Redistribution and the Monetary–Fiscal Policy Mix*

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Abstract

We show that the effectiveness of redistribution policy in stimulating the economy and improving welfare is directly tied to how much inflation it generates, which in turn hinges on monetary-fiscal adjustments that ultimately finance the transfers. We compare two distinct types of monetary-fiscal adjustments: In the *monetary regime*, the government eventually raises taxes to finance transfers, while in the *fiscal regime*, inflation rises, effectively imposing inflation taxes on public debt holders. We show analytically in a simple model how the fiscal regime generates larger and more persistent inflation than the monetary regime. In a quantitative application, we use a two-sector, two-agent New Keynesian model, situate the model economy in a COVID-19 recession, and quantify the effects of the transfer components of the Coronavirus Aid, Relief, and Economic Security (CARES) Act. We find that the transfer multipliers are significantly larger under the fiscal regime—which results in a milder contraction—than under the monetary regime, primarily because inflationary pressures of this regime counteract the deflationary forces during the recession. Moreover, redistribution produces a Pareto improvement under the fiscal regime.

JEL classification: E53; E62; E63

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1 Introduction

What are the macroeconomic effects of redistribution policies that transfer resources from one set of agents in the economy to another? What are the determinants of the transfer multiplier? When is the transfer multiplier large? What are the welfare implications of such redistribution policies?

Recently, the U.S. experienced the two largest contractions after World War II—the Great Recession and the COVID-19 recession. The government responded to these contractions with unprecedented fiscal measures—namely the American Recovery and Reinvestment Act of 2009 and the Coronavirus Aid, Relief, and Economic Security (CARES) Act of 2020. These fiscal responses included significant transfer components, and they have renewed interest in the effectiveness of transfer policies in terms of rebooting the economy and improving household welfare.

In a dynamic general equilibrium model, one would have to take numerous factors into account to answer the above questions.[1] In this paper, we focus on the source of financing and show how the government finances transfers has a first-order importance for their effectiveness. Our focus is motivated by the ongoing rapid increase in public debt caused by the large-scale transfer programs. This eventually requires fiscal and/or monetary adjustments, which would *ultimately* finance current transfers.

We compare two distinct ways to finance transfers in a two-agent New Keynesian (TANK) model. In the model, a set of households are unable to borrow and lend to smooth consumption over time. A transfer policy redistributes resources toward such "hand-to-mouth" (HTM) households and away from "Ricardian" households that own government bonds.[2] In the first policy regime, the government raises taxes. Inflation is then stabilized in the usual way by the central bank. We call this case the "monetary regime." In the second regime, the government commits itself to no adjustments in taxes, and the central bank allows inflation to rise to stabilize the real value of debt, thereby imposing "inflation taxes" on households that hold nominal government debt. In this "fiscal regime," the fiscal theory of the price level operates.

We find that the effectiveness of transfer policy is directly tied to how much inflation it generates. A transfer policy is inflationary irrespective of the policy regimes in the model. It is, however, more inflationary in the fiscal regime than in the monetary regime.

[1] We discuss previous findings in more detail later. Some well-known determinants of the fiscal multiplier are the marginal propensity to consume of targeted households and whether the economy is in a liquidity trap.

[2] As we describe in further detail later, in our application, we think of these HTM households as working in the service sector that is affected by a large negative sectoral shock.

Therefore, inflation-financed transfers can be used to fight deflationary pressures during recessions, thereby preventing output and consumption of both types of households from dropping significantly. As a result, the welfare of both household types is higher when transfers are inflation-financed than when they are tax-financed.

Furthermore, somewhat surprisingly, inflation-financed transfers can produce a Pareto improvement relative to the no-transfer case. Notice that, since the model features staggered Calvo-type price setting, inflation is not a free lunch: it generates, *ceteris paribus*, significant resource misallocation, which leads to a decrease in labor productivity and in welfare. These negative effects of inflation are, however, outweighed by the positive effects of inflation in the low-inflation environment considered in this paper. In fact, without an inflationary intervention, the economy would experience deflation, so there is little cost of inflation.

Our paper starts with a simplified flexible-price version of the model that permits analytical results, thereby allowing us to illuminate the mechanism of the fiscal theory in a heterogeneous-household framework. This model also serves as a useful reference point, as the two policy regimes produce exactly the same multipliers for output and consumption and an identical level of household welfare, even if inflation dynamics are different. This is due to two features. First, *both* conventional taxes, which are assumed to be lump sum, and inflation taxes are non-distortionary. Second, price flexibility shuts down any feedback effects from inflation on real variables.[3]

For inflation, the fiscal regime gives rise to higher and more persistent inflation than the monetary regime. In particular, transfers affect inflation through two channels in this regime. First, an increase in transfers leads *directly* to an increase in public debt, which accumulates over time. Consequently, inflation rises to stabilize the real value of debt. Second, an increase in transfers may *indirectly* raise future public debt through an interest rate channel. Redistribution changes Ricardian household consumption, which in turn affects real interest rates and thus outstanding public debt in the following periods. That is, redistribution generates a new valuation effect through real interest rate changes, an effect that is absent in the standard one-agent model often used to analyze the fiscal regime. This interest rate channel may lead to a further increase in inflation. Showing these two effects explicitly in a nonlinear two-agent model is a contribution of our paper.

We then build on the analytical results and proceed to a quantitative analysis employing a two-sector TANK model. Relative to the simplified version, the quantitative model

[3]The transfer multiplier for output is small yet still positive due to the classical labor supply channel. Redistribution causes Ricardian household consumption to fall, creating a negative "wealth effect" on labor supply. The households thus supply more hours for a given wage rate, which in turn raises output.

includes several realistic features that break the uniformity of the two regimes in terms of the multipliers. The two most important are nominal rigidities and the "COVID shocks." Sticky prices are important, as transfers now can increase output through the usual New Keynesian channel by generating inflation—on top of the classical labor supply channel. Introducing shocks is also consequential as the multipliers are generally state-dependent. In particular, the COVID shocks cause the economy to fall into what we refer to as a "COVID recession" as well as a liquidity trap, in which the effects of redistribution can be different quantitatively. Finally, another difference from the analytical model is that the government raises (gradually) labor taxes, rather than lump-sum taxes, in the monetary regime, which, through distortionary effects, influences the transfer multipliers.

Specifically, in order to capture the salient characteristics of the COVID recession, we suppose that the COVID shocks consist of adverse aggregate and sector-specific demand shocks and sector-specific labor supply shocks. The sector-specific shocks intend to capture the observation that "locked out" of work and fear of "unsafe consumption" features are more pronounced in certain sectors of the economy. We decompose the U.S. economy into two sectors—(1) transportation, recreation, and food service sector and (2) the rest of the economy—and let the HTM households work in the former sector in our model.[4] For convenience, we call this sector the HTM sector.

Figure 1 presents dynamics of employment, hours, inflation, and consumption based on such a two-sector decomposition of the U.S. economy. As is clear, there was a sharp adverse effect on employment/hours in the HTM sector following the COVID crisis. Moreover, inflation in this sector also fell. Finally, while the HTM sector was disproportionately affected, there was also an aggregate, economy-wide contraction and fall in inflation as well. We calibrate the COVID shocks to perfectly re-produce the dynamics of hours in the two sectors and that of inflation in the HTM sector, thereby situating the model economy in a COVID-recession-like environment. We then calibrate the size of transfers to match the transfer amount in the CARES Act and study how the economy responds to the redistribution policy under several alternative scenarios.[5]

We find that the transfer multipliers are significantly larger under the fiscal regime than under the monetary regime, primarily because of the difference in inflation dynamics as mentioned above. For instance, the four-year cumulative multiplier for aggregate output is 1.126 in the monetary regime while it is 7.739 in the fiscal regime. Notice that this multiplier is greater than unity even under the monetary regime, thanks to nom-

[4]We assume that the Ricardian households work in the other sectors that are less affected by the COVID pandemic.

[5]We also show with the vertical dashed line in Figure 1 when transfer payments from the CARES Act started to get mailed.

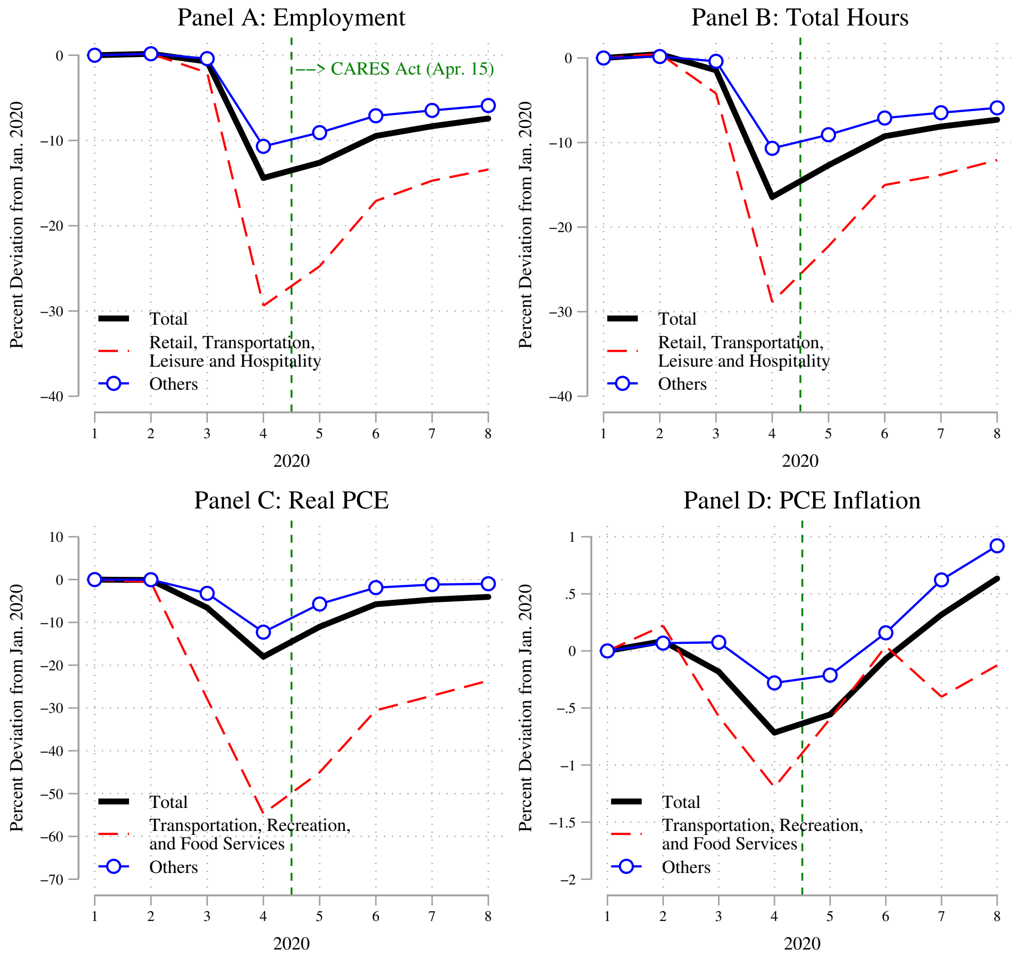

Figure 1: Aggregate and Sectoral Effects of COVID Crisis

Notes: This figure shows the dynamics of key variables from January 2020. Panels A and B show employment and total hours dynamics in U.S. Bureau of Labor Statistics, respectively. Black lines are dynamics of total variable and red lines represent retail, transportation, leisure, and hospitality sector, and blue lines represent all other sectors. Panels C and D present real personal consumption expenditure and PCE inflation in U.S. Bureau of Economic Analysis, respectively. Black lines are dynamics of total variable and red lines represent transportation, recreation and food services sector, and blue lines represent all other sectors.

