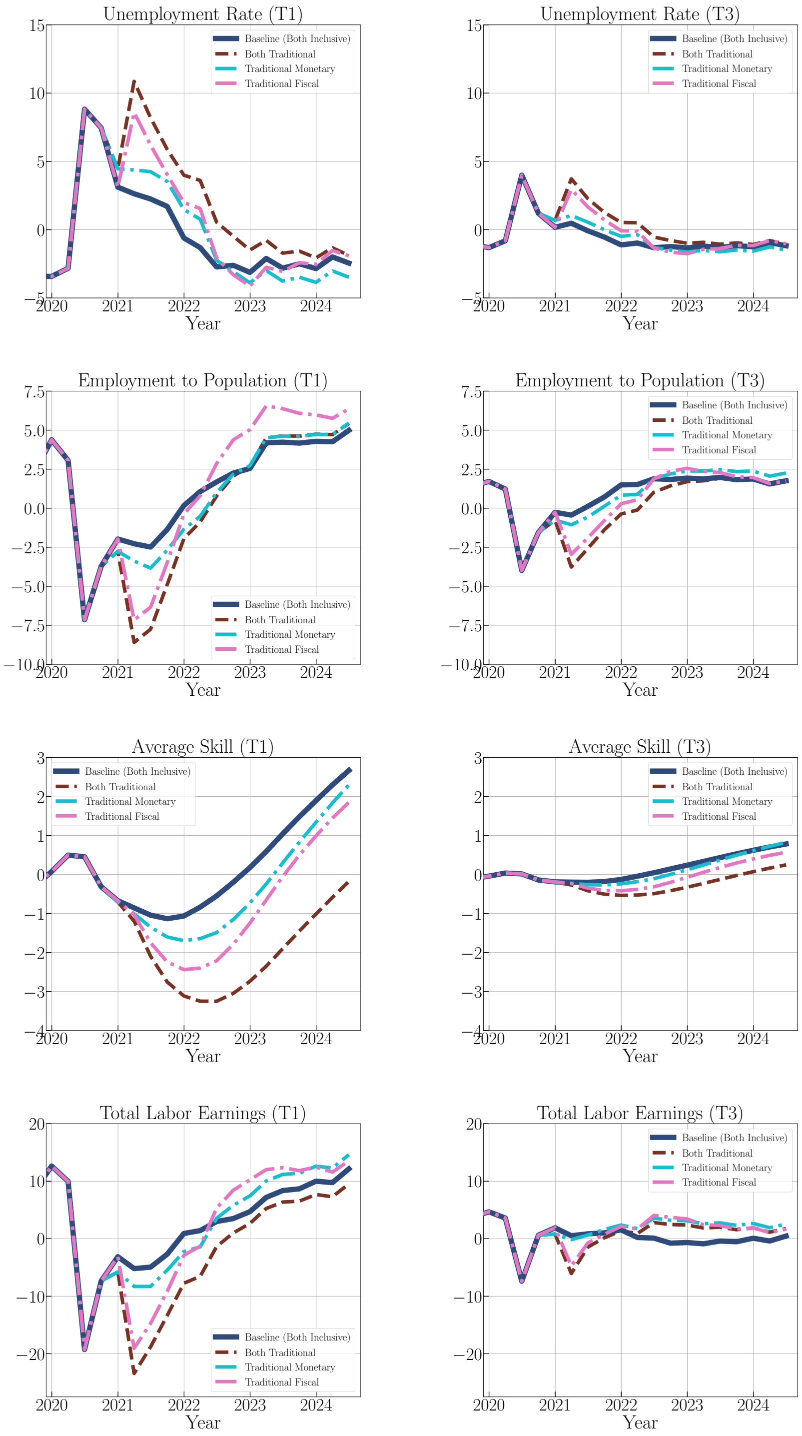

Figure 10: Unemployment rate, employment-population ratio, average skills, and total labor earnings for the bottom (T1) and top (T3) terciles in the baseline and the three counterfactuals.

Both Traditional: monetary and fiscal policy both restrained (Fed maintains IT and fiscal support is limited to the first 2020Q2 package only). Traditional Monetary: restrained monetary and inclusive fiscal policy (fiscal authority enacts both 2020Q2 and 2021Q1 stimulus rounds, but the Fed sticks with IT). Traditional Fiscal: inclusive monetary and restrained fiscal policy (Fed adopts the LfL rule in 2020Q4, while fiscal support is curtailed to the initial 2020Q2 package only).

their absence. There are three key differences between these two groups of households. First, the low-skill workers are more exposed to aggregate fluctuations and thus experience worse outcomes by 2021 in the counterfactual without fiscal and monetary policy support. The bottom tercile experiences a 7 ppts rise in the unemployment rate (3 ppts in the top tercile) and a drop in earnings of nearly 20 percent (5 percent in the top tercile) relative to the baseline. Second, the effects of this delayed recovery are more persistent at the bottom, as evident from the average skill dynamics. While average skills of the top tercile are already near the baseline in 2024, at the bottom they are still 3 percent below it. Third, total earnings at the bottom tercile remain below the baseline for the whole sample period, whereas at the top they recover quickly and, by early 2022, stabilize at roughly 4 percent above the baseline. This divergence reflects opposing forces from employment and real-wage dynamics. At the bottom, greater exposure to unemployment leads to more skill scarring and persistently lower earnings. At the top, employment remains fairly stable, so earnings are driven primarily by real wage dynamics, which are more favorable in this counterfactual. This is an important result, which will be reflected in our welfare calculations.

7.2 Counterfactual Under Traditional Monetary and Inclusive Fiscal Policy

In the second experiment labeled 'Traditional Monetary', we force the monetary authority to follow a strict inflation targeting rule (the pre-2020 regime), but keep fiscal policy unchanged from the baseline. In this counterfactual economy, the monetary authority would have raised rates much earlier in response to the first signs of inflation (Figure 8), keeping the economy away from the capacity constraints and avoiding much of the inflation spike and the consequent erosion of wages and interest rates.

The aggregate labor market recovery would have suffered somewhat from the more inflation-focused monetary policy rule, but overall the economy would have experienced a quick recovery with earnings well above the baseline already in 2022 (Figure 9). Zooming in on the bottom tercile, labor earnings exceed the baseline starting from 2022, even though employment and average skills remain consistently below the baseline at every horizon in this counterfactual (Figure 10). These stronger earnings are the result of lower real wage erosion, which is enough to push labor earnings above the baseline even for low-skilled workers.

7.3 Counterfactual Under Traditional Fiscal and Inclusive Monetary Policy

Finally, we study a counterfactual (labeled 'Traditional Fiscal') where the fiscal authority abstains from implementing the second fiscal package of 2021:Q1, but the monetary authority follows the "Lower-for-Longer" rule as in the baseline. Notably, without the second round of transfers expanding the economy, the inclusive monetary policy conduct would have led the Fed to maintain nominal rates at the ZLB until early 2023. As a side effect, this policy approach reduces the interest burden on outstanding government debt, thereby helping to partially finance the fiscal transfers. This mechanism is reflected in the dynamics of government debt, which exhibit a much faster decline during 2023–2024 relative to the other scenarios. As in the other two counterfactuals, tighter fiscal policy also avoids hitting the capacity constraints and prevents much of the inflation surge (Figure 8). Yet, without the second round of fiscal support—and with monetary policy constrained by the ZLB—the labor market would have been substantially weaker throughout 2021 (Figure 9). Despite this, labor force participation and aggregate earnings would have surpassed the baseline already by early 2022. Two forces contribute to this strong response of the labor market later in the recovery: the protracted monetary stimulus the absence of negative wealth effects on labor force participation that would have accompanied a second round of fiscal transfers. Similar to our earlier counterfactuals, these forces operate with more intensity at the bottom of the skill distribution, where the extensive margin of labor supply is especially sensitive to aggregate shocks (Figure 10).

7.4 Takeaways

Overall, our counterfactuals deliver three main findings. First, had fiscal and/or monetary policy adopted a more restrained stance, the economy would have contained much of the surge in prices, resulting in higher real wages and real returns. Yet this outcome would have come at the cost of a weaker labor market recovery, especially for workers at the bottom of the skill distribution. This tension epitomizes the inflation-inclusion trade-off implicit in stabilization policy. Second, we find that either inclusive fiscal policy or inclusive monetary policy would, in isolation, have been sufficient to contain the negative labor market hysteresis at the bottom of the distribution. In both of those counterfactuals ('Traditional Monetary' and 'Traditional Fiscal'), labor earnings in the first skill tercile would have exceeded baseline earnings already in early 2022. Third, while both inclusive fiscal policy or inclusive monetary policy alone are able to generate, eventually, a broad-based recovery, the labor market dynamics differ significantly between these two counterfactuals: the 'Traditional Monetary' strategy is more successful at stabilizing the labor market in 2021, whereas the 'Traditional Fiscal' strategy cannot avoid a sharp decline in 2021, but engineers a stronger recovery by 2023 by limiting negative wealth effects on employment.

