Debt-Financed Fiscal Stimulus, Heterogeneity, and Welfare*

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Abstract

This paper studies the welfare consequences of the debt-financed fiscal stimulus implemented in the United States during the 2020 recession. I develop an open economy heterogeneous-agent model calibrated to the U.S. and compute a transition between a pre-stimulus stationary equilibrium and a new equilibrium with a higher debt-to-GDP ratio resulting from the fiscal response to the recession. The transition path incorporates the observed evolution of government policies from 2020 to 2024. The model reproduces the dynamics in U.S. households' self-reported well-being through a novel empirical validation exercise that mimics households' survey responses, and rationalizes why well-being remained depressed during 2023 and 2024 despite low levels of unemployment and inflation — a puzzling fact for the literature. Behind this result, low- and middle-income households spend the stimulus transfers and gradually decumulate assets, while high-income households absorb these assets. The government policy generates lifetime welfare gains concentrated at the bottom of the wealth distribution, while households at the top experience small losses. Stimulus checks and the revaluation of assets are the key drivers of these results. In the counterfactual exercises, I find scope for further increases in debt and better-designed tax policies that increase welfare.

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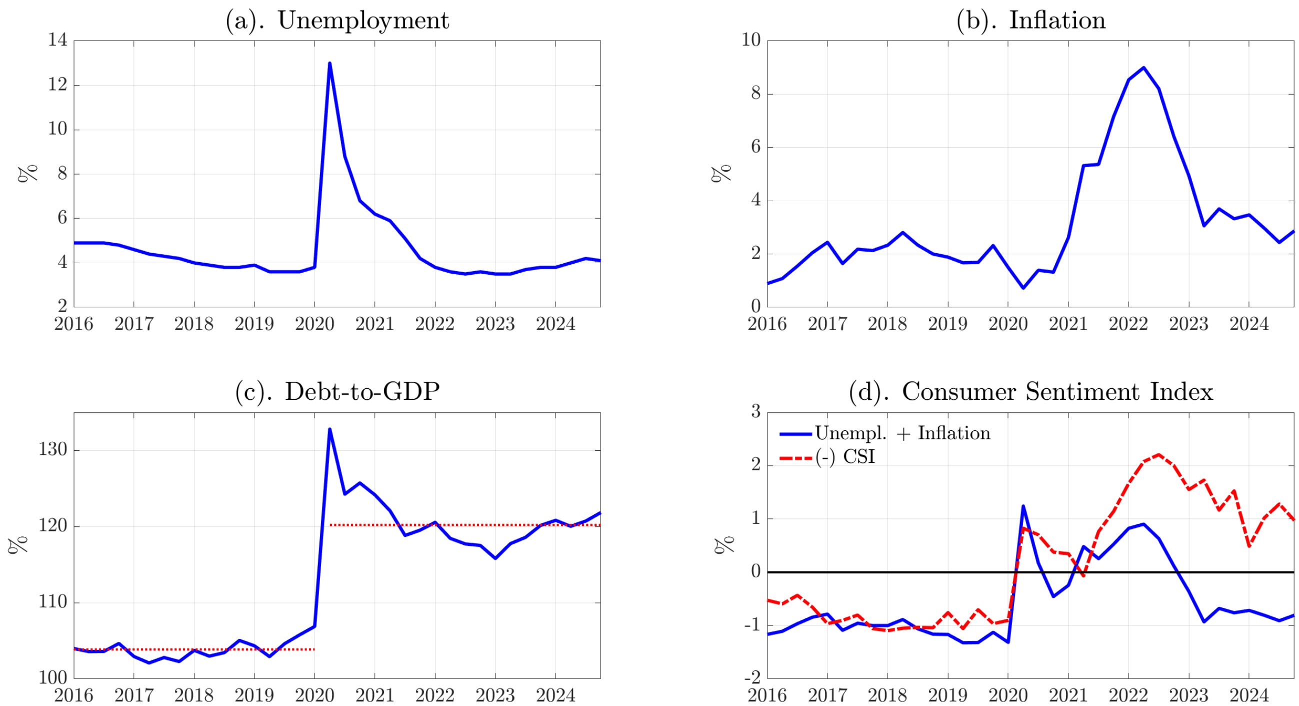
1 Introduction

During 2020 the pandemic triggered a deep recession and an unprecedented fiscal expansion in the United States. The federal government issued significant amounts of new debt to finance targeted transfers to households and firms. As shown in Figure 1, this period was marked by a surge in unemployment to nearly 13%, a rise in inflation that eventually peaked at 9%, and an increase in the federal debt-to-GDP ratio of about 15 percentage points. While unemployment and inflation returned to pre-pandemic levels by 2023, the debt-to-GDP ratio remained elevated.

Figure 1: Macroeconomic variables in the U.S: 2016-2024



Notes: Panel (a) plots the U.S. unemployment rate (percent, quarterly, seasonally adjusted); panel (b) shows the annual inflation rate based on the Consumer Price Index for All Urban Consumers (CPI-U); and panel (c) displays the public debt-to-GDP ratio. All series are from FRED for the period 2016–2024. Panel (d) presents the sum of unemployment and inflation, normalized to have mean zero and unit standard deviation, and the University of Michigan's Consumer Sentiment Index, standardized in the same way and multiplied by -1 for comparison.

Despite the normalization of unemployment and inflation, traditional measures of household well-being remain well below their pre-pandemic levels. Panel (d) of Figure 1 illustrates this divergence. The solid blue line plots the sum of unemployment and inflation, while the dashed red line shows the Consumer Sentiment Index (CSI), an index produced by the University of Michigan that measures households' perceptions of their financial situation and the broader economy. Both series are normalized for comparison. Historically, these indicators move closely together: when unemployment and inflation are low, reported economic well-being is high, and vice versa. In recent years, however, a persistent gap has emerged between the two. The combined measure of unemployment and inflation has fallen to roughly one standard deviation below its historical average, yet the CSI remains depressed and has not returned to its pre-pandemic level. This is puzzling because there is an extensive literature documenting a strong relationship between inflation, unemployment, and the CSI.

Motivated by these recent empirical regularities, I focus my analysis on three questions: First, who gains and who loses from the debt-financed fiscal stimulus, by how much, and why? Second, why did the consumer sentiment index remain depressed in 2023–2024, despite low levels of inflation and unemployment? Third, what alternative policies could have delivered better outcomes?

To answer these questions, I build an open economy heterogeneous agent model in the tradition of Bewley (1977), Imrohoroğlu (1989), Aiyagari (1994), and Huggett (1996), and compute a perfect foresight transition between a pre-stimulus stationary equilibrium and a new stationary equilibrium with a higher debt-to-GDP ratio resulting from the debt expansion during 2020. The transition incorporates the observed paths of government policies and main macroeconomic variables between 2020 and 2024. In the model, domestic households face time-varying idiosyncratic income and unemployment risk, and they self-insure by borrowing and saving in capital and long-term nominal bonds. Foreign households also save using these domestic bonds, and firms produce a final good using a constant-returns-to-scale technology with capital and labor as inputs. The government pays out transfers to households and finances its expenditures through taxes on labor and capital income and by issuing debt.

At period $t = 0$, which corresponds to 2020Q2, households and firms receive news about the future paths of lockdowns, unemployment, inflation, and foreign demand for domestic bonds. At the same time, the government announces a new fiscal policy plan, including the issuance of new debt and the distribution of transfers to households and firms. These transfers take the form of expanded unemployment insurance, stimulus checks, and capital subsidies. Lockdowns are modeled as a combination of two temporary constraints in the first period of the transition: one restricting labor supply and another limiting domestic consumption. After the initial announcement, agents have perfect foresight over the transition path, and the economy gradually converges to the new steady state.

The model is calibrated to match key moments of the U.S. economy in 2019 and disciplined along the transition to match the exact observed evolution of inflation, unemployment, and fiscal aggregates between 2020 and 2024, including public debt, government consumption, foreign bond holdings, and the stimulus package. The decline in GDP and consumption observed in 2020Q2 is calibrated to match the data through the lockdown constraints. The model then predicts the recovery in the following quarter, with consumption and output closely tracking the rebound observed in the data. The transition features a temporary decline in effective labor due to higher unemployment and restrictions on labor supply, together with an increase in real wages that gradually falls and stabilizes below the pre-pandemic level. Aggregate labor income drops sharply on impact, partially recovers during 2021–2022, and settles permanently below its initial steady state. With the arrival of news about future inflation and higher unemployment risk, the return on government bonds declines, reflecting stronger precautionary demand for assets, while the return on capital rises due to temporary firm subsidies. As labor market conditions improve and unemployment risk falls, interest rates increase, reaching a higher level in the new stationary equilibrium. Over the transition, the expansion of debt crowds out private capital, leading to a gradual decline in aggregate savings.

I test the predictions of the model through two empirical validation exercises. The first compares the model's implied evolution of aggregate wealth and its distribution to data from the Survey of Consumer Finances, showing that the model matches well both aggregate assets and the concentration of wealth between 2019 and 2022. The second exercise, which to the best of my knowledge is novel in the literature, uses the Michigan Survey of Consumers to evaluate the model's welfare implications. I simulate a large set of households over time, track each household's utility across periods, and compare its utility to that of one year earlier to replicate the question from the first item of the Consumer Sentiment Index: *"Would you say that you (and your family living there) are better off or worse off financially than you were a year ago?"*. Here, the model reproduces the dynamics observed in the survey responses, capturing the rise in self-reported well-being during 2020–2021 and the subsequent decline through 2023–2024.

Having developed a model that reproduces the depressed Consumer Sentiment Index observed in a period of low unemployment and inflation, I now examine the forces that drive this result. Two mechanisms operate simultaneously in the model. The first reflects how households respond to changes in idiosyncratic risk: higher unemployment risk in 2020 makes households temporarily worse off, while welfare tends to improve as employment recovers in the following years. The second mechanism captures households' responses to the aggregate states and quantitatively dominates the overall result. Low- and middle-income households receive stimulus payments, benefit from the revaluation of their asset positions, and accumulate savings early in the transition, but subsequently decumulate assets over time, leaving them worse off in 2023–2024 compared with earlier years. In contrast, high-income households absorb these assets, increasing their savings over the transition.

After validating the model's predictions, I quantify lifetime welfare gains and losses across the wealth distribution. Welfare is measured in consumption-equivalent terms, defined as the permanent change in consumption that makes a household indifferent between two scenarios: one in which the economy follows the transition induced by the fiscal stimulus, and another in which it remains permanently in the initial pre-stimulus steady state. The results show that most households gain from the policy. Average welfare increases by 1.82 percent in permanent consumption. At the bottom of the distribution, households in the 10th percentile experience the largest gains—about 3 percent relative to the initial steady state. Gains decline gradually across the distribution: at the 40th percentile welfare improves by roughly 2.5 percent, and at the 70th percentile by about 1.5 percent. At the very top, however, the pattern reverses: the richest households experience a small welfare loss of around 0.2 percent.

To understand the mechanisms behind these results, I conduct two complementary welfare decompositions. The first is a *partial-equilibrium decomposition*, in which I take the equilibrium sequences of prices and government policies from the baseline transition, hold one sequence at a time fixed at its initial steady-state level, and solve the household block. This exercise isolates the contribution of each sequence to the overall welfare results. I find that stimulus transfers and the revaluation of assets are the main drivers of the welfare gains. Transfers play a central role for low- and middle-income households: they allow these households to sustain consumption early in the transition, when lockdown constraints are binding, and they help relax borrowing constraints for those that are against the limit. Asset revaluation effects are particularly important for middle- and high-income households. Middle-income households hold a negative position in government bonds and a positive position in capital. The inflation path reduces the real value of their debt, while the temporarily higher return on capital induced by firm subsidies provides an additional source of gains. This increase in the return on capital is especially relevant for high-income households, whose portfolios are heavily weighted toward capital. By contrast, households at the bottom 10 percent are relatively insulated from interest rate dynamics, as they hold little wealth in either asset.

The second decomposition is an *aggregate decomposition*, which breaks down mean welfare into gains from aggregate efficiency, redistribution, and insurance, following Bhandari et al. (2023). I find that redistribution is the main driver, accounting for 62% of the mean welfare gains. As discussed earlier, the fiscal stimulus dilutes the real value of outstanding government bonds, shifting resources from wealthy to indebted households, while higher future taxes reinforce this channel through the progressive tax system. The insurance component explains 21% of the welfare gains, as the increase in public debt expands the supply of assets available to households, improving risk-sharing against idiosyncratic income shocks. The remaining 17% reflects gains in aggregate efficiency: transfers relax borrowing constraints, mitigating distortions from incomplete markets, and the lower real value of foreign-held debt reduces external liabilities, releasing resources to domestic households.

I use the model to run a series of counterfactual exercises to evaluate the alternative fiscal policies and external conditions. These scenarios include: removing capital subsidies to firms, reducing foreign demand for U.S. debt, allocating all new borrowing exclusively to stimulus checks, and extending the debt-to-GDP trajectory according to the Congressional Budget Office's long-term projections. Removing capital subsidies reduces the return on capital at the beginning of the transition and thus welfare at the top of the distribution. At the same time, the resources no longer used to subsidize firms are rebated to households via the progressive tax system, effectively lowering average tax rates. This reallocation favors low- and middle-income households, who experience higher welfare gains relative to the baseline. With lower foreign demand for government debt, domestic households absorb a greater share of the total issuance, leading to higher equilibrium interest rates. Wealthier households benefit from these higher returns, but the increased debt service requires higher future taxes, which fall disproportionately on low- and middle-income households and reduce their welfare relative to the baseline.

When the fiscal expansion is implemented exclusively through stimulus checks, mean welfare gains more than doubles relative to the baseline, with the benefits concentrated at the bottom of the distribution. Borrowing-constrained, unemployed, and low-income households use the additional transfers to support consumption in the early stages of the transition. However, this scenario limits the capital revaluation effects present in the baseline with firm subsidies, leaving the richest 10 percent worse off, as they neither benefit from asset revaluation nor receive direct transfers. Finally, under the CBO debt projections, results remain broadly similar to the baseline. The additional increases in the debt-to-GDP ratio occur far in the future and have a moderate effect on the present value of household utility. Along the transition, real interest rates are higher and labor taxes are generally lower in the first decades, as the government postpones tax increases by issuing additional debt each period. Toward the end of the transition, however, labor taxes rise as the debt service burden accumulates. These alternative paths increase welfare across the entire wealth distribution, amplifying the gains identified in the baseline scenario.

Related Literature. My paper is related to several strands of the literature. My work builds on the literature that has studied the role of public debt in heterogeneous agent economies. Heathcote (2005) analyzes optimal fiscal policy in incomplete markets, demonstrating how taxes and debt issuance can partially insure households against idiosyncratic income shocks while preserving incentives. Heathcote, Storesletten, and Violante (2017) extend this analysis by characterizing the optimal degree of tax progressivity in a heterogeneous agent framework, balancing redistribution, insurance, and efficiency. Kaplan and Violante (2014) develop a model of heterogeneous households that emphasizes the role of wealthy hand-to-mouth agents in amplifying the effects of fiscal stimulus policies. Bhandari et al. (2022) examine how incomplete markets shape optimal fiscal and debt management policies, emphasizing the redistributive role of debt alongside the future costs associated with higher debt levels. Ferriere and Navarro (2024) study the heterogeneous welfare effects of government spending depending on whether it is financed by taxes or debt. More recently, Aguiar, Amador, and Arellano (2024) show that in the Aiyagari model it is possible to design fiscal policies that deliver Pareto improvements across all agents when the interest rate on government debt is below the growth rate of the economy. Angeletos, Lian, and Wolf (2024) show that in non-Ricardian economies with nominal rigidities, it is possible for government deficits to be self-financing. Perhaps more related to my analysis, Cao, Gaspar, and Peralta-Alva (2024) build an overlapping generations model to show that the increase in the debt-to-GDP ratio, from 60% to 120%, is associated with a reduction in the capital stock of about 15% and a decrease in GDP of about 8%.

There is a large literature studying the effects of fiscal policies during the pandemic. Kaplan, Moll, and Violante (2020) explore the trade-offs between health outcomes and the distribution of economic outcomes associated with alternative policy responses to the pandemic. Auclert, Rognlie, and Straub (2023) analyze the distribution of excess savings during 2020-2022 across households and its relationship to the dynamics of aggregate demand. They find that the poorest households with the highest marginal propensities to consume spend down their excess savings the fastest. Aggarwal et al. (2023) revisit the effects of debt-financed fiscal transfers in a model of the world economy. Castro (2021) analyzes the U.S. fiscal response using a two-agent New Keynesian model and finds that direct transfers played a key role in mitigating the downturn. Guerrieri et al. (2022) highlight the amplification effects of "Keynesian supply shocks," where supply disruptions reduce aggregate demand, motivating the need for aggressive fiscal interventions. Other studies include Bayer et al. (2023), Carroll et al. (2021), Pallotti et al. (2024), Fourakis and Karabarbounis (2024). This paper complements previous studies by focusing on the welfare implications of the fiscal stimulus and its relationship with the depressed self-reported well-being during 2023 and 2024.

My work also contributes to the literature studying the relationship between aggregate macroeconomic variables and households' self-reported well-being. Early contributions studied the welfare implications of macroeconomic policies using a social welfare function that depends on inflation and unemployment (Nordhaus (1975), Barro and Gordon (1983), Blanchard and Fischer (1989), Persson and Tabellini (1990)). Barro (1999) proposes Arthur Okun's Economic Discomfort Index, later called "Misery Index" - the unweighted sum of these two variables - to measure the economic social costs of different U.S. administrations. In pioneering studies, Lovell and Tien (2000) and Di Tella, MacCulloch, and Oswald (2001) use life-satisfaction survey data to examine how reported well-being responds to changes in unemployment and inflation, finding that unemployment more heavily influences unhappiness than inflation. Di Tella, MacCulloch, and Oswald (2003) find similar results after controlling for individual characteristics and different fixed effects. Welsch (2007) includes growth rate and the long-term interest rate as additional variables in life satisfaction regressions. More recently, Bolhuis et al. (2024) document the disconnect between inflation and unemployment, and the consumer sentiment index since 2023, arguing that elevated interest rates are the primary driver of this pattern. My paper provides an alternative explanation for this disconnection based on the deaccumulation of assets from low- and middle-income households, and proposes a novel empirical validation method that confirms its predictions.

Finally, my work highlights the importance of interest rates and inflation in determining welfare across the wealth distribution. As such, it relates to work that explores the distributional consequences of monetary policy and inflation (Doepke and Schneider (2006), Coibion et al. (2017), Auclert (2019), McKay and Wolf (2023), Pugsley and Rubinton (2023)), the role of agent heterogeneity in amplifying economic outcomes (Kaplan, Moll, and Violante (2018), Auclert, Rognlie, and Straub (2023), Kekre and Lenel (2022)), and welfare implications of changes in assets prices (Fagereng et al. (2025), Del-Canto et al. (2025), among others).

Outline. The rest of the article proceeds as follows. Section 2 presents the model and Section 3 defines the equilibrium concept. Section 4 describes the calibration while Section 5 presents the quantitative analysis. Section 6 provides an empirical validation of the main predictions of the model, Section 7 presents the main results, and Section 8 presents the main counterfactual exercises. Section 9 concludes. An online appendix contains additional details on the income process (Appendix A), mathematical derivations (Appendix B), additional figures (Appendix C), additional details on data construction and treatment (Appendix D), and a description of the computational algorithm (Appendix E).

2 Model

I build an open economy heterogeneous agent model in the spirit of Bewley (1977), Imrohoroğlu (1989), Aiyagari (1994), and Huggett (1996). Time is discrete and indexed by $t \in \{1, 2, \dots\}$. There is no aggregate uncertainty, and I assume an exogenous inflation rate. The economy is populated by domestic and foreign households, final good firms, and a government. Domestic households supply labor, consume final goods, face time-varying idiosyncratic income risk, and self-insure by saving and borrowing in capital and long-term nominal bonds. Foreign households also demand domestic bonds. Firms produce the final good using a constant-returns-to-scale technology with capital and labor as inputs. The government pays out transfers to households and finances its expenditures through labor and capital income taxes as well as bond issuance. I consider a perfect foresight transition sequence between an initial stationary equilibrium with a given stock of government debt and a new stationary equilibrium with a higher debt-to-GDP ratio following a one-time zero-probability shock. In the following subsections, I describe each block of the model.

2.1 Domestic Households

Preferences. The economy is populated by a unit continuum of ex-ante identical households indexed by $i \in [0, 1]$. Household preferences are given by the following Epstein and Zin (1989) utility function:

$$V_{it} = \left\{ (1-\beta) x_{it}^{1-1/\xi} + \beta \left[\mathbb{E}\left(V_{it+1}^{1-\gamma} \right) \right]^{\frac{1-1/\xi}{1-\gamma}} \right\}^{\frac{1}{1-1/\xi}} \tag{1}$$

where $\mathbb{E}$ denotes the expectation operator over idiosyncratic states, $\beta \in (0, 1)$ is the discount factor, ξ is the elasticity of intertemporal substitution, γ is the risk aversion coefficient, and x is the Greenwood, Hercowitz, and Huffman (1988) composite of consumption and labor:

$$x_{it} = c_{it} - \theta \frac{n_{it}^{1-1/\nu}}{1 - 1/\nu} \tag{2}$$

where c_{it} denotes consumption of the final good in period t, which is sold at a nominal price P_t, and n_{it} denotes the amount of labor supplied in period t. The parameter ν controls the Frisch elasticity of labor supply, and θ is a labor disutility parameter.

Idiosyncratic income risk. Households face uninsurable risk to their individual incomes. Let $z_{it} \geq 0$ be the idiosyncratic component of household i's income at date t. This idiosyncratic component follows a Markov process with mean normalized to one, $\mathbb{E}(z_{it}) = 1$ for all t, evolves according to a time-varying transition matrix Ω_t, and has an "unemployment state" in which $z_{it} = 0$. The probability that an unemployed worker stays unemployed, denoted as the U-U transition probability is given by $P_t^{uu} \equiv \text{Prob}(z_{it} = 0 \mid z_{it-1} = 0)$ and the probability that an employed worker remains employed, referred to as the E-E transition probability, is $P_t^{ee} \equiv \text{Prob}(z_{it} > 0 \mid z_{it-1} > 0)$. As I will discuss in the calibration, these probabilities help capture the dynamics of the labor market occurred since 2020. Appendix A provides additional details of the income process and the transition probability matrices.