Sources: U.S. Bureau of Economic Analysis, U.S. Bureau of Labor Statistics

inal rigidities and the binding zero lower bound (ZLB). Just as strikingly different are the four-year cumulative consumption multipliers. For the Ricardian households, it is negative 0.244 in the monetary regime and 6.036 in the fiscal regime, while for the HTM households, it is 5.609 in the monetary regime and 13.311 in the fiscal regime.[6]

We isolate the role played by various model elements in driving our quantitative re-

[6]The positive consumption multiplier for the Ricardian household is unique, even qualitatively so, in the fiscal regime.

sults using counterfactual exercises. The unusually large multipliers reported above, especially under the fiscal regime, result from the economy being situated in the historically severe COVID-recession with large deflationary pressures. For example, shutting down the COVID shocks, the four-year cumulative multiplier for aggregate output is 0.96 in the monetary regime, while it is 1.475 in the fiscal regime. This result underscores the state-dependency of policy effects. Importantly, the difference in the multipliers for output and consumption between the two regimes gets larger in the presence of COVID shocks, which implies that while both labor-tax-financed transfers and inflation-financed transfers are more effective in the COVID recession than in a normal environment, the latter is even more so. In addition, we also find that relying on labor taxes rather than lump-sum taxes in the monetary regime plays a role.

Overall, as a consequence, the contraction in output and consumption is much more muted when transfers are financed by inflation taxes. Specifically, transfers, when inflation-financed, would reduce the output loss caused by the COVID shocks by roughly 5 percentage points at the trough compared to no-intervention case. We also find that the expansionary effects of inflation-financed transfers are so large that such redistribution policy generates a Pareto improvement: It increases the welfare of both the recipients and sources of transfers, even taking into account the resources taken away from the Ricardian household and the fact that the Ricardian household's leisure decreases as a result of output increases and distortions generated by high and persistent inflation.

Our paper builds on several strands of the literature. It is related to the fiscal-monetary interactions literature as originally developed in Leeper (1991), Sims (1994), Woodford (1994), Cochrane (2001), Schmitt-Grohé and Uribe (2000), and Bassetto (2002).[7] Sims (2011) introduced long-term debt under this regime in a sticky price model, while Cochrane (2018) developed it further to analyze the inflation implications following the Great Recession. Analytical characterization of the fiscal regime in a linearized sticky price model is in Bhattarai, Lee and Park (2014).

Our additional analytical contribution here is to derive the fully nonlinear results of this fiscal regime in a tractable two-agent model. Motivated by the COVID crisis and the CARES Act, we then assess the quantitative effects of redistribution policy as well as its welfare implications in a two-sector, two-agent nonlinear model.

We build on two-agent models as originally developed in Campbell and Mankiw (1989), Galí, López-Salido and Vallés (2007), and Bilbiie (2018). Moreover, Bilbiie, Monacelli and Perotti (2013), closely related to this paper, show that different financing schemes affect the size of the output transfer multiplier in a TANK model. However, they only

[7] Canzoneri, Cumby and Diba (2010) and Leeper and Leith (2016) are recent surveys of this literature.

consider the monetary regime. Our main contribution is in assessing the effects of redistribution policy in such an environment and showing how it depends critically on the monetary-fiscal policy mix.

Recently there have been several contributions to an analysis of macroeconomic effects of the COVID crisis. Our quantitative two-sector, two-agent model is closest to the important work of Guerrieri, Lorenzoni, Straub and Werning (2020). In assessing the quantitative effects of fiscal policy during the pandemic using a model with household heterogeneity, we are also related to Faria-e-Castro (2020) and Bayer, Born, Luetticke and Müller (2020). Our relative contribution is in showing how the effects of redistribution depend on the monetary-fiscal policy regime and then assessing both quantitative effects and welfare implications by matching some important aggregate and sectoral aspects of the U.S. data.

Our paper is also related to recent papers that analyze monetary-fiscal policy interactions in TANK models—in particular, Bhattarai, Lee, Park and Yang (2020), Bianchi, Faccini and Melosi (2020), and Motyovszki (2020). Bhattarai, Lee, Park and Yang (2020) study the effects of one-time permanent capital tax rate changes in a model that also features capital-skill complementarity. Bianchi, Faccini and Melosi (2020) and Motyovszki (2020) are motivated by the COVID crisis and are closely related to our analysis.[8] Our relative contribution analytically is a nonlinear solution of the simple TANK model under the two regimes. On the quantitative side, while these studies focus on the positive implications of transfers under the different regimes, we additionally provide welfare implications for different types of households. We also emphasize that the positive and normative implications of redistribution are state-dependent and that inflation-financed transfers are *disproportionately* more effective than tax-financed transfers in a COVID-recession-like environment in which both sector-specific and aggregate shocks hit the economy.

Finally, our paper is also related to the government spending multiplier literature, as the effects of transfer policy in two-agent models share some common elements with the effects of government spending policy in representative agent models. Thus, in connecting the effects to the nature of monetary policy, the binding ZLB, and the monetary-fiscal policy regime, our work builds on important contributions in the government spending multiplier literature by Woodford (2011), Christiano, Eichenbaum and Rebelo (2011), Eggertsson (2011), Leeper, Traum and Walker (2017), and Jacobson, Leeper and Preston (2019).

[8] Bianchi, Faccini and Melosi (2020) show that inflating away a targeted fraction of debt will increase the effectiveness of the fiscal stimulus in a rich medium-scale model while Motyovszki (2020) considers a small-open economy environment.

2 Simple Model and Redistribution Policy

We present a simple model that yields analytical results on effects of redistribution policy.

2.1 Model

There are two types of households: Ricardian and HTM. The Ricardian household makes optimal labor supply and consumption/savings decisions, while the HTM household simply consumes government transfers every period. In this setup, we analytically show the effects on inflation of transferring resources away from the Ricardian households to the HTM households and point out that these effects depend critically on how the transfer policy is financed.

2.1.1 Households

Ricardian Households. There are Ricardian households of measure $1-\lambda$. These households, taking prices as given, choose $\{C_t^R, L_t^R, B_t^R\}$ to maximize

$$\sum_{t=0}^{\infty} \beta^t \left[\log C_t^R - \chi \frac{\left(L_t^R\right)^{1+\varphi}}{1+\varphi} \right]$$

subject to a standard No-ponzi-game constraint and a sequence of flow budget constraints

$$C_t^R + \frac{B_t^R}{P_t} = R_{t-1} \frac{B_{t-1}^R}{P_t} + w_t L_t^R + \Psi_t^R - \tau_t^R,$$

where C_t^R is consumption, L_t^R is hours, B_t^R is nominal government debt, Ψ_t^R is real profits, τ_t^R is lump-sum taxes, P_t is the price level, w_t is the real wage, and R_t is the nominal gross interest rate. The discount factor and the inverse of the Frisch elasticity are denoted by $\beta \in (0,1)$ and $\varphi \geq 0$ respectively. The superscript, R, represents "Ricardian". The flow budget constraints can be written as

$$C_t^R + b_t^R = R_{t-1} \frac{1}{\Pi_t} b_{t-1}^R + w_t L_t^R + \Psi_t^R - \tau_t^R,$$

where $b_t^R = \frac{B_t^R}{P_t}$ is the real value of debt, and $\Pi_t = \frac{P_t}{P_{t-1}}$ is the gross rate of inflation.

Optimality conditions are given by the Euler equation, the intra-termporal labor supply condition, and the transversality condition (TVC):

$$\frac{C_{t+1}^R}{C_t^R} = \beta \frac{R_t}{\Pi_{t+1}}, \tag{2.1}$$

$$\chi \left(L_t^R\right)^{\varphi} C_t^R = w_t, \tag{2.2}$$

$$\lim_{t\to\infty} \left[\beta^t \frac{1}{C_t^R} \left(\frac{B_t^R}{P_t}\right)\right] = 0. \tag{2.3}$$

Hand-to-Mouth Households. The hand-to-mouth (HTM) households, of measure λ, simply consume government transfers, s_t^H, every period

$$C_t^H = s_t^H,$$

and have no optimization problem to solve. The superscript, H, represents "HTM".

2.1.2 Firm

A representative firm in the competitive product market chooses hours, L_t, in each period to maximize profits:

$$\Psi_t = Y_t - w_t L_t,$$

subject to the production function

$$Y_t = L_t. \tag{2.4}$$

Zero profit condition implies

$$w_t = 1. \tag{2.5}$$

2.1.3 Government

The government issues one-period nominal debt, B_t. Its budget constraint (GBC) is

$$\frac{B_t}{P_t} = R_{t-1}\frac{B_{t-1}}{P_t} - \tau_t + s_t,$$

where s_t is transfers and τ_t is taxes. It can be re-written as

$$b_t = \frac{R_{t-1}}{\Pi_t} b_{t-1} - \tau_t + s_t, \tag{2.6}$$

where $b_t = \frac{B_t}{P_t}$ is the real value of debt. Transfer, s_t, is exogenous and deterministic.

Monetary and tax policy rules are

$$\frac{R_t}{\bar{R}} = \left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\phi}, \tag{2.7}$$

$$(\tau_t - \bar{\tau}) = \psi(b_{t-1} - \bar{b}), \tag{2.8}$$

where ϕ and ψ determine the responsiveness of the policy instruments to inflation and government indebtedness respectively. The steady-state values of inflation, debt, and transfers, $\{\bar{\Pi}, \bar{b}, \bar{s}\}$, are set by policymakers and given exogenously.