Beyond their labor market effects, the alternative fiscal and monetary policy scenarios also induce shifts in other income components—such as transfers, interest, and profits—which, like labor market dynamics, generate heterogeneous impacts across the worker distribution. In the next section, we combine all these channels by computing the total welfare implications of each policy regime.

8 Welfare Analysis

We first describe how we calculate welfare, and next present our findings.

8.1 Methodology

First, we compute the household value function $v_{k,t_0}(s, a, z)$ with $t_0 = 2019Q4$ for each combination of employment status s, wealth a, and skills z and for each alternative policy combination $k \in \{$'Both Inclusive', 'Both Traditional', 'Traditional Fiscal', 'Traditional Monetary'$\}$. This value depends on the entire path of realized and expected movements, from time t_0 onwards, in hours worked $\{h_{k,t}\}_{t \geq t_0}$, job-finding and separation rates $\{\lambda^{eu}_{k,t}, \lambda^{ue}_{k,t}, \lambda^{ne}_{k,t}\}_{t \geq t_0}$, nominal wage inflation and real wages $\{\pi^{\omega}_{k,t}, w_{k,t}\}_{t \geq t_0}$, real rate of returns and asset prices $\{r_{k,t}, q_{k,t}\}_{t \geq t_0}$, fiscal transfers, UI payments, and labor taxes $\{\phi_{k,t}, \phi^{UI}_{k,t}, \tau_{k,t}\}_{t \geq t_0}$.[37] The value also depends directly on the path of labor disutility shocks $\{\zeta^{\ell}_t\}_{t \geq t_0}$, which is the same across all our counterfactuals and the baseline.

Through this value function, we assess the welfare gains or losses of each counterfactual policy using the following money-metric measure

$$\mathfrak{m}^k(s, a, z) = \frac{v_{k,t_0}(s, a, z) - v_{\text{Both Inclusive},t_0}(s, a, z)}{\partial_a v_{\text{Both Inclusive},t_0}(s, a, z)} \tag{18}$$

where $\partial_a v_{\text{Both Inclusive},t_0}(\cdot)$ denotes the marginal value of wealth. This measure captures an individual's willingness to pay to experience counterfactual policy k instead of the baseline. A positive value indicates that the individual prefers the counterfactual scenario, while a negative value indicates that they are better off under the baseline.

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[37] For computational tractability, we compute individuals' value function under the assumption that individuals have perfect foresight over the realized outcomes under each counterfactual. Specifically, we use the ex-post realized path of aggregate variables for $t \geq t_0$ to solve the household problem backward and compute the value function $v_{k,t_0}(s, a, z)$ in each of our different counterfactuals. While this differs from workers' ex-ante expectations on the evolution of these aggregate variables at t_0, it has the advantage of

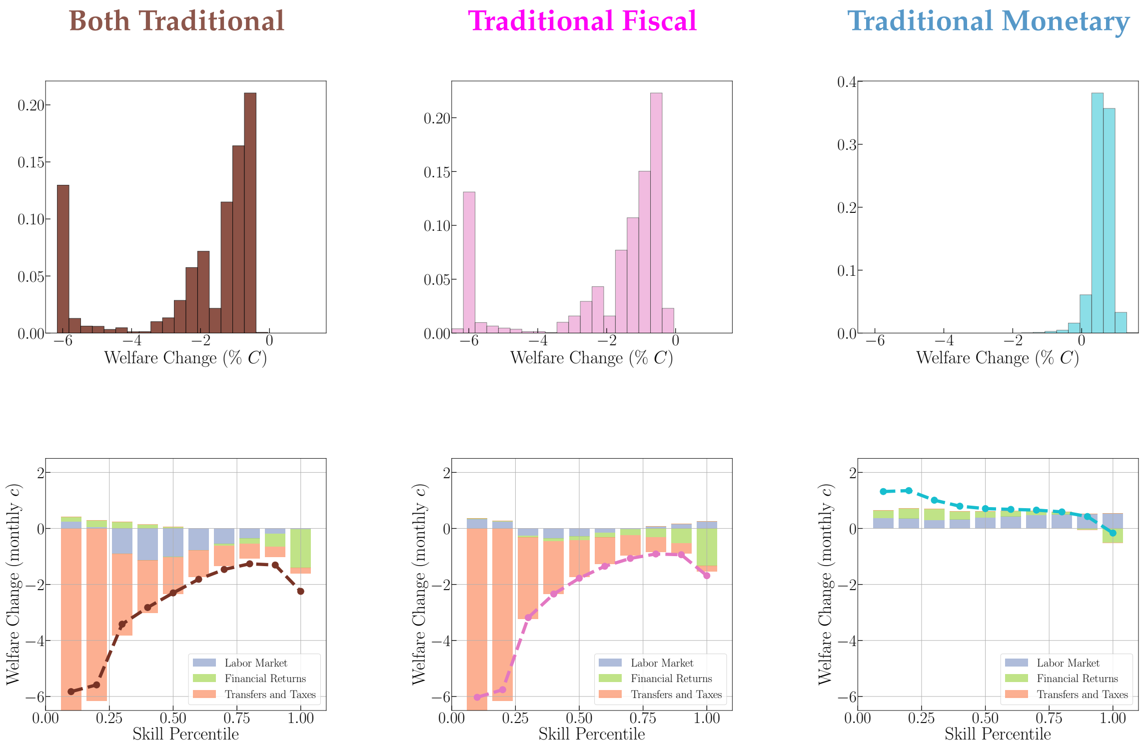

Figure 11: Welfare gains of counterfactual policies.

Note: Welfare effects are computed using the money-metric (18) and are expressed as a share of steady-state monthly consumption. Columns correspond to different counterfactual scenarios. The first row reports the distribution of welfare changes across households. The second row reports mean welfare changes by skill decile: the dashed line shows the total effect, and the bars decompose it into the labor market, financial returns, and transfers-and-taxes channels (see main text for definition of the different channels). Differences between the total effect and the sum of the channels reflect non-linearities in the value function. Measures over skill deciles are calculated by averaging our welfare metric according to the distribution of skills in steady state.

8.2 Results

For each counterfactual, Figure 11 plots the full distribution of welfare changes (top row) as well as welfare changes across skill deciles (bottom row). To compute welfare changes across the skill distribution, we partition individuals into steady-state skill deciles and average our money-metric measure in equation (18) across all individuals belonging to a given decile. To facilitate the comparison across skill deciles, we scale welfare gains and losses by individual steady-state monthly consumption.[38]

The top row of Figure 11 clearly shows that virtually all individuals in the model are worse off under the 'Both Traditional' and 'Traditional Fiscal' counterfactual policies. The associated welfare losses are sizable, they vary between one and six months of steady-

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allowing the ex-post realized outcomes to determine welfare gains and losses.

[38] Table F1 in the Appendix reports the welfare changes by both skill and wealth quartiles and allows a more granular analysis of winners and losers.

state consumption. In contrast, most households are better off in the 'Traditional Monetary' counterfactual, although the gains are small (less than one month of steady-state consumption). Importantly, these welfare rankings highlight the importance of moving beyond labor market outcomes to evaluate the impact of the alternative policies—'Traditional Fiscal' and 'Traditional Monetary' have markedly different welfare implications despite producing comparable inflation and labor-market outcomes (see discussion in 7.2 and 7.3). The dashed lines in the bottom row of Figure 11 illustrate how these changes correlate with individuals' skill. In the first two columns, corresponding to the 'Both Traditional' and 'Traditional Fiscal' counterfactuals, there is a steeply decreasing relation between welfare losses and skills, except at the top of the distribution. By contrast, the relationship between welfare change and skills is instead much flatter in the 'Traditional Monetary' counterfactual.

8.2.1 Welfare Decomposition

To gain some intuition about the underlying drivers of the welfare patterns across the workers' distribution, the bottom row of Figure 11 also shows a decomposition of our welfare metric into three distinct channels. The first one, which we label the *labor market channel*, captures the role of labor market dynamics in each counterfactual. It combines the joint effect of movements in hours worked, job-finding and separation rates, and real wages. The second channel, which we label the *financial returns channel*, reflects welfare changes driven by shifts in the real rate of return and asset prices. The third channel, which we label the *transfers and taxes channel*, summarizes welfare changes associated with changes in fiscal transfers and labor income taxes.[39] For each channel, we repeat the welfare calculations in (18) assuming that only the channel-relevant subset of aggregate variables follows their counterfactual path, while holding all other variables fixed at their steady-state values. Since individual's value function is nonlinear, the welfare effects of the three channels do not need to sum up to the total effect, though, in practice, the difference is small. We analyze each channel separately below. The bottom row of Figure 11 reports the total effect of each channel, while Figure F1 in the Appendix provides a more granular breakdown by income component within each channel.