Budget and borrowing constraints. When households provide $n_{it} \geq 0$ units of labor, they receive $W_t z_{it} n_{it}$ in labor earnings, where W_t is the nominal wage rate per efficiency unit of labor. Households receive different transfers from the government depending on their total labor earnings. As I describe in detail later, labor income is taxed in a progressive way according to a Heathcote, Storesletten, and Violante (2017) tax and transfer scheme $\mathcal{T}$ that depends on a tax rate τ_t^n, so high-income households pay labor income taxes while low-income households receive a net transfer. Households also receive unemployment benefits, $P_t T_t^u$, when they are unemployed, and potentially lump-sum transfers, $P_t T_t^s$, in the form of "stimulus checks" if their income is below certain threshold, which happens when $z_{it} < \bar{z}$.

Households can save in two different assets: long-term non-state contingent nominal bonds $\tilde{b}_{it}$ and capital k_{it}. Let $b_{it} \equiv \tilde{b}_{it}/P_{t-1}$ be the real bond position of household i at the beginning of period t (chosen in period $t-1$), and q_{t-1} be the bond price. At the start of period t, household i has b_{it} and k_{it} units of financial assets, which receive a real return $(1 + r_t^k)$ and $(1 + r_t^b)$ in period t, respectively. Since there is no aggregate uncertainty, both assets provide the same returns along any equilibrium transition path, with the possible exception of period 0, where the arrival of news about the economy may lead to a revaluation of asset prices and heterogeneous realized returns across households. Hence, for $t > 0$, there is no need to model a portfolio choice, as it is enough to track each household's net asset position, and not their individual holdings. Letting $a_{it} = k_{it} + q_{t-1} b_{it}$ denote household i's asset position in period t, and $(1 + r_t)$ the equalized gross return on assets in period $t > 0$, the overall budget constraints in real terms are:

$$c_{it} + a_{it+1} \leq w_t z_{it} n_{it} + (1+r_t) a_{it} - \mathcal{T}(w_t z_{it} n_{it}) + T^u_t \cdot \mathbb{1}_{z_{it}=0} + T^s_t \cdot \mathbb{1}_{z_{it}<\bar{z}}; \quad \text{for } t > 0 \tag{3}$$

$$c_{i0} + a_{i1} \leq w_0 z_{i0} n_{i0} + (1+r^k_0) k_{i0} + (1+r^b_0) q_{-1} b_{i0} - \mathcal{T}(w_0 z_{i0} n_{i0}) + T^u_0 \cdot \mathbb{1}_{z_{i0}=0} + T^s_0 \cdot \mathbb{1}_{z_{i0}<\bar{z}} \tag{4}$$

where $w_t \equiv W_t/P_t$ is the equilibrium real wage per efficiency unit of labor, and $\mathbb{1}$ is an indicator function that takes the value of 1 when the condition in the subscript is satisfied. I write separately in (4) the budget constraint in period 0 to make explicit that returns on each asset are not necessarily equalized. Finally, I impose a standard borrowing constraint on total household assets:

$$a_{it+1} \geq \underline{a} \tag{5}$$

where $\underline{a} \leq 0$.

Lockdown constraints. I introduce a lockdown indicator $\text{lock}_t \in \{0, 1\}$ to model the restrictions on work and consumption observed during the pandemic. When $\text{lock}_t = 1$, households face constraints that limit their ability to work and consume, reflecting stay-at-home orders and reduced access to goods and services. Specifically, labor supply and consumption cannot exceed an individual-specific upper bound. These restrictions are written as

$$\mathbb{1}_{\text{lock}_t=1} \cdot (n_{it} - \bar{n}_i) \leq 0 \tag{6}$$

$$\mathbb{1}_{\text{lock}_t=1} \cdot (c_{it} - \bar{c}_i) \ \leq 0 \tag{7}$$

This setup follows Fourakis and Karabarbounis (2024) and will allow the model to match the observed drop in output and consumption in 2020Q2. I discuss in detail the calibration of $\bar{c}_i$ and $\bar{n}_i$ in section 4.2.

Recursive formulation. The household's problem can be formulated recursively. Let $s \equiv \{z, a\}$ be the vector of idiosyncratic state variables for an individual household. The aggregate states are the perfect-foresight sequences for factor prices $\{w_t\}_{t\geq 0}$, $\{r_t\}_{t\geq 1}$, r^b_0 and r^k_0, labor taxes $\left\{\tau^n_t\right\}_{t\geq 0}$, transfers $\left\{T^s_t, T^u_t\right\}_{t\geq 0}$, lockdown policies $\{\text{lock}_t\}_{t\geq 0}$ and the transition matrices for idiosyncratic productivity $\{\Omega_t\}_{t\geq 0}$. Given these states and an initial portfolio $\{q_{-1}b, k\}$, the household's problem is:

$$V_t(z,a) = \max_{c,n,a'} \left\{ (1-\beta)x^{1-1/\xi} + \beta \left[\mathbb{E}\left(V_{t+1}(z',a')^{1-\gamma} \right) \right]^{\frac{1-1/\xi}{1-\gamma}} \right\}^{\frac{1}{1-1/\xi}} \tag{8}$$

subject to:

$$\begin{aligned}
& c + a' \leq w_t zn + (1+r_t)a - \mathcal{T}(w_t zn) + T_t^u \cdot \mathbb{1}_{z=0} + T_t^s \cdot \mathbb{1}_{z<\bar{z}}; \quad \text{for } t > 0 \\
& c + a' \leq w_0 zn + (1+r_0^k)k + (1+r_0^b)q_{-1}b - \mathcal{T}(w_0 zn) + T_0^u \cdot \mathbb{1}_{z=0} + T_0^s \cdot \mathbb{1}_{z<\bar{z}} \\
& a' \geq \underline{a} \\
& \mathbb{1}_{\text{lock}_t=1} \cdot (n - \bar{n}) \leq 0 \\
& \mathbb{1}_{\text{lock}_t=1} \cdot (c - \bar{c}) \ \leq 0
\end{aligned}$$

Appendix B.2 shows the optimality conditions of this problem. Now let $c_{it}^{\star}(z,a)$, $n_{it}^{\star}(z)$ and $a_{it+1}^{\star}(z,a)$ be the optimal consumption, labor and saving policy functions in time t, respectively. The aggregate household consumption is:

$$C_t \equiv \int_i c_{it}^{\star}(z,a)di$$

Similarly, the aggregate effective labor supply is:

$$N_t \equiv \int_i z \cdot n_{it}^{\star}(z)di$$

and the aggregate stock of savings chosen in period t and carried into period $t+1$ is:

$$\mathcal{A}_{t+1} \equiv \int_i a_{it+1}^{\star}(z,a)di$$

2.2 Foreign Households

I assume that foreign households demand government bonds. Let $B_{t+1}^{\star}$ denote the real position of these households in domestic bonds at the beginning of period $t+1$, chosen in period t. Their demand is specified by:

$$B_{t+1}^{\star} = \Psi_t \cdot q_t^{-\chi} \tag{9}$$

where q_t is the bond price in period t, $\chi > 0$ governs the elasticity of foreign demand with respect to the bond price, and Ψ_t is an exogenous shifter.

2.3 Firms

The final good is produced by a representative firm in a perfectly competitive market using a standard constant-returns to scale technology given by:

$$F(K_t, L_t) = ZK_t^{\alpha} L_t^{1-\alpha} \tag{10}$$

where K_t is capital and L_t is effective units of labor in period t, α is the capital share and Z is a productivity parameter. Firms hire labor at a wage rate w_t, rent capital at a pre-tax rate $\hat{r}_t^k$, and pay a proportional tax (or receive a proportional subsidy) τ_t^k on factor payments for capital. The firm's first order conditions are:

$$F_K(K_t, L_t) = (1 + \tau_t^k)\hat{r}_t^k \tag{11}$$

$$F_L(K_t, L_t) = w_t \tag{12}$$

Equations (11) and (12) are standard: the firm demands aggregate capital and effective units of labor up to the point where the marginal product of each factor is equal to the marginal cost.

2.4 Asset Structure

In this economy there are two different assets: a long-term nominal bond and capital. Domestic and foreign households can purchase a unit of the bond for a real price q_t. Let $\pi_t \equiv P_t/P_{t-1} - 1$ be the inflation rate in period t. As in Hatchondo and Martinez (2009), I assume that a bond issued in period t promises $(\bar{\imath} + \vartheta)(1 - \vartheta)^{j-1}/(1 + \pi_{j+1})$ units of the final good in period $t + j$. As such, the stream of coupons decays at an exogenous constant rate ϑ, and each unit of the bond calls for a real payment of $(\bar{\imath} + \vartheta)/(1 + \pi_{t+j})$ for every period $j \geq 1$. Hence, the bond holdings' dynamics of household i are given by:

$$b_{it+1} = \ell_{it} + \left(\frac{1 - \vartheta}{1 + \pi_t}\right) b_{it} \tag{13}$$

where b_{it} is the stock of bonds for household i at the beginning of period t, and ℓ_{it} represents the new savings. On the other hand, capital depreciates every period at a rate δ.

Assets returns and no-arbitrage. The returns on each asset are the following:

1. *Long-term nominal bond*: A household that purchases a bond in period $t - 1$ receives in period

t a real coupon of $(\bar{i} + \vartheta)/(1 + \pi_t)$ and retains a fraction $(1 - \vartheta)/(1 + \pi_t)$ of the asset position, now valued at a price q_t. The constant $\bar{i}$ is such that the bond price is equal to one in steady-state, while the parameter ϑ controls the maturity of the bond. It follows from the discussion above that:

$$1 + r_t^b = \frac{(\bar{i} + \vartheta)/(1 + \pi_t) + [(1 - \vartheta)/(1 + \pi_t)]q_t}{q_{t-1}} \tag{14}$$

2. *Capital*: A unit of capital has a price of one unit of the final good. The payoff of a unit of capital is the rental rate of capital, net of depreciation:

$$1 + r_t^k = 1 + \hat{r}_t^k - \delta \tag{15}$$

Due to no-arbitrage, the rental rate of capital net of depreciation is equated to the return on bonds along the equilibrium transition path for all $t > 0$: $r_t^b = r_t^k = r_t$.

Revaluation of assets. At time 0, returns are not necessarily equalized due to the arrival of unanticipated shocks. Households start period 0 with some positions in bonds and capital; these positions will be reevaluated when news about the economy arrives, leading to unexpected fluctuations in returns captured by r_0^k and r_0^b. The distributional consequences of the date-0 shock, therefore, will depend on the composition of their portfolios. Appendix B.1 shows how these revaluation effects affect the budget constraint of the households. As I explain later, I discipline the initial distribution of portfolios using data from the Survey of Consumer Finances.

2.5 Government

The government raises revenue through labor and capital taxation, issues long-term nominal bonds, and allocates these resources toward interest payments on bonds, transfers to households, and public consumption expenditures.

Taxes and transfers.

1. *Labor income:* In order to capture the extent of redistribution embedded in the U.S. tax system, the government administers a nonlinear tax and transfer scheme on labor income as in Heathcote,

Storesletten, and Violante (2017):

$$\mathcal{T}(w_t z_{it} n_{it}) = w_t z_{it} n_{it} - (1 - \tau_t^n)(w_t z_{it} n_{it})^{1-\tau} \tag{16}$$

where $\mathcal{T}(w_t z_{it} n_{it})$ represents the net tax of a household with labor income $w_t z_{it} n_{it}$. The tax rate τ_t^n controls the level of taxation, while the parameter τ is a measure of tax progressivity. This rate will serve as a residual fiscal instrument, helping to ensure that the government budget constraint is satisfied each period. Note that at the break-even labor income level $(1 - \tau_t^n)^{1/\tau}$ the average tax rate is zero, so households with labor earnings below this level obtain a net transfer from the government while those above it pay taxes.

2. *Capital income:* Firms are subject to a linear tax on capital income. Specifically, a time-varying tax rate τ_t^k is applied to their gross capital returns $\hat{r}_t^k K_t$. This approach reflects the fact that, in practice, corporate income is taxed at the firm level in the U.S. In the model, this tax becomes negative during the pandemic, effectively turning into a subsidy to firms. This captures the large-scale support the Federal government provided to businesses in 2020, including tax relief and forgivable loans under programs like the Paycheck Protection Program.

3. *Unemployment insurance:* Households who are unemployed in period t receive a real transfer T_t^u from the government. The transfer does not depend on previous earnings or employment history and is the same across all unemployed households. This captures the basic structure of unemployment benefits in the U.S., which provide support to households with no labor income. While the transfer is always in place in the model, I will show later in the calibration that unemployment insurance played a larger role during the pandemic, when the government temporarily expanded benefits as part of the broader stimulus package.

4. *Lump-sum transfers:* The government provides real lump-sum transfers to households T_t^s, conditional on whether their income falls below an eligibility threshold. This formulation is designed to reflect the structure of the economic impact payments distributed by the Federal government during the pandemic, where stimulus checks were targeted toward lower- and middle-income households. In the model, households with income below a government-specified cutoff receive a fixed transfer, while those above the threshold do not.

Government debt. As previously discussed, I assume that the government issues long-term bonds. This means that the government receives resources from new bond issuances but must also service its outstanding debt by paying coupons each period on previously issued bonds. Since I focus on a perfect foresight transition path, the absence of aggregate uncertainty implies that the maturity structure of government bonds is irrelevant for periods $t > 1$. However, in period 0, the maturity profile matters due to revaluation effects, analogous to the earlier discussion on the valuation of assets in households' portfolios.

Budget constraint. The government also consumes resources each period through public spending, denoted by G_t. Its budget constraint in real terms is given by:

$$\tau_t^k \hat{r}_t^k K_t + q_t \ell_t + \int_i \mathcal{T}(w_t z_{it} n_{it})\, di = \left(\frac{\bar{i} + \vartheta}{1 + \pi_t}\right) B_t + \int_i T_t \cdot \mathbb{1}_{z_{it} < \bar{z}}\, di + \int_i T_t^u \cdot \mathbb{1}_{z_{it} = 0}\, di + G_t \tag{17}$$

where B_t denotes the stock of government bonds in period t and $\ell_t = B_{t+1} - [(1-\vartheta)/(1+\pi_t)]\, B_t$ is the new issuance. The left-hand side of the equation represents the government's total revenue: capital income tax revenue, new resources from issuing long-term bonds, and net revenue from labor income taxation. The right-hand side reflects total expenditures: interest payments on existing debt, unemployment insurance transfers, lump-sum transfers, and government consumption or other public spending G_t.

2.6 Market Clearing

Market clearing in the labor market requires that the total supply of efficiency units of labor from households equals the aggregate labor demand by firms:

$$N_t = L_t \tag{18}$$

Asset market clearing requires that the aggregate stock of household savings equals the value of the capital stock demanded by firms plus the market value of government debt held domestically:

$$t > 0: \quad \mathcal{A}_t = q_{t-1}\left(B_t - B_t^\star\right) + K_t \tag{19}$$

$$t = 0: \quad \mathcal{B}_0 = B_0 - B_0^\star \quad \text{and} \quad \mathcal{K}_0 = K_0 \tag{20}$$

where $\mathcal{B}_0 \equiv \int_i b^{\star}_{i0}\, di$ and $\mathcal{K}_0 \equiv \int_i k^{\star}_{i0}\, di$ denote the initial aggregate holdings of government bonds and physical capital by domestic households, and $B^{\star}_t$ is the foreign bond position. The resource constraint for final goods requires that total output is allocated to household consumption, investment, government spending, and net exports:

$$F(K_t, N_t) = C_t + I_t + G_t + NX_t \tag{21}$$

where investment is given by $I_t := K_{t+1} - (1-\delta)K_t$ and net exports are defined as $NX_t := q_t B^{\star}_{t+1} - (1 + r_t)q_{t-1}B^{\star}_t$, capturing the change in the real value of the foreign asset position.

3 Equilibrium

I can now define the competitive equilibrium of this economy as follows:

Definition 1 (Competitive Equilibrium). *Given an initial distribution of household assets and idiosyncratic productivities* $\{b_{i0}, k_{i0}, z_{i0}\}_{i\in[0,1]}$, *a sequence of transition matrices* $\{\Omega_t\}_{t\geq 0}$, *and a government policy composed by a fiscal policy* $\{B_t, \tau^n_t, \tau^k_t, T_t, T^u_t, G_t\}_{t\geq 0}$ *and a lockdown policy* $\{\text{lock}_t\}_{t\geq 0}$, *an equilibrium is a sequence of aggregates* $\{\mathcal{A}_t, B^{\star}_t, K_t, N_t, Y_t, C_t\}_{t\geq 0}$, *and prices* $\{q_t, r^b_t, r^k_t, w_t\}_{t\geq 0}$ *such that:*

- *Given prices, transition matrices and government policy, households optimize*
- *Given prices and government policy, firms optimize*
- *The sequential government budget constraint is satisfied*
- *The no-arbitrage condition is satisfied for* $t > 0$
- *Markets clear*

I define a stationary equilibrium to be an equilibrium in which all sequences are constant over time, with $\text{lock}_t = 0$ for all t and $\Omega_t = \bar{\Omega}$ for all t and some transition matrix $\bar{\Omega}$.

4 Calibration

The model is calibrated to the U.S. economy using quarterly data spanning 2019 to 2024. Some parameters are set to values commonly used in the literature, while others are calibrated using various empirical sources. The initial stationary equilibrium is calibrated using data from 2019Q1 to 2019Q4. The transition path begins in 2020Q2, and I use observed time series through 2024Q4 to discipline the evolution of key aggregate variables. I take 2020Q2 as the initial period of the transition, coinciding with the onset of the pandemic and the expansion of federal government debt.

4.1 Initial Steady-State

Income process. Since the debt-expansion involves changes in interest rates and revaluation effects arising from changes in asset prices, it is important that the model replicates the empirical distribution of wealth, particularly its concentration in the upper tail. To do so, I follow the estimation procedure of Guvenen, McKay, and Ryan (2023) and McKay and Wolf (2023), and specify an income process that includes unemployed households, regular workers, and high earners. Formally, the log income of an employed individual i at time t, denoted y_{it}, is given by:

$$\log y_{it} = \log(z_{it})(1 + \chi \log y_t) + \log \bar{e}_t + \mu_i + \epsilon^y_{it} \tag{22}$$

where μ_i is an individual fixed effect, ϵ^y_{it} is a transitory income shock drawn from a mixture of two normal distributions, χ is a parameter that controls the sensitivity of income dispersion to the aggregate business cycle, and e_t is a normalization constant. For regular workers, the state $\log(z_{it})$ follows an AR(1) process:

$$\log(z_{it}) = \rho^z \log(z_{it-1}) + \epsilon^z_{it}$$

where ϵ^z_{it} represents transitory innovations drawn from a normal distribution. High-earning households can receive one of two high levels of earnings $\{z^H_1, z^H_2\}$. I extend the specification proposed in McKay and Wolf (2023), who estimate a flexible income process that allows for heterogeneous exposure to aggregate fluctuations and match a set of moments from the wealth and income distribution, as well as additional moments using Social Security Administration data. I start from their baseline parameterization without unemployment and add an unemployment state where $z_{it} = 0$.

I discipline the transition probabilities into and out of unemployment using monthly Labor Force Flows from 2019. Specifically, I use employed-to-employed and unemployed-to-unemployed flows, along with the monthly employment and unemployment stocks from the CPS. These flows are converted to quarterly frequencies, leading to an E-E transition probability of $P^{ee} = 0.97$ and a U-U transition probability of $P^{uu} = 0.40$, consistent with an unemployment rate of about 4% in the ergodic distribution. Appendix A describes in detail the equations of this process, and Appendix D.2 describes the computation of the transition probabilities in the data.

Assets portfolio. To map asset classes in the model to the data, I group the asset and liability categories reported in the Survey of Consumer Finances (SCF) into two main types: capital and bonds. I use data from 2019 since this is the last SCF survey before the COVID-19 recession. Capital includes direct holdings of corporate equities, business assets, and nonfinancial wealth such as real estate used in production. It also includes the share of retirement accounts and mutual funds that are invested in equities and similar assets. Bond holdings include deposits, short-term government bonds, and other liquid financial assets, net of total debt. For households with indirect holdings through retirement accounts and mutual funds, I use data from the Financial Accounts of the U.S. in 2019 to split these assets into capital and bond components. For example, in 2019, mutual funds allocated roughly 82% of their assets to corporate bonds and equities, and 18% to government bonds and liquid assets. Pension funds, which in turn invest in mutual funds, had about 22% of their holdings in mutual funds, 62% in corporate bonds and equities, and 16% in government and liquid claims. I use these shares to allocate mutual fund and pension fund wealth into capital and bond components, and then reassign those components to individual households in the SCF. Appendix D.1 provides additional details of these calculations. Table 1 summarizes the results, expressed as a fraction of total networth.