2.1.4 Aggregation and the Resource Constraint

Aggregating the variables over the households yields $s_t = \lambda s_t^H$, $\tau_t = (1-\lambda)\,\tau_t^R$, $b_t = (1-\lambda)\,b_t^R$, $L_t = (1-\lambda)\,L_t^R$, and $\Psi_t = (1-\lambda)\,\Psi_t^R$. Combining household and government budget constraints gives:

$$(1-\lambda)C_t^R + \lambda C_t^H = Y_t.$$

The resource constraint above, together with the HTM household budget constraint, implies that output is simply divided between the two types of households as:

$$C_t^H = \frac{1}{\lambda} s_t, \quad C_t^R = \frac{1}{1-\lambda} Y_t - \frac{1}{1-\lambda} s_t. \tag{2.9}$$

2.2 Effects of Redistribution Policy

We now show the effects of transferring resources away from the Ricardian households to the HTM households. The government can finance such a transfer program in two distinct ways. In the first policy regime, the government raises taxes sufficiently. Inflation is then stabilized in the usual way by the central bank. In the second regime, the government does not raise taxes, and the central bank allows inflation to rise to stabilize the real value of debt, thereby imposing "inflation taxes" on the Ricardian households that hold nominal government debt. The fiscal theory of the price level operates in this case.

We solve for the equilibrium time path of $\{Y_t, C_t^R, C_t^H, \Pi_t, R_t, b_t, \tau_t\}$ given exogenous $\{s_t\}$. Output and consumption of the two households, and thus their welfare, are independent of whether the government relies on conventional or inflation taxes.[9] We first consider those policy-invariant variables in Section 2.2.1. The alternative financing schemes, however, generate quite different inflation dynamics, which is the main focus of this simple model. The rise of inflation tends to be greater and more persistent in the second regime. The determination of the rate of inflation is detailed in Section 2.2.2.

[9]This "neutrality" result does not hold in a model with nominal rigidities, as discussed in detail later.

2.2.1 Output and Consumption

We start with output. Equation (2.2) can be written as

$$Y_t = \chi^{-1} (1-\lambda)^{1+\varphi} Y_t^{-\varphi} + s_t \tag{2.10}$$

using Equations (2.4), (2.5), and (2.9). Equation (2.10) implicitly defines output as a function of transfers: $Y_t = Y(s_t)$. Then, one can obtain the "transfer multiplier" as

$$\frac{dY(s_t)}{ds_t} = \frac{1}{1 + (1-\lambda)^{1+\varphi} \frac{\varphi}{\chi} Y_t^{-(1+\varphi)}}.$$

Notice that $0 \leq \frac{dY_t}{ds_t} \leq 1$.

An increase in transfers raises output not for the Keynesian demand-side reason. The channel here instead is purely classical and supply-side: An increase in s_t causes Ricardian household consumption to fall, creating a negative "wealth effect" on labor supply. The households supply more hours for a given wage rate, which in turn raises output.[10] The multiplier is maximized ($dY_t/ds_t = 1$) when labor supply is perfectly elastic ($\varphi = 0$) while it is minimized ($dY_t/ds_t = 0$) when the Ricardian household does not value leisure ($\chi = 0$), which shuts down the wealth effect.

The Ricardian household consumption is obtained from Equation (2.9) as

$$C_t^R = C^R(s_t) \equiv \frac{1}{1-\lambda} \left[Y(s_t) - s_t \right]. \tag{2.11}$$

The derivative is

$$\frac{dC^R(s_t)}{ds_t} = \frac{1}{1-\lambda} \left[\frac{dY(s_t)}{ds_t} - 1 \right] \leq 0.$$

As will be clear below, how Ricardian household consumption depends on transfers matter for inflation dynamics as it affects the real interest rate. That is, there is a valuation effect on government debt due to changes in the real interest rate. This *interest rate channel* of transfers is absent in the model with a representative household, where transfers have no redistributive role, or with a perfectly elastic labor supply.

Notice that both tax types are non-distorting in this model. Consequently, for given $\{s_t\}$, the alternative ways to finance transfers (i.e., the policy regimes) have no effect on output and consumption, as seen above.

[10] The channel thus is the same as the effect of government spending in a one-agent model.

2.2.2 Inflation

We now turn to the rest of the variables, $\{\Pi_t, R_t, b_t, \tau_t\}_{t=0}^{\infty}$, with a focus on inflation determination, given a path of $\{s_t\}_{t=0}^{\infty}$. The equilibrium time path of $\{\Pi_t, R_t, b_t, \tau_t\}$ satisfies the following conditions:

- Difference Equations from (2.1), (2.6), (2.7) and (2.8):

$$\Pi_{t+1} = \frac{C_t^R}{C_{t+1}^R}\beta R_t, \quad b_t = R_{t-1}b_{t-1}\frac{1}{\Pi_t} - \tau_t + s_t,$$

$$\frac{R_t}{\bar{R}} = \left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\phi}, \quad (\tau_t - \bar{\tau}) = \psi(b_{t-1} - \bar{b}).$$

- Terminal condition, as given by TVC from Equation (2.3):

$$\lim_{t\to\infty}\left[\beta^t \frac{1}{C_t^R} b_t\right] = 0.$$

- Initial conditions:

$$b_{-1} \text{ and } R_{-1}.$$

We first solve for the deterministic steady state. When $s_t = \bar{s}\ \forall t$, the system of difference equations simplifies to

$$\bar{R} = \beta^{-1}\bar{\Pi}, \quad \bar{\tau} = \left(\beta^{-1} - 1\right)\bar{b} + \bar{s},$$

with the TVC trivially satisfied. Given $\bar{s}$, $\bar{\Pi}$ and $\bar{b}$, which we assume exogenously determined by policymakers, the equations above determine $\bar{R}$ and $\bar{\tau}$. We set $R_{-1} = \bar{R}$ and $b_{-1} = \bar{b}$, without loss of generality.

The system of difference equations can be simplified as[11]:

$$\left(\frac{\Pi_{t+1}}{\bar{\Pi}}\right) = \frac{C_t^R}{C_{t+1}^R}\left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\phi}, \tag{2.12}$$

$$\left(b_t - \bar{b}\right) = \left[\beta^{-1}\frac{C_t^R}{C_{t-1}^R} - \psi\right](b_{t-1} - \bar{b}) + (s_t - \bar{s}) + \bar{b}\left[\beta^{-1}\frac{C_t^R}{C_{t-1}^R} - \beta^{-1}\right] \forall t \geq 1 \tag{2.13}$$

$$\left(b_0 - \bar{b}\right) = \beta^{-1}\left(\frac{\bar{\Pi}}{\Pi_0} - 1\right)\bar{b} + (s_0 - \bar{s}) \quad \text{at } t = 0, \tag{2.14}$$

which determines $\{\Pi_t, b_t\}$ given $\{s_t\}$ and $\{C_t^R\}$, where note that from Equation (2.11), the latter is a simple function of transfers.

[11] The online appendix provides detail.

Equation (2.12), obtained by combining the Euler equation and the monetary policy rule, shows how future inflation (Π_{t+1}) depends on current inflation (Π_t) and the real rate captured by C_{t+1}^R / C_t^R. Equation (2.13) is the GBC for $t \geq 1$ after we substitute out the nominal interest rate (R_{t-1}) and taxes (τ_t) using the Euler equation and the fiscal policy rule. Equation (2.14) is the GBC at $t = 0$. This looks different from Equation (2.13) because R_{-1} is exogenous, and thus cannot be replaced by the Euler equation.

Equation (2.13) describes how the deviation of the real value of debt from the steady state, $\left(b_t - \bar{b}\right)$, evolves over time. An increase in transfers over its steady state value ($s > \bar{s}$) affect debt dynamics directly and indirectly. First, *ceteris paribus*, such an increase causes b_t, debt carried over to the next period, to rise above $\bar{b}$. This direct effect is captured by the second term, $(s_t - \bar{s})$, on the right hand side of Equation (2.13). Second, a change in transfers affects Ricardian household consumption as shown in Equation (2.11) and hence the real interest rate, which in turn influences debt dynamics. This indirect effect is reflected by $r_{t-1} \equiv \beta^{-1} \frac{C_t^R}{C_{t-1}^R}$ in Equation (2.13), and operates even when the current period debt stays at the steady state (i.e. $b_{t-1} = \bar{b}$). The reason is a change in interest payments for a given amount of debt—as shown in the last term, $\bar{b} \left[\beta^{-1} \frac{C_t^R}{C_{t-1}^R} - \beta^{-1} \right]$.

In solving the system, we consider a redistribution program in which $\{s_t\}_{t=0}^{\infty}$ can have arbitrary values greater than $\bar{s}$ until a time period T, and then $s_t = \bar{s}$ for $t \geq T + 1$. In this case, regardless of the history until time $T + 1$, starting $T + 2$, Equation (2.13) becomes

$$\left(b_t - \bar{b}\right) = \left(\beta^{-1} - \psi\right) (b_{t-1} - \bar{b}).$$

How the TVC is satisfied *depends* on the fiscal policy parameter ψ. When $\psi > 0$, debt dynamics satisfies the TVC regardless of the value of b_{T+1}.[12] When $\psi \leq 0$, however, the TVC requires $b_{T+1} = \bar{b}$, which can be achieved when monetary policy allows inflation to adjust by the required amount. Below, we discuss each case in turn.

Inflation under the Monetary Regime. When $\psi > 0$, , inflation is solely determined by Equation (2.12) which becomes

$$\left(\frac{\Pi_{t+1}}{\bar{\Pi}}\right) = \left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\phi} \quad \text{for } t \geq T + 1,$$

as C_t^R, Ricardian household consumption, is constant. In this case, if we were to consider $\phi < 1$, the system of Equations (2.12)–(2.14) does not pin down initial inflation Π_0, and the model permits multiple non-explosive solutions.

[12] In addition, ψ should not be too big. We do not explicitly consider such empirically irrelevant cases.

We therefore, instead consider the standard case, $\phi > 1$, which we call the *monetary regime*. This regime produces multiple equilibria in which inflation is unbounded and a unique bounded equilibrium.[13] Here we focus on the bounded equilibrium. In this case, it is necessary that

$$\frac{\Pi_{T+1}}{\bar{\Pi}} = 1.$$

Given this "stability" condition on inflation, one can pin down Π_t from $t = 0$ to T along the *saddle path*. In particular, inflation before $T + 1$ can be solved backward using Equation (2.12). The initial inflation is given by

$$\frac{\Pi_0}{\bar{\Pi}} = C^R(\bar{s})^{\frac{1}{\phi^{T+1}}} \left[\frac{1}{C^R(s_T) C^R(s_{T-1}) \cdots C^R(s_0)} \right]^{\frac{1}{\phi}} = \prod_{t=0}^{T} \left[\frac{C^R(\bar{s})}{C^R(s_t)} \right]^{\frac{1}{\phi}}. \tag{2.15}$$

Inflation in the following periods is then determined by Equation (2.12).

Equation (2.15) shows that an increase in transfers is inflationary as the Ricardian household consumption declines below the pre-transfer level. The magnitude of the effect depends on the response of monetary policy (measured by ϕ), the size of transfer increases, and the duration of the redistribution program. Most importantly, the effect is *transitory*: When the redistribution program ends, inflation returns immediately to the steady-state value. Finally, redistribution programs with the same value of total transfer payments, but with different payment schedules, have different implications for the real interest rate and inflation dynamics. We discuss this in more detail below.