Labor market channel. The labor market channel reflects two opposing forces at work in our counterfactuals. On one hand, the counterfactuals avoid hitting the capacity constraints, which helps sustain higher real wages and thereby raises welfare across the entire distribution. On the other hand, they weaken labor market conditions—by increasing

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[39] We leave out wage inflation from our decomposition because it has a negligible impact on individual welfare (0.01% of monthly consumption). This is consistent with the way we model the nominal wage adjustment costs, which are zero to first order.

job separation rates and decreasing job finding rates—which reduces welfare, especially in the middle of the distribution. In the 'Traditional Fiscal' and 'Traditional Monetary' scenarios, the real wage erosion effect dominates at most skill levels. By contrast, under the 'Both Traditional' scenario, which withdraws both fiscal and monetary support, the deterioration in labor market conditions is severe enough to overwhelm the real-wage gains, leading to welfare losses that extend up to the upper-middle segment of the skill distribution.

Surprisingly, the labor market channel contributes very little to the welfare effects at the very bottom of the skill distribution, even though—as we showed in Section 7—this group is the most sensitive to labor market conditions and therefore experiences the worst employment outcomes under all our counterfactuals (at least throughout 2021). This apparent contradiction between outcomes and welfare arises because these individuals are also marginal workers—i.e., those for whom the value difference between employment and non-employment states is close to zero. As a result, even sizable fluctuations in employment translate into only small welfare changes for this group.

Financial returns channel. The impact of financial returns across the distribution declines sharply with skill level. This result reflects our calibrated portfolio composition across the skill distribution. In our counterfactuals, low-skilled individuals, who hold most of their wealth in bonds, benefit from higher real interest rates. By contrast, high-skilled individuals, whose portfolios are concentrated in equity, are worse off because of the lower profits and the realized capital losses associated with the weaker demand stimulus from the government. It is this component that accounts for welfare losses of the top decile under the 'Traditional Monetary' scenario, a counterfactual economy where virtually every other group is better off.

Transfers and taxes channel. The second round of transfers is by far the largest driver of welfare changes, especially for the bottom half of the skill distribution, where these gains are an order of magnitude larger than those arising from other channels. By contrast, we find that differences in taxes—which are assumed to start adjusting only in the distant future to finance the transfers—have a negligible impact on individual welfare. Thus, the absence of transfers under the 'Both Traditional' and 'Traditional Fiscal' counterfactuals accounts for the bulk of welfare losses faced by low- and middle-skilled workers.

8.3 Aggregate Stabilization or Completing Markets?

The sizable welfare gains associated with inclusive fiscal policy might give the impression that the policy constituted a highly effective response to the pandemic shocks. However, these large gains should not be interpreted as arising solely from the mitigation of

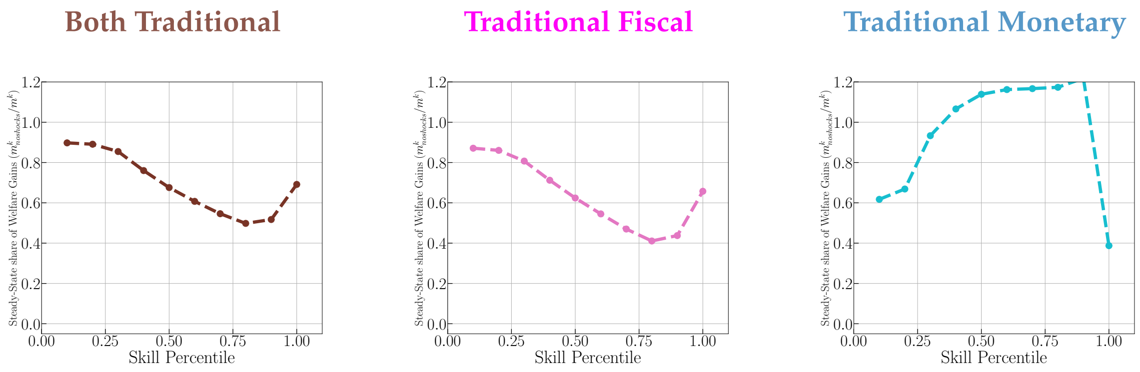

Figure 12: Ratio of the welfare gains of counterfactual policies in the "no-shocks" case to the welfare gains in the presence of aggregate shocks ($\mathfrak{m}^k_{\text{no shocks}}/\mathfrak{m}^k$).

Note: Columns correspond to different counterfactual scenarios. See description in the text for the definition of the $\mathfrak{m}^k_{\text{no shocks}}$ money-metric measure. Values near 1 indicate that welfare gains (or losses) are essentially the same with or without aggregate shocks—implying that they reflect primarily corrections of steady-state distortions rather than gains from aggregate stabilization. Values near zero indicate the opposite.

aggregate fluctuations. This is because the welfare calculations also incorporate the redistributive and efficiency gains that would be present even in the absence of aggregate shocks, which are non-zero due to steady-state distortions, namely market incompleteness (McKay and Reis, 2016; Kaplan and Miyahara, 2025).

To isolate the welfare effects associated with aggregate stabilization, we first compute the policy-induced change in the time path of aggregate inputs to the household problem between counterfactual k and the baseline, $\{\Delta X_{k,t}\}_{t\geq t_0} \equiv \{X_{k,t} - X_{\text{Both Inclusive},t}\}_{t\geq t_0}$, where the vector

$$X_{k,t} \equiv \{h_{k,t}, \lambda^{eu}_{k,t}, \lambda^{ue}_{k,t}, \lambda^{ne}_{k,t}, \pi^{\omega}_{k,t}, w_{k,t}, r_{k,t}, q_{k,t}, \phi_{k,t}, \phi^{UI}_{k,t}, \tau_{k,t}\}$$

collects all aggregate variables entering the household problem in the counterfactual scenario k, and similarly for $X_{\text{Both Inclusive},t}$ in the baseline. Intuitively, one can think of the paths $\{X_{k,t}\}_{t\geq t_0}$ as the sum of two components: one that reflects the impact of the aggregate shocks, which is common between counterfactual k and the baseline, and one that reflects the impact of the policy response in the two scenarios. By subtracting the baseline path from the one in counterfactual k, $\{\Delta X_{k,t}\}_{t\geq t_0}$ isolates the differences in aggregate inputs arising exclusively from the policy response component.

We then repeat our money-metric welfare calculation for counterfactual k by solving the value function for an individual facing the (exogenous) aggregate sequence of inputs $\{\Delta X_{k,t}\}_{t\geq t_0}$ and compare it to that of an individual where all variables remain fixed at their steady-state values.[40] This calculation yields the policy-induced welfare gains and

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[40] Throughout, we subject both the counterfactual and the baseline to the labor disutility $\{\zeta^{\ell}_t\}_{t\geq t_0}$ shocks,

losses that arise *independently of the pandemic recessionary shocks*, i.e., those that are due to redistribution and efficiency gains arising even in the steady state of our economy. We label this money-metric welfare measure as the "no-shocks welfare change" and denote it with $\mathfrak{m}^k_{\text{no shocks}}$.

Figure 12 plots these welfare changes over the skill distribution expressed as a share of the total welfare effects computed previously (i.e., we plot the ratio $\mathfrak{m}^k_{\text{no shocks}}/\mathfrak{m}^k$). A value close to 1.0 implies that welfare gains (or losses) are essentially the same with or without aggregate shocks, indicating that the policy's welfare effects are driven primarily by its impact on steady-state distortions rather than by its aggregate stabilization component. By contrast, a value close to zero indicates that the gains/losses of the policy arise primarily from their ability to mitigate the negative impacts of the aggregate shocks.

Overall, the shares exceed 50% across all counterfactuals and throughout most of the skill distribution, indicating that the bulk of the gains and losses under the alternative policies we consider stems from correcting steady-state distortions rather than from cushioning the aggregate shocks that struck the economy over this period.[41,42] Interestingly, though, stabilization considerations become relevant around the second and third quartiles of the skill distribution, where the extensive margin of the labor market channel plays a big role, as seen in Figure F1.

9 Conclusions

We have studied the macroeconomic and welfare implications of inclusive stabilization policies, i.e., fiscal and monetary policies that run the economy hot for longer after a contraction in order to achieve a broad-based labor market recovery that offsets persistent scarring effects of the recession and does not leave any group behind.

The central insight of our analysis is that two aggregate constraints—the ZLB and short-run limits to productive capacity—jointly generate an inherent trade-off for policymakers aiming to foster an inclusive recovery. The ZLB deepens downturns and can induce long-lasting labor market hysteresis, particularly among low-skilled workers. In that case, prolonged fiscal or monetary support serves as an antidote to ZLB-induced hysteresis. However, an overly accommodative policy stance risks pushing the economy against its capacity constraints, giving rise to inflationary pressures and real income

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since those affect workers utility directly.

[41] This finding echoes results from the optimal monetary policy literature in HANK models which concludes that, when planner weights are chosen so that the steady-state distribution of consumption is efficient, welfare gains from cyclical stabilization are small (McKay and Wolf, 2023).