Table 1: Summary of Taxonomy of Assets

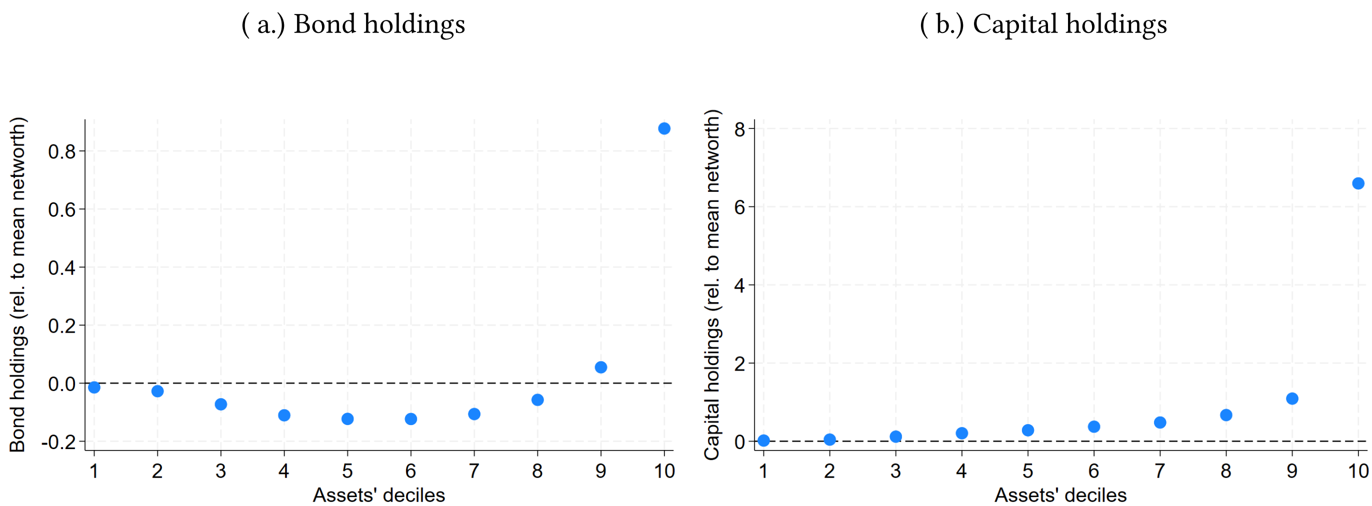
Bond holdings		**Capital holdings**		**Total**
Transaction accounts	5.5	Real estate	42.4	
Certificates of deposit	0.8	Durable goods and businesses	26.4	
Savings and directly held bonds	0.7	Corporate equities	6.3	
Mutual funds holdings	1.8	Mutual funds holdings	8.4	
Retirement accounts holdings	2.2	Retirement accounts holdings	8.9	
Other assets	8.1	Other assets	5.0	
Mortgage liabilities	-14.1			
Consumer credit and loans	-2.3			
Other debt	-0.2			
Total	2.5		97.5	100

Notes: This table shows the categorization of assets into bond and capital holdings. Values are expressed as a fraction of total net worth. Data comes from the 2019 Survey of Consumer Finances and the Financial Accounts of the U.S. See Appendix D.1 for details of the calculations.

Bond holdings represent 2.5% of total net worth, as all household debt—including mortgage liabilities, consumer credit, and other loans—is assigned to this asset category. The remaining 97.5% is held in the form of capital.

I use now this classification to assign asset portfolios across households in the model. For each net worth decile in the SCF, I calculate average holdings of capital and bonds relative to the mean level of wealth in the economy. These values, denoted by $k_i/\bar{a}$ and $qb_i/\bar{a}$, are used to determine each household's initial position in the model's steady state. This step helps the model reflect the differences in portfolio composition across the wealth distribution, and will discipline the revaluation effects across households. Figure 2 displays the composition of household portfolios by wealth decile.

Figure 2: Portfolios across the wealth distribution



Notes: This figure shows the composition of household portfolios across asset deciles, using data from the 2019 Survey of Consumer Finances (SCF) and the 2019 Flow of Funds. Panel (a) plots bond holdings and Panel (b) plots capital holdings, both expressed relative to the aggregate mean net worth.

Fiscal policy. I now turn to the calibration of fiscal policy in the initial steady state. To this end, I target average fiscal ratios to GDP using data from the National Income and Product Accounts (NIPA) Table 3.2 for the year 2019. Government debt is set at 105% of GDP, matching the level of federal debt held by the public. Government consumption is calibrated to 5% of GDP, corresponding to the average of total government expenditures on goods and services over that year. Unemployment insurance is set to 0.5% of GDP, pinned down from Table 2.6 by the average spending on unemployment benefits as a share of GDP across the four quarters of 2019.

Capital income taxes in the model are calibrated to match the combined revenues from corporate income taxes, Social Security contributions paid by employers, and current transfer receipts from businesses, amounting 4% of GDP. For the social security component, I calculate the share paid by employers using data from NIPA Table 3.6 by dividing employer contributions by total contributions in 2019, which gives 45%. The capital income tax rate is set to $\tau^k = 0.138$ to replicate this 4% ratio. The labor income tax rate is set so that the government budget constraint holds with equality in the steady state. This residual tax is $\tau_n = 0.149$ and ensures that, given all other components of fiscal policy, total government revenues match expenditures. Finally, I assume that $T^s = 0$, so there are no steady-state lump-sum transfers. See Appendix D.4 for additional details on these calculations.

External debt. I target the ratio of foreign holdings of government debt to GDP using data on federal debt held by foreign and international investors as a percent of GDP for 2019Q1–2019Q4, published by the U.S. Office of Management and Budget and the St. Louis Fed. Since the bond price equals one in the initial steady state, I set $\Psi = 0.31\bar{y}$ to match an external debt-to-GDP ratio of 31%, in line with the data.

Other parameters. I set the intertemporal elasticity of substitution to 1 and the coefficient of relative risk aversion to 4, both standard values in the literature. The Frisch elasticity of labor supply is set to 1, in line with Pistaferri (2003), and the disutility of labor parameter θ is normalized to 1. The annualized inflation rate is fixed at 2%, consistent with the Federal Reserve's inflation target. The progressivity parameter of the tax function is $\tau = 0.181$, following Heathcote, Storesletten, and Violante (2017), while the elasticity of foreign demand with respect to the bond price is calibrated to $\chi = 0.44$ based on Krishnamurthy and Vissing-Jorgensen (2012)'s estimates of the semi-elasticity of the demand curve for Treasury securities held by the foreign private sector.

The household discount factor is set to 0.988 to target net worth-to-GDP ratio of 506%, in line with calculations based on the 2019 Survey of Consumer Finances. The decay rate of government bonds, ϑ, is chosen to match a Macaulay duration of 5 years, consistent with estimates of the federal government's debt maturity structure reported by Lannoy et al. (2022). The coupon rate parameter is set to $\bar{i} = 0.03$ and normalizes the bond price in the initial steady state to 1. The depreciation rate is $\delta = 0.014$, targeting a capital-to-GDP ratio of 401% consistent with the difference between the networth and debt-to-GDP ratios. The borrowing constraint is calibrated to $\underline{a} = -0.02$, targeting the net worth of the 10th percentile of the U.S. wealth distribution. Finally, the capital share of income is $\alpha = 0.33$, a standard value in the literature, and the total factor productivity is $Z = 0.035$, consistent with an average annual real interest rate of 1% in 2019. All parameters are summarized in Table 2.

Table 2: Parameter Values

Parameters Set Externally	**Value**	**Target statistic/Source**
Preferences		
Intertemporal elasticity of substitution	$\xi = 1$	Standard business cycles literature
Risk aversion coefficient	$\gamma = 4$	Standard business cycles literature
Frisch elasticity	$\nu = 1$	Pistaferri (2003)
Labor disutility parameter	$\theta = 1$	Normalization
Other parameters		
Inflation rate	$\bar{\pi} = 0.02$	Federal Reserve inflation target
Progressivity parameter	$\tau = 0.181$	Heathcote, Storesletten, and Violante (2017)
Foreign demand elasticity	$\chi = 0.44$	Krishnamurthy and Vissing-Jorgensen (2012)
Parameters Set Internally	**Value**	
Preferences		
Discount factor	$\beta = 0.988$	Networth-to-GDP ratio
Probability of E-E transition	$P^{ee} = 0.97$	E-E labor market flows
Probability of U-U transition	$P^{uu} = 0.40$	U-U labor market flows
Assets		
Debt decay parameter	$\vartheta = 0.041$	Federal debt Macaulay duration
Coupon rate parameter	$\bar{i} = 0.03$	Bond price normalization
Foreign demand shifter	$\Psi = 0.31\bar{y}$	External debt-to-GDP
Depreciation rate	$\delta = 0.014$	Capital-to-GDP ratio
Borrowing limit	$\underline{a} = -0.02$	Tenth percentile of net worth
Production		
Capital share	$\alpha = 0.33$	Capital share of income
Productivity parameter	$Z = 0.035$	Steady-state real interest rate
Fiscal policy		
Capital income tax	$\tau^k = 0.138$	Tax revenue from firms
Labor income tax	$\tau^n = 0.183$	Government budget constraint
Steady-state unemployment insurance	$T^u = 0.005\bar{y}$	Unemployment insurance-to-GDP ratio
Steady-state lump-sum transfers	$T^s = 0$	No stimulus checks in steady state
Idiosyncratic productivity threshold	$\bar{z} = 1.52$	Stimulus checks eligibility

4.2 Transition Path

Now, I describe the calibration of the time paths fed into the model along the transition. The goal here is to capture the economic impacts of the pandemic, including the increase in unemployment, disruptions in labor supply and consumption due to lockdowns, the decline in output, as well as the government's fiscal policy response through transfers to households and firms, and the evolution of the foreign holdings of government debt.

Labor force flows. I introduce time-varying transition probabilities that govern flows between employment states. As in the initial steady state calibration, I compute the E–E and U-U transition probabilities using monthly data from the Labor Force Statistics of the CPS. This produces quarterly transition probability paths $\{P^{ee}_t, P^{uu}_t\}_{t\geq 0}$ starting in 2020Q2, which gradually converge back to their pre-pandemic steady-state values by 2022Q1. As I will show later, these flows closely replicate the observed unemployment dynamics during this period, capturing the rise to 15% in 2020Q2 and its subsequent decline to approximately 4% within two years.

Lockdowns. As explained in Section 2.1, I model the economic impact of the lockdowns through temporary constraints on household labor supply and consumption. These constraints are motivated by stay-at-home orders and limits on the consumption of services during 2020Q2. I feed into the model a time path for lock_t, which equals one only in 2020Q2 and zero otherwise. The constraint thresholds are defined as $\bar{n}_i = \Gamma_n n_i^{ss}$ and $\bar{c}_i = \Gamma_c c_i^{ss}$, where n_i^{ss} and c_i^{ss} are household i's labor supply and consumption in the initial steady state. I calibrate $\Gamma_n = 0.88$ and $\Gamma_c = 0.92$ to match the observed 8.4% fall in GDP and 9.3% drop in consumption during the second quarter of 2020.

External debt. I use the same series described in the steady state calibration, namely the federal debt held by foreign and international investors as a share of GDP. I take the observed path of this ratio from 2020Q2 through 2024Q4 and assume it remains constant at its 2024Q4 value of 28% thereafter. Given the equilibrium path of the bond price and the elasticity of foreign demand, the sequence of Ψ_t is chosen such that the implied path of external debt in the model coincides with the data.

Fiscal policy and inflation. Now, I also feed into the model time-paths for different fiscal policy components that reflect the actual government interventions observed during the pandemic. These include changes in government debt, unemployment insurance, government consumption, capital taxes, and lump-sum transfers. The calibration is based on quarterly data from the NIPA tables and uses average fiscal ratios relative to 2019 GDP to quantify the size of each policy. This setup allows the model to match both the magnitude and timing of the main policy responses during the crisis.

Government debt rises from 105% to roughly 120% of GDP, reflecting the scale of federal borrowing during 2020. Public consumption rises slightly, from 5.5% to 6.7% of GDP, consistent with the data on increased federal spending. Unemployment insurance expands by about one trillion USD—roughly 20% of the total stimulus package—capturing the increased benefits and broader eligibility implemented during the pandemic. I also include a large temporary reduction in firm-side taxes to reflect the various support programs targeted at businesses. This is implemented as a capital subsidy equal to 33% of the full stimulus package

In addition, I include a temporary lump-sum transfer to households to capture the stimulus checks issued during the pandemic. This transfer represents 22% of the fiscal package and is targeted toward low- and middle-income households, following the same eligibility criteria as in the data. I set $\bar{z} = 0.152$ to match the income threshold in the data. Appendix D.5 summarizes the various programs implemented during the pandemic under the CARES Act, the Consolidated Appropriations Act, and the American Rescue Plan Act, detailing their scale, and how I classify the allocation of resources between firms and households. The labor income tax rate adjusts throughout the transition to ensure that the government budget constraint holds with equality each period. Finally, I feed the inflation rate path observed in the data from 2020Q2 to 2024Q4, assuming it stays at the target thereafter.

5 Quantitative Analysis

5.1 Numerical Solution

The model is solved globally by combining a backward iteration using an endogenous grid method to find the optimal decision rules of the domestic households, with a forward iteration, as in Young (2010), to obtain a transition function for the distribution of households and compute the stationary distribution. For the initial stationary equilibrium, I iterate on the real interest rate until aggregate savings in the stationary state are consistent with the capital stock and the initial supply of government bonds, net of the foreign holdings. The final stationary equilibrium follows a similar approach, adjusting the real interest rate until total demand for assets equals the capital stock and the new, higher supply of government debt.

For the transition path between steady-states, I follow the approach in Aguiar, Amador, and Arellano (2024). At $t = 0$, agents receive news about the future paths of government policies, lockdowns, unemployment, inflation, and foreign holdings of government bonds. I assume that at period H the economy is in the final equilibrium with a higher debt-to-GDP ratio. I iterate backwards from this high-debt stationary equilibrium: for a given sequence of interest rates and government policies, I find the sequences of optimal decision rules and the transition function for the distribution of domestic households. Then, starting from the initial stationary equilibrium, I iterate forward the evolution of the distribution and compute the aggregate savings $\mathcal{A}_t$ at each time. Finally, I use a root-finding algorithm to find the sequence of real interest rates that clears the asset markets, ensuring that in period 0 both the bond and capital markets clear separately. Appendix E details the algorithm.

5.2 Model Fit

Table 3 shows the performance of the model in replicating key moments in the initial steady state.

Table 3: Model Fit in the Initial Steady State

	Data	**Model**
Targeted moments		
Aggregates		
Interest rate (%)	1	1
Unemployment rate (%)	4	4
Inflation rate (%)	2	2
Assets (% of GDP)	506	506
Fiscal variables		
Public debt (% of GDP)	105	105
External debt (% of GDP)	31	31
Public debt maturity (years)	5	5
Government consumption (% of GDP)	5	5
Tax revenue from firms (% of GDP)	4	4
Unemployment insurance (% of GDP)	0.5	0.5
Wealth distribution		
Bottom 10%	-0.1	-0.1
Nontargeted moments		
Wealth distribution		
Top 1%	37	31
Top 5%	65	69
Top 10%	76	81
Top 25%	91	92
Top 50%	99	99

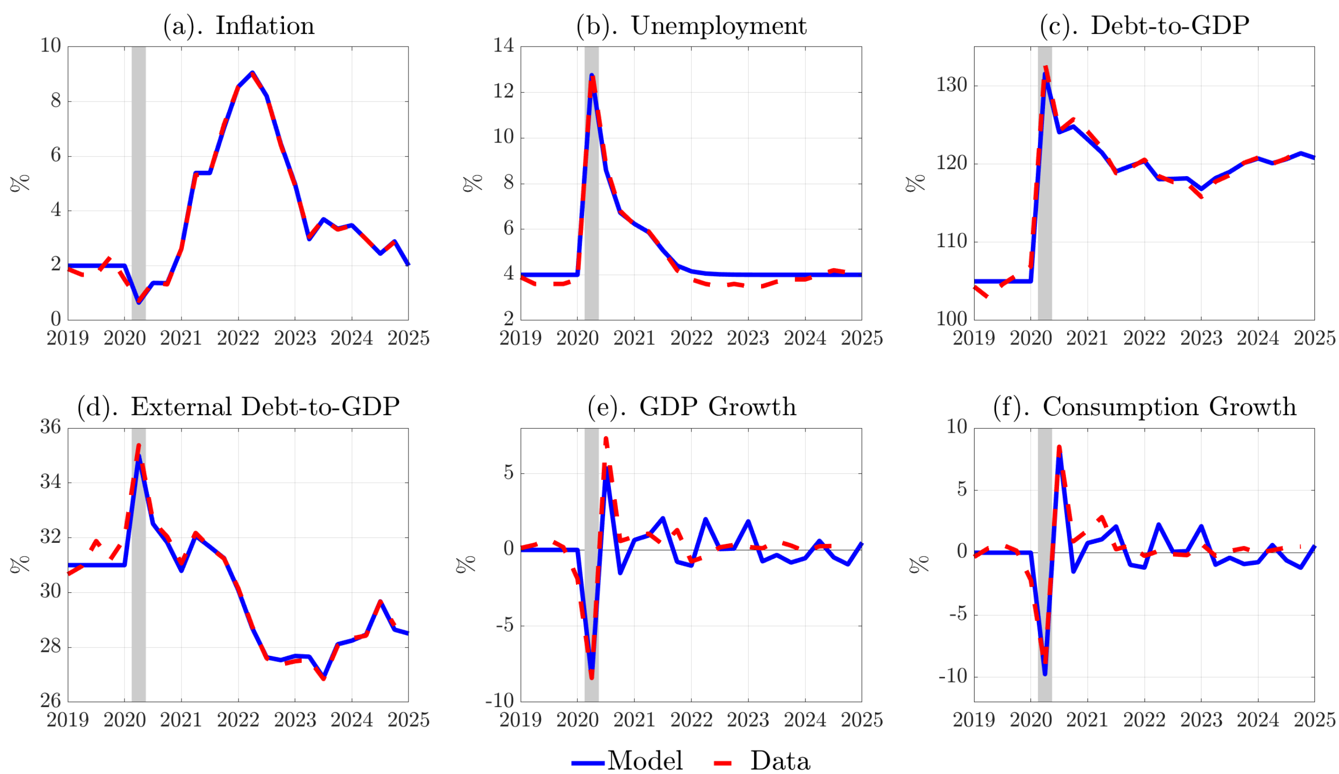
All targeted moments are matched exactly. The real interest rate is pinned down at 1%, matching the observed 2019 value, while the unemployment rate and inflation rate also coincide with their data counterparts at 4% and 2%, respectively. The aggregate asset-to-GDP ratio is matched at 506%. Fiscal variables are also aligned with data targets: public debt is 105% of GDP with an average maturity of 5 years, external debt is 31% of GDP, government consumption is 5% of GDP, and tax revenue from firms and unemployment insurance expenditures are 4% and 0.5% of GDP, respectively. The model replicates the bottom 10% net position at -0.1%, consistent with observed negative wealth.

The model also delivers a good fit for the distribution of wealth. It captures the concentration of assets at the top of the distribution, with the top 1%, 5%, and 10% holding 31%, 69%, and 81% of total wealth, respectively—close to the empirical values of 37%, 65%, and 76%. The model slightly overestimates the share held by the top deciles but remains well aligned with the data.

5.3 Transition Dynamics

In this section, I present the results for the main policy experiment. Figures 3 and 4 display the transition dynamics of the main macroeconomic variables, where the dashed red lines represent the data, the solid blue lines represent the model, and the gray bar indicates the period of the fiscal expansion. For completeness, Figure C1 in the Appendix C reports the remaining fiscal policy variables, and Figures C14, C15 and C16 display the transition paths for a longer horizon.

Figure 3: Transition Path for Selected Variables



The top panels display the paths of inflation, unemployment, and government debt, which are calibrated to match the empirical dynamics observed in the U.S. economy during and after the onset of the pandemic. Inflation is low at the beginning of the transition, it peaks at 9% around 2022Q2 before returning to the target. Unemployment rises sharply in the first period, reaching around 13% in 2020Q2 and decreasing faster in the subsequent quarters to settle at 4% by 2021Q3. Public debt increases from 105% of GDP to 132% in 2020Q2, reflecting both new issuances and the fall in output. As GDP recovers, the ratio falls and settles at about 120% by mid-2021, a 15 percentage point increase relative to the initial steady state. Panel (d) at the bottom reports the path of external debt to GDP, which coincides in the model and the data. It rises from 31% to 35% of GDP in 2020Q2 and then declines during 2021 and 2022 to about 28%, where it is assumed to remain for the rest of the transition. Panels (e) and (f) present GDP and consumption growth. In the data, both series are demeaned to make them comparable with the model. As I mentioned before, the declines in 2020Q2 are targeted in the calibration through the stay-at-home and consumption constraints, while the rebound that follows is not. The model captures this recovery well: consumption increases by about 9% in 2020Q3, and GDP growth is slightly lower than in the data but follows a similar path. Over 2021–2024, both series continue to move around the data series.

Figure 4: Transition Path for Selected Variables

The top panel of Figure 4 displays the labor market variables, all expressed relative to their initial steady-state levels. Panel (a) shows effective labor, which falls by about 12% in 2020Q2, reflecting both the rise in unemployment and the lockdown restrictions on labor supply. It then recovers as unemployment declines to 4% over 2021–2022. Panel (b) plots the real wage, which rises initially by roughly 4% due to the contraction in labor supply that raises the marginal productivity of labor. Wages subsequently decline and stabilize in the long run at a level below the initial steady state. Panel (c) reports aggregate labor income, which combines the effects of wages and employment. It falls by around 8% in 2020Q2 and partially recovers in 2021–2022, but remains below its pre-pandemic level through 2023–2024 and stabilizes at a permanently lower level in the long run.

The bottom panel shows the dynamics of capital and asset prices, expressed relative to their initial steady-state levels. Panel (d) displays the capital stock relative to initial output. It rises slightly in 2020Q2, consistent with the temporary recovery in output, but then declines along the transition path as higher government borrowing crowds out private investment. Panel (e) plots the interest rate. In the first period, the return on capital jumps to 13% due to the temporary subsidies received by firms, while the bond return falls with the arrival of news about future inflation and the rise in precautionary savings from households facing higher unemployment risk. From 2020Q3 onward, the two returns equalize and the common interest rate remains below 1% during 2020, before gradually increasing as unemployment risk falls. In the long run, it stabilizes above its initial steady-state level, reflecting the higher return that households demand to absorb the larger supply of government debt. Finally, Panel (f) shows the bond price, which drops by about 8% in 2020Q2 and remains below its initial value throughout the transition.

6 Empirical Validation

This section provides an empirical validation of the model's main predictions by comparing its implications for wealth and welfare with survey data. I focus on two exercises. The first examines how well the model replicates the evolution of aggregate wealth and its distribution across households using the Survey of Consumer Finances (SCF). The second evaluates whether the model can reproduce the dynamics of households' perceived financial situation from the Michigan Survey of Consumers. As I describe in detail later, I simulate the model for two million households over time and "ask" them the same question as in the first question of the Consumer Sentiment Index. To the best of my knowledge, this second exercise is novel in the literature, as it directly compares the distributional welfare implications of the model with households' survey responses about their financial situation.

Survey of Consumer Finances. The first empirical exercise uses the most recent round of the Survey of Consumer Finances for 2022. I compare the evolution of wealth implied by the transition in the model to the wealth patterns observed in the data. Table 4 reports assets relative to GDP and the distribution of wealth across different percentiles.