Inflation under the Fiscal Regime. We now consider the *fiscal regime* where $\psi \leq 0$ and $\phi < 1$. Solving for inflation involves a similar procedure as in the monetary regime. We first identify a terminal condition and follow the saddle path to pin down initial inflation.

As mentioned above, when $\psi \leq 0$, the TVC requires $b_{T+1} = \bar{b}$. Given this terminal condition, debt in preceding periods can be solved backward using Equation (2.13). Finally, given the solved b_0, the time-0 GBC Equation (2.14) determines initial inflation Π_0, after which Equation (2.12) produces a non-explosive time path of inflation.

Before presenting the general solution, we consider a simple example that is helpful to develop the intuition. Suppose transfers increase only for one period: $s_0 > \bar{s}$ and $s_t = \bar{s}$ afterwards. In the single-period redistribution program, it is necessary that $b_1 = \bar{b}$;

[13] We rule out the case in which the price level approaches zero by the TVC.

otherwise, the TVC would be violated. The GBC at $t = 1$ is then given as

$$\underbrace{\left(b_1 - \bar{b}\right)}_{=0} = \left[\beta^{-1} \underbrace{\frac{C^R(\bar{s})}{C^R(s_0)}}_{>1} - \psi\right] \left(b_0 - \bar{b}\right) + \underbrace{\left(s_1 - \bar{s}\right)}_{=0} + \bar{b}\left[\beta^{-1} \underbrace{\frac{C^R(\bar{s})}{C^R(s_0)}}_{>1} - \beta^{-1}\right], \tag{2.16}$$

from which we can obtain the initial debt level b_0 ensuring that b_1 equals $\bar{b}$:

$$b_0 = \bar{b} - \bar{b}\left[\beta^{-1}\frac{C^R(\bar{s})}{C^R(s_0)} - \psi\right]^{-1}\left[\beta^{-1}\frac{C^R(\bar{s})}{C^R(s_0)} - \beta^{-1}\right].$$

The terminal condition ($b_1 = \bar{b}$) requires b_0 to decline below $\bar{b}$. For this to happen, Π_0 adjusts according to Equation (2.14):

$$\frac{\Pi_0}{\bar{\Pi}} = \frac{1}{1 - \frac{\beta}{\bar{b}}\left(s_0 - \bar{s}\right) - \beta\left[\beta^{-1}\frac{C^R(\bar{s})}{C^R(s_0)} - \psi\right]^{-1}\left[\beta^{-1}\frac{C^R(\bar{s})}{C^R(s_0)} - \beta^{-1}\right]}. \tag{2.17}$$

The redistribution policy is more inflationary under the fiscal regime than under the monetary regime. Inflation rises by more on *impact*: Π_0 in Equation (2.17) is greater than Π_0 in Equation (2.15) even under the most dovish monetary regime (i.e. when $\phi \to 1$.) More importantly, the one-time transitory increase in transfers has *persistent* effects on inflation here, while the effect lasts only for one period under the monetary regime.

The result above holds without the *interest rate channel*. The presence of the third term in the denominator, $-\beta\left[r_0 - \psi\right]^{-1}\left[r_0 - \bar{r}\right]$, however, does cause Π_0 to increase by *more* than it would in an analogous model with a representative household where transfer changes have no effect on the real interest rate.[14] This term results from increased interest payments that exert an upward pressure on b_1 (see Equation (2.16)). The upward pressure is offset by a further decrease in b_0, which is generated by a greater increase in Π_0.

The effects of the interest rate channel on inflation, however, is subtler in a multi-period redistribution program. The initial inflation in the general case is given by[15]

$$\frac{\Pi_0}{\bar{\Pi}} = \frac{1}{1 - \frac{\beta}{\bar{b}}\sum_{k=0}^{T}\Omega_k\left(s_k - \bar{s}\right) - \beta\sum_{k=1}^{T+1}\Omega_k\left[\beta^{-1}\frac{C^R(s_k)}{C^R(s_{k-1})} - \beta^{-1}\right]}, \tag{2.18}$$

[14] In that model, the term would drop because $\frac{C_1^R}{C_0^R} = 1$.

[15] The online appendix provides detail.

where the "discount factor" Ω_k is defined as:

$$\Omega_k \equiv \Omega_{k-1} \left[\beta^{-1} \frac{C^R(s_k)}{C^R(s_{k-1})} - \psi\right]^{-1} = \left\{\prod_{j=1}^{k} \left[\beta^{-1} \frac{C^R(s_j)}{C^R(s_{j-1})} - \psi\right]\right\}^{-1}, \ \Omega_0 \equiv 1.$$

The solution (2.18) reveals that the interest rate channel can in principle, work in both directions. On the one hand, as shown in the one-period transfer increase case, a redistribution program that raises the real interest rate leads to an increase in interest payments and a larger rise in inflation—as captured by the last term in the denominator. On the other hand, such redistribution decreases the discount factor Ω_k. The economy thus discounts future primary surplus/deficits more heavily, which causes inflation to adjust by less when *future* transfers rise.[16] Therefore, generally, the net effect on inflation through the interest rate channel of a multi-period redistribution program is difficult to isolate analytically, without further restrictions on the path of transfers.[17]

In this paper, we focus on programs with constant s_t for $0 \leq t \leq T$. In such a case, the interest rate channel works in the same way as described in the simple example, and leads to a larger response of inflation. To show this, we use the property that the real interest rate is constant throughout except for the last period of a program; that is, $r_t = \bar{r}$ for $0 \leq t \leq T-1$ and $r_T > \bar{r}$, if $s_t = s_0 > \bar{s}$ for $0 \leq t \leq T$. Equation (2.18) simplifies to

$$\frac{\Pi_0}{\bar{\Pi}} = \frac{1}{1 - \frac{\beta}{\bar{b}}(s_0 - \bar{s}) \sum_{k=0}^{T} (\beta^{-1} - \psi)^{-k} - \beta (r_T - \psi)^{-1} (r_T - \bar{r}) (\beta^{-1} - \psi)^{-T}},$$

which looks similar to Equation (2.17).

2.3 Summary and an Extension to Nominal Rigidities

To summarize, transferring resources from Ricardian to HTM households is inflationary regardless of the financing schemes considered. The fiscal regime, in which the government effectively imposes "inflation taxes" on Ricardian households that hold nominal government debt, however, generates *greater and more persistent inflation* than the monetary regime that finances transfers raising "conventional taxes."

[16] Equation (2.16) also provides intuition: To achieve a target level of b_1, b_0 needs not decrease as much when the coefficient (which is increasing in the real rate) is greater; consequently, inflation increases by less.

[17] Moreover, there is a significant flexibility in the schedule of transfer payments when studying a multi-period redistribution program. The time path of transfers $\{s_t\}_{t=0}^{T}$ can be constant, (weakly) monotonic, or neither. Depending on the time path, the real interest rate, $\beta^{-1}\frac{C^R(s_t)}{C^R(s_{t-1})}$, need not be greater than or equal to its steady-state value β^{-1} for the entire duration of a redistribution program. Interest payments thus can be lower than the pre-program level in some periods. Generally, different transfer schedules would result in different dynamics of the real interest rate. A constant or monotonic schedule is however, most commonly used in quantitative models.

When it comes to output, consumption, and hours, the policy regimes are "neutral." As we mentioned before, this result does not carry over to a model with nominal rigidities. In the online appendix, we provide a simple sticky-price model that permits some analytical results with simplifying assumptions. The model nests the flexible-price model presented so far as a special case.[18] The result on inflation is essentially the same in that model. A redistribution program generates greater and more persistent inflation under the fiscal regime. Analytical results on inflation are more difficult to obtain, as Ricardian household consumption now also depends on inflation. Thus, the solution involves finding a fixed point in an equation analogous to Equation (2.17). Nevertheless, the mechanisms discussed in Sections 2.2.1 and 2.2.2 still apply.

The policy regimes are no longer neutral for output, consumption, and hours with sticky prices because of the short-run relationship between output and inflation. Abusing the notation, and in comparison to output in Equation (2.10), it is convenient to regard output now as a function of transfers and inflation, where inflation in turn is also a function of the entire schedule of transfers:

$$Y_t = Y\left(s_t, \Pi_t\left(\{s_t\}_{t=0}^{T}\right)\right).$$

Therefore, output would increase not only through the (labor) supply channel. When wealth redistribution is inflationary, output would increase further due to the demand-side channel. Consequently, Ricardian household consumption in Equation (2.9) would not decrease as much as in the flexible-price case, while HTM household consumption would still be unaffected.

Since inflation generally increases by more under the fiscal regime compared to the monetary regime, alternative financing schemes now have different welfare implications. With inflation taxes, Ricardian household consumption would not decrease as much, which would increase their welfare. At the same time, the Ricardian households would have to work more not only to produce more output but in addition, high and persistent inflation in the fiscal regime produces resource misallocations, which increase labor hours required to produce the same amount of final output. Therefore, it is unclear a priori that inflation taxes are a better or worse way to finance a redistribution program compared to other taxes. We explore this question in a quantitative model in the next section.

[18] The next section presents a quantitative sticky-price model. In addition, the role of nominal rigidities (in this simple model) is relatively easy to understand as discussed below. Therefore, for brevity, we do not present this sticky price extension of the simple model in the main text.

3 Quantitative Model and COVID Application

We now present a quantitative version of the model with an application focused on the economic crisis induced by COVID, modeled by introducing demand and supply shocks, and subsequent transfer policy, as embedded in the CARES Act. Compared to the simple model, the main extension is a development of a two-sector production structure with sticky prices, as well as the introduction of distortionary taxes such that the trade-off between different sources of financing government debt is meaningful. We then analyze how the implications of increasing transfers to HTM households, which are hit disproportionately in a COVID crisis, depend on the monetary-fiscal policy mix.

3.1 Model

There are two distinct sectors where the two types of households work. Each sector produces a distinct good, which is in turn produced in differentiated varieties. Firms in both sectors are owned by the Ricardian household. The government finances transfers to the HTM household by levying distortionary labor taxes on the Ricardian household. In the fiscal regime, partial financing also happens by inflating away nominal debt.