[42] The estimated share of no-shocks welfare gains in the Traditional Monetary counterfactuals are not very informative because for a large part of the skill distribution the welfare gains are very close to zero.

erosion. When these effects are sufficiently pronounced, the approach can become self-defeating in its aim of improving labor market outcomes for low-wage workers. We argue that this inclusion-inflation trade-off is the right way to think about the aggregate and distributional impact of stabilization policy in the U.S. post-pandemic recovery, and we develop a model to investigate this trade-off.

The model, calibrated to account for this historical episode, yields three main conclusions. First, it was the joint implementation of inclusive monetary policy (focused on making up the employment shortfall) and inclusive fiscal policy (focused on engineering a broad-based recovery) which triggered capacity constraints and the inflation surge. Implementing each of the two in isolation does not, and avoids nearly half of the cumulative rise in the price level. Lack of coordination between fiscal and monetary authorities was at the heart of inflation.

Second, either inclusive fiscal policy or inclusive monetary policy in isolation would have been sufficient to contain the negative labor market hysteresis at the bottom of the distribution, albeit with different timing. The policy counterfactual with traditional, inflation-focused, monetary policy is most successful at stabilizing the dynamics of labor earnings throughout the recovery. The one with more traditional, restrained, fiscal policy features sharp earnings drop in 2021, but a stronger recovery in 2022 largely thanks to the absence of negative wealth effects on labor supply from fiscal transfers.

Third, our welfare analysis indicates that focusing only on labor market outcomes to judge the success of stabilization policy can be misleading. The offsetting forces intrinsic in labor market dynamics (i.e., more broad-based employment growth but faster erosion of real wages) make the net effect of this component on welfare small. Fiscal transfers play the biggest role below the median, while capital gains are dominant at the top. Overall, in this historical episode, departing from inclusive fiscal policy would have led to sizable welfare losses across the distribution, relative to the baseline. Instead, an inflation-focused central bank combined with an inclusive fiscal authority would have led to modest welfare gains for the vast majority of households.

We also highlight, though, that a large share of the welfare effects we calculate are not associated with the ability of policy to stabilize the economy in response to aggregate shocks, but rather with its correction of steady-state distortions arising from market incompleteness and imperfect consumption insurance, which are present even in the absence of aggregate fluctuations.

References

Aaronson, Stephanie R, Mary C Daly, William L Wascher, and David W Wilcox (2019), "Okun Revisited: Who Benefits Most From a Strong Economy?" *Brookings Papers on Economic Activity*, 2019(1), 333–404.

Achdou, Yves, Jiequn Han, Jean-Michel Lasry, Pierre-Louis Lions, and Benjamin Moll (2021), "Income and Wealth Distribution in Macroeconomics: A Continuous-Time Approach," *Review of Economic Studies*, 89(1), 45–86.

Afrouzi, Hassan, Andres Blanco, Andres Drenik, and Erik Hurst (2024), "A Theory of How Workers Keep Up With Inflation," Working Paper, Columbia University.

Aladangady, Aditya, Donghoon Cho, Laura Feiveson, and Eugenio Pinto (2022), "Excess Savings during the COVID-19 Pandemic," FEDS Notes 2022-10-21, Board of Governors of the Federal Reserve System.

Alves, Felipe, and Giovanni L Violante (2025), "Monetary Policy under Okun's Hypothesis," National Bureau of Economic Research WP 33488.

Angeletos, George-Marios, Chen Lian, and Christian K Wolf (2024), "Can Deficits Finance Themselves?" *Econometrica*, 92(5), 1351–1390.

Auclert, Adrien, Bence Bardóczy, Matthew Rognlie, and Ludwig Straub (2021), "Using the Sequence-Space Jacobian to Solve and Estimate Heterogeneous-Agent Models," *Econometrica*, 89(5), 2375–2408.

Auclert, Adrien, Bence Bardóczy, and Matthew Rognlie (2023a), "MPCs, MPEs, and Multipliers: A Trilemma for New Keynesian Models," *Review of Economics and Statistics*, 105(3), 700–712.

Auclert, Adrien, Matthew Rognlie, and Ludwig Straub (2023b), "The Trickling Up of Excess Savings," *AEA Papers and Proceedings*, 113, 70–75.

Auclert, Adrien, Matthew Rognlie, and Ludwig Straub (2024a), "Fiscal and Monetary Policy With Heterogeneous Agents," National Bureau of Economic Research WP 32991.

Auclert, Adrien, Matthew Rognlie, and Ludwig Straub (2024b), "The Intertemporal Keynesian Cross," *Journal of Political Economy*, 132(12), 4068–4121.

Autor, David, Arindrajit Dube, and Annie McGrew (2023), "The Unexpected Compression: Competition at Work in the Low Wage Labor Market," Working Paper, MIT.

Bagga, Sadhika, Lukas Friedrich Mann, Ayşegül Şahin, and Giovanni L Violante (2025), "Job Amenity Shocks and Labor Reallocation," Technical report, National Bureau of Economic Research.

Bai, Xiwen, Jesús Fernández-Villaverde, Yiliang Li, and Francesco Zanetti (2024), "The Causal Effects of Global Supply Chain Disruptions on Macroeconomic Outcomes: Evidence and Theory," Technical report, National Bureau of Economic Research.

Bardóczy, Bence (2022), "Spousal Insurance and the Amplification of Business Cycles," Working Paper, Federal Reserve Board.

Bardóczy, Bence, Jae W. Sim, and Andreas Tischbirek (2024), "The Macroeconomic Effects of Excess Savings," Technical report, FEDS Working Paper 2024-062.

Barrero, José María, Nicholas Bloom, and Steven J Davis (2023), "The Evolution of Work from Home," *Journal of Economic Perspectives*, 37(4), 23–49.

Bayer, Christian, Benjamin Born, and Ralph Luetticke (2024), “Shocks, Frictions, and Inequality in US Business Cycles,” *American Economic Review*, 114(5), 1211–47.

Benigno, Gianluca, Julian di Giovanni, Jan J. J. Groen, and Adam I. Noble (2022), “The GSCPI: A New Barometer of Global Supply Chain Pressures,” Staff Report 1017, Federal Reserve Bank of New York, New York, NY.

Benigno, Pierpaolo, and Gauti B Eggertsson (2023), “It’s baaack: The Surge in Inflation in the 2020s and the Return of the Non-linear Phillips Curve,” National Bureau of Economic Research.

Bergholt, Drago, Fabio Canova, Francesco Furlanetto, Nicolò Maffei-Faccioli, and Pål Ulvedal (2024), “What Drives the Recent Surge in Inflation? The Historical Decomposition Roller Coaster,” Norges Bank.

Bernanke, Ben, and Olivier Blanchard (2025), “What Caused the US Pandemic-Era Inflation?” *American Economic Journal: Macroeconomics*.

Blanchet, Thomas, Emmanuel Saez, and Gabriel Zucman (2022), “Real-Time Inequality,” University of California, Berkeley, data available at `https://realtimeinequality.org`.

Blanco, Andres, Corina Boar, Callum Jones, and Virgiliu Midrigan (2024), “Non-linear Inflation Dynamics in Menu Cost Economies,” National Bureau of Economic Research.

Cajner, Tomaz, Tyler Radler, David Ratner, and Ivan Vidangos (2017), “Racial Gaps in Labor Market Outcomes in the Last Four Decades and Over the Business Cycle,” FED Working Paper.

Cavallo, Alberto, and Oleksiy Kryvtsov (2024), “Price discounts and cheapflation during the post-pandemic inflation surge,” *Journal of Monetary Economics*, 148, 103644.

Comin, Diego A, Robert C Johnson, and Callum J Jones (2023), “Supply Chain Constraints and Inflation,” Working Paper 31179, National Bureau of Economic Research.

Davis, Steven J., and Till Von Wachter (2011), “Recessions and the Costs of Job Loss,” *Brookings Papers on Economic Activity*, 2011(2), 1–72.

Del Canto, Felipe N, John R Grigsby, Eric Qian, and Conor Walsh (2024), “Are Inflationary Shocks Regressive? A Feasible Set Approach,” National Bureau of Economic Research WP 31124.

Eggertsson, Gauti B, and Don Kohn (2023), “The Inflation Surge of the 2020s: The Role of Monetary Policy,” Brown University.

Erceg, Christopher J, Dale W Henderson, and Andrew T Levin (2000), “Optimal Monetary Policy With Staggered Wage and Price Contracts,” *Journal of Monetary Economics*, 46(2), 281–313.

Faia, Ester, Ekaterina Shabalina, and David Wiczer (2025), “Monetary Policy and Labour Mobility,” Technical report, Goethe University.

Gabaix, Xavier (2020), “A Behavioral New Keynesian Model,” *American Economic Review*, 110(8), 2271–2327.

Gagliardone, Luca, and Mark Gertler (2023), “Oil Prices, Monetary Policy and Inflation Surges,” National Bureau of Economic Research.

Galí, Jordi, Frank Smets, and Rafael Wouters (2012), “Unemployment in an Estimated New Keynesian Model,” *NBER Macroeconomics Annual*, 26, 329–360.

Giannone, Domenico, and Giorgio Primiceri (2024), “The Drivers of Post-Pandemic Inflation,” National Bureau of Economic Research.