Table 4: Wealth Distribution: Model vs. SCF (2019–2022)

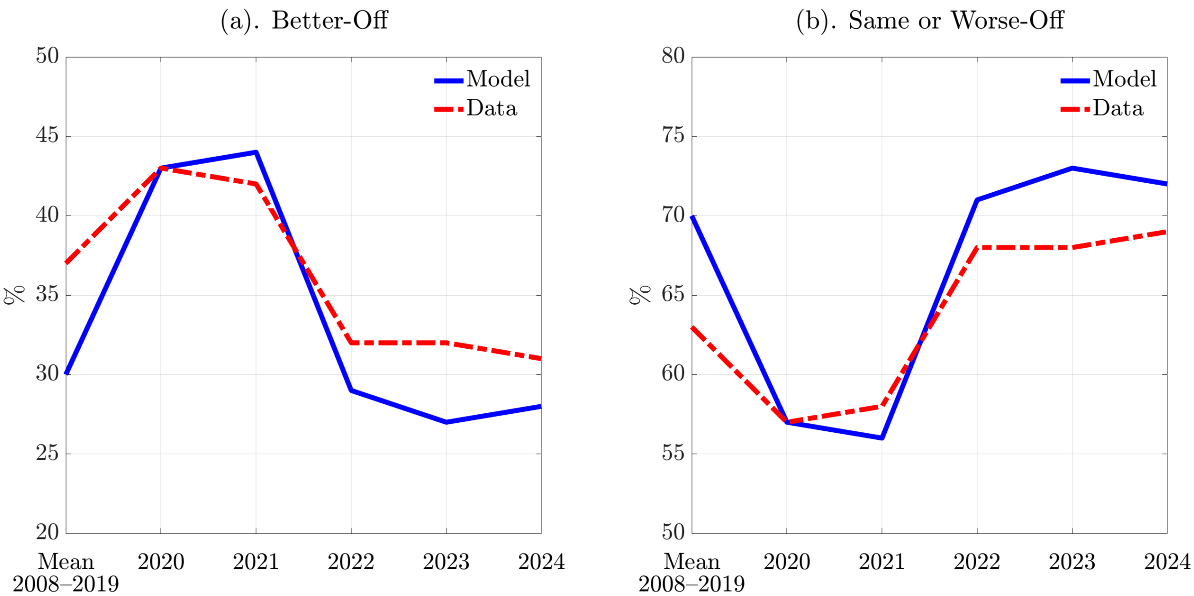
	2019		**2022**	
	Data	**Model**	**Data**	**Model**
Assets (% of GDP)	506	506	535	533
Top 1%	37	31	35	31
Top 5%	65	69	61	69
Top 10%	76	81	73	79
Top 25%	91	92	89	91
Top 50%	99	99	98	98
Bottom 10%	-0.1	-0.1	-0.1	-0.1

The model generates an assets-to-GDP ratio of 533 in 2022, very close to the value of 535 observed in the SCF. It also reproduces well the changes in the wealth distribution between 2019 and 2022. The shares of the top 1, 5, and 10 percent are close to the data, and the model captures the evolution of wealth while preserving the high concentration at the top. In the data, the share of wealth held by the top 10% declines by 3% (from 76 to 73%), while in the model it declines by 2% (from 81 to 79%). Similarly, the top 50% share falls by one percentage point in both the model and the data (from 99 to 98%). At the bottom of the distribution, the share of the bottom 10% remains at -0.1% in both cases, with no change between 2019 and 2022.

Michigan Survey of Consumers. The second validation exercise draws on the Michigan Survey of Consumers, which asks households: "*Would you say that you (and your family living there) are better off or worse off financially than you were a year ago?*". I use the responses of U.S. households from 2008Q1 to 2024Q4 to compute two series: the share of households reporting to be better off, and the complementary share reporting to be the same or worse off in each period. The average shares over 2008Q1–2019Q4 serve as benchmarks, representing the long-run means before the debt expansion in the U.S. For each year from 2020 to 2024, I then calculate the quarterly means of both series.

To replicate this question in the model, I simulate two million households for 30 quarters and compute, for each household, the change in utility relative to four quarters earlier. Households whose utility is higher are classified as better off, while those with lower or unchanged utility are classified as the same or worse off. I then calculate the share of households in each group at every period, following the same procedure as in the data. Figure 5 compares the model and the data. Panel (a) reports the share of households saying they are better off, and Panel (b) the complementary share reporting to be the same or worse off. The dashed red line shows the data, while the solid blue line shows the model simulation.

Figure 5: Financial Situation Compared to a Year Ago: Model vs. Data



Notes: This figure compares households' financial situation relative to a year ago in the model simulation and the data. Panel (a) shows the share of households reporting that they are better off, while Panel (b) shows the share reporting that they are the same or worse off. The dashed red line represents the data, and the solid blue line represents the model simulation. "Mean 2008–2019" refers to the average share over 2008–2019 in the data and the average share in the initial steady state in the model.

The model reproduces closely the dynamics observed in the data. The average share of households reporting to be better off over 2008–2019 is about 37 percent in the data and 30 percent in the model. In 2020 and 2021, both series rise sharply, reaching about 44 percent in the data and a slightly higher level in the model. After 2021, they decline markedly: by 2022–2024, the share stabilizes around 30–32 percent in the data and remains just below in the model. The complementary pattern is visible in Panel (b): the share of households reporting to be the same or worse off falls in 2020–2021 and then rises again after 2022, with the model slightly amplifying the changes seen in the data. Overall, the model tracks well the timing and magnitude of the swings in household responses, capturing both the rise in the share of households reporting to be better off during 2020–2021 but also the decline that followed, consistent with the lower consumer sentiment observed in 2023–2024.

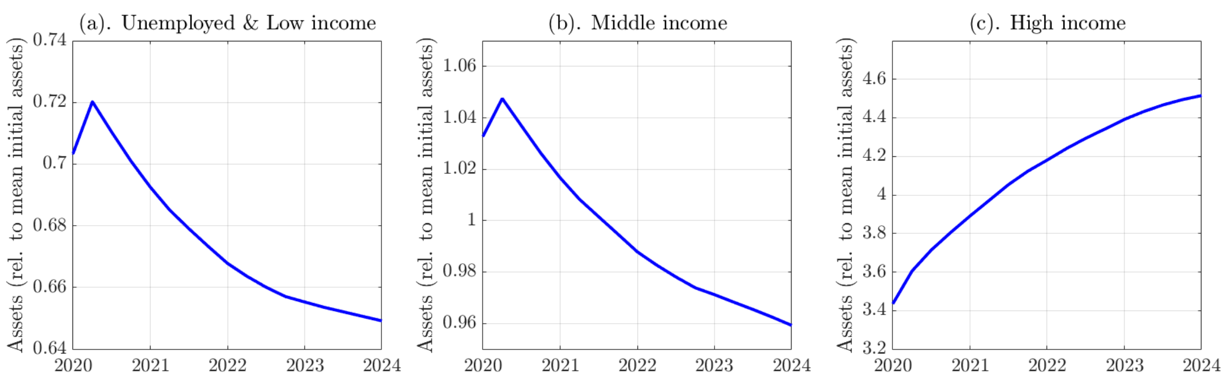
7 Results

7.1 Consumer Sentiment Index

Now that I have shown that the model reproduces the dynamics of the first question in the Consumer Sentiment Index, we are ready to address one of the main questions of the paper: why was the index depressed between 2023 and 2024, despite inflation and unemployment being at low levels?

In the model, there is a race between how households respond to changes in idiosyncratic risk and to changes in aggregate states. Increases in the probability of unemployment reduce household welfare during 2020, while the subsequent decline in 2021 and 2022 raises it. However, the effects of aggregate policies such as the stimulus checks, unemployment insurance, and the revaluation of assets dominate the swings in households' utility over time. These elements will be shown to be the key drivers of the welfare results discussed in Section 7.2.

Figure 6: Evolution of the Distribution of Savings



Notes: The figure shows the evolution of average asset holdings for households grouped by their initial income, measured one quarter before the debt expansion. Asset levels are expressed relative to the mean assets in the economy in 2020Q1. Panel (a) presents unemployed and low-income households, Panel (b) middle-income households, and Panel (c) high-income households.

Figure 6 displays the evolution of average asset holdings across all simulated households, grouped by their initial income one quarter before the debt expansion. The classification of households is based on their state in 2020Q1, that is, whether they were unemployed, low-income, middle-income, or high-income at that time, although their income and employment status evolve in later periods according to the realizations of their idiosyncratic productivity. All groups increase their savings initially, as they receive additional resources at the beginning of 2020. Over time, however, unemployed, low-income, and middle-income households increase consumption and de-accumulate assets, while high-income households continue to accumulate wealth due to their lower marginal propensity to consume. This de-accumulation of assets is consistent with the gradual crowding out of capital over time, as shown in Figure 4. The gradual reallocation of assets toward higher-income households helps explain the decline in the share of people reporting to be financially better off compared to a year earlier, and therefore the depressed Consumer Sentiment Index observed in 2023–2024.

7.2 Consumption-Equivalent Welfare

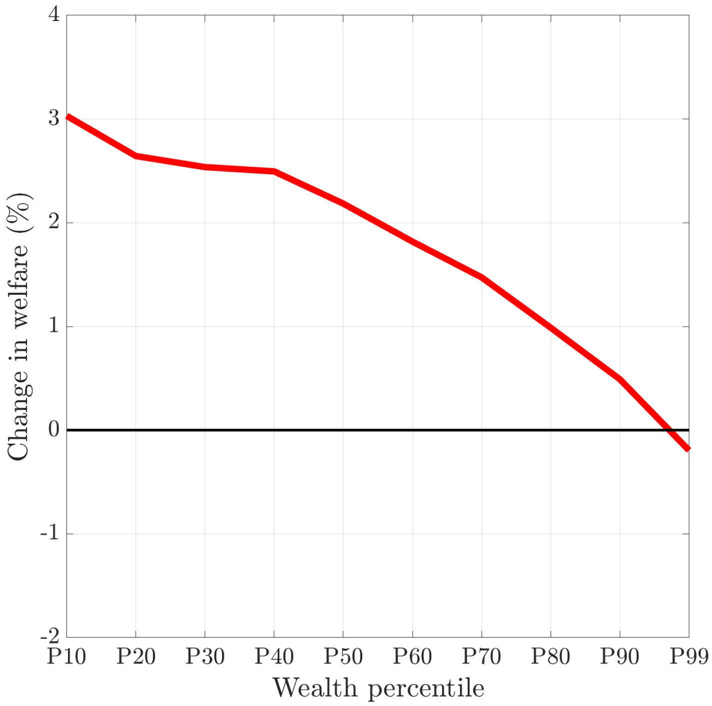
I now evaluate the magnitude of welfare gains and losses by computing welfare in consumption-equivalent units across the wealth distribution. For each household i, I calculate the permanent change in consumption required to make the household indifferent between two scenarios: one in which the economy follows the transition triggered by the debt-financed fiscal stimulus, and another in which the economy remains permanently in the initial steady state. Formally, welfare is measured as

$$\mathcal{W}_{i0} = 100 \cdot \left[\frac{V_{i0}}{V_i^{ss}} - 1 \right]$$

where $\mathcal{W}_{i0}$ is the consumption-equivalent welfare of household i in period 0 after the arrival of news, V_{i0} is the value of lifetime utility under the transition path at time 0, and V_i^{ss} is the corresponding value in the initial steady state, where there are no policies in place. Figure 7 reports welfare outcomes across households with different wealth levels. Here, welfare gains are computed by integrating over all idiosyncratic states, conditional on belonging to a given wealth bracket, with weights given by the invariant distribution of the initial steady-state economy.[1] When $\mathcal{W}_i < 0$, household i would be willing to sacrifice a fraction $|\mathcal{W}_i|$ of consumption in every period to avoid experiencing the transition. Conversely, when $\mathcal{W}_i > 0$, household i would need to be compensated with an additional fraction $\mathcal{W}_i$ of consumption each period in order to remain indifferent to staying in the initial steady state.

1. Let μ_0 be the distribution in the initial stationary equilibrium in the space (z, a). The welfare gains for households in a given wealth bracket $[a_{\mathrm{l}}, a_{\mathrm{h}}]$, denoted here as $\mathcal{W}_{\mathrm{lh}}$, are computed as $\mathcal{W}_{\mathrm{lh}} = \int_{a \in [a_{\mathrm{l}}, a_{\mathrm{h}}]} \int_z \mathcal{W}_{i0}(z, a)\mu_0(z, a) dz\, da$

Figure 7: Distribution of Welfare Gains and Losses



Notes: The figure shows the consumption-equivalent welfare for households with different levels of wealth in the initial stationary distribution. welfare gains are computed by integrating over all idiosyncratic states, conditional on belonging to a given wealth bracket, with weights given by the invariant distribution of the pre-stimulus steady-state economy.

This analysis shows that mean welfare gains are 1.82% in permanent consumption. However, Figure 7 shows that such gains are heterogeneous across the wealth distribution. At the bottom, households in the 10th percentile experience the largest gains, close to 3% in lifetime consumption relative to the initial steady state. Gains decline gradually across the distribution: at the 40th percentile welfare improves by about 2.5%, and by the 70th percentile the gains fall to roughly 1.5%. Households in the 90th percentile obtain only a modest increase of around 0.5%. At the very top, however, the pattern reverses: the richest households (top 10%) face a small welfare loss of about 0.2%. Overall, the expansion thus delivers sizable gains for low- and middle-wealth households, modest improvements for most of the upper half, and losses at the very top.

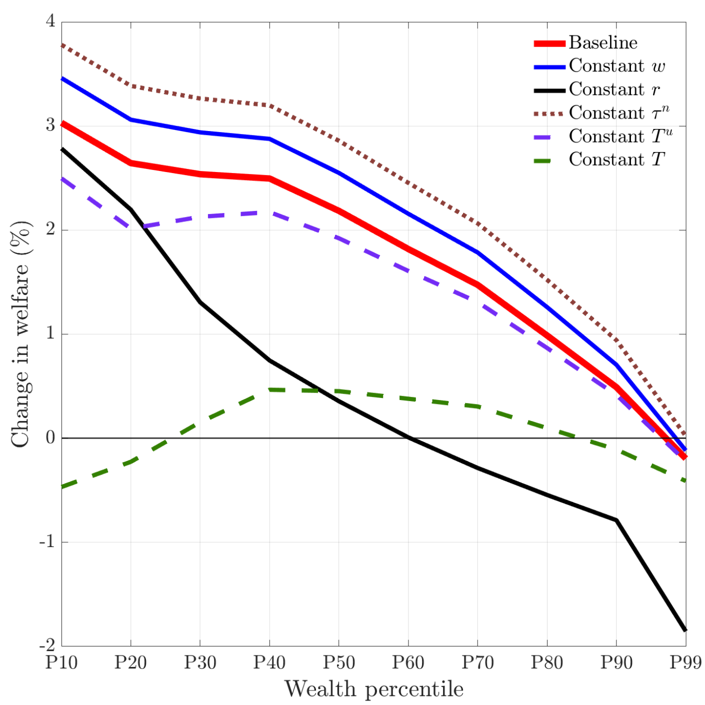
7.3 Partial Equilibrium Decomposition

I now turn to isolating which policies and sequences of prices matter most for understanding the previous results. To do so, let $\boldsymbol{x} \equiv \{x_t\}_{t\geq 0}$ denote the equilibrium path of variable x in our baseline transition for $x \in \{w, r^b, r^k, \tau^n, T^u, T, \text{lock}, \Omega\}$, where $\{\Omega_t\}_{t\geq 0}$ is the time path for the probability transition matrix of the idiosyncratic productivity. The solution to the consumption–savings problem of household i provides a mapping from the paths of wages $\boldsymbol{w}$, real returns $\boldsymbol{r^b}$ and $\boldsymbol{r^k}$, labor taxes $\boldsymbol{\tau^n}$, lump-sum transfers $\boldsymbol{T}$, unemployment insurance $\boldsymbol{T^u}$, lockdown policies **lock**, and the evolution of the idiosyncratic productivity transition matrix Ω into the corresponding paths of consumption, labor, and ultimately utility. Therefore:

$$V_i = \mathcal{V}(\boldsymbol{w}, \boldsymbol{r^b}, \boldsymbol{r^k}, \boldsymbol{\tau^n}, \boldsymbol{T^u}, \boldsymbol{T}; \mathbf{lock}, \Omega).$$

for some function $\mathcal{V}$. The idea is to take these equilibrium sequences recovered from the baseline transition, hold one sequence at a time at its initial steady-state level, and solve the household block. This isolates the role of each sequence in shaping the welfare results. Figure 7 presents the welfare gains and losses under these alternative partial-equilibrium scenarios.

Figure 8: Partial Equilibrium Decomposition of Welfare Gains and Losses



Notes: This figure shows welfare gains across the wealth distribution under partial-equilibrium experiments. Each line holds one sequence fixed at its steady-state level while the others follow the baseline transition. The solid red line corresponds to the baseline welfare results, where all equilibrium sequences are considered. The "Constant x" lines keep variable x fixed at its initial steady-state level along the transition, for $x \in \{w, r, \tau^n, T, T^u\}$. In the "Constant r" case, both the bond return r^b and the capital return r^k are fixed.

The red line in Figure 7 corresponds to the baseline case, in which all equilibrium sequences are fed into the household block. In the solid black line ("Constant r" case), both the bond return r^b and the capital return r^k are held at their steady-state level; along the baseline path these returns coincide at all dates except the initial period, so this case abstracts from asset revaluation effects. This case is especially relevant, since interest rate dynamics account for much of the heterogeneity in welfare outcomes across the wealth distribution. As shown in Figure 2, the bottom 80% of households hold a negative position in bonds and a positive position in capital. For these households, the "Constant r" case leads to lower welfare, since they lose the benefit of debt dilution through inflation and the temporary increase in the return on capital in period 0. The bottom 10% are relatively insulated from interest rate dynamics, as they hold little wealth in either asset, so their welfare path is almost identical to the baseline. By contrast, the top 10% would forgo significant gains: given that most of their wealth is invested in capital, their lifetime consumption equivalent falls by about 2% relative to the baseline when interest rates are held constant, as they both lose the high capital return in period 0 and the higher future interest rates.

The green dotted line ("Constant T" case) represents a scenario without stimulus checks. This is another relevant experiment, as it isolates the role of transfers during the pandemic. In this case, the bottom 10% of households experience welfare losses of about 3.5% in lifetime consumption relative to the baseline. The absence of transfers prevents them from relaxing borrowing constraints and sustaining consumption during the lockdowns. While all eligible households receive the same transfer, it matters more for poorer households in percentage terms, which explains the larger welfare losses at the bottom. Toward the middle of the distribution, welfare falls by about 2% relative to the baseline. By contrast, the effect on the top 20% is modest, since high-income households are not eligible for stimulus checks and rely less on transfers to smooth consumption. This highlights the importance of the stimulus checks in supporting households with limited wealth.

Now, the blue line ("Constant w"), the brown dotted line ("Constant τ^n"), and the purple dashed line ("Constant T^u") remain relatively close to the baseline, with gains concentrated among poorer households and gradually declining toward the top of the distribution. Still, each counterfactual highlights a distinct margin of welfare losses. Eliminating unemployment insurance reduces welfare for almost all households, with the largest effects at the bottom, since these households depend more heavily on transfers during periods of job loss. Holding wages constant in the initial steady state would increase welfare, as in the baseline path wages decline and remain below this initial level, a change that disproportionately affects poorer households who rely primarily on labor income. Finally, keeping labor taxes constant prevents the increase in taxation needed to service higher debt in the long run. Under the progressive tax system, high-income households contribute more in absolute terms, but labor income makes up a much larger share of total income at the bottom. This means that higher taxes weigh more heavily on low-income households. Consequently, the scenario with constant labor taxes improves welfare across the distribution, but the relative gains are larger for households at the lower end.

7.4 Aggregate Welfare Decomposition

To provide further insights into the sources of the welfare results, I decompose welfare into three components: aggregate efficiency, redistribution, and insurance, following Bhandari et al. (2023). In my environment, welfare depends not only on how efficiently goods are produced but also on how they are distributed across households. Aggregate efficiency captures changes in the total resources available to the economy. Redistribution reflects changes in ex ante consumption shares, that is, the share of aggregate resources that a given household expects to consume. Insurance measures changes in ex post consumption risk, capturing how policies affect the variability of household consumption across states of the world.

Let $\mathcal{W} \equiv \int_i \mathcal{W}_i \, di$ denote the mean welfare effect of the fiscal stimulus relative to the mean welfare of an economy that remains in the initial stationary equilibrium permanently. Bhandari et al. (2023) show that, using a Taylor expansion of $\mathcal{W}$ around a nonstochastic midpoint, the welfare difference can be approximated as

$$\mathcal{W} \simeq \text{Aggregate efficiency} + \text{Redistribution} + \text{Insurance}$$

where

$$\text{Aggregate efficiency} = \frac{1}{V^{ss}} \sum_t \int_i \phi_{it}(z_0, a_0) \, \Gamma_t \, di$$

$$\text{Redistribution} = \frac{1}{V^{ss}} \sum_t \int_i \phi_{it}(z_0, a_0) \, \Delta_{it}(z_0, a_0) \, di$$

$$\text{Insurance} = \frac{1}{V^{ss}} \int_i \phi_{it}(z_0, a_0) \, \frac{1}{\xi} \Lambda_{it}(z_0, a_0) \, di$$

and $\simeq$ denotes equality up to a third-order remainder term in the Taylor series expansion.