3.1.1 Ricardian Sector

Households. Ricardian (R) households, of measure $1-\lambda$, solve the problem

$$\max_{\{C_t^R, L_t^R, \frac{B_t^R}{P_t^R}\}} \sum_{t=0}^{\infty} \beta^t \exp(\eta_t^{\xi}) \left[\frac{\left(C_t^R\right)^{1-\sigma}}{1-\sigma} - \chi \frac{\left(L_t^R\right)^{1+\varphi}}{1+\varphi} \right]$$

subject to a standard No-ponzi-game constraint and sequence of flow budget constraints

$$C_t^R + b_t^R = R_{t-1} \frac{1}{\Pi_t^R} b_{t-1}^R + \left(1 - \tau_{L,t}^R\right) w_t^R L_t^R + \Psi_t^R,$$

where σ is the coefficient of relative risk aversion, η_t^{ξ} is a preference shock, C_t^R is consumption, L_t^R is labor supply, $b_t^R = \frac{B_t^R}{P_t^R}$ is the real value of government issued debt, Π_t^R is inflation, R_{t-1} is the nominal interest rate, w_t^R is the real wage, and Ψ_t^R is real profits (this household owns firms in both sectors). Labor tax, $(1-\tau_{L,t}^R)$, constitutes one way in which the government finances transfers to the Hand-to-mouth household.

Consumption good C_t^R is a CES aggregator ($\varepsilon > 0$) of the consumption goods produced in the two sectors

$$C_t^R = \left[(\alpha)^{\frac{1}{\varepsilon}} \left(C_{R,t}^R\right)^{\frac{\varepsilon-1}{\varepsilon}} + (1-\alpha)^{\frac{1}{\varepsilon}} \left(\exp(\zeta_{H,t}) C_{H,t}^R\right)^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}}$$

where $C^R_{R,t}$ and $C^R_{H,t}$ are R-household's demand for R-sector and for HTM-sector goods, respectively. α is Ricardian households' consumption weight on R-sector goods and $\zeta_{H,t}$ is a demand shock that is specific for HTM goods. Let us define for future use, one of the relative prices, $S_{R,t} \equiv \left(\frac{P^R_{R,t}}{P^R_t}\right)$, where $P^R_{R,t}$ is the R-sector's good price while P^R_t is the CPI price index of the R-household.

Within each sector, differentiated varieties are produced under monopolistic competition. Thus, $C^R_{R,t}$ and $C^R_{H,t}$ are Dixit-Stiglitz aggregates of a continuum of varieties. That is, with $\theta > 1$,

$$C^R_{R,t} = \left[\int_0^1 \left(C^R_{R,t}(i)\right)^{\frac{\theta-1}{\theta}} di\right]^{\frac{\theta}{\theta-1}}, \; C^R_{H,t} = \left[\int_0^1 \left(C^R_{H,t}(i)\right)^{\frac{\theta-1}{\theta}} di\right]^{\frac{\theta}{\theta-1}}.$$

Firms. Firms produce differentiated varieties using the linear production function

$$Y_{R,t}\left(i\right) = L^R_t(i),$$

and set prices according to the Calvo friction, where ω^R is the probability of not getting a chance to adjust prices. Firms that get to adjust prices solve the maximization problem

$$\max_{\{P^{R*}_{R,t}(i)\}} \sum_{s=0}^{\infty} \left(\omega^R \beta\right)^s \left(\frac{C^R_{t+s}}{C^R_t}\right)^{-\sigma} \left[\left(\frac{P^{R*}_{R,t}\left(i\right)}{P^R_{R,t+s}}\right) S_{R,t+s} - w^R_{t+s}\right] \left(\frac{P^{R*}_{R,t}\left(i\right)}{P^R_{R,t+s}}\right)^{-\theta} Y_{R,t+s}$$

where $P^{R*}_{R,t}\left(i\right)$ denotes the optimally chosen price. There is no price discrimination across sectors for varieties and we impose the law of one price. Thus, we write demand directly in terms of $Y_{R,t}(i) = \left(\frac{P^R_{R,t}(i)}{P^R_{R,t}}\right)^{-\theta} Y_{R,t}$, which is derived from the household's expenditure minimization problem across varieties.

3.1.2 Hand-to-Mouth Sector

Households. There are Hand-to-mouth (HTM) households of measure λ. HTM household's labor endowment is exogenously fixed and can change with a shock. The HTM household then consumes, every period, wage income and government transfers

$$C^H_t = w^H_t \overline{L^H}(1 + \eta^\xi_t) + s^H_t,$$

where η^ξ_t is HTM labor supply shock.

The utility function of the HTM is (again, labor supply is inelastic)

$$\frac{\left(C^H_t\right)^{1-\sigma}}{1-\sigma}$$

where the aggregate consumption C_t^H is a CES aggregator of sector-specific goods

$$C_t^H = \left[(1-\alpha)^{\frac{1}{\varepsilon}} \left(\exp\left(\zeta_{H,t}\right) C_{H,t}^H\right)^{\frac{\varepsilon-1}{\varepsilon}} + (\alpha)^{\frac{1}{\varepsilon}} \left(C_{R,t}^H\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}$$

and where $1-\alpha$ is HTM households' consumption weight on *HTM*-sector goods while $\zeta_{H,t}$ is a demand shock specific for *HTM*-sector goods.[19] Let us define for future use one of the relative prices, $S_{H,t} \equiv \frac{P_{H,t}^H}{P_t^H}$, where $P_{H,t}^H$ is the HTM sector's good price while P_t^H is the CPI price index of the HTM household. $C_{HH,t}$ and $C_{HR,t}$ are Dixit-Stiglitz aggregates of a continuum of varieties. That is, with $\theta > 1$,

$$C_{H,t}^H = \left(\int_0^1 \left(C_{H,t}^H(i)\right)^{\frac{\theta-1}{\theta}} di\right)^{\frac{\theta}{\theta-1}}, \; C_{R,t}^H = \left(\int_0^1 \left(C_{R,t}^H(i)\right)^{\frac{\theta-1}{\theta}} di\right)^{\frac{\theta}{\theta-1}}.$$

Firms. Firms produce differentiated varieties using the linear production function

$$Y_{H,t}(i) = L_t^H(i)$$

and set prices according to the Calvo friction, where ω^H is the probability of not getting a chance to adjust prices. Firms that get to adjust prices solve the maximization problem

$$\max_{\{P_{H,t}^{H*}(i)\}} \sum_{s=0}^{\infty} \left(\omega^H \beta\right)^s \left(\frac{C_{t+s}^R}{C_t^R}\right)^{-\sigma} \left[\left(\frac{P_{H,t}^{H*}(i)}{P_{H,t+s}^H}\right) S_{H,t+s} - w_{t+s}^H\right] \left(\frac{P_{H,t}^{H*}(i)}{P_{H,t+s}^H}\right)^{-\theta} Y_{H,t+s}$$

where $P_{H,t}^{H*}(i)$ denotes the optimally chosen price.

3.1.3 Government

The government flow budget constraint is

$$B_t + T_t^L = R_{t-1}B_{t-1} + P_t^R s_t,$$

where tax revenues $T_t^L = (1-\lambda)\, \tau_{L,t}^R P_t^R w_t^R L_t^R$. Transfer (deflated by CPI of the Ricardian household), s_t, is exogenous and deterministic. Note that, $s_t = \lambda s_t^H$ and $b_t = (1-\lambda)\, b_t^R$.

Monetary and tax policy rules are of the feedback types given by

$$\frac{R_t}{\bar{R}} = \max\left\{\frac{1}{\bar{R}}, \left(\frac{(1-\lambda)\,\Pi_t^R + \lambda\Pi_t^H}{\bar{\Pi}}\right)^{\phi}\right\}, \; \tau_{L,t}^R - \bar{\tau}_L^R = \psi_L(b_{t-1} - \bar{b}),$$

where the zero lower bound on the nominal rate applies. As in the simple model, the monetary regime will feature a large enough monetary and tax rule response coefficients,

[19] Our modeling choice of the same consumption basket for the two types of households is driven by the data, as we discuss later. This implies that CPI of the two households is the same.

ϕ and ψ_L, such that government debt sustainability is not ensured via inflation. In contrast, in the fiscal regime, a low enough tax rule coefficient, ψ_L, implies that monetary policy has to be accommodative via a low enough ϕ, such that debt is (at least partly) financed via inflation.

3.1.4 Market Clearing, Aggregation, Resource Constraints

We now discuss market clearing conditions as well as some key aggregate relationships.[20] Labor market clearing conditions are

$$(1-\lambda)\, L_t^R = \int L_{R,t}\,(i)\, di, \;\; \lambda \overline{L^H}(1+\eta_t^{\xi}) = \int L_{H,t}\,(i)\, di,$$

while the goods market clearing conditions, imposing law of one price, are

$$Y_{j,t}\,(i) = (1-\lambda)\, C_{j,t}^R\,(i) + \lambda C_{j,t}^H\,(i) = \left(\frac{P_{j,t}\,(i)}{P_{j,t}}\right)^{-\theta} Y_{j,t},$$

where $Y_{j,t} = (1-\lambda)\, C_{j,t}^R + \lambda C_{j,t}^H$ for $j \in \{R, H\}$.

Define economy-wide consumption as $C_t = (1-\lambda)\, C_t^R + \lambda C_t^H$. To derive an aggregate resource constraint, we combine households' budget constraints, government budget constraint, and goods market clearing condition to obtain

$$C_t = S_{R,t} Y_{R,t} + S_{H,t} Y_{H,t}.$$

To derive aggregate sectoral outputs, we aggregate firms' product functions and get

$$(1-\lambda)\, L_t^R = Y_{R,t}\Xi_{R,t}, \;\; \lambda \overline{L^H}(1+\eta_t^{\xi}) = Y_{H,t}\Xi_{H,t}, \tag{3.1}$$

where $\Xi_{j,t}$ for $j \in \{R, H\}$ is price dispersion term given by

$$\Xi_{j,t} = \left(1-\omega^j\right)\left(\frac{P_{j,t}^*}{P_{j,t}}\right)^{-\theta} + \omega^j \left(\pi_{j,t}\right)^{\theta} \Xi_{j,t-1}.$$

3.2 Data and Calibration

Our parameterization strategy is to pick values based on long-run averages or from the literature for the structural and policy parameters while calibrating the shocks to match employment and inflation dynamics during the COVID crisis. Table 1 presents our calibration. The data are described in detail in Appendix Section A.

[20] All equilibrium conditions are derived in detail in the online appendix.