Glover, Andrew, Jonathan Heathcote, Dirk Krueger, and José-Víctor Ríos-Rull (2023), “Health versus Wealth: On the Distributional Effects of Controlling a Pandemic,” *Journal of Monetary Economics*, 140, 34–59.

Golosov, Mikhail, Michael Graber, Magne Mogstad, and David Novgorodsky (2023), “How Americans Respond to Idiosyncratic and Exogenous Changes in Household Wealth and Unearned Income,” *Quarterly Journal of Economics*, 139(2), 1321–1395.

Graves, Sebastian, Christopher Huckfeldt, and Eric T Swanson (2023), “The Labor Demand an Labor Supply Channels of Monetary Policy,” Working Paper, Federal Reserve Board.

Grigsby, John, Erik Hurst, and Ahu Yildirmaz (2021), “Aggregate Nominal Wage Adjustments: New Evidence from Administrative Payroll Data,” *American Economic Review*, 111(2), 428–71.

Guerreiro, Joao, Jonathon Hazell, Chen Lian, and Christina Patterson (2024), “Why Do Workers Dislike Inflation? Wage Erosion and Conflict Costs,” National Bureau of Economic Research WP 32956.

Guerrieri, Veronica, Guido Lorenzoni, Ludwig Straub, and Ivan Werning (2021), “Monetary Policy in Times of Structural Reallocation,” Proceedings of the 2021 Jackson Hole Symposium.

Hall, Robert E., and Marianna Kudlyak (2019), “Job-Finding and Job-Losing: A Comprehensive Model of Heterogeneous Individual Labor-Market Dynamics,” National Bureau of Economic Research WP 25625.

Harding, Martín, Jesper Lindé, and Mathias Trabandt (2023), “Understanding post-COVID inflation dynamics,” *Journal of Monetary Economics*, 140, 101–118.

Heathcote, Jonathan, Fabrizio Perri, and Giovanni L Violante (2020), “The Rise of US Earnings Inequality: Does the Cycle Drive the Trend?” *Review of Economic Dynamics*, 37, S181–S204.

Heathcote, Jonathan, Fabrizio Perri, Giovanni L. Violante, and Lichen Zhang (2023), “More Unequal We Stand? Inequality in the United States From the Great Recession to the Covid Pandemic,” *Review of Economic Dynamics*, 50, 235–266.

Hebden, James, and Fabian Winkler (2024), “Computation of Policy Counterfactuals in Sequence Space,” Working Paper, Federal Reserve Board.

Hobijn, Bart, and Ayşegül Şahin (2021), “Maximum Employment and the Participation Cycle,” National Bureau of Economic Research WP 29222.

Holden, Tom D (2016), “Computation of Solutions to Dynamic Models With Occasionally Binding Constraints,” Working Paper, University of Surrey.

Huo, Zhen, and José-Víctor Ríos-Rull (2020), “Sticky Wage Models and Labor Supply Constraints,” *American Economic Journal: Macroeconomics*, 12(3), 284–318.

Jaravel, Xavier (2021), “Inflation Inequality: Measurement, Causes, and Policy Implications,” *Annual Review of Economics*, 13(1), 599–629.

Kaplan, Greg, and Ken Miyahara (2025), “How Does Monetary and Fiscal Policy Shape Macroeconomic Dynamics in the Face of Large Shocks?” Technical report, University of Chicago.

Kaplan, Greg, Benjamin Moll, and Giovanni L Violante (2020), “The Great Lockdown and the Big Stimulus: Tracing the Pandemic Possibility Frontier for the US,” National Bureau of Economic Research.

Kaplan, Greg, and Giovanni L Violante (2022), “The Marginal Propensity to Consume in Heterogeneous Agent Models,” *Annual Review of Economics*, 14, 747–775.

Krusell, Per, Toshihiko Mukoyama, Richard Rogerson, and Ayşegül Şahin (2017), “Gross Worker Flows Over the Business Cycle,” *American Economic Review*, 107(11), 3447–76.

Levy, Mickey D, Charles I Plosser, and Monetary Policy Strategy (2024), "The Fed's Strategic Approach to Monetary Policy Needs a Reboot," in *Hoover Monetary Policy Conference: Getting Global Monetary Policy on Track, Hoover Institution, Stanford University, May*, volume 3.

Liu, Zheng, and Thuy Lan Nguyen (2023), "Global Supply Chain Pressures and U.S. Inflation," Frbsf economic letter 2023-14.

Lorenzoni, Guido, and Iván Werning (2023), "Wage-Price Spirals," *Brookings Papers on Economic Activity*, 54(2), 317–393.

McKay, Alisdair, and Ricardo Reis (2016), "The Role of Automatic Stabilizers in the U.S. Business Cycle," 84(1), 141–194.

McKay, Alisdair, and Christian K Wolf (2023), "Monetary Policy and Inequality," *Journal of Economic Perspectives*, 37(1), 121–144.

Okun, Arthur M (1973), "Upward Mobility in a High-Pressure Economy," *Brookings Papers on Economic Activity*, 1973(1), 207–261.

Olivi, Alan, Vincent Sterk, and Dajana Xhani (2023), "Optimal Monetary Policy During a Cost of Living Crisis," Working Paper, UCL.

Ozimek, Adam, and Michael Ferlez (2015), "The Fed's Mistake," Moody's Analytics.

Pallotti, Filippo, Gonzalo Paz-Pardo, Jiri Slacalek, Oreste Tristani, and Giovanni L. Violante (2024), "Who Bears the Costs of Inflation? Euro Area Households and the 2021-23 Shock," ECB Working Paper.

Romer, Christina D., and David H. Romer (2024), "Did the Federal Reserve's 2020 Policy Framework Limit Its Response to Inflation? Evidence and Implications for the Framework Review," *Brookings Papers on Economic Activity*.

Rubbo, Elisa (2024), "What Drives Inflation? Lessons from Disaggregated Price Data," National Bureau of Economic Research 32194.

Smets, Frank, and Rafael Wouters (2007), "Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach," *American Economic Review*, 97(3), 586–606.

Stantcheva, Stefanie (2024), "Why Do We Dislike Inflation?" *Brookings Papers on Economic Activity*, 2004(1), 1–46.

Yagan, Danny (2019), "Employment Hysteresis From the Great Recession," *Journal of Political Economy*, 127(5), 2505–2558.

Appendix

A Household Optimization Problems

In this section we describe the dynamic optimization problem of households who are not employed (the decision problem for employed workers is contained in Section 2 of the main text).

The problem of the passive non-participant (n_0) is

$$v_0\left(n_0, a_0, z_0\right) = \max_{\{c_t\}_{t\geq 0}} \quad \mathbb{E}_0^{CD} \int_0^{\mathfrak{t}^{n_1}} e^{-\rho t} \mathfrak{u}^n\left(c_t, 0\right) dt + e^{-\rho \mathfrak{t}^{n_1}} v_{\mathfrak{t}^{n_1}}\left(n_1, a_{\mathfrak{t}^{n_1}}, z_{\mathfrak{t}^{n_1}}\right)$$

$$\begin{aligned} s.t.\ c_t + \dot{a}_t &= r_t a_t + \phi_t \\ a_t &\geq 0 \end{aligned} \tag{A1}$$

Passive non-participants do not receive any job opportunity. At rate $\eta^{n_0 n_1}$, with $\mathfrak{t}^{n_1}$ being the first arrival rate of this event, they become active non-participants and enter employment status n_1. When in the passive state, workers only get to choose their consumption flow c_t.

The problem of an unemployed household who is not eligible for UI benefits is:

$$\begin{aligned} v_0\left(u_0, a_0, z_0\right) = \max_{\{c_t\}_{t\geq 0}, t^*} \quad \mathbb{E}_0^{CD} \Bigg[& \int_0^{\mathfrak{t}^{\min}} e^{-\rho t} \mathfrak{u}^u\left(c_t, 0\right) dt + \mathbb{I}_{\{\mathfrak{t}^{\min} = \mathfrak{t}^e\}} e^{-\rho \mathfrak{t}^e} v_{\mathfrak{t}^e}\left(e, a_{\mathfrak{t}^e}, z_{\mathfrak{t}^e}\right) \\ & + \mathbb{I}_{\{\mathfrak{t}^{\min} = \mathfrak{t}^*\}} e^{-\rho \mathfrak{t}^*} v_{\mathfrak{t}^*}\left(n_1, a_{\mathfrak{t}^*}, z_{\mathfrak{t}^*}\right) + \mathbb{I}_{\{\mathfrak{t}^{\min} = \mathfrak{t}^{n_0}\}} e^{-\rho \mathfrak{t}^{n_0}} v_{\mathfrak{t}^{n_0}}\left(n_0, a_{\mathfrak{t}^{n_0}}, z_{\mathfrak{t}^{n_0}}\right) \Bigg] \end{aligned}$$

$$\begin{aligned} s.t.\ c_t + \dot{a}_t &= r_t a_t + \phi_t \\ a_t &\geq 0 \end{aligned} \tag{A2}$$

Ineligible unemployed workers receive a job opportunity at rate λ_{zt}^{ue} (with $\mathfrak{t}^e$ being the arrival time of this event) and always find it optimal to take it. At any time $\mathfrak{t}^*$ during the unemployment spell, the individual can quit the labor force $\left(\mathfrak{p}_t^u = 0\right)$. Finally, at rate $\eta^{n_1 n_0}$ (with $\mathfrak{t}^{n_0}$ being the first arrival rate of this shock) they can become passive non-participants.