Here $\phi_{it}(z_0, a_0) \equiv \beta^t \alpha_i (1 - \beta)(\hat{x}_{it}(z_0, a_0))^{1-1/\xi}$ are the welfare weights that convert changes in individual utility into social utility, with α_i being the Pareto weight for household i, which I set to one for all i. $\hat{x}_{it}$ here is the approximation point. The three components on the right-hand side of the previous expressions are defined as

$$\Gamma_t \equiv \log\left(\int \mathbb{E}\left[x_{it} \mid z_0, a_0\right] di\right) - \log\left(\int \mathbb{E}\left[x_i^{ss} \mid z_0, a_0\right] di\right)$$
$$\Delta_{it}(z_0, a_0) \equiv \log\left(\omega_i(z_0, a_0)\right) - \log\left(\omega_i^{ss}(z_0, a_0)\right)$$
$$\Lambda_{it}(z_0, a_0) \equiv -\frac{1}{2}\left\{\text{var}\left[\log\left(x_{it} \mid z_0, a_0\right)\right] - \text{var}\left[\log\left(x_i^{ss} \mid z_0, a_0\right)\right]\right\},$$

with $\omega_i(z_0, a_0) \equiv \frac{\mathbb{E}[x_{it}|z_0,a_0]}{\int \mathbb{E}[x_{it}|z_0,a_0]di}$ denoting the expected consumption share of household i. Intuitively, Γ_{it} measures the change in aggregate resources, Δ_{it} captures changes in expected consumption shares across households, and Λ_{it} reflects changes in *ex-post* consumption risk. Table 5 reports the quantitative decomposition.

Table 5: Welfare Decomposition

	Lifetime consumption
Aggregate efficiency	0.31
	(17%)
Redistribution	1.13
	(62%)
Insurance	0.38
	(21%)
Total	1.82
	(100%)

Redistribution accounts for the largest share, explaining 62% of the average welfare gain. This reflects the importance of the asset revaluation effects documented earlier: the fiscal expansion dilutes the real value of outstanding government bonds, shifting resources from households with positive bond holdings, primarily those at the top 20% of the wealth distribution, to the bottom 80% of households who are net debtors. Redistribution is also reinforced by the progressive tax system: the higher future taxes required to service the additional debt fall more heavily on high-income households, while low-income households benefit more directly from the transfers introduced during the fiscal stimulus.

The second component, insurance, accounts for about 21% of the mean welfare gains. The increase in public debt expands the supply of assets available to households, improving risk-sharing against idiosyncratic income shocks. This additional buffer helps households smooth consumption in the face of income fluctuations, thereby raising welfare across the distribution. There are also intertemporal insurance gains, since many low-income households that receive transfers during the pandemic are expected to transition into higher-income states in the future, at which point they contribute through higher taxes to financing the transfers that supported them earlier.

The remaining 17% of the mean welfare gains is attributable to aggregate efficiency, corresponding to an increase in mean lifetime consumption of about 0.3%. The policy influences aggregate resources through several channels. First, the dilution of the value of foreign-held government bonds lowers the government's external liabilities, effectively releasing resources to domestic households. Second, transfers relax borrowing constraints for low-wealth households, reducing distortions associated with incomplete markets. Third, higher future labor taxes introduce additional distortions in labor supply, reducing efficiency gains. Note, however, that diluting the real value of bonds in hands of foreigners effectively reduces the debt service in the government budget constraint, allowing the government to limit the increase in future labor taxes. In sum, these effects raise aggregate efficiency, though by a smaller magnitude compared to redistribution and insurance.

Summary. I conclude this section by summarizing the main findings. First, the model rationalizes the puzzling behavior of the Consumer Sentiment Index in 2023–2024 through a gradual reallocation of assets from low- and middle-income households toward higher-income households. Second, the fiscal stimulus generated sizable but heterogeneous welfare gains. Most households benefit, with the largest gains concentrated among those with low and middle wealth, while the richest experience small losses. Third, the partial-equilibrium exercises show that these welfare differences are primarily driven by interest rate dynamics and transfers: stimulus checks play a key role in supporting poorer households, while revaluation effects associated with a lower real value of debt benefit middle-income households, and higher capital returns favor richer households. Finally, at the aggregate level, redistribution accounts for the majority of the mean welfare gains, followed by better insurance and aggregate efficiency gains.

8 Counterfactuals

The baseline welfare results reflect a trade-off between the short-run benefits of debt-financed transfers, the redistribution from asset revaluation effects, and the dynamics of real interest rates, wages, and taxes along the transition. Over the longer run, higher debt service requires higher labor taxes, which further shape distributional outcomes. To assess the robustness of these results, I consider several counterfactual scenarios. These include a scenario without capital subsidies, a reduction in foreign demand for government bonds, providing only stimulus checks (without other fiscal measures), and an increasing path of debt-to-GDP consistent with the Congressional Budget Office's projections. Appendix C.3 presents the corresponding transition paths for all variables in each counterfactual scenario.

8.1 Description of Alternative Scenarios

No capital subsidies. In this counterfactual I remove the capital subsidies that firms received, while keeping the rest of the policies (new borrowing, lockdowns, stimulus checks, and unemployment insurance) unchanged. In the baseline, support to firms through programs like the Paycheck Protection Program, the Economic Injury Disaster Loans, etc., is captured as capital subsidies. Here, instead, I assume those resources are distributed to households through the progressive tax system. Without the subsidies, the return on capital at the beginning of the transition falls.

Lower foreign demand. In this scenario I assume that foreign investors are willing to hold less U.S. debt. Specifically, the path of external debt to GDP is set 10 percentage points lower than in the baseline between 2020 and 2024, and it stabilizes at 18% of GDP thereafter. The overall path of total government debt remains unchanged, so the lower share held abroad implies that a larger fraction of debt must be absorbed domestically. As a result, real interest rates are higher along the transition compared to the baseline.

Only stimulus checks. A key driver of the welfare gains in the baseline is the set of lump-sum transfers delivered through stimulus checks. Now I consider a counterfactual in which all the additional resources from the debt expansion are directed exclusively to eligible households in the form of these transfers. The overall path of debt-to-GDP, together with the lockdown, inflation, unemployment, and foreign debt holdings paths, is kept the same as in the baseline. Unlike the baseline, however, there is no increase in unemployment insurance or support to firms through capital subsidies. This counterfactual highlights how overall welfare would change if the fiscal expansion had relied exclusively on stimulus checks rather than on a broader policy mix.

CBO projections. The final counterfactual is based on the long-term debt projections of the Congressional Budget Office (Congressional Budget Office 2025). In this scenario, the path of debt-to-GDP coincides with the baseline until 2024, after which I impose the CBO projections for 2025–2055. The CBO projects federal debt held by the public to increase from 100% of GDP in 2025 to 156% of GDP by

2055, a rise of 50 percentage points. In the model, this implies a total debt-to-GDP ratio of 184% by 2055, given that the external share remains constant at 28%. Beyond 2055, I assume the government rolls over its debt, keeping it at this level. As in the baseline, the labor tax adjusts period by period to satisfy the government budget constraint. In equilibrium, the interest rate rises from 1% in the initial steady state to 1.4% in the new higher-debt steady state, reflecting the higher return required by domestic households to absorb additional debt. Labor taxes are lower in the first decades, as the government postpones tax increases by expanding debt each period. By the end of the transition, however, labor taxes rise as the debt service burden accumulates.

8.2 Welfare Results

Table 6 reports the welfare results for the baseline and the four counterfactuals. For reference, the first column reproduces the baseline welfare gains across the wealth distribution, while the following columns report the corresponding results under each alternative scenario.

Table 6: Counterfactuals

	Baseline	No capital subsidies	Lower foreign demand	Only stimulus checks	CBO debt projections
Welfare gains at $t = 0$					
Overall mean	1.82	2.02	1.22	4.29	2.51
Overall minimum	-1.77	-6.18	-3.72	-5.80	-1.27
Poor (bottom 10%)	3.03	3.77	2.03	8.60	4.00
Middle (40–60%)	2.00	2.27	1.34	4.28	2.62
Rich (top 10%)	-0.20	-1.69	0.06	-1.90	0.50

No capital subsidies. Eliminating capital subsidies slightly increases the mean welfare gain from 1.82 to 2.02 percent. Households at the bottom and middle of the distribution benefit the most: welfare rises from roughly 3 to 3.77 percent for the bottom 10 percent and from 2 to 2.27 percent for the middle group. These gains occur because the resources that would have been used to subsidize firms are instead returned to households through the progressive tax system, effectively lowering average tax rates. By contrast, high-income households experience a larger welfare loss of −1.69 percent, compared with −0.2 percent in the baseline. Without the temporary increase in the return on capital induced by the subsidies, these households no longer benefit from the revaluation of assets that was an important source of welfare gains in the baseline.

Lower foreign demand. When foreign investors are willing to hold less U.S. government debt, the mean welfare gain declines from 1.82 to 1.22 percent. Top 10 percent households benefit slightly from the path of higher interest rates, with welfare improving from −0.2 to 0.06 percent. However, the higher interest burden on public debt requires future increases in labor taxes, which fall more heavily on low- and middle-income households. Welfare for the bottom 10 percent declines from 3.03 to 2.03 percent, and for the middle group from 2.00 to 1.34 percent. In addition, since fewer government bonds are held abroad, the fiscal expansion generates smaller gains from debt dilution, further reducing welfare for domestic households.

Only stimulus checks. Implementing the fiscal stimulus exclusively through checks more than doubles the mean welfare gain, from 1.82 to 4.29 percent, with the gains concentrated at the bottom of the distribution. Welfare for the bottom 10 percent rises sharply from about 3 to 8.6 percent, and for middle-income households from 2 to 4.28 percent. These gains reflect the direct transfers received by borrowing-constrained, unemployed, and low-income households, which allow them to sustain consumption in the first periods of the transition when lockdown constraints are binding and labor income is depressed. However, in this scenario, firms no longer receive capital subsidies, and thus there is no increase in the return on capital at the start of the transition. As a result, the top 10 percent experience welfare losses of −1.9 percent, compared with −0.2 percent in the baseline, since they neither benefit from the revaluation of their assets nor receive the direct stimulus transfers.

CBO debt projections. Under the CBO debt projections, welfare results are broadly similar to the baseline with moderately higher gains on average. The mean welfare gain rises from 1.82 to 2.51 percent, with improvements across the entire wealth distribution. For the bottom 10 percent, welfare increases from 3 to 4 percent, for middle-income households from 2 to 2.62 percent, and for the top 10 percent from −0.2 to 0.5 percent. Because most of the additional borrowing occurs far in the future, its effect on the present value of welfare is moderate. During the transition, higher interest rates benefit the top 10 percent and lower labor taxes in the first decades raise disposable income, especially for poor and middle-assets households. Later in the transition, as the government raises taxes to meet higher debt-service costs, the negative effects are more than offset by earlier gains.

9 Conclusion

The recession that followed the 2020 pandemic triggered an unprecedented fiscal expansion in the United States. The federal government issued large amounts of new debt to finance targeted transfers to households and firms, raising the debt-to-GDP ratio by about 15 percentage points. While unemployment and inflation both returned to pre-pandemic levels by 2023, the Consumer Sentiment Index (CSI) remained unusually low. This represents a puzzle for the literature, given the historically close relationship between unemployment, inflation, and the CSI.

To study the welfare consequences of this episode, I develop an open economy heterogeneous-agent model calibrated to U.S. data and compute a transition between a pre-stimulus stationary equilibrium and a new equilibrium with a permanently higher debt-to-GDP ratio. The model reproduces the dynamics of the first question of the CSI through a novel empirical validation exercise that replicates households' survey responses within the model. Households report being better off in 2020–2021 but worse off in 2023–2024, thereby rationalizing the observed decline in the CSI. At the core of this result, low- and middle-income households save the stimulus transfers early in the transition and subsequently decumulate these assets over time, which ultimately become new savings for high-income households.

I then quantify welfare gains and losses across the wealth distribution. The fiscal expansion generates lifetime welfare gains concentrated among low- and middle-wealth households, while the richest households experience small losses. Stimulus checks and revaluation of asset positions are the key drivers of these results. In the counterfactual exercises, I find scope for further increases in debt and alternative fiscal policies that increase average welfare. Methodologically, my paper contributes to the literature by introducing a novel approach to validating model predictions using survey data. This method may prove useful in future studies of particular episodes. On the policy side, I highlight the importance of debt-financed direct transfers to households and the role of asset price dynamics in increasing welfare during recessions.

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Online Appendix to

Debt-Financed Fiscal Stimulus, Heterogeneity, and Welfare

A Income process

This appendix provides additional details on the calibration of the income process described in the main text. Following the approach in Guvenen, McKay, and Ryan (2023) and McKay and Wolf (2023), I model individual log income for employed households as

$$\log y_{it} = \log(z_{it})(1 + \chi \log y_t) + \log \bar{e}_t + \mu_i + \epsilon^y_{it} \tag{23}$$

where μ_i is a fixed individual effect, ϵ^y_{it} is a transitory income shock drawn from a mixture of two normal distributions, χ captures the sensitivity of income dispersion to the aggregate business cycle, and $\bar{e}_t$ is a normalization constant ensuring that average earnings match the aggregate path y_t.

For regular workers, the persistent component of earnings, $\log(z_{it})$, follows an AR(1) process:

$$\log(z_{it}) = \rho^z \log(z_{it-1}) + \epsilon^z_{it} \tag{24}$$

where ϵ^z_{it} is an innovation drawn from a normal distribution with mean zero and variance σ^2_ϵ.

In addition to regular workers, the income process incorporates high-earning households, who can transition into one of two discrete high-income states $\{z^H_1, z^H_2\}$. If a worker is in the regular income state at time $t-1$, with probability Ω^{RH}_j they transition to the high-income state $z_{it} = z^H_j$, for $j \in \{1,2\}$. If an individual is already in one of the high-income states $\{z^H_1, z^H_2\}$, they remain in their current high state with probability Ω^{HH}_j; otherwise, they return to the regular AR(1) process, drawing z_{it} from the stationary distribution of the AR(1), $z_{it} \sim \mathcal{N}\left(0, \sigma^2_\epsilon/(1-\rho^z)\right)$.

I simulate the income process at a quarterly frequency and time-aggregate to annual observations for calibration purposes. Following Guvenen, McKay, and Ryan (2023) and McKay and Wolf (2023), the parameters are disciplined by matching a variety of earnings dynamics moments from the Social Security Administration data. These moments include earnings growth distributions at 1-, 3-, and 5-year horizons, as well as other moments reflecting the shape and dispersion of earnings growth.

The unemployment state is incorporated as an absorbing state where $z_{it} = 0$. I start by modeling unemployment transitions with a 2×2 transition matrix:

$$\hat{\Omega}_t = \begin{bmatrix} P_t^{uu} & 1 - P_t^{uu} \\ 1 - P_t^{ee} & P_t^{ee} \end{bmatrix}$$

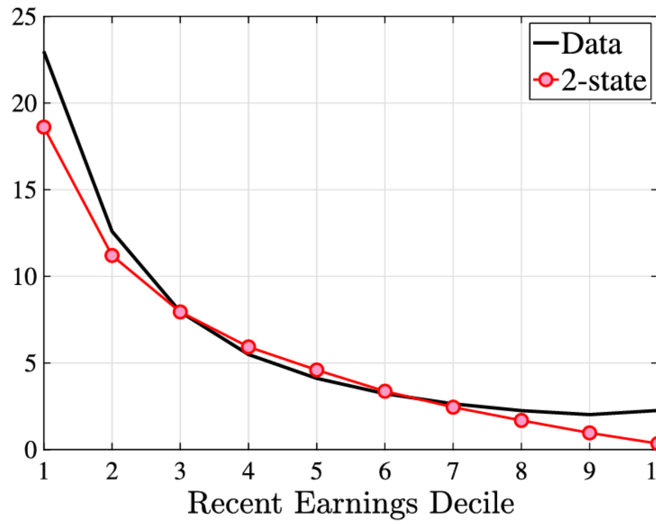
where P^{ee} is the probability of remaining employed conditional on employment, and P^{uu} is the probability of remaining unemployed conditional on unemployment. These are constructed using monthly data from the Labor Force Statistics of the Current Population Survey (CPS), particularly the series on Labor Force Flows from Employed to Employed and from Unemployed to Unemployed, along with monthly stocks of employment and unemployment. The E–E probability in a given month is obtained by dividing the number of individuals who remain employed by the total number employed in the previous month. Similarly, the U–U probability is calculated as the share of individuals who remain unemployed out of the total unemployed in the previous month. After obtaining these monthly probabilities, I convert them to a quarterly frequency by chaining them over three months (i.e., multiplying the monthly probabilities within each quarter). I feed into the model a time path $\{P_t^{ee}, P_t^{uu}\}_{t\geq 0}$ to capture changes in labor market conditions over the transition path.

To incorporate heterogeneity across income groups, I extend the 2×2 matrix to an $N \times N$ transition matrix that governs transitions across productivity states, as follows:

$$\Omega_t = \begin{bmatrix} P_t^{uu} & \cdot \quad \cdot \quad \cdot \\ \cdot & \\ \cdot & \begin{bmatrix} \\ P_t^{ee} \cdot \mathrm{M} \\ \\ \end{bmatrix} \\ \cdot & \end{bmatrix}$$

where M is the estimation of McKay and Wolf (2023). Now, Guvenen et al. (2021) study lifecycle earnings dynamics across millions of U.S. workers and document that the fraction of individuals who are non-employed next year increases sharply as earnings fall below the median of the recent earnings distribution. The solid black line in Figure A1 shows this evidence.

Figure A1: Fraction of Nonemployed Individuals One Period Ahead, from Guvenen et al. (2021)



Notes: This figure plots the probability of being nonemployed between t and $t+1$, conditional on recent earnings, based on Guvenen et al. (2021).

Afrouzi et al. (2024) document similar evidence on job separation rates across recent income deciles in the income distribution. To incorporate this evidence into the estimation of the income process, I feed in a vector of probabilities of becoming unemployed in the next period, conditional on being employed today—i.e., $\text{Prob}(z_{it} = 0 \mid z_{it-1} = \hat{z})$ for each $\hat{z} > 0$—such that the relative probabilities replicate the empirical pattern shown in Figure A1. I then rescale this vector by a constant ω, chosen to match the aggregate unemployment rate in the data each period, using a root-finding algorithm. This procedure ensures that the income process is consistent with (i) the earnings dynamics in the Social Security Administration data, (ii) the empirical relationship between unemployment risk and recent earnings, and (iii) the evolution of labor market flows observed in the CPS.

B Model Derivations

B.1 Revaluation of Assets as a Transfer

We start from the budget constraint in period 0:

$$c_{i0} + a_{i1} \leq w_0 z_{i0} n_{i0} + (1 + r_0^k) k_{i0} + (1 + r_0^b) q_{-1} b_{i0} - \mathcal{T}(w_0 z_{i0} n_{i0}) + T_0^u \cdot \mathbb{1}_{z=0} + T_0^s \cdot \mathbb{1}_{z<\bar{z}}$$

Define $a_{i0} \equiv k_{i0} + q_{-1} b_{i0}$ and let r_0 be the return on assets in the initial pre-stimulus steady state. We can write previous expression as:

$$\begin{aligned} c_{i0} + a_{i1} &\leq w_0 z_{i0} n_{i0} + (1 + r_0^k) k_{i0} + (1 + r_0^b) q_{-1} b_{i0} + (1 + r_0) a_{i0} - (1 + r_0) a_{i0} - \mathcal{T}(w_0 z_{i0} n_{i0}) + T_0^u \cdot \mathbb{1}_{z=0} + T_0^s \cdot \mathbb{1}_{z<\bar{z}} \\ &= w_0 z_{i0} n_{i0} + (1 + r_0^k - (1 + r_0)) k_{i0} + (1 + r_0^b - (1 + r_0)) q_{-1} b_{i0} + (1 + r_0) a_{i0} - \mathcal{T}(w_0 z_{i0} n_{i0}) + T_0^u \cdot \mathbb{1}_{z=0} \\ &\quad + T_0^s \cdot \mathbb{1}_{z<\bar{z}} \end{aligned}$$

Simplifying common terms, we have:

$$c_{i0} + a_{i1} \leq w_0 z_{i0} n_{i0} + (r_0^k - r_0) k_{i0} + (r_0^b - r_0) q_{-1} b_{i0} + (1 + r_0) a_{i0} - \mathcal{T}(w_0 z_{i0} n_{i0}) + T_0^u \cdot \mathbb{1}_{z=0} + T_0^s \cdot \mathbb{1}_{z<\bar{z}}$$

Define $T^{\text{rev}}(q_{-1} b_{i0}, k_{i0}) \equiv (r_0^k - r_0) k_{i0} + (r_0^b - r_0) q_{-1} b_{i0}$ as the transfer that household i with a portfolio $(q_{-1} b_{i0}, k_{i0})$ receives in period 0 after the arrival of news. We can write the budget constraint as:

$$c_{i0} + a_{i1} \leq w_0 z_{i0} n_{i0} + (1 + r_0) a_{i0} + T^{\text{rev}}(q_{-1} b_{i0}, k_{i0}) - \mathcal{T}(w_0 z_{i0} n_{i0}) + T_0^u \cdot \mathbb{1}_{z=0} + T_0^s \cdot \mathbb{1}_{z<\bar{z}}$$

which is the standard budget constraint in (3) with this additional transfer on the right-hand side capturing the revaluation effects.