Table 1: Calibration

	Value	Description	Sources
Households			
β	0.9932	Time preference	2-month frequency
σ	1.7	Inverse of EIS	Del Negro et al. (2015)
φ	2.2	Inverse of Frisch elasticity	Del Negro et al. (2015)
χ	94.6	Labor supply disutility parameter	Steady-state $\bar{L}^R = 0.3$
λ	0.23	Fraction of HTM households	Employment share of retail, transportation, leisure/hospitality
α	0.72	Consumption weight on Ricardian goods	Consumer Expenditure Surveys data
Firms			
θ	6.0	Elasticity of substitution across firms	Steady-state markup: 20% (Hall, 2018)
ε	0.8	Elasticity of substitution between Ricardian and HTM goods	Assigned
ω^R	0.833	Calvo parameter for Ricardian sector	Del Negro et al. (2015)
ω^H	0.0	Calvo parameter for HTM sector	Assigned
Government			
$\frac{\bar{b}}{\bar{Y}}$	0.509	Steady-state debt to GDP	Data (1990Q1–2020Q1)
$\frac{\bar{T}^L}{\bar{Y}}$	0.122	Steady-state labor tax revenue to GDP	Data (1990Q1–2020Q1)
$\frac{\bar{s}}{\bar{Y}}$	0.127	Steady-state transfers to GDP	Data (1990Q1–2020Q1)
Monetary and Fiscal Policy Rules			
ϕ	(1.3, 0.0)	Interest rate response to inflation	Del Negro et al. (2015)
ψ_L	(0.6, 0.0)	Labor tax rate response to debt	Assigned
Shocks			
η_t^H	(-17%, -19%, -13%)	Size of HTM labor supply shock	Total hours for retail, transportation, leisure/hospitality
η_t^ξ	(-41%, -42%, -17%)	Size of preference shock	Total hours excluding retail, transportation, leisure/hospitality
$\zeta_{H,t}$	(-21%, -16%, 4.7%)	Size of HTM sector demand shock	PCE Inflation for recreation, transportation, food services
s_t	26.8%	Size of transfer distribution	2020 CARES Act

Notes: This table shows model parameter values we use for our baseline model simulation. See Section 3.2 for details.

Our benchmark model is calibrated at a two-month frequency with a time discount factor of $\beta = 0.9932$. We set the inverse of the Frisch elasticity (φ) to be 2.2 and the inverse of the elasticity of intertemporal substitution (σ) to be 1.7, which are the estimates in Del Negro, Giannoni and Schorfheide (2015). We set the elasticity of substitution across firms to be six ($\theta = 6$), which corresponds to a recent estimate of average markup of 20 percent (Hall, 2018). We assume that the Ricardian and HTM goods are complements by setting the elasticity (ϵ) as 0.8, which is broadly consistent with the estimates in Hobijn and Nechio (2018).[21] We assume flexible prices in the HTM sector for simplicity, while we set

[21] Hobijn and Nechio (2018) estimate the elasticity to be 1 at a level of aggregation that distinguishes

the Calvo parameter for the Ricardian sector to be 0.833, which implies a 12-month duration of price changes, consistent with estimates in Del Negro, Giannoni and Schorfheide (2015). Finally, the steady-state inflation rate is 1.

We set the fraction of HTM households (λ) to be 0.23, based on employment share of retail trade, transportation and warehousing, and leisure and hospitality sectors in the U.S. Bureau of Labor Statistics (BLS). We use the 2019 Consumer Expenditure Surveys (CEX) data to calibrate α, the share parameters in the consumption baskets. We assume households in the top 80 percentile of the income distribution as Ricardian households and set $1-\alpha$ as 0.28 to match their consumption share for transportation, entertainment, and food away from home.[22]

For the steady-state of fiscal variables, we use federal debts, federal receipts, and government current transfer payments data from 1990:Q1 through 2020:Q1. We set the Taylor rule parameter under the monetary regime to be 1.3, as estimated in Del Negro, Giannoni and Schorfheide (2015). We set the tax rule parameter (ψ_L) to be 0.6 under the monetary regime, and we perform a sensitivity analysis later. We assume both the Taylor rule (ϕ) and tax rule parameters (ψ_L) to be zero under the fiscal regime, which is the parameterization often used in the literature.

To examine the dynamic effects of transfer policy, we calibrate the size of transfer distribution using the transfer amounts specified in the CARES Act, which came into operation in mid-April. In particular, we target the sum of three key components of the Act: \$293 billion to provide one-time tax rebates to individuals; (ii) \$268 billion to expand unemployment benefits; and (iii) \$150 billion in transfers to state and local governments. These three components of the CARES Act consist of around 3.4 percent of GDP. Given our calibration of steady-state government transfers, this in turn amounts to an increase in transfers of 26.8 percent.[23] In our baseline exercise of transfer policy, we assume that the total amount of transfer is equally distributed over six months—that is, three periods.

A key component of our calibration is how we choose the shock sizes. The size of the three shocks ($\eta_t^H, \eta_t^\xi, \xi_{H,t}$) are estimated to match the dynamics, under the monetary regime without transfer policy, of total hours for both the HTM and Ricardian sectors and inflation for the HTM sector, as given in our motivating Figure 1. In our baseline calibration, we assume that the three shocks in the model are over after three periods.

across 10 categories of goods and services. Since we only have two sectors in the model, we set an elasticity slightly below 1 as the baseline. Then, in a sensitivity analysis, we do an alternate calibration of 1.2.

[22] This value of α is the same if we assume households in the bottom 20 percentile of the income distribution as HTM households and target their consumption share for these sectors. For this reason, we modeled the same consumption basket for the two households.

[23] In a sensitivity analysis we drop the tax rebate component of the CARES Act while calibrating the transfer increase.

In particular, we set the size of HTM sector labor supply shocks to match BLS total hours changes from April through August in HTM sectors (retail trade, transportation and warehousing, and leisure and hospitality sectors). We then calibrate the size of the preference shocks to match BLS total hours changes for sectors excluding HTM sectors, also from April through August. Finally, we set the size of HTM sector-specific demand shocks to match the PCE inflation for recreation, transportation, and food services sectors from the U.S. Bureau of Economic Analysis. The three shocks series can perfectly match the dynamics of total hours and inflation from April through August, as reported in detail in Panel A of Appendix Table B.1.[24]

Moreover, Panel B of Table B.1 shows that our calibration is also reasonable at matching several non-targeted moments. For example, our model-implied dynamics of aggregate output is quite close to the data, even though we did not use any output data in our calibration. Moreover, model dynamics of consumption in the HTM sector is also fairly close to the dynamics of the real PCE data, even though our calibration only targets the dynamics of PCE inflation for the HTM sector.

3.3 Quantitative Results

We now present quantitative results on positive and normative implications of redistribution policy during a crisis.

3.3.1 Dynamic Effects of Transfer Policy

We show how key variables evolve over time in response to the COVID shocks—a combination of aggregate and sector-specific demand and supply shocks as discussed above. We then illustrate the effects of an increase in transfers for the two regimes. These results are in Figure 2, which presents four different scenarios: the monetary regime with and without transfers to the HTM households and the fiscal regime with and without transfers. As mentioned before, we calibrate the COVID shocks to match the targeted moments under the monetary regime in the absence of transfers. This case thus serves as our baseline. Throughout, the duration of the redistribution policy is three periods (six months), which coincides with the duration of the shocks.[25]

In the baseline, where the policymakers just stick to the usual policy, the COVID shocks generate significant short-run contractions in aggregate output and household

[24]Since the transfer payments from the CARES Act started in mid-April while our calibration strategy matches model dynamics without transfer policy to the data, there is a slight mismatch between the data and model counterparts, especially for August.

[25]We solve the model non-linearly under perfect foresight.

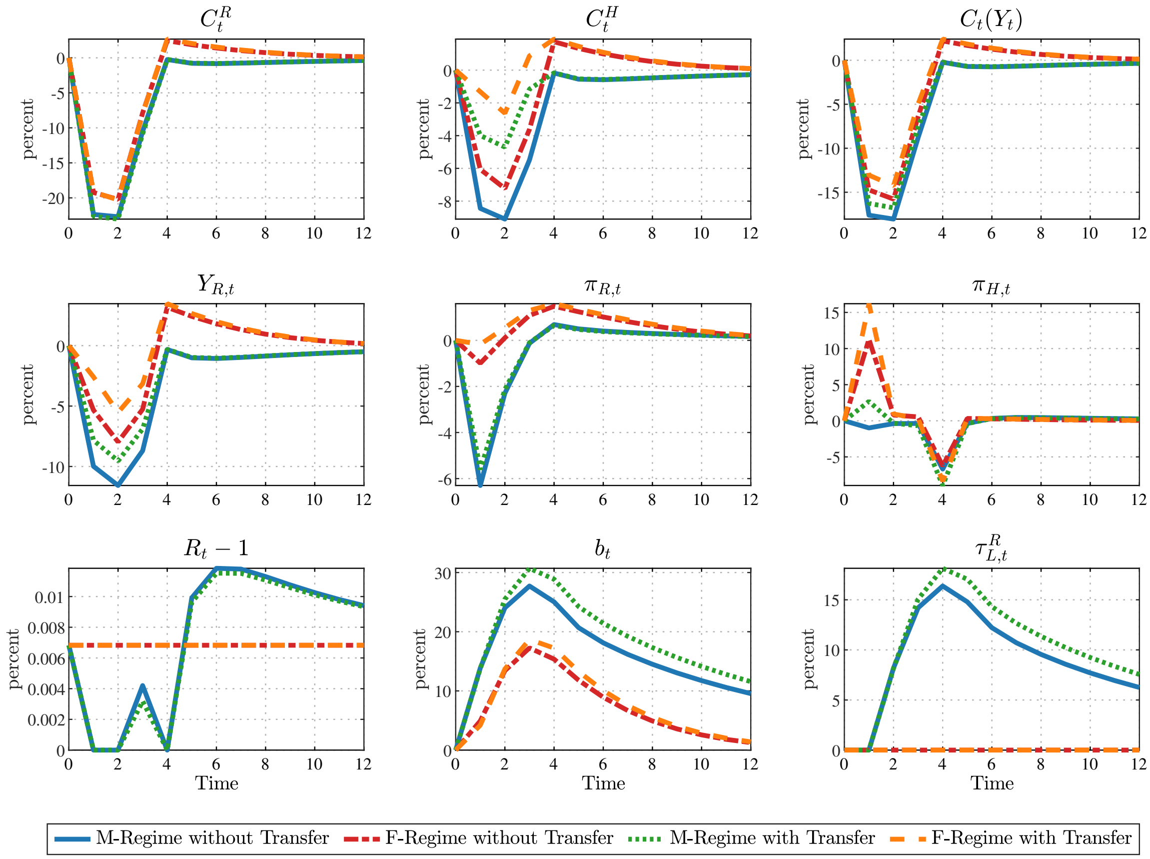

Figure 2: Redistribution Policy with Different Policy Regimes

Notes: This figure shows dynamics of key variables in response to the COVID shocks under different regimes. Blue solid lines represent the baseline case: the monetary regime without transfers. Red dashed lines, green dotted lines, and orange dashed lines represent respectively the fiscal regime without transfers, the monetary regime with transfers, and the fiscal regime with transfers.

consumption of both types, as shown by the solid *blue* lines in the first row of the figure. The contraction leads to a decline in inflation (as shown in the second row) and in labor tax revenues, both of which in turn increase the real value of government debt. The government responds by increasing the tax rate to stabilize debt under this standard monetary regime. Meanwhile, the central bank decreases the nominal interest rate in response to the decline in inflation. These policy responses are shown in the bottom row of the figure. Notice that the ZLB binds in our model during the pandemic.