The problem of an unemployed household who is eligible for UI benefits is:

$$\begin{aligned} v_0\left(u_1, a_0, z_0\right) = \max_{\{c_t\}_{t\geq 0}, \mathfrak{t}^*} \quad & \mathbb{E}_0^{CD}\Bigg[\int_0^{\mathfrak{t}^{\min}} e^{-\rho t}\mathfrak{u}^u\left(c_t, 0\right)dt + \mathbb{I}_{\{\mathfrak{t}^{\min}=\mathfrak{t}^e\}}e^{-\rho\mathfrak{t}^e}\max\left\{v_{\mathfrak{t}^e}\left(e, a_{\mathfrak{t}^e}, z_{\mathfrak{t}^e}\right), v_{\mathfrak{t}^e}\left(u_1, a_{\mathfrak{t}^e}, z_{\mathfrak{t}^e}\right)\right\} \\ & + \mathbb{I}_{\{\mathfrak{t}^{\min}=\mathfrak{t}^*\}}e^{-\rho\mathfrak{t}^*}v_{\mathfrak{t}^*}\left(n_1, a_{\mathfrak{t}^*}, z_{\mathfrak{t}^*}\right) + \mathbb{I}_{\{\mathfrak{t}^{\min}=\mathfrak{t}^{u_0}\}}e^{-\rho\mathfrak{t}^{u_1}}v_{\mathfrak{t}^{u_0}}\left(u_0, a_{\mathfrak{t}^{u_0}}, z_{\mathfrak{t}^{u_0}}\right) \\ & + \mathbb{I}_{\{\mathfrak{t}^{\min}=\mathfrak{t}^{n_0}\}}e^{-\rho\mathfrak{t}^{n_0}}v_{\mathfrak{t}^{n_0}}\left(n_0, a_{\mathfrak{t}^{n_0}}, z_{\mathfrak{t}^{n_0}}\right)\Bigg] \end{aligned}$$

$$\begin{aligned} s.t.\ c_t + \dot{a}_t &= r_t a_t + (1-\tau_t)b_t\left(z_t\right) + \phi_t \\ a_t &\geq 0 \end{aligned} \tag{A3}$$

Besides receiving job opportunities and choosing whether to take them, choosing to drop out of the labor force, and exogenously switching to passive non-participant status, the eligible unemployed could lose its entitlement to UI benefit at rate $\lambda_z^{u_1 u_0}$, with $\mathfrak{t}^{u_0}$ being the first arrival time of this event.

Finally, the problem of the employed household is:

$$\begin{aligned} v_0\left(e, a_0, z_0\right) = \max_{\{c_t\}_{t\geq 0}, \mathfrak{t}^*} \quad & \mathbb{E}_0^{CD}\Bigg[\int_0^{\mathfrak{t}^{\min}} e^{-\rho t}\mathfrak{u}^e\left(c_t, h_t; z_t\right)dt + \mathbb{I}_{\{\mathfrak{t}^{\min}=\mathfrak{t}^u\}}e^{-\rho\mathfrak{t}^u}v_{\mathfrak{t}^u}\left(u_1, a_{\mathfrak{t}^u}, z_{\mathfrak{t}^u}\right) \\ & + \mathbb{I}_{\{\mathfrak{t}^{\min}=\mathfrak{t}^*\}}e^{-\rho\mathfrak{t}^*}v_{\mathfrak{t}^*}\left(n_1, a_{\mathfrak{t}^*}, z_{\mathfrak{t}^*}\right) + \mathbb{I}_{\{\mathfrak{t}^{\min}=\mathfrak{t}^{n_0}\}}e^{-\rho\mathfrak{t}^{n_0}}v_{\mathfrak{t}^{n_0}}\left(n_0, a_{\mathfrak{t}^{n_0}}, z_{\mathfrak{t}^{n_0}}\right)\Bigg] \end{aligned}$$

$$\begin{aligned} s.t.\ c_t + \dot{a}_t &= r_t a_t + \left(1-\tau_t\right)w_t z_t h_t + \phi_t \\ a_t &\geq 0 \end{aligned} \tag{A4}$$

Employed workers (e) can be laid-off at rate λ_{zt}^{eu}, in which case they become eligible for UI benefits ($u = u_1$). Let $\mathfrak{t}^u$ be the first arrival time of this Poisson shock. At every instant $\mathfrak{t}^*$, the employed worker can choose to quit the labor force $\left(\mathfrak{p}_t^e = 0\right)$.[43] In addition, an employed worker can exogenously switch to passive non-participant status at rate η^{en_0}, with $\mathfrak{t}^{n_0}$ being the first arrival time of this event.

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[43] Quitting into unemployment is never optimal, because the worker would not receive UI benefits, and would pay a higher disutility cost κ^u for the opportunity to be re-employed at the same wage.

B Intermediate goods sector with capacity constraints

The problem of the intermediate firm follows the description in the main text.[44] In keeping with the other symmetry assumptions made in this block of the model, we assume that intermediate firms are also subject to a common and exogenous maximum capacity constraint $y_{jt} \leq \bar{Y}_t$. Following Comin et al. (2023), the problem of the intermediate firm can be written as

$$\max_{\{p_{jt}\}_{t\geq 0}} \int_0^\infty e^{-(\rho+\chi)t} \left[\frac{p_{jt}}{P_t} y_{jt} - (1-\tau_\ell) w_t \ell_t - \frac{\Theta}{2} \left(\frac{\dot{p}_{jt}}{p_{jt}} - \pi^* \right)^2 Y_t \right] \tag{B1}$$

$$s.t.$$

$$y_{jt} = \Gamma \ell_{jt}^{(1-\alpha)}, \qquad y_{jt} = \left(\frac{p_{jt}}{P_t} \right)^{-\epsilon} Y_t, \qquad y_{jt} - \bar{Y}_t \leq 0 \tag{B2}$$

After building the Hamiltonian, computing the necessary conditions for optimality, and dropping the j index because of symmetry, we obtain

$$\begin{aligned} \lambda_t &= \frac{\Theta(\pi_t - \pi^*) Y_t}{p_t} \\ (\rho+\chi)\lambda_t - \dot{\lambda}_t &= -\left(\frac{p_t}{P_t} - (1-\tau_\ell) m_t - \mu_t \right) \epsilon \left(\frac{p_t}{P_t} \right)^{-\epsilon-1} \frac{Y_t}{P_t} + \left(\frac{p_t}{P_t} \right)^{-\epsilon} \frac{Y_t}{P_t} \\ \mu_t (y_t - \bar{Y}_t) &= 0 \end{aligned}$$

where $m_t = w_t / \left((1-\alpha) \Gamma \ell_t^{-\alpha} \right)$ denotes the firms' real marginal cost, and μ_t denotes the Lagrange multiplier associated with firm's capacity constraint. The last equation denotes the complementarity slackness condition that the multiplier is positive whenever firms hit their capacity constraint.

In a symmetric equilibrium, the optimal price setting decisions of firms yields the price Phillips curve

$$(\rho+\chi)(\pi_t - \pi^*) - \dot{\pi}_t = \frac{\varepsilon}{\Theta} \left((1-\tau_\ell) m_t + \mu_t - \frac{\epsilon - 1}{\epsilon} \right) \tag{B3}$$

with the multiplier μ entering the price-setting decision next to the marginal cost.

When the constraint is not binding, firms set their prices optimally to trade off the adjustment cost with their desire to maintain markups at their desired level. When capacity constraints bind—either because demand for a firm's output surges or because its productive capacity is curtailed by input disruptions—firms are instead forced to "price to demand", so that the demand for their product does not exceed their maximum capacity and their production exhausts demand at that price. Note that it would not be optimal

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[44] For simplicity, the derivation sets the indexation parameter γ to zero.

for firms to price so their demand is below productive capacity. Moving the multiplier μ_t outside of the brackets and relabelling the resulting term as $\zeta_t^{cc} \equiv \frac{\varepsilon}{\Theta}\mu_t$, we obtain

$$\rho(\pi_t - \pi^*) - \dot{\pi}_t = \frac{\varepsilon}{\Theta}\left((1-\tau_\ell)m - \frac{\epsilon - 1}{\epsilon}\right) + \zeta_t^{cc} \tag{B4}$$

which illustrates that binding capacity constraints $\zeta_t^{cc} > 0$ are isomorphic to positive cost-push shocks ζ_t^p in the price Phillips curve (13).