B.2 Optimality Conditions

Given an initial portfolio and idiosyncratic productivity $(q_{-1} b_{i0}, k_{i0}, z_{i0})$, the problem of household i is:

$$V_{it} = \max_{\{c_{it}, n_{it}, a_{it+1}\}_{t \geq 0}} \left\{ (1 - \beta) x_{it}^{1-1/\xi} + \beta \left[\mathbb{E}\left(V_{it+1}^{1-\gamma}\right) \right]^{\frac{1-1/\xi}{1-\gamma}} \right\}^{\frac{1}{1-1/\xi}}, \qquad \text{where} \qquad x_{it} = c_{it} - \theta \frac{n_{it}^{1+1/\nu}}{1 + 1/\nu},$$

subject to

$$
\begin{aligned}
& c_{it} + a_{it+1} \leq w_t z_{it} n_{it} + (1+r_t) a_{it} - \mathcal{T}(w_t z_{it} n_{it}) + T_t^u \mathbb{1}_{z_{it}=0} + T_t^s \mathbb{1}_{z_{it}<\bar{z}}; \quad \text{for} \quad t > 0 \\
& c_{i0} + a_{i1} \leq w_0 z_{i0} n_{i0} + (1+r_0) a_{i0} + T^{\text{rev}}(q_{-1} b_{i0}, k_{i0}) - \mathcal{T}(w_0 z_{i0} n_{i0}) + T_0^u \cdot \mathbb{1}_{z=0} + T_0^s \cdot \mathbb{1}_{z<\bar{z}} \\
& a_{it+1} \geq \underline{a} \\
& \mathbb{1}_{\text{lock}_t=1}(c_{it} - \bar{c}_i) \leq 0 \\
& \mathbb{1}_{\text{lock}_t=1}(n_{it} - \bar{n}_i) \leq 0
\end{aligned}
$$

The tax function has the following functional form:

$$
\mathcal{T}(w_t z_{it} n_{it}) = w_t z_{it} n_{it} - (1 - \tau_t^n)(w_t z_{it} n_{it})^{1-\tau}
$$

Let $\nu_{it} \geq 0$ be the Lagrange multiplier on the borrowing constraint, and $\kappa_{it}^c, \kappa_{it}^n \geq 0$ on the lockdown constraints for consumption and labor, respectively. The complementary slackness conditions are given by:

$$
\begin{aligned}
\nu_{it}(a_{it+1} - \underline{a}) &= 0, & \nu_{it} &\geq 0, \\
\kappa_{it}^c \mathbb{1}_{\text{lock}_t=1}(c_{it} - \bar{c}_i) &= 0, & \kappa_{it}^c &\geq 0, \\
\kappa_{it}^n \mathbb{1}_{\text{lock}_t=1}(n_{it} - \bar{n}_i) &= 0, & \kappa_{it}^n &\geq 0.
\end{aligned}
$$

Euler equation. The first order condition with respect to consumption is:

$$
(1-\beta) x_{it}^{-1/\xi} + \kappa_{it}^c \mathbb{1}_{\text{lock}_t=1} = \beta \left[\mathbb{E}\left(V_{it+1}^{1-\gamma}\right) \right]^{\frac{\gamma - 1/\xi}{1-\gamma}} \mathbb{E}\left[V_{it+1}^{-\gamma} \frac{\partial V_{it+1}}{\partial a_{it+1}} \right] + \nu_{it} + \kappa_{it+1}^c \mathbb{1}_{\text{lock}_{t+1}=1}
$$

The envelope conditions is:

$$
\frac{\partial V_{it+1}}{\partial a_{it+1}} = (1-\beta)(1+r_{t+1}) V_{it+1}^{1/\xi} x_{it+1}^{-1/\xi}.
$$

Then, we can write the Euler equation as:

$$
(1-\beta) x_{it}^{-1/\xi} + \kappa_{it}^c \mathbb{1}_{\text{lock}_t=1} = \beta(1-\beta) \left[\mathbb{E}\left(V_{it+1}^{1-\gamma}\right) \right]^{\frac{\gamma - 1/\xi}{1-\gamma}} \mathbb{E}\left[(1+r_{t+1}) V_{it+1}^{1/\xi - \gamma} x_{it+1}^{-1/\xi} \right] + \nu_{it} + \kappa_{it+1}^c \mathbb{1}_{\text{lock}_{t+1}=1}
$$

Note that when the borrowing and the lockdowns constraints are slack, we obtain the standard Euler equation for unconstrained households:

$$x_{it}^{-1/\xi} = \beta \Big[\mathbb{E}\big(V_{it+1}^{1-\gamma}\big) \Big]^{\frac{\gamma - 1/\xi}{1-\gamma}} \mathbb{E}\Big[(1 + r_{t+1}) V_{it+1}^{1/\xi - \gamma} x_{it+1}^{-1/\xi} \Big]$$

Labor supply. The labor supply in the absence of lockdowns is determined by:

$$\theta n_{it}^{1/\nu} = (1 - \tau_t^n)(1 - \tau)(w_t z_{it})^{1-\tau} n_{it}^{-\tau}$$

Solving for n_{it} yields

$$n_{it}^{\tau + 1/\nu} = \frac{(1 - \tau_t^n)(1 - \tau)(w_t z_{it})^{1-\tau}}{\theta}$$

so that

$$n_{it} = \left[\frac{(1 - \tau_t^n)(1 - \tau)(w_t z_{it})^{1-\tau}}{\theta} \right]^{\frac{\nu}{1+\tau\nu}}$$

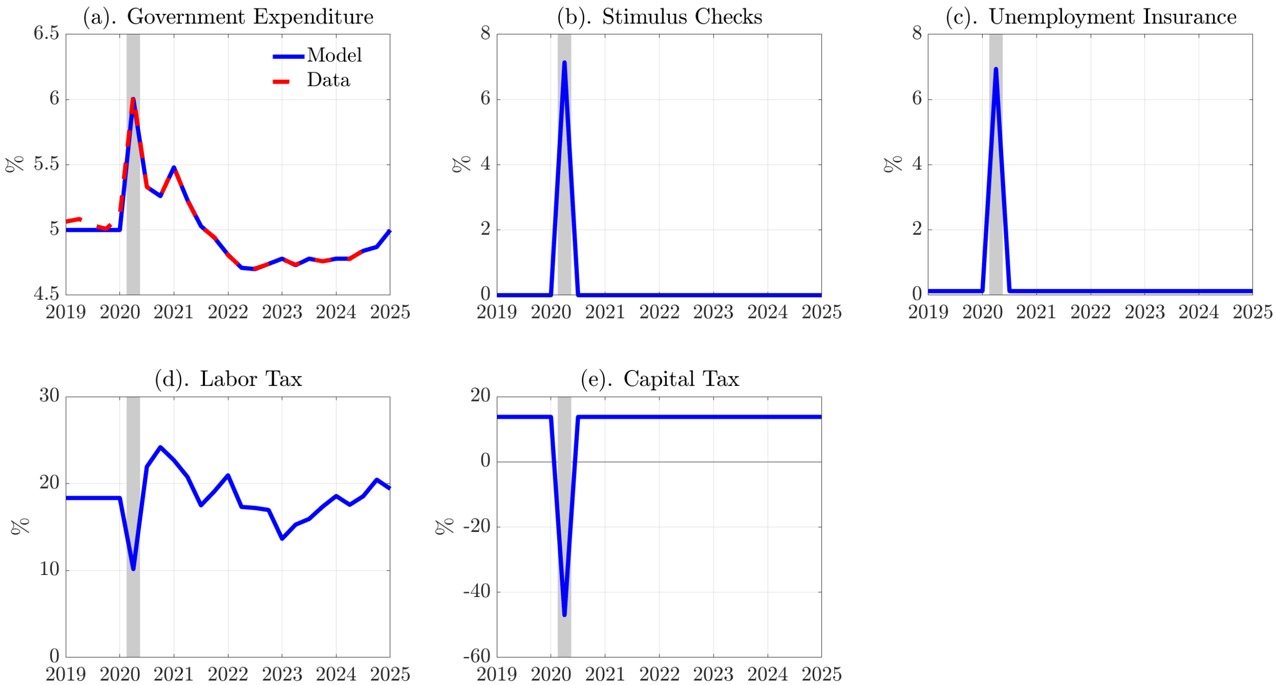
If the lockdown constraint binds on labor, $n_i = \bar{n}_i$, so we can write more generally the labor supply equation as:

$$n_{it} = \min \left\{ \bar{n}_i, \ \left[\frac{(1 - \tau_t^n)(1 - \tau)(w_t z_{it})^{1-\tau}}{\theta} \right]^{\frac{\nu}{1+\tau\nu}} \right\}$$

C Additional Figures

C.1 Baseline: Other fiscal policy variables

Figure C1: Transition Path for Selected Variables



C.2 Baseline: Extended horizon

Figure C2: Transition Path for Selected Variables

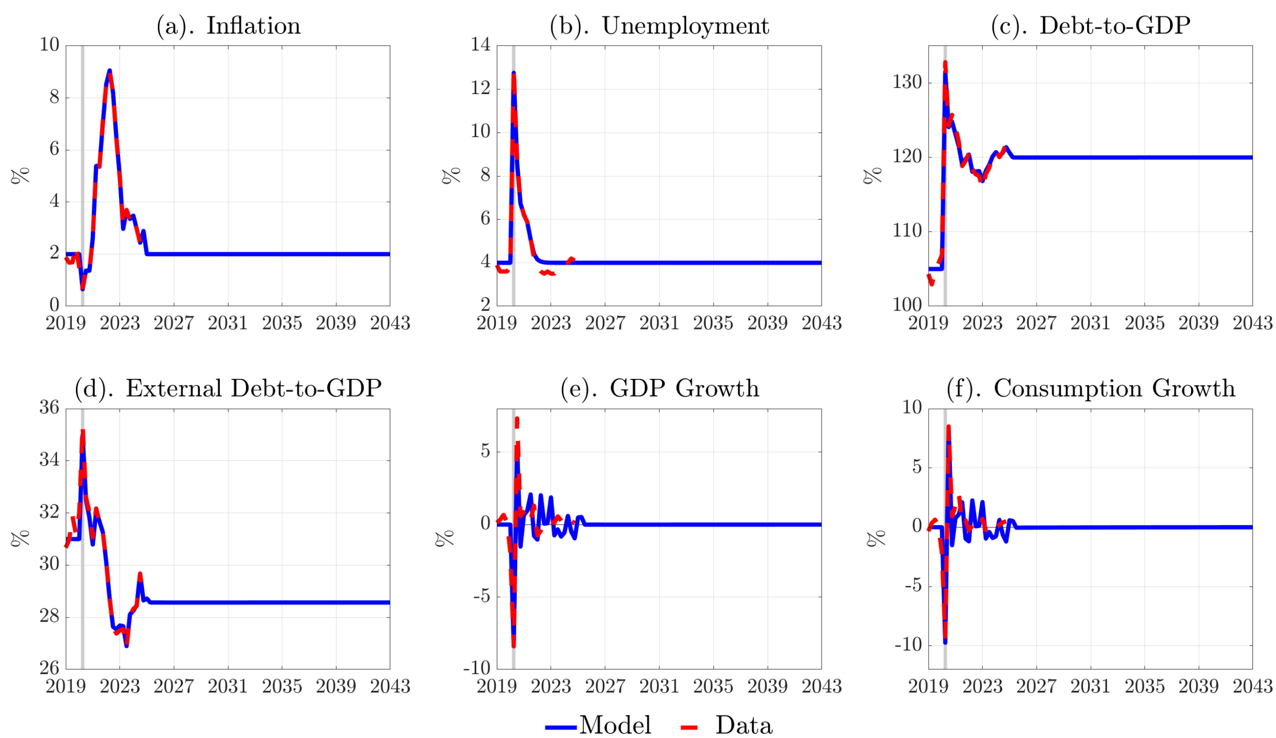
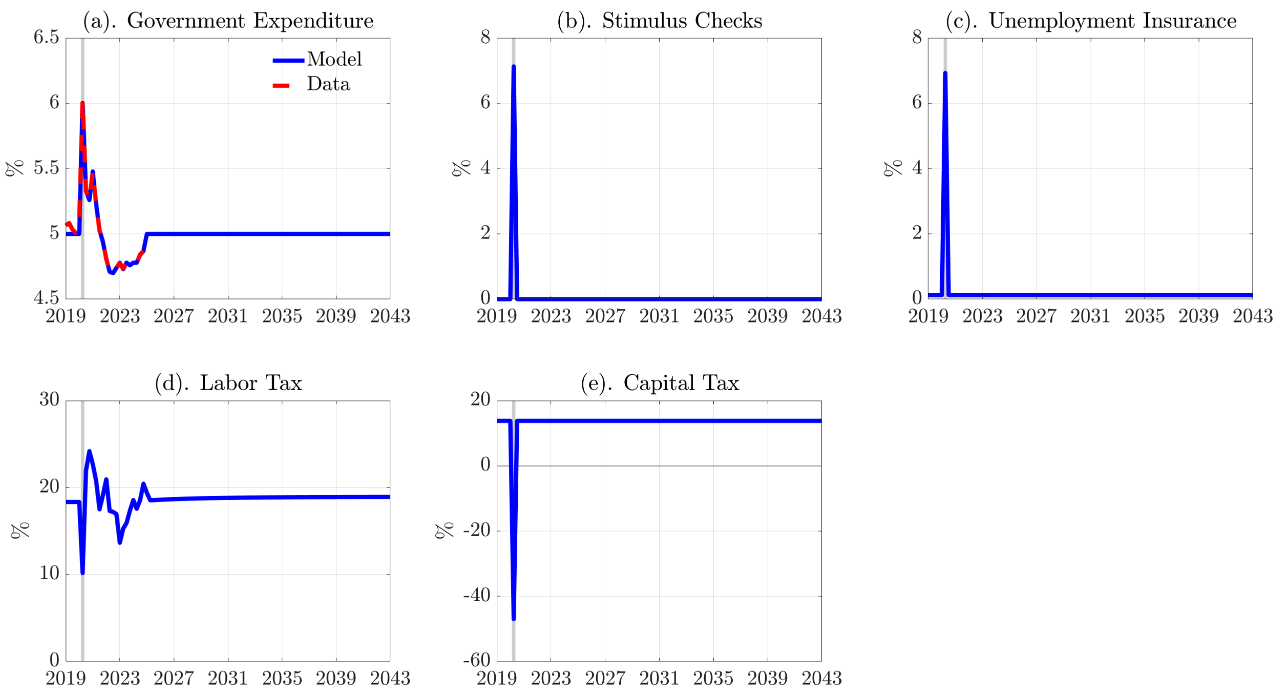


Figure C3: Transition Path for Selected Variables

Figure C4: Transition Path for Selected Variables



C.3 Counterfactuals

C.3.1 No capital subsidies

Figure C5: Transition Path for Selected Variables

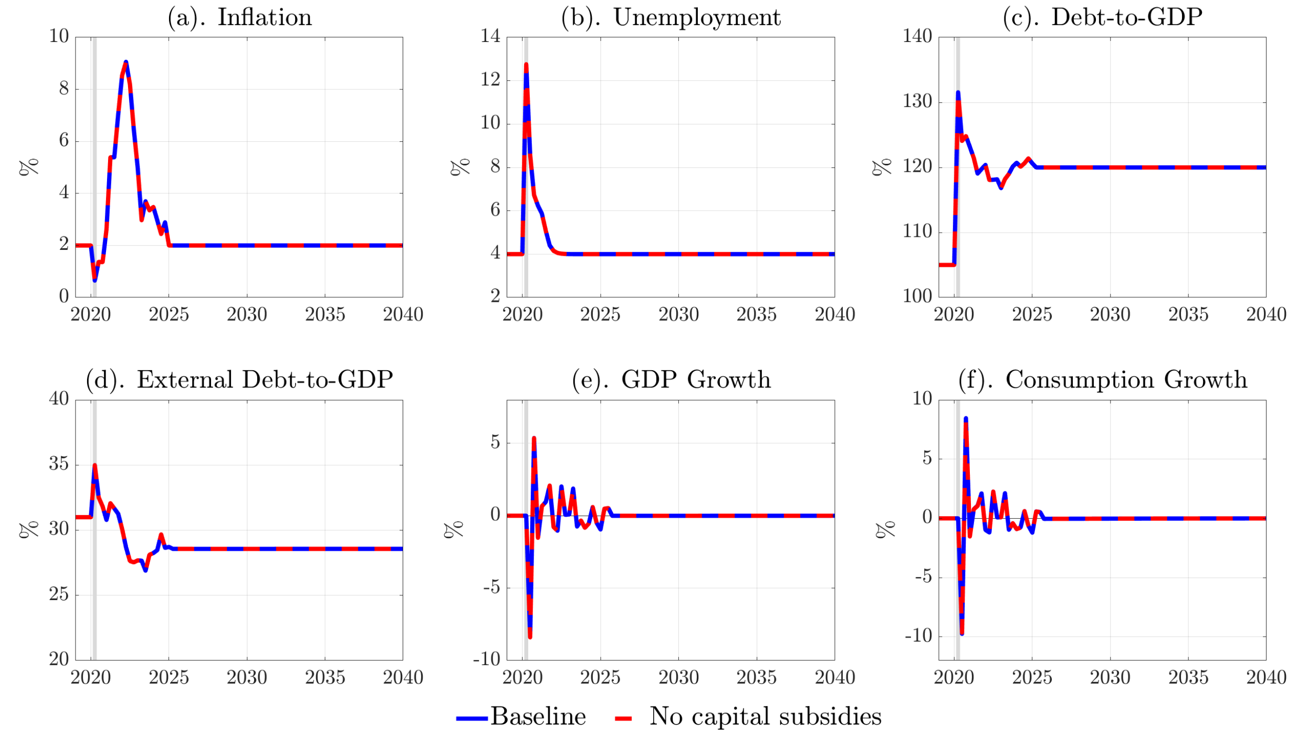


Figure C6: Transition Path for Selected Variables

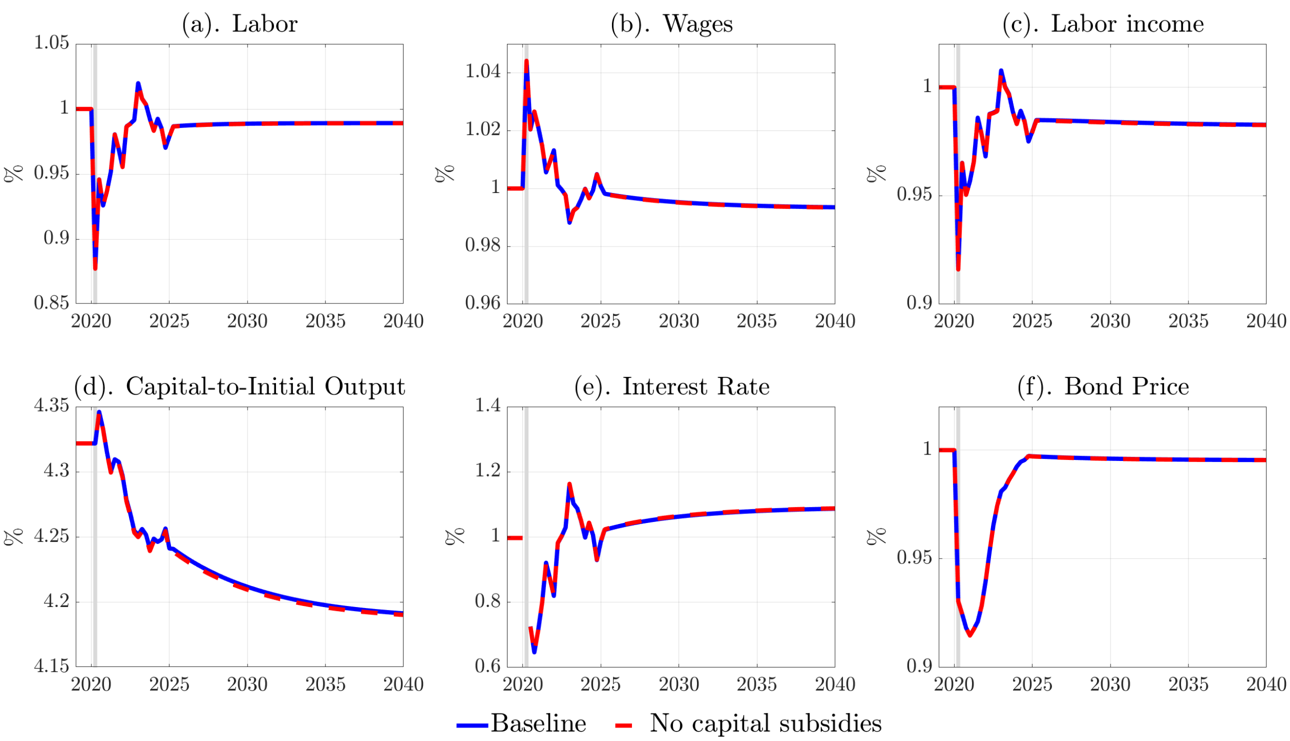
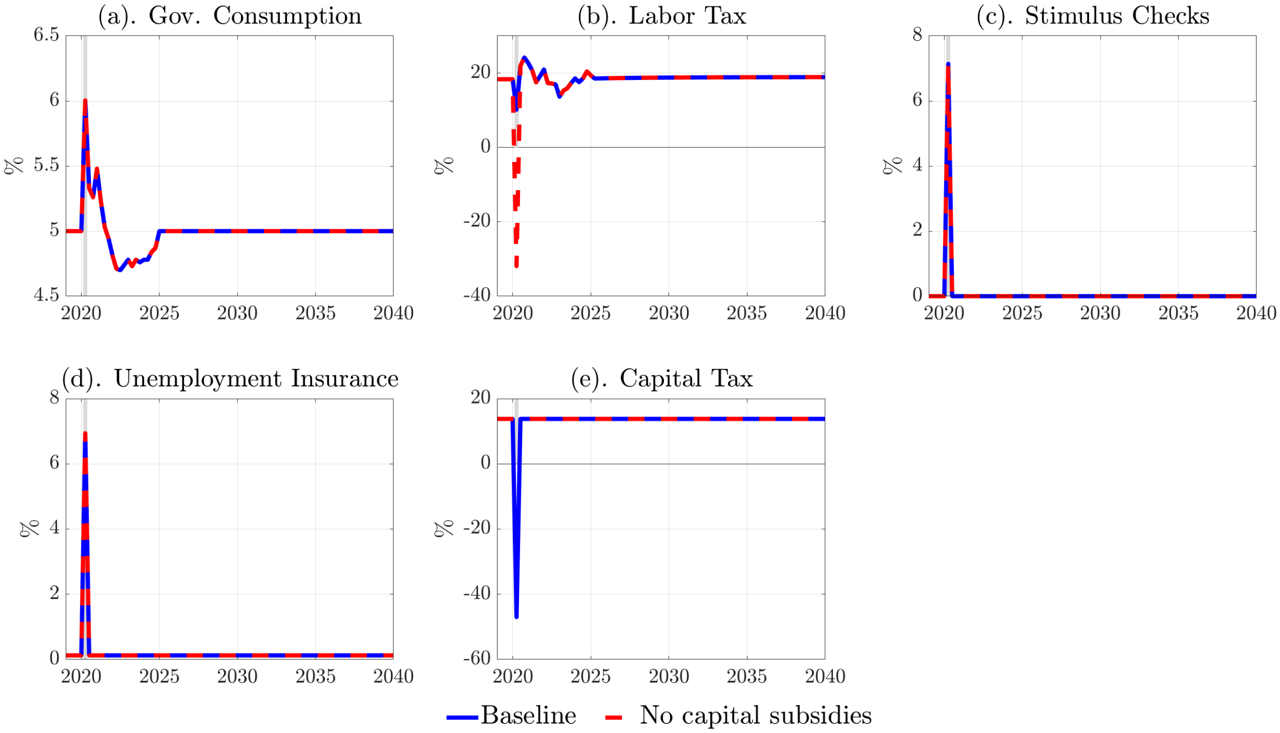