Now, let us introduce the redistribution program to the monetary regime baseline case, the results of which are shown by the dotted green lines in Figure 2.[26] Overall, the effects of the redistribution program are largely in line with what we have shown using the simple model in Section 2. One major difference from the simple model is that the

[26] As we discussed in the calibration section, transfers increase by 26.8 percent in total, and here, they are evenly distributed over three periods.

redistribution program is more expansionary here because both the classical labor supply channel and the Keynesian channel operate thanks to nominal rigidities, as we discussed in Section 2.3.

Clearly, transfers increase HTM household consumption and decrease Ricardian household consumption (due to the resulting increase in the tax rate) relative to the baseline. These are the direct effects of the redistribution. As discussed in Section 2, however, the redistribution program is inflationary, as shown by the difference between the solid blue lines and the dotted green lines in the second row. This indirectly has a positive effect on household consumption of both types through general equilibrium. In particular, the decline of Ricardian household consumption caused by the redistribution is very small, and in fact in this parameterization it is nearly indistinguishable visually from the baseline case.

Let us now turn to the fiscal regime where neither the tax rate nor the nominal interest rate changes. The results for this case are shown by the red (without transfers) and orange (with transfers) lines in Figure 2. The COVID shocks are also contractionary in this regime, and, moreover, redistribution leads to an increase in HTM consumption as well as aggregate output.[27] In this fiscal regime, the main aspect we want to highlight is that aggregate output and consumption of both types do not drop as much as in the monetary regime. There are three main reasons, which all also help us understand how the transmission of shocks and transfer policy is different in this regime.

First, irrespective of whether there is redistribution or not, the fiscal regime generates greater and more persistent inflation than the monetary regime, as that stabilizes the real value of government debt without relying on labor taxes. Due to nominal rigidities, this in turn has larger and longer-lasting positive effects on output and consumption of both types, as presented in the first row of Figure 2. Second, as shown in the simple model in Section 2.2.2, the redistribution program is more inflationary in the fiscal regime than in the monetary regime. This result is illustrated in the second row of the figure. The fifth and sixth panels reveal that the gap between the orange and red lines is greater than that between the green and blue lines. Finally, the ZLB binds in the monetary regime as we discussed above, which prevents the central bank from decreasing the policy rate according to the monetary policy rule, and leads to a bigger drop in the monetary regime with the shocks. This mechanism is not relevant for the fiscal regime.

[27] In contrast to the monetary regime, redistribution actually increases Ricardian consumption in the fiscal regime as the aforementioned indirect effect on consumption through inflation dominates the direct effect in our calibration. This result, however, is difficult to see in the figure. We revisit it in Section 3.3.2.

3.3.2 Transfer Multipliers

As a way to summarize these dynamic responses with and without redistribution policy, we now present results in terms of transfer multipliers for output and consumption.

The transfer multiplier for output, for instance, under regime $i \in \{M, F\}$ is defined as

$$\mathcal{M}_t^i(Y) = \left(\frac{\sum_{h=0}^{t} \beta^h (\tilde{Y}_h^i - Y_h^M)}{\sum_{h=0}^{t} \beta^h s_h} \right),$$

where $\tilde{Y}_h^i$ is output at horizon h under i-regime *with* transfers, Y_h^M is output at horizon h under the monetary regime *without* transfers (i.e. the baseline), and s_h is transfers at horizon h. The multipliers for Ricardian sector output and the two consumption under i-regime—denoted respectively by $\mathcal{M}_t^i(Y^R)$, $\mathcal{M}_t^i(C^R)$ and $\mathcal{M}_t^i(C^H)$—are similarly defined. Following the government spending multiplier literature, we consider impact multiplier ($t = 0$) as well as 2–year ($t = 12$) and 4–year ($t = 24$) cumulative multipliers, which allows for a consideration of dynamic effects in the model.

Note that in calculating these multipliers, our baseline case, as in Section 3.3.1, is always the monetary regime without transfers. This is the most interesting case to study, as we want to study the following question: Given a transfer policy we want to implement, what are the differences if conventional labor taxes or inflation taxes are used to finance the resulting increase in government debt?

Table 2: Transfer Multipliers

	Monetary Regime				Fiscal Regime			
	$\mathcal{M}_t^M(Y)$	$\mathcal{M}_t^M(Y_R)$	$\mathcal{M}_t^M(C^R)$	$\mathcal{M}_t^M(C^H)$	$\mathcal{M}_t^F(Y)$	$\mathcal{M}_t^F(Y_R)$	$\mathcal{M}_t^F(C^R)$	$\mathcal{M}_t^F(C^H)$
Impact Multipliers	1.175	1.538	-0.205	5.692	3.983	5.272	2.418	9.105
2-Year Cumulative Multipliers	1.154	1.450	-0.217	5.641	7.289	8.884	5.607	12.796
4-Year Cumulative Multipliers	1.126	1.417	-0.244	5.609	7.739	9.408	6.036	13.311

Notes: This table shows the transfer multipliers under the monetary and fiscal regimes. $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers ($t = 0$) as well as 2–year ($t = 12$) and 4–year ($t = 24$) cumulative multipliers when the government distributes transfers evenly over 6 months.

Table 2 shows that aggregate output and Ricardian sector output multipliers are both above 1 in the monetary regime. The binding ZLB and sticky prices play an important role in this result.[28] Moreover, the C^H multiplier is above the simple model benchmark of $(1/\lambda)$, which would be 4.35 according to our calibration.

Table 2 also shows that those multipliers are even higher in the fiscal regime, even though the ZLB is binding in our simulations under the monetary regime. In fact, uniquely,

[28] In the simple model, we showed analytically that the Ricardian sector output multiplier is below 1.

even the C^R multiplier is now positive in the fiscal regime, which is different from the monetary regime.[29] The persistent inflation dynamics in this regime lead to persistent real effects due to sticky prices, which contributes to these higher multipliers. Later, in Section 3.4.1, we delve more deeply into the mechanisms that produce such large differences in the multipliers between the two regimes.

3.3.3 Welfare Effects of Transfer Policy

We finally show the effects on household welfare of the recession created by the COVID shocks under the four different scenarios discussed above. In particular, we consider both short- and long-run welfare effects. To this end, we implicitly define our measure of welfare gain for household of type $i \in \{R, H\}$, $\mu^i_{t,k}$, as

$$\sum_{j=0}^{t} \beta^j U\left(C^i_j, L^i_j\right) = \sum_{j=0}^{t} \beta^j U\left(\left(1+\mu^i_{t,k}\right)\bar{C}^i, \bar{L}^i\right),$$

where $\{\bar{C}^i, \bar{L}^i\}$ is the steady-state level of type-i household's consumption and hours, and $\left\{C^i_j, L^i_j\right\}$ are the time path of type-i household's consumption and hours under the different transfer duration policies (indexed by k). In this way, $\mu^i_{t,k}$ measures welfare gains from period 0 till (arbitrary) period t in units of a percentage of the steady-state (or pre-COVID) level of consumption—when the redistribution program lasts for k periods.[30] The lifetime (total) welfare gain is then measured by $\mu^i_{\infty,k} \equiv \lim_{t\to\infty} \mu^i_{t,k}$, often the focus of the business cycle literature. Recall that, unless otherwise noted, we report the case in which k=3; that is, the duration of the redistribution coincides with the duration of the shocks.

We find that whether the government introduces the redistribution program and how it is financed make a very small difference for the *lifetime* welfare for both types of households. This result is presented in Table 3. For example, the redistribution program financed by inflation taxes, that is the fiscal regime, increases the HTM households' lifetime welfare by 0.198 percentage point and increases the Ricardian households' lifetime welfare by 0.070 percentage point, compared to the baseline. This result is expected because the COVID shocks under consideration are short-lived, which implies the recession is only a small bump in the lifetime.[31]

[29] In the simple model where inflation is neutral for real variables, we showed analytically that this multiplier is negative.

[30] It thus measures welfare gains at the point when the agents are t periods, or 2xt months, old since the initial COVID shocks.

[31] We shut down all shocks other than the three-period COVID shocks over the lifetime. Therefore, this exercise is different from the usual ones in the business cycle literature.

Table 3: Welfare Gains

Transfer Distribution	Monetary Regime		Fiscal Regime	
	Long-run	Short-run ($t = 4$)	Long-run	Short-run ($t = 4$)
Ricardian Household	-0.012	-0.819	0.070	1.131
HTM Household	0.074	3.386	0.198	5.600

Notes: This table shows long- and short-run welfare gains resulting from the redistribution, compared to the baseline. The values are the difference in the welfare measure ($\mu^i_{t,k}$) between the transfer cases (under the two regimes) and the baseline case (the monetary regime without transfers). In the latter case, the long-run welfare gains for the Ricardian households and for the HTM households are -0.439 and -0.202 percent of the steady-state level of consumption respectively.

What is more interesting are the welfare effects in the short run, which are presented in detail in Figure 3. We ask two different, yet related questions. First, taking as given the redistribution program enacted, what is the better way to finance it? Second, should the government enact the redistribution policy at all?

On the first question, we find that, taking the redistribution program as given, inflation taxes, as used in the fiscal regime, produce far better welfare outcomes than labor taxes, as used in the monetary regime. For example, at the point when the pandemic is over (at $t = 4$), as given in Table 3, the redistribution program, financed by inflation taxes (i.e., the fiscal regime), would have increased the welfare of the HTM households and that of the Ricardian households by 5.6 percentage points and 1.131 percentage points, respectively, compared to the baseline. This result on the welfare gains under the fiscal regime can be inferred from the second and third panels of Figure 3.[32] In contrast, if the government relied on labor taxes, the HTM households' welfare gain resulting from the redistribution would amount to 3.386 percentage points of the steady-state level of consumption at the end of the pandemic. Therefore, labor-tax financed transfers are less effective. Moreover, the redistribution now decreases the welfare of the Ricardian households by 0.819 percentage point, as these households work more hours with little change in consumption.

We now consider the second question—that is, whether the redistribution policy is desirable at all. The answer is obviously that it depends. Figure 3 shows that the inflation-financed redistribution program under the fiscal regime benefits the HTM households the most, but it is not the best option for the Ricardian households. But if the policy objective was simply to maximize the aggregate welfare, which is not likely the most realistic

[32]Specifically, the welfare improvements over the baseline case can be obtained by taking the difference between the orange lines and the blue lines (the baseline).

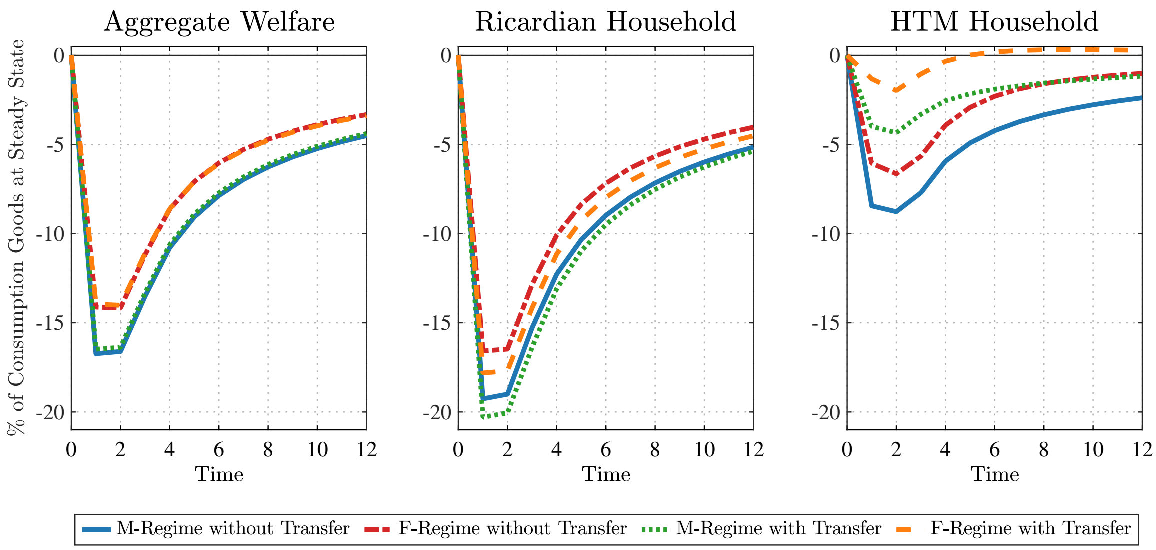

Figure 3: Short-Run Welfare Gains Comparison

Notes: This figure presents the short-run welfare gains under the four different scenarios, showing $\mu^i_{t,k}$ as a function of t. The numbers are in units of a percentage of the steady-state level of consumption.

case, the redistribution program by itself would do very little *given the policy regime* in this model, as shown in the first panel of Figure 3. With transfer payments, in either policy regime, the HTM households would consume more, which would also lead to an increase in aggregate output. At the same time, the Ricardian households would have to work more for two reasons. The first reason is to produce more output. The second reason is that inflation created by the redistribution generates resource misallocation, which increases labor hours required to produce a given amount of output, as shown in Equation (3.1). In our calibration here, these two welfare effects almost cancel each other out in both regimes.

3.4 Extensions and Sensitivity Analysis

We now consider some important extensions and sensitivity analysis.

3.4.1 Inspecting the Mechanisms of Transfer Multipliers

As our main extension, we do several exercises to inspect the mechanisms that drive transfer multipliers across the two regimes. First, we decompose the transfer multiplier into three different components in Table 4, where in this decomposition, the output multiplier, for instance, under regime $i \in \{M, F\}$ is

$$\mathcal{M}_t^i(Y) = \underbrace{\left(\frac{\sum_{h=0}^t \beta^h(\tilde{Y}_h^i - \tilde{Y}_{\text{no shock},h}^i)}{\sum_{h=0}^t \beta^h s_h}\right)}_{\text{COVID Effect with Transfer}} + \underbrace{\left(\frac{\sum_{h=0}^t \beta^h(\tilde{Y}_{\text{no shock},h}^i - \bar{Y})}{\sum_{h=0}^t \beta^h s_h}\right)}_{\text{Transfer Effect without COVID Shocks}} - \underbrace{\left(\frac{\sum_{h=0}^t \beta^h(Y_h^M - \bar{Y})}{\sum_{h=0}^t \beta^h s_h}\right)}_{\text{COVID Effect without Transfer}} \tag{3.2}$$

where $\tilde{Y}_h^i$ is output at horizon h under i-regime *with* both transfers and COVID shocks, $\tilde{Y}_{\text{no shock},h}^i$ is output at horizon h under i-regime *with* transfers, but *without* COVID shocks, Y_h^M is output at horizon h under the monetary regime *with* COVID shocks, but *without* transfers, $\bar{Y}$ is output at steady-state, and s_h is transfers at horizon h. Note that the third effect is the same across regimes, while the first two are different as they compute the effect for a given regime.

Table 4: Transfer Multipliers Decomposition

	Monetary Regime				Fiscal Regime			
	$\mathcal{M}_t^M(Y)$	$\mathcal{M}_t^M(Y_R)$	$\mathcal{M}_t^M(C^R)$	$\mathcal{M}_t^M(C^H)$	$\mathcal{M}_t^F(Y)$	$\mathcal{M}_t^F(Y_R)$	$\mathcal{M}_t^F(C^R)$	$\mathcal{M}_t^F(C^H)$
Panel A: Impact Multipliers								
Total Effect	1.175	1.538	-0.205	5.692	3.983	5.272	2.418	9.105
COVID Effect with Transfer	-14.982	-6.446	-16.435	-10.226	-12.920	-3.589	-14.523	-7.671
Transfer Effect without COVID	0.742	0.867	-0.597	5.125	1.488	1.743	0.115	5.984
COVID Effect without Transfer	-15.415	-7.117	-16.827	-10.793	-15.415	-7.117	-16.827	-10.793
Panel B: 2-Year Cumulative Multipliers								
Total Effect	1.154	1.450	-0.217	5.641	7.289	8.884	5.607	12.796
COVID Effect with Transfer	-14.161	-8.455	-15.090	-11.123	-8.493	-1.568	-9.711	-4.504
Transfer Effect without COVID	1.007	1.178	-0.344	5.430	1.474	1.725	0.101	5.967
COVID Effect without Transfer	-14.308	-8.727	-15.217	-11.333	-14.308	-8.727	-15.217	-11.333
Panel C: 4-Year Cumulative Multipliers								
Total Effect	1.126	1.417	-0.244	5.609	7.739	9.408	6.036	13.311
COVID Effect with Transfer	-14.655	-9.030	-15.561	-11.688	-8.557	-1.643	-9.773	-4.578
Transfer Effect without COVID	0.960	1.123	-0.389	5.376	1.475	1.727	0.103	5.968
COVID Effect without Transfer	-14.821	-9.324	-15.707	-11.921	-14.821	-9.324	-15.707	-11.921

Notes: This table shows the decomposition of the transfer multipliers for aggregate output, Ricardian sector output, Ricardian consumption and HTM consumption, as given in Equation (3.2). $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers ($t = 0$) as well as 2–year ($t = 12$) and 4–year ($t = 24$) cumulative multipliers.

As Table 4 shows, even without the COVID shocks, the transfer multipliers are higher in the fiscal regime. This result is captured by the second component in Equation (3.2). For example, this component of the impact multiplier for output is 1.488 under the fiscal regime, while it is only 0.742 under the monetary regime. Moreover, uniquely in the fiscal regime, the Ricardian consumption multiplier is positive (e.g. 0.115 on impact). The main reason for these results is the high and persistent effects on inflation in the fiscal regime induced by an increase in transfer, as shown in our analytical analysis.

We now consider the state-dependence of the transfer multipliers, first within and then across the regimes. First, in each of the two regimes, the transfer multipliers conditional on *no* COVID shocks (i.e. the second component) are less than the total multipliers. In the absence of the COVID shocks—that is, if the economy were in the steady state—transfer-induced inflation, while boosting the economy, would also generate inefficient price dispersion, which in turn would lead to resource misallocations and decrease labor productivity. However, if the economy were already in a COVID-recession, inflationary pressures resulting from redistribution would actually *counteract* deflation due to the COVID shocks, thereby decreasing, rather than increasing, the extent of such price dispersion. In addition, in the case of monetary regime, the ZLB is irrelevant with no COVID shocks, which means that transfer-induced inflationary pressures do not lead to as strong a boost in consumption as the real interest rate does not decrease strongly.

Second, comparing the two regimes, the transfer multipliers are *more state-dependent* in the fiscal regime than in the monetary regime. That is, transfers are disproportionately more effective in the fiscal regime than in the monetary regime when the economy falls into a COVID-recession. The reason is that the aforementioned "counteracting" force is much stronger in the fiscal regime that produces higher and more persistent inflation.[33] Table 4 shows that the large difference in the multipliers between the two regimes is driven quantitatively by the first component, which captures how the effectiveness of transfers depends on the presence of COVID shocks. This is a measure of state dependence.

Besides the state dependence, our quantitative model includes two additional features that break the uniformity—obtained in the simple, analytical model—of the two regimes in terms of the multipliers. They are nominal rigidities and distortionary labor taxes. In order to isolate the role of these two features, we delve more into the second component of the transfer multipliers in Equation (3.2) through counterfactual exercises.

For reference, Panel A of Table 5 first re-reports the second component in the presence of the two features.[34] We then remove nominal rigidities (in Panel B) and further remove distortionary labor taxes (in Panel C). The last version then is quite close to our simple, analytical model. This exercise thus progressively allows an analysis of which elements are responsible for differences between the simple and the quantitative model results—besides the COVID shocks.

Panel B of Table 5 shows that the multipliers decrease substantially with flexible prices,

[33] We can see this in the fifth panel of Figure 2. Without transfer, as shown by the blue line, the COVID shocks generate a significant deflation, which can be undone by inflation-financed transfers (shown by the orange line).

[34] The values in the panel are thus the same as those in the third row of each panel of Table 4

Table 5: Transfer Multipliers without COVID Shocks

	Monetary Regime				Fiscal Regime			
	$\mathcal{M}_t^M(Y)$	$\mathcal{M}_t^M(Y_R)$	$\mathcal{M}_t^M(C^R)$	$\mathcal{M}_t^M(C^H)$	$\mathcal{M}_t^F(Y)$	$\mathcal{M}_t^F(Y_R)$	$\mathcal{M}_t^F(C^R)$	$\mathcal{M}_t^F(C^H)$
Panel A: Without COVID Shocks under sticky price								
Impact Multipliers	0.742	0.867	-0.597	5.125	1.488	1.743	0.115	5.984
2-Year Cumulative Multipliers	1.007	1.178	-0.344	5.430	1.474	1.725	0.101	5.967
4-Year Cumulative Multipliers	0.960	1.123	-0.389	5.376	1.475	1.727	0.103	5.968
Panel B: Without COVID Shocks under flexible price								
Impact Multipliers	0.465	0.543	-0.861	4.807	0.465	0.543	-0.861	4.807
2-Year Cumulative Multipliers	0.214	0.251	-1.101	4.520	0.465	0.543	-0.861	4.807
4-Year Cumulative Multipliers	0.095	0.111	-1.215	4.383	0.465	0.543	-0.861	4.807
Panel C: Without COVID Shocks under flexible price and lump-sum tax adjustment								
Impact Multipliers	0.465	0.543	-0.861	4.807	0.465	0.543	-0.861	4.807
2-Year Cumulative Multipliers	0.465	0.543	-0.861	4.807	0.465	0.543	-0.861	4.807
4-Year Cumulative Multipliers	0.465	0.543	-0.861	4.807	0.465	0.543	-0.861	4.807

Notes