C Equilibrium

We now formally state the definition of a perfect foresight equilibrium for our economy. A stationary equilibrium (or steady-state) is a particular case of our definition where all decisions, prices, aggregate variables, and distributions are constant over time.

For any given initial distribution of households $\mu_0(s, a, z)$, with $s \in \{e, u, n\}$, and a time path for shocks $\{\zeta_t^k\}_{t\geq 0}$, with $k \in \left\{d, \ell, m, \bar{Y}\right\}$, a *perfect foresight equilibrium* is defined as time paths for household consumption, participation and job offer acceptance decisions $\{c_t\left(s, a, z\right), \mathfrak{p}_t\left(s, a, z\right), \mathfrak{j}_t\left(s, a, z\right)\}_{t\geq 0}$, unions' nominal wage setting $\{\omega_{kt}\}_{t\geq 0}$, intermediate producers' hiring decisions $\{\ell_{kt}\}_{t\geq 0}$, real rates of return on real and nominal government bonds $\left\{r_t^b, r_t^m\right\}_{t\geq 0}$, firms' share price $\left\{q_t\right\}_{t\geq 0}$, fiscal variables (UI benefits, taxes, transfer, and debt) $\left\{b_t(z), \tau_t, \phi_t, B_t^g\right\}_{t\geq 0}$, nominal interest rates $\{i_t\}_{t\geq 0}$, aggregate output, consumption, hours worked, price and wage inflation $\left\{Y_t, C_t, h_t, \pi_t, \pi_t^\omega\right\}_{t\geq 0}$, and measures of households $\left\{\mu_t\left(s, a, z\right)\right\}_{t>0}$ such that at every t: (i) households optimize; (ii) firms optimize and inflation satisfies the price Phillips curve; (iii) unions optimize and wage inflation satisfies the wage Phillips curve; (iv) no-arbitrage condition holds for all assets; (v) the government budget constraint holds; (vi) the fiscal and monetary authorities follow their policy rules; (vii) the sequence of distributions satisfies aggregate consistency conditions; (viii) asset and annuity markets clear, and (ix) all goods markets clear.

The asset market clears when households' asset holdings equals the equity value plus government real bonds

$$\int a_t d\mu_t = q_t + B_t^g.$$

This, together with the no-arbitrage conditions, determine firm share prices and real interest rates. Market clearing in the continuum of intermediate goods' markets requires $Y_t = y_{jt}$, for all j. Given the set of employed workers, average hours per worker h_t is determined by the demand of intermediate goods producers, $y_{jt} = \Gamma\left(h_t \int_{s_{it}=e} z_{it}\right)^{1-\alpha} di$, for all j. The final good market, $Y_t = C_t + G_t$, clears by Walras law. Lastly, we note that the labor market is frictional and the evolution of the distribution of employed, unemployed, and non participants is implicit in the KFEs for μ_t.

D Parameters

Steady State		
Parameter		Value
Demographics and Preferences		
Death rate	ϱ	$1/432$
Effective discount rate	ρ	0.0053
Labor supply elasticity	σ	1.00
Utility weight on hours	ψ	1.00
Disutility of nonparticipation	κ^n	0
Disutility of searching	κ^u	0.33
Disutility of working	κ^e	1.05
Skill dynamics		
Mean of initial skill distribution	$\bar{z}_0$	$\log(0.68) - \sigma_{z_0}^2/2$
S.D. of initial skill distribution	σ_{z_0}	0.50
Skill mean reversion	γ_z	0.0017
Skill drift while employed	δ_z^+	0.0024
Skill drift while non-employed	δ_z^-	0.0214
Skill diffusion coefficient	σ_z	0.0467
Labor market frictions		
Job-separation rate out of E	λ_z^{eu}	—
Job-finding rate out of U	λ_z^{ue}	—
Job-finding rate out of N	λ_z^{ne}	—
Passive nonparticipation rate during E	η^{en_0}	0.0075
Passive nonparticipation rate during U/N	$\eta^{un_0}, \eta^{n_1 n_0}$	0.0750
Passive nonparticipation exit rate	$\eta^{n_0 n_1}$	0.2500
Technology		
Liquidity premium	ι	0.001
Elast. of subst. between goods	ν	10
Elast. of subst. between tasks	ε	10
Firm productivity	Γ	1.56
Decreasing returns to scale	α	0.20
Fixed costs	Ω	0.30
Taxes, transfers and expenditures		
Government debt	B^g	1.69
UI replacement rate	$\bar{b}$	0.50
UI expiration rate	$\lambda^{u_1 u_0}$	0.167
Labor income tax rate	τ	0.20
Lump-sum transfer	ϕ	0.068
Government expenditures	G	0.17
Intermediate firms labor subsidy	τ^ℓ	0.10
Intermediate firms net subsidy	Ψ^ℓ	0.001

Out of Steady State		
Parameter		Value
Monetary and Fiscal Policy		
Trend inflation	π^*	$0.02/12$
Taylor rule persistence	β_i	0.07
Taylor rule reaction to inflation	β_π	2.25
Taylor rule reaction to unemployment rate	β_u	-0.10
Labor tax response to debt	β_τ	0.008
Phillips Curve		
Indexation of current to past inflation	γ	0.950
Slope of the price Phillips curve	θ	0.050
Slope of the wage Phillips curve	θ_w	0.005
Aggregate Fluctuations		
Cognitive discounting	χ	$-1/3 \log(0.65)$
Elasticity of (λ_z^{eu}) to hours	ϑ^{eu}	-11.00
Elasticity of $(\lambda_z^{ue}, \lambda_z^{ne})$ to hours	$\vartheta^{ue}, \vartheta^{ne}$	24.00

Table D1: Model parameter values expressed in monthly frequency. See Section 4 in the main text for a discussion of parameter choices and targets.

E Impulse Response Functions

We model all shocks as Ornstein-Uhlenbeck diffusion processes

$$d\zeta_t^k = -\gamma_k \zeta_t^k dt + \sigma_k d\mathcal{W}_t^k, \tag{E1}$$

where $d\mathcal{W}_t^k$ is a standard Wiener process. Figure E1 summarizes the IRFs of some key equilibrium aggregate outcomes.

Demand shock. A negative shock to the demand for final goods reduces labor demand, thus hours decline and unemployment rises. In response to weaker labor demand, unions lower nominal wages, which pushes down prices. Output, hours, and inflation comove positively under this shock, which is why we refer to it as a demand shock.[45] The monetary authority responds to these fluctuations by cutting nominal (and real) rates, which helps cushion the decline in consumption expenditures. Labor productivity jumps at impact because of selection into employment. However, approximately 10 quarters later, productivity turns negative as workers who experienced non-employment spells reenter the labor force after suffering some degree of skill losses.

Labor supply shock. The labor supply shock primarily leads to a decline in labor force participation. This reduction to labor supply creates a labor shortage, which in turn leads to an increase in hours per worker and a reduction in unemployment. The tight labor market exerts mild upward pressure on inflation, prompting the monetary authority to raise interest rates. The shock has also a pronounced impact on labor productivity through selection, as it is predominantly lower-skilled workers who exit the labor force.

Cost-push shock. As discussed above, it is more intuitive to describe the impact of a cost-push shock in the case of a positive shock to firms' desired markup ($\zeta_t^m > 0$). The shock induces firms to raise prices given their real marginal cost, putting upward pressure on inflation and causing real wages to fall. In response, the monetary authority increases nominal (and real) interest rates to contain inflation. The resulting tightening in monetary policy reduces aggregate demand, leading to lower hours worked and higher unemployment. Overall, this shock generates a negative comovement between inflation and output.