Figure C7: Transition Path for Selected Variables



C.3.2 Lower foreign demand

Figure C8: Transition Path for Selected Variables

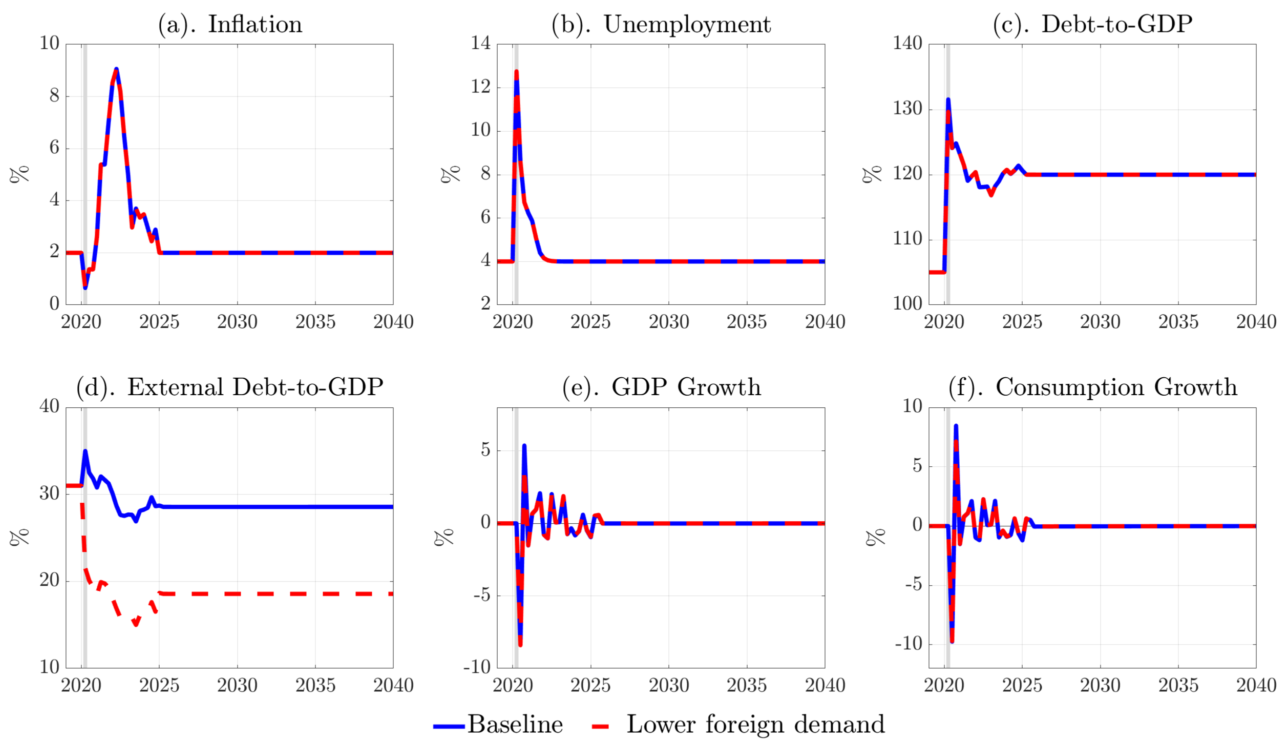


Figure C9: Transition Path for Selected Variables

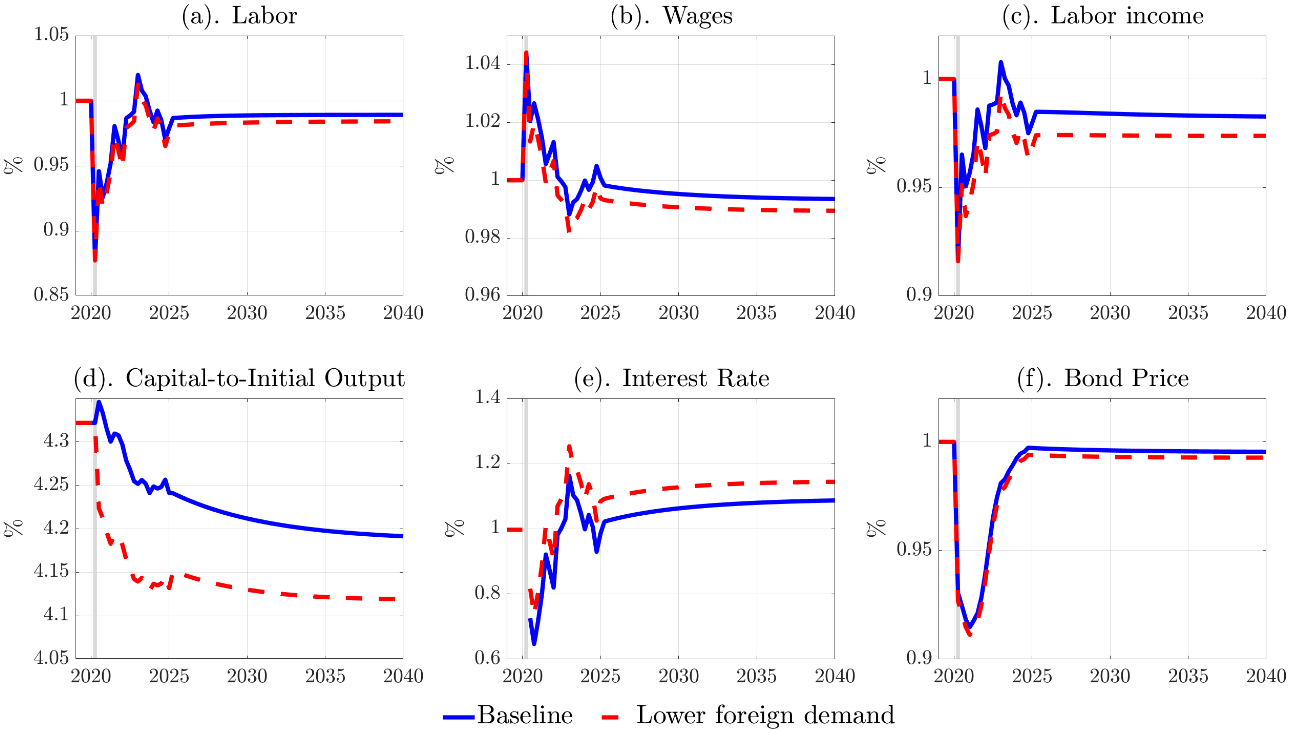
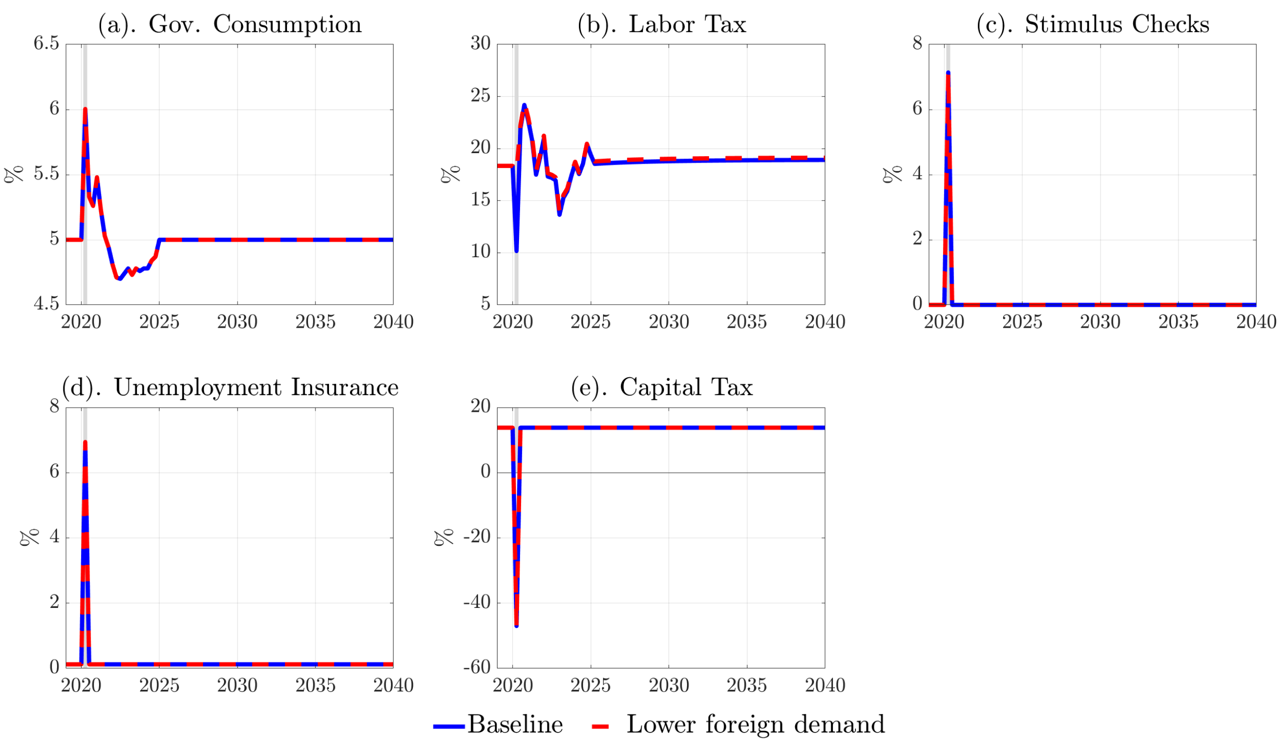


Figure C10: Transition Path for Selected Variables



C.3.3 Only stimulus checks

Figure C11: Transition Path for Selected Variables

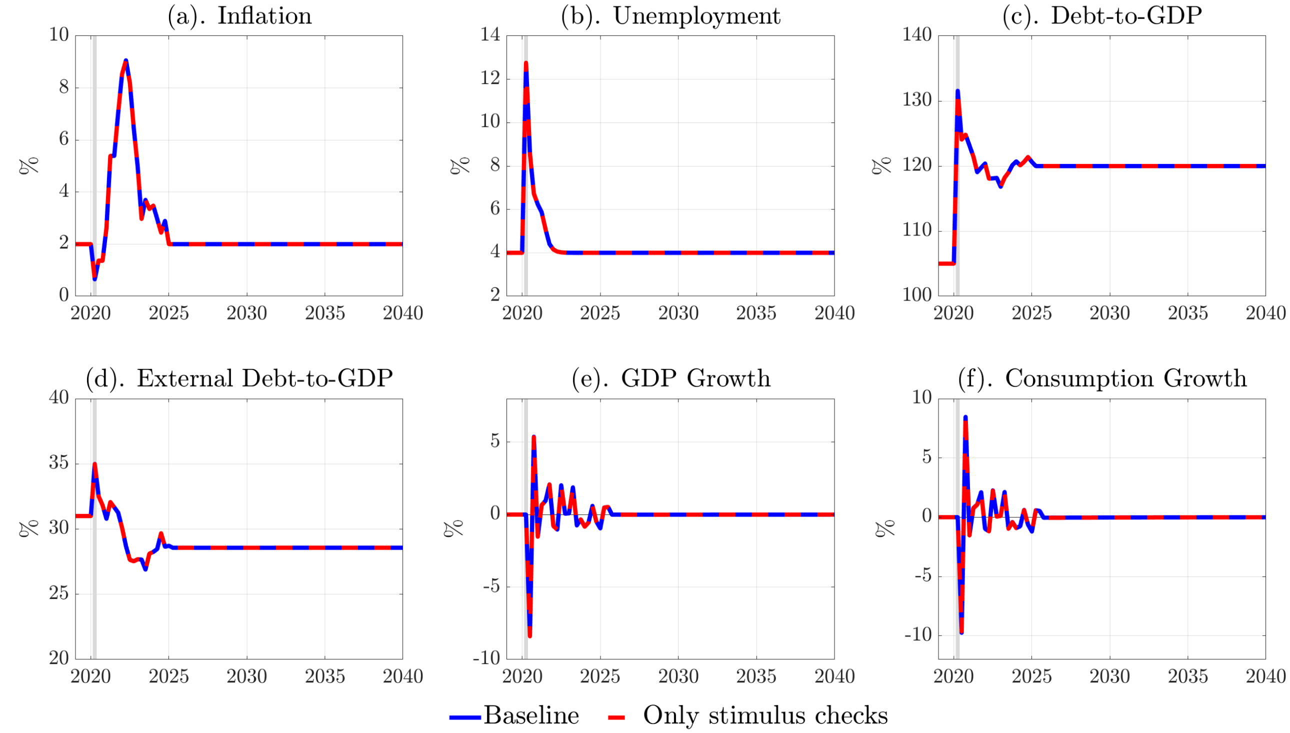


Figure C12: Transition Path for Selected Variables

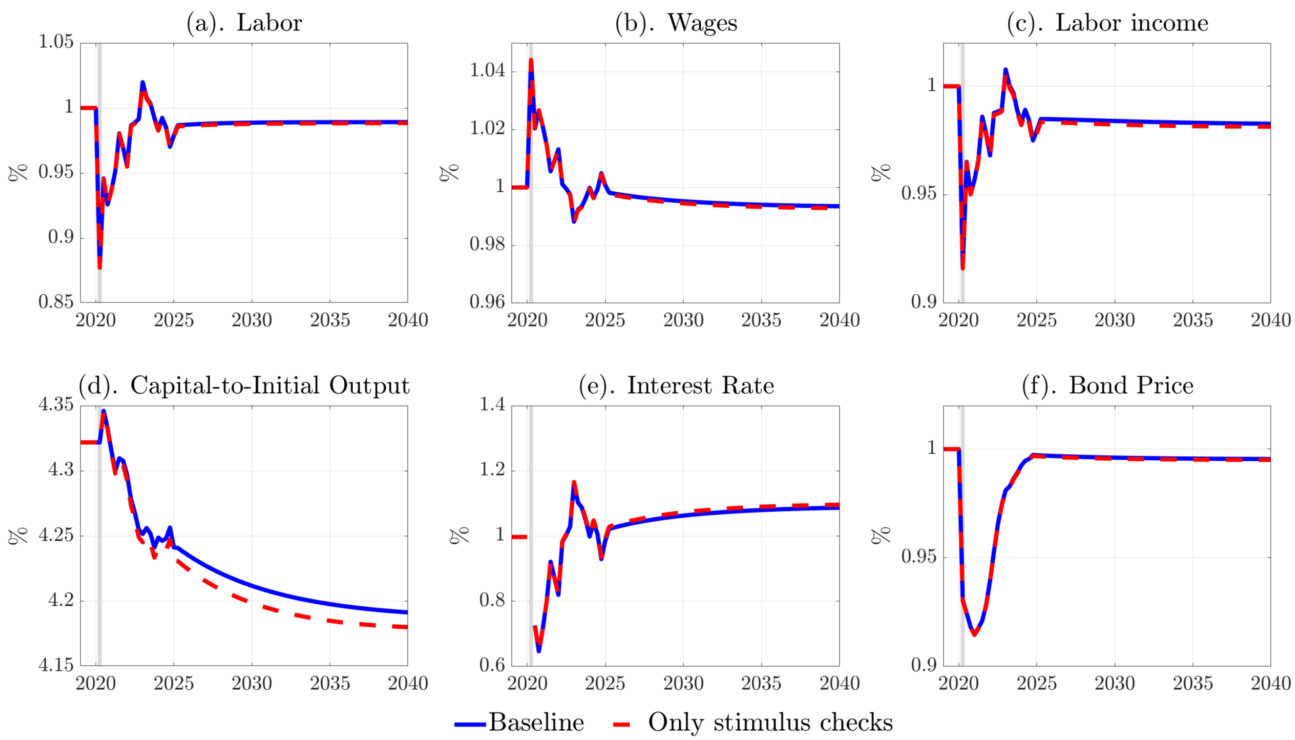
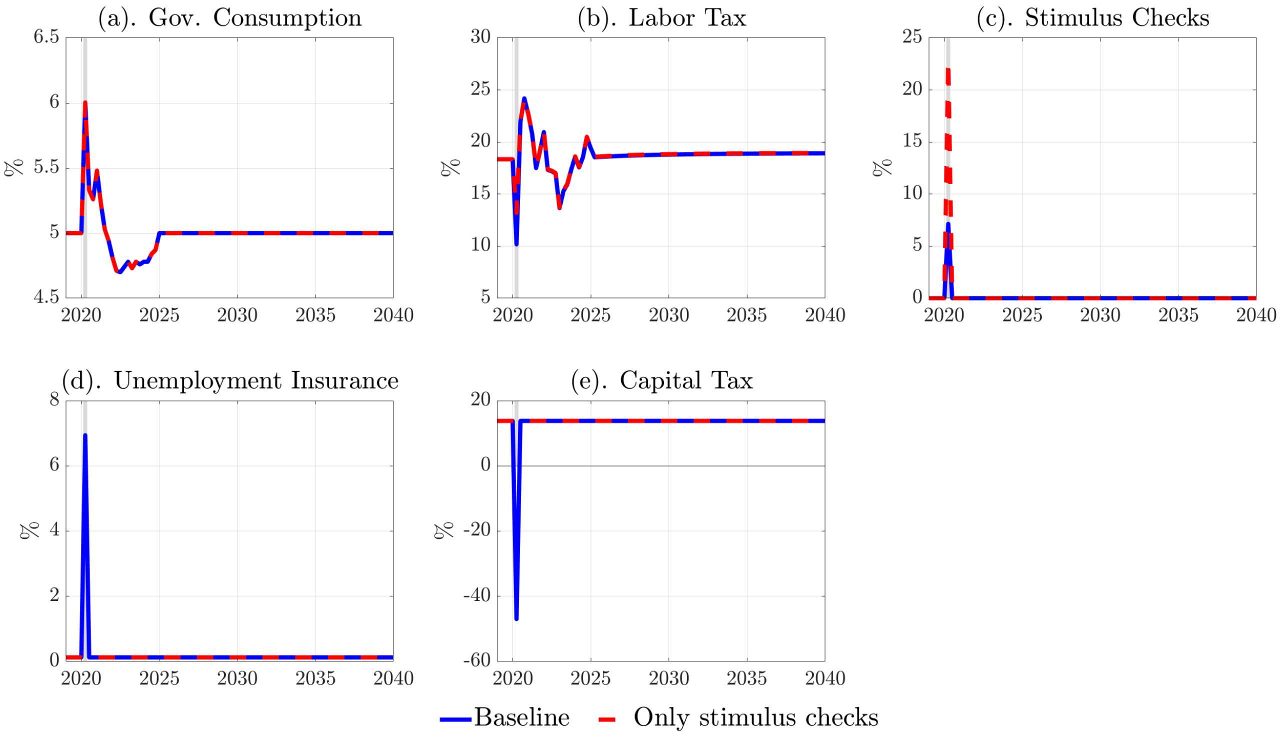