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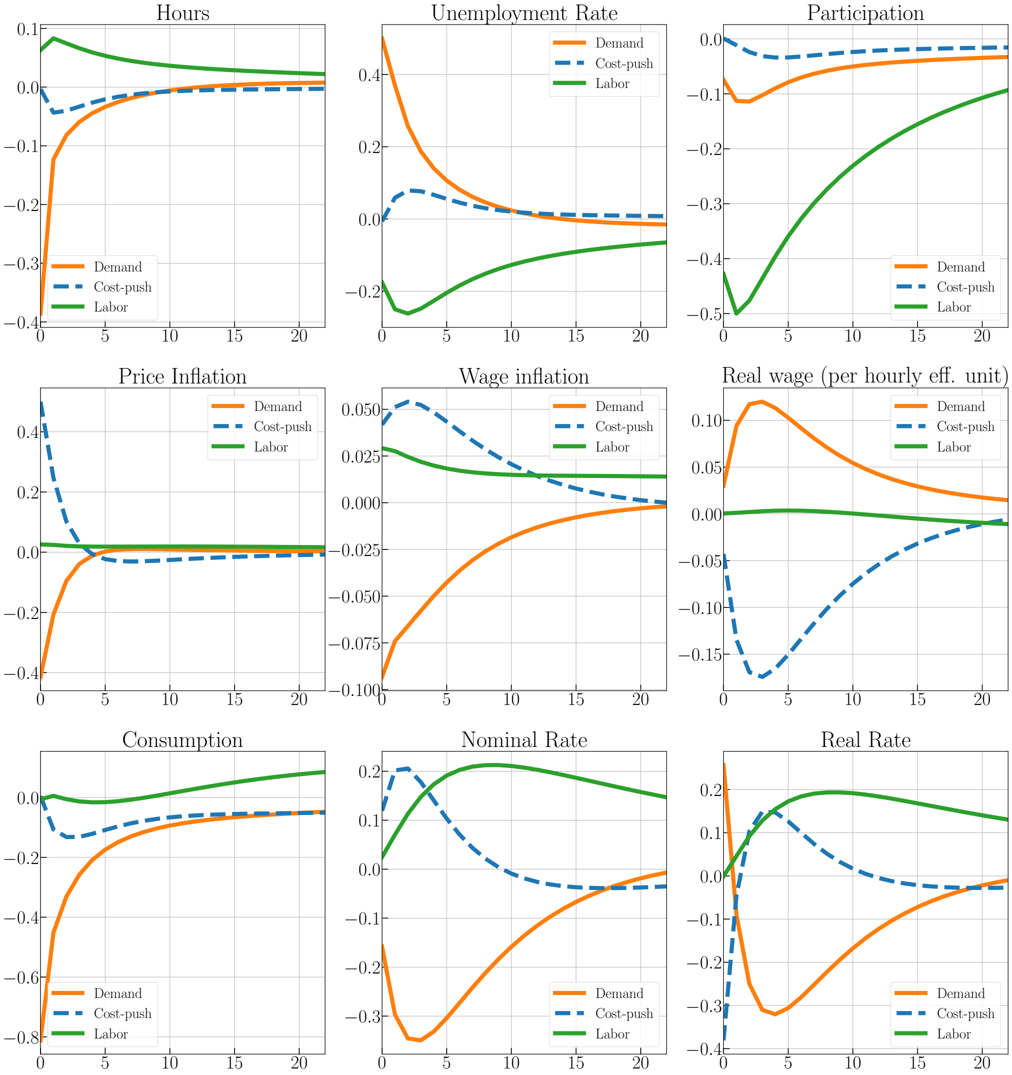
[45] This disturbance is akin to a "risk-premium" shock, common in the literature on estimated New Keynesian DSGE models, and routinely found to contribute significantly to the overall fluctuations of total hours worked in the US economy (see, e.g. Smets and Wouters, 2007; Galí et al., 2012).



Hours

Unemployment Rate

Participation

Price Inflation

Wage inflation

Real wage (per hourly eff. unit)

Consumption

Nominal Rate

Real Rate

Figure E1: Impulse response functions of some of model's aggregate variables to demand (ζ^d), mark-up (ζ^m), and labor supply (ζ^ℓ) shocks.

F Additional Results on Welfare Analysis

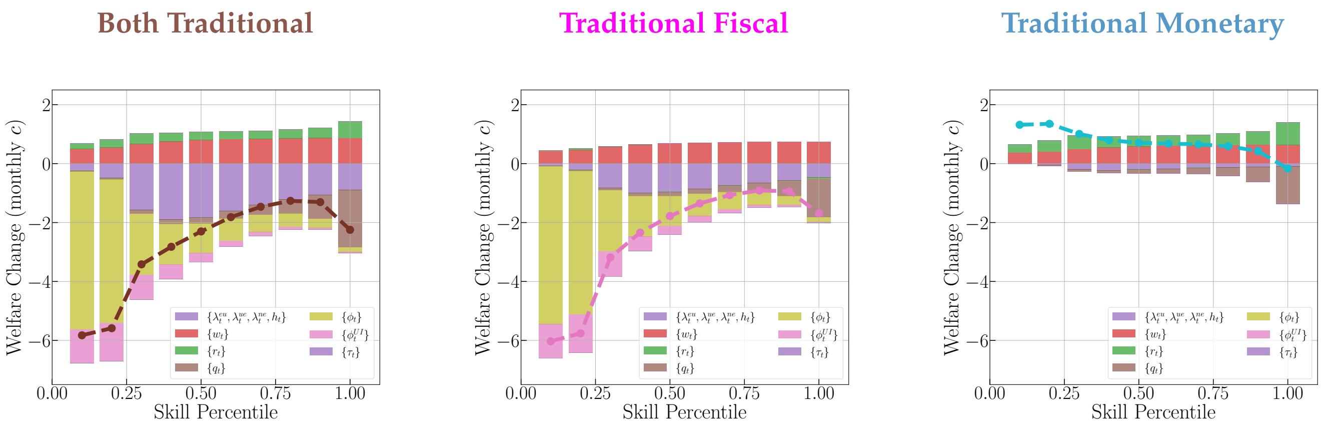


Figure F1: Full decomposition of welfare gains of counterfactual policies into all the individual components determining the labor market channel, the financial return channel and the transfers and taxes channel.

Note: Welfare effects are computed using the money-metric (18) and are expressed as a share of steady-state monthly consumption. Columns correspond to different counterfactual scenarios. *Note:* Values are expressed as a share of steady-state monthly consumption. Columns correspond to different counterfactual scenarios. The first row reports the distribution of welfare changes across households. The second row reports mean welfare changes by skill decile: the dashed line shows the total effect, and the bars decompose it into the effect of different inputs to the household problem (see main text for channel definitions). Differences between the total effect and the sum of the channels reflect nonlinearities in the value function.

Total Effect

	Both Traditional				Traditional Fiscal				Traditional Monetary			
Wealth	Q01	Q02	Q03	Q04	Q01	Q02	Q03	Q04	Q01	Q02	Q03	Q04
Q04	2.906	-1.303	-1.378	-1.771	1.255	-1.520	-1.109	-1.316	6.091	1.837	0.731	0.139
Q03	-3.143	-2.295	-1.479	-1.118	-3.425	-1.929	-1.082	-0.764	1.485	0.815	0.648	0.535
Q02	-4.168	-2.660	-1.739	-1.258	-4.286	-2.186	-1.249	-0.872	1.267	0.755	0.642	0.591
Q01	-5.901	-3.412	-2.335	-1.690	-5.987	-2.742	-1.662	-1.213	1.173	0.729	0.693	0.704

Skills

Labor Market

	Both Traditional				Traditional Fiscal				Traditional Monetary			
Wealth	Q01	Q02	Q03	Q04	Q01	Q02	Q03	Q04	Q01	Q02	Q03	Q04
Q04	-0.009	-0.675	-0.476	-0.113	0.003	-0.159	0.009	0.212	0.012	0.297	0.454	0.527
Q03	-0.410	-0.954	-0.596	-0.248	-0.052	-0.264	-0.052	0.138	0.240	0.346	0.454	0.533
Q02	-0.366	-1.063	-0.727	-0.276	0.004	-0.319	-0.126	0.138	0.298	0.339	0.451	0.581
Q01	0.077	-1.314	-0.896	-0.302	0.267	-0.437	-0.207	0.183	0.375	0.350	0.499	0.723

Skills

Financial Income

	Both Traditional				Traditional Fiscal				Traditional Monetary			
Wealth	Q01	Q02	Q03	Q04	Q01	Q02	Q03	Q04	Q01	Q02	Q03	Q04
Q04	5.634	1.067	-0.066	-0.917	4.269	0.374	-0.303	-0.939	6.688	1.646	0.302	-0.261
Q03	0.581	0.122	-0.047	-0.236	0.080	-0.151	-0.201	-0.313	0.861	0.331	0.152	-0.001
Q02	0.319	0.106	-0.010	-0.179	-0.031	-0.101	-0.142	-0.258	0.490	0.245	0.128	0.000
Q01	0.051	0.071	-0.001	-0.172	-0.085	-0.083	-0.127	-0.267	0.131	0.168	0.111	0.000

Skills

Fiscal

	Both Traditional				Traditional Fiscal				Traditional Monetary			
Wealth	Q01	Q02	Q03	Q04	Q01	Q02	Q03	Q04	Q01	Q02	Q03	Q04
Q04	-1.138	-1.168	-0.614	-0.282	-1.138	-1.168	-0.614	-0.282	0.000	0.000	0.000	0.000
Q03	-3.394	-1.468	-0.745	-0.444	-3.394	-1.468	-0.745	-0.444	0.000	0.000	0.000	0.000
Q02	-4.251	-1.757	-0.918	-0.564	-4.251	-1.757	-0.918	-0.564	0.000	0.000	0.000	0.000
Q01	-6.381	-2.254	-1.225	-0.793	-6.381	-2.254	-1.225	-0.793	0.000	0.000	0.000	0.000

Skills

Table F1: Welfare gains of counterfactual policies by skill and wealth.

Note: Welfare effects are computed using the money-metric (18) and are expressed as a share of steady-state monthly consumption. Columns correspond to different counterfactual scenarios. The top row displays the total welfare effects, while the second to fourth rows decompose the effect into the labor market, financial returns, and transfer and taxes channels (see main text for a description of the channels). Measures over skill and wealth groups are calculated by averaging our welfare metric according to the joint distribution of skills and wealth in steady state.