Figure C13: Transition Path for Selected Variables



C.3.4 CBO debt projections

Figure C14: Transition Path for Selected Variables

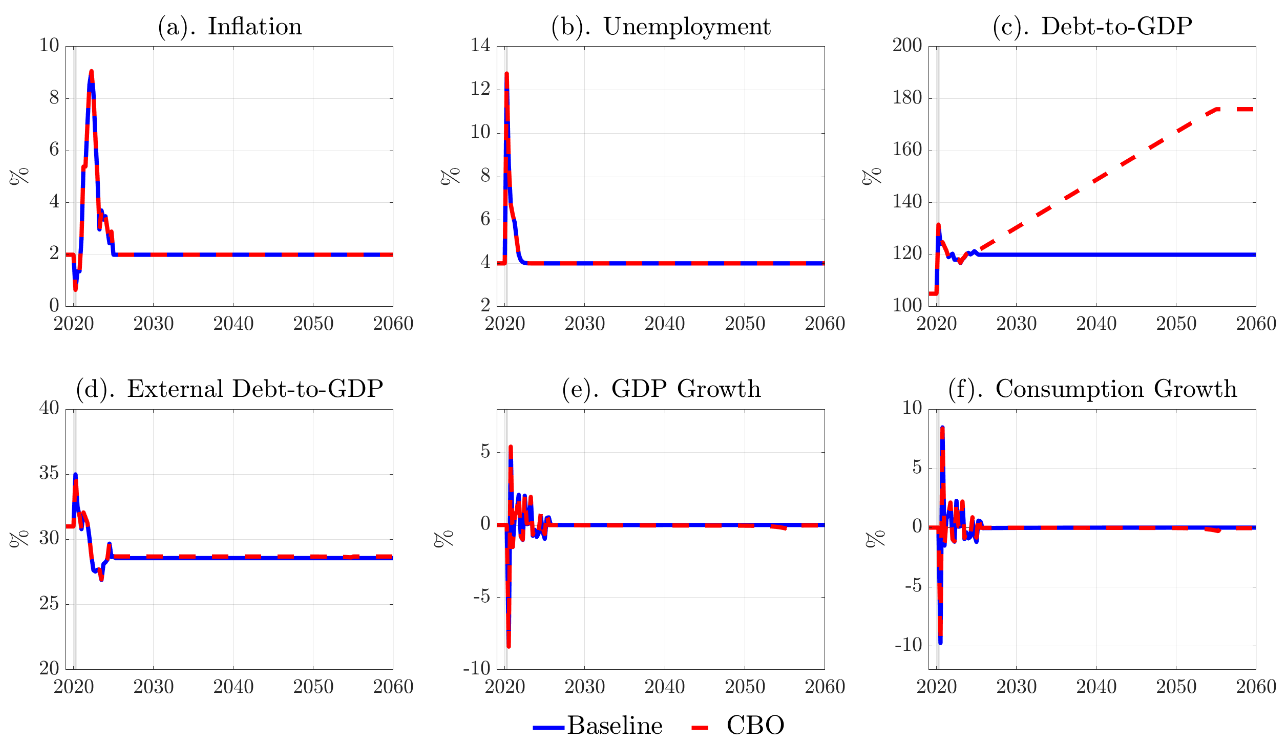


Figure C15: Transition Path for Selected Variables

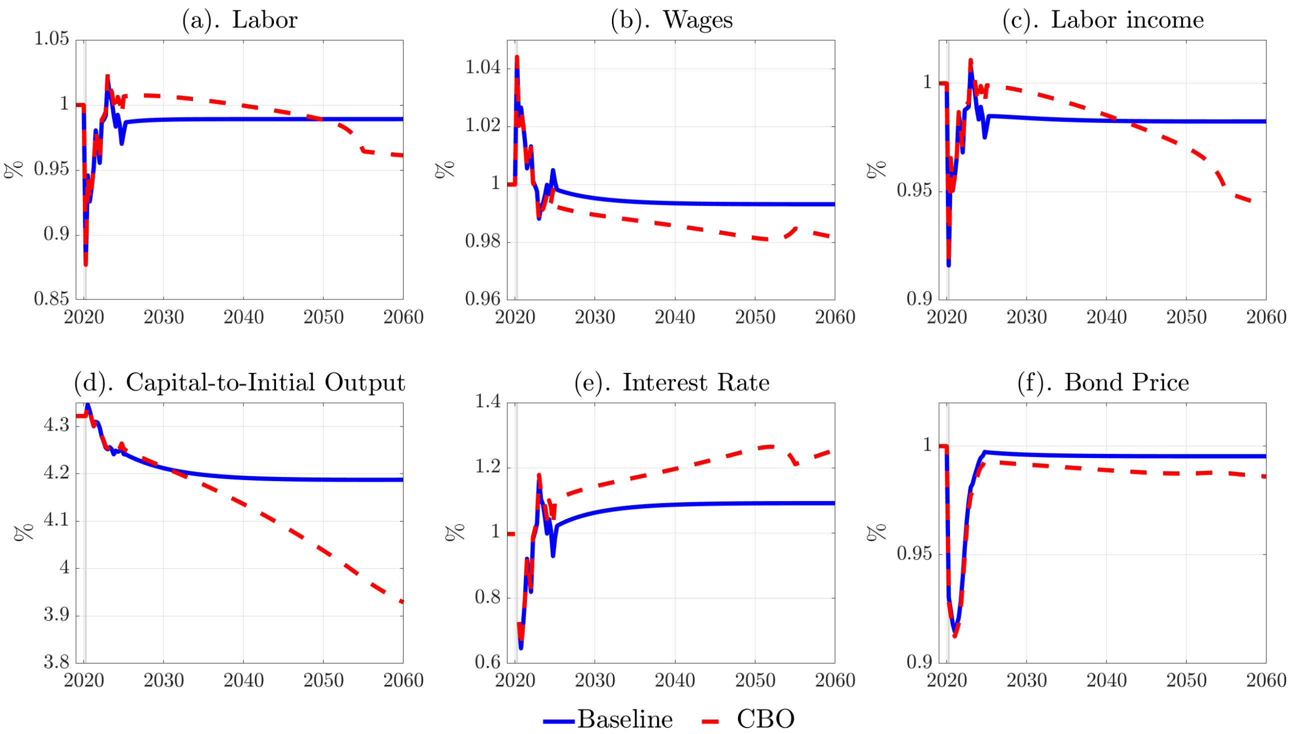
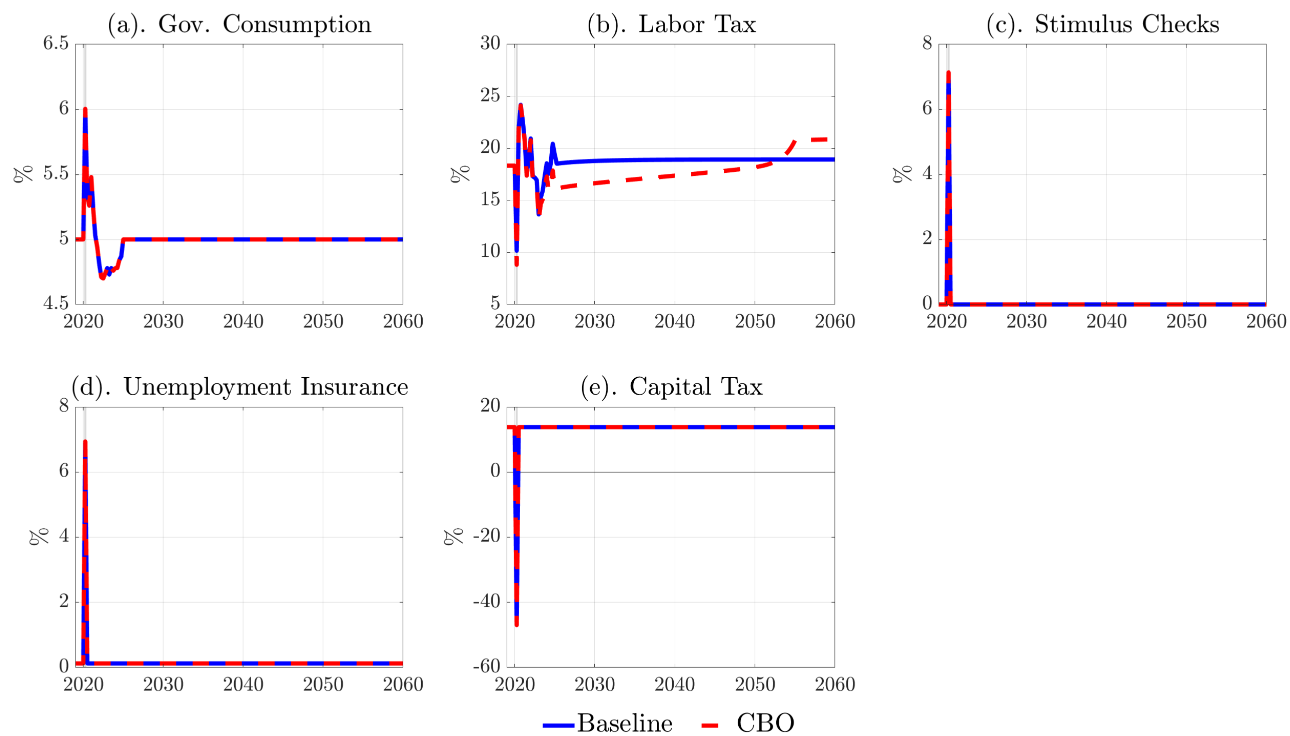


Figure C16: Transition Path for Selected Variables



D Data Sources

This section describes the data used in our analysis in more detail. It describes the Survey of Consumer Finances (SCF) and Financial Accounts of the U.S. (FA), Current Population Survey (CPS), Michigan Survey of Consumers (SoC), the National Income and Product Accounts (NIPA), and Pandemic Federal Programs from "Pandemic Oversight", and outlines the approach to cleaning them.

D.1 Survey of Consumer Finances (SCF) and Financial Accounts (FA)

I use data from the Federal Reserve's Survey of Consumer Finances (SCF) and the Financial Accounts of the U.S. (FA) to construct measures of household portfolios and aggregate wealth in the economy. The FA, available from the Federal Reserve Board's website, reports transactions and levels of financial assets and liabilities by sector and financial instrument, as well as full balance sheets—including net worth—for households, nonprofit organizations, and nonfinancial corporations. I use Table L.118 (Private Pension Funds) and Table L.122 (Mutual Funds) from the FA to obtain the composition of indirect household holdings of bonds and capital through these intermediaries.

The SCF provides micro-level data on household balance sheets. I use both the Full Public Data Set and the Summary Extract Public Data. The 2019 SCF is used to calibrate the initial steady state of the model, and the 2022 wave is used to evaluate the model's predictions for the evolution of the wealth distribution along the transition. The sample is restricted to households with positive labor income (keep if wageinc > 0.01). Reported assets and liabilities are grouped into capital and bonds. Capital includes business assets, real estate used in production, corporate equities, and the portion of retirement accounts and mutual funds invested in similar assets. Bonds comprise deposits, government and private bonds, liquid financial assets, and total debt netting.

For households with indirect holdings through pensions and mutual funds, I use the portfolio allocations from the 2019 FA tables to decompose total wealth. Mutual funds allocate 82% of assets to equities and corporate bonds and 18% to government and liquid claims, while pension funds invest 62% in corporate assets, 22% in mutual funds, and 16% in government and liquid assets. These portfolio weights are applied to the SCF variables, and the variable names referenced below correspond to those in the Summary Extract of the SCF.

Define bonds_pensions = 0.22 * 0.18 * (thrift + futpen + currpen) + 0.16 * (thrift + futpen + currpen), and define also capital_pensions = 0.22 * 0.82 * (thrift + futpen + currpen) + 0.62 * (thrift + futpen +

currpen), which measure households' positions in bonds and capital through pension funds. Similarly, define the holdings through mutual funds as bonds_funds = 0.18 * nmmf and capital_funds = 0.82 * nmmf. Total holdings are constructed as total_bonds = liq + bonds_funds + savbnd + bond + irakh + bonds_pensions - debt + 0.5 * cashli + cds and total_capital = capital_funds + stocks + othma + capital_pensions + othfin + nfin + 0.5 * cashli.

I then rank households by deciles of net worth and express both capital and bond holdings as shares of mean aggregate net worth. Using the SCF sample weights, I compute for each decile the mean holdings of the two asset types. The resulting portfolio distribution, shown in Figure 2, is used to discipline household asset positions in the model at period 0.

D.2 Current Population Survey (CPS)

The Current Population Survey (CPS) is a monthly household survey conducted jointly by the U.S. Census Bureau and the Bureau of Labor Statistics. It provides nationally representative data on the U.S. population and serves as the main source for official labor market indicators, including the unemployment rate and labor force participation rate.

I use CPS data to construct the time series $\{P_t^{ee}, P_t^{uu}\}_{t\geq 0}$, where P_t^{ee} denotes the probability of remaining employed conditional on employment, and P_t^{uu} denotes the probability of remaining unemployed conditional on unemployment. These probabilities are derived from the Labor Force Statistics of the CPS, using monthly data on labor force flows—specifically, transitions from employed to employed and from unemployed to unemployed—along with the corresponding monthly stocks of employment and unemployment.

Flows in and out of the labor force are treated as transitions into and out of employment, respectively, so that the resulting series replicate the observed unemployment rate path. The E-E transition probability in each month is calculated as the share of individuals who remain employed out of those employed in the previous month, while the U-U transition probability measures the share of individuals who remain unemployed relative to those unemployed in the previous month. After obtaining these monthly probabilities, I convert them to quarterly frequency by averaging over three months within each quarter.

D.3 Michigan Survey of Consumers (SoC)

I use data from the Michigan Survey of Consumers, conducted by the Survey Research Center of the University of Michigan, covering the period 2008Q1–2024Q4. I download data for the Consumer Sentiment Index (CSI), constructed as

$$\mathrm{CSI} = A \cdot (\mathrm{Q1} + \mathrm{Q2} + \mathrm{Q3} + \mathrm{Q4} + \mathrm{Q5}) + c$$

where the constant A and scalar c standardize the index. Each subindicator Q_j is expressed as a relative score, defined as the percentage of respondents giving favorable responses minus the percentage giving unfavorable responses, plus 100.

The survey is based on a random, nationally representative sample drawn from all possible cell phone numbers in the 48 contiguous U.S. states and the District of Columbia. The five questions that form the CSI are:

- Q1: "Would you say that you (and your family living there) are better off or worse off financially than you were a year ago?"
- Q2: "Now looking ahead—do you think that a year from now you (and your family living there) will be better off financially, or worse off, or just about the same as now?"
- Q3: "Now turning to business conditions in the country as a whole—do you think that during the next twelve months we'll have good times financially, or bad times, or what?"
- Q4: "Looking ahead, which would you say is more likely—that in the country as a whole we'll have continuous good times during the next five years or so, or that we will have periods of widespread unemployment or depression, or what?"
- Q5: "About the big things people buy for their homes—such as furniture, a refrigerator, stove, television, and things like that. Generally speaking, do you think now is a good or bad time for people to buy major household items?"

I use quarterly data from Table 6: Current Financial Situation Compared with a Year Ago, corresponding to households' responses to Q1, to perform the empirical validation of the model.

D.4 National Income and Product Accounts (NIPA)

I use data from the National Income and Product Accounts (NIPA) published by the U.S. Bureau of Economic Analysis (BEA) to calibrate fiscal policy variables in both the initial steady state and along the transition paths. These tables provide a consistent accounting framework for the federal government's revenues, expenditures, and net government savings, allowing the model to match some fiscal aggregates observed in the U.S. economy. Specifically, I use NIPA Tables 3.2, 3.7, and 3.12 to construct measures of government revenue, transfers, consumption, and net interest payments relative to GDP in 2019.

Table D1: Federal Government Revenue and Expenditure Ratios (Percent of GDP, 2019)

Revenue and Borrowing		Expenditure	
Taxes on households	**12.50**	**Transfers**	**14.32**
Personal current taxes	7.90	Current transfer payments	13.98
Social insurance taxes	3.54	Subsidies	0.34
Taxes from rest of the world	0.12		
Taxes on production and imports	0.81		
Current transfer receipts from persons	0.12		
Current transfer receipts from rest of the world	0.00		
Taxes on firms	**4.13**	**Government expenditure**	**5.05**
Taxes on corporate income	0.98	Government consumption	5.05
Social insurance taxes	2.98		
Current transfer receipts from business	0.17		
New borrowing	**4.85**	**Interest payments**	**2.50**
Net federal government saving	-4.85	Net interest	2.50
Total revenue	**16.63**	**Total expenditure**	**21.87**

D.5 Pandemic-Related Federal Programs

This subsection provides a detailed breakdown of federal pandemic-related programs implemented in response to COVID-19. Data were obtained from "Pandemic Oversight", the official website of the U.S. government's Pandemic Response Accountability Committee (PRAC). The PRAC was created by the CARES Act to support and coordinate independent oversight of pandemic relief spending, overseeing more than $5 trillion in programs enacted under the CARES Act, the Consolidated Appropriations Act, and the American Rescue Plan Act.

Table D2 reports the size of each program in U.S. dollars and as a share of the full stimulus package, and classifies them by category—households, firms, or other. The last column shows each program's share of total pandemic relief spending. This classification is used to calibrate the distribution of fiscal transfers in the model's transition path.

Table D2: Pandemic-Related Federal Programs by Category

Program	**Amount (millions USD)**	**Category**	**% of Total Programs**
Stimulus checks and others	1,100,000	Households	21.9
Unemployment benefits	1,000,000	Households	19.9
Financial institutions	81,200	Firms	1.6
Health care	351,400	Firms	7.0
Transportation	159,200	Firms	3.2
Global assistance	16,100	Other	0.3
Public services	91,200	Other	1.8
Tax credits	161,700	Households	3.2
Private sector pensions	86,000	Households	1.7
Federal program administration	92,100	Other	1.8
Paycheck Protection Program	778,000	Firms	15.5
Small businesses	184,000	Firms	3.7
Veterans	34,400	Households	0.7
Farming industry	32,200	Firms	0.6
Education	283,500	Other	5.6
State and local governments	674,300	Other	13.4
Broadband and technology	19,100	Other	0.4
Total (Households)			**47.4**
Total (Firms)			**32.6**
Total (Other)			**20.0**

E Computational Algorithm

E.1 Steady-States

This appendix describes the numerical procedure used to compute the initial and final steady states of the model. Both equilibria are computed as fixed points in which aggregate variables are constant and household decisions are optimal given prices, policies, and constraints. The main difference between the two steady states is the level of government debt, which is 20% higher in the final steady state. The solution involves nested fixed-point algorithms across prices, policy functions, and the distribution of households.

Step 1: Initial Steady State

1. **Calibration and government targets.** Start with a guess for the real interest rate r_0 and targets (as shares of GDP) for unemployment insurance, tax revenue from firms, total and external government debt, government spending, lump-sum transfers, aggregate assets, as well as the inflation target, and the maturity of debt.

2. **Labor income tax consistent with budget.** For each r_0, solve for the labor income tax τ^n that balances the government budget. Given the wage w from the firm's FOC, household labor supply is

$$n_i = \left[\frac{(1-\tau)(1-\tau^n)(wz_i)^{1-\tau}}{\theta} \right]^{\frac{\nu}{1+\tau\nu}}$$

   Aggregate to obtain L and $Y = F(K, L)$, compute revenues, and iterate on τ^n by root-finding until the budget constraint holds. This has two solutions due to the Laffer curve, so I select the lower root.

3. **Household policy functions.** Given taxes and prices, solve with the endogenous grid method under Epstein–Zin preferences:

$$V_{it} = \left[(1-\beta) x_{it}^{1-1/\xi} + \beta \big(\mathbb{E}_z V_{it+1}^{1-\gamma} \big)^{\frac{1-1/\xi}{1-\gamma}} \right]^{\frac{1}{1-1/\xi}},$$

   with the Euler condition

$$x_{it}^{-1/\xi} \geq \beta \big(\mathbb{E}_z V_{it+1}^{1-\gamma} \big)^{\frac{\gamma-1/\xi}{1-\gamma}} \mathbb{E}_z \left[(1+r_{t+1}) V_{it+1}^{1/\xi-\gamma} x_{it+1}^{-1/\xi} \right].$$

   Impose the borrowing constraint using linear interpolation and iterate until convergence in V and x.

4. **Stationary distribution.** Iterate forward on the law of motion using the policy functions and the Markov transition process until the distribution converges.

5. **General equilibrium.** Aggregate household savings must satisfy

$$\mathcal{A}(r_0) = K(r_0) + q\big(B(r_0) - B^\star(r_0)\big),$$

   where $B^\star$ denotes external debt. If not, update r_0 and repeat steps 2–5 until market clearing holds (with $q = 1$ for all guesses r_0).

Step 2: Final Steady State

The final steady state is computed using the same algorithm as above, except that the debt-to-annual GDP ratio target Λ_b is increased by 15% relative to the initial steady state. The updated debt level requires a new general equilibrium interest rate r_1. I follow the same nested procedure to find r_1, the corresponding tax rate τ^n, and the household policy functions and distribution that are consistent with the new environment.

E.2 Transition Path

This section describes the computational procedure used to solve for the perfect foresight transition path between the initial and final steady states. The objective is to find a sequence of prices, policies, and distributions such that markets clear and households and firms optimize given the anticipated evolution of the economy.

Step 1: Inputs and Exogenous Sequences

The transition begins from the initial steady-state distribution of households and converges to the final steady state in period H. The following sequences are exogenously fed into the model:

$$\{\text{lock}_t, \Omega_t, \pi_t, B^\star_t\}_{t\geq 0} \qquad \text{and} \qquad \{B_t, \tau^k_t, T^s_t, T^u_t, G_t\}_{t\geq 0}.$$

The first set governs the lockdown intensity, the transition probabilities across productivity and unemployment states, the inflation path, and external debt. The second represents the fiscal policy plan announced by the government, including the paths for public debt, capital taxes, transfers, and expenditures.

Step 2: Backward Iteration on Prices and Policy Functions

The transition path is computed by first iterating backward on prices, taxes, and household policies from the terminal steady state in period H to the initial period 0.

1. **Initial conditions.** Set $r_H = r_1$, the final steady-state interest rate. Provide an initial guess for the path of interest rates $\{r_t\}_{t=1}^{H-1}$, and for the initial period returns on capital and bonds, r^k_0 and

r_0^b.

2. **Bond price recursion.** At each $t = H-1, \ldots, 1$, given next period's bond price q_{t+1}, inflation π_{t+1}, and the guessed return r_{t+1}, recover the current bond price q_t from the bond pricing equation.

3. **Fiscal policy and labor taxation.** At each $t = H-1, \ldots, 1$, compute the wage w_t from the firm's first-order condition and solve for the labor income tax τ_t^n that satisfies the government's period-by-period budget constraint. When doing so, ensure that the individual labor supply implied by the wage rate and the guessed τ_t^n does not exceed $\bar{n}_i$ whenever $\text{lock}_t = 1$.

4. **Household optimization.** Given prices, taxes, and transfers, solve the household problem using the endogenous grid method. For each household, given the continuation value $V_{i,t+1}$, iterate backward to recover V_{it} using the Euler equation, ensuring that both the borrowing constraint and, when $\text{lock}_t = 1$, the consumption constraint are not violated. Policy functions for savings and consumption are stored for each t.

5. **Period $t = 0$.** In period 0, the same procedure is applied with two distinctions due to potentially different returns on bonds and capital:

   (a) The labor tax τ_0^n is determined taking into account that r_0^k affects revenues from capital taxes, while r_0^b determines the government's debt service in the budget constraint.

   (b) In the household problem, asset revaluations imply an additional transfer $T^{\text{rev}}(r_0^b, r_0^k, b_{i0}, k_{i0})$ in the budget constraint, reflecting the capital gains or losses on pre-existing portfolios.

   This step produces the time path of household value functions, savings and consumption policies, and labor supply decisions.

Step 3: Forward Iteration on Household Distribution

Given the policy functions for savings and the sequence of idiosyncratic productivity transition matrices $\{\Omega_t\}_{t\geq 0}$, I compute the forward evolution of the household distribution $\{\mu_t(s)\}$ over assets and productivity states $s = (a, z)$:

1. Starting from the initial distribution $\mu_0(s)$, update the mass of households across states using the optimal savings policies and the transition probabilities in Ω_t.

2. Iterate this law of motion forward to obtain $\{\mu_t(s)\}_{t=1}^{H}$, and compute aggregate savings $\mathcal{A}_t$ in each period. Note that in period 0, given our calibration of the portfolios, we know $\mathcal{B}_0$ and $\mathcal{K}_0$

This determines the evolution of the cross-sectional distribution of households throughout the transition.

Step 4: General Equilibrium

Iterate on the sequence of interest rates $\{r_t\}_{t=1}^{H}, r_0^b, r_0^k$ until all markets clear within tolerance at each t.

$$\begin{aligned} t > 0: &\quad \mathcal{A}_t = q_{t-1}(B_t - B_t^{\star}) + K_t, \\ t = 0: &\quad \mathcal{B}_0 = B_0 - B_0^{\star}, \quad \mathcal{K}_0 = K_0. \end{aligned}$$

In period $t = 0$, the real returns on bonds and capital (r_0^b, r_0^k) are adjusted separately to clear the corresponding markets.

F References for Appendix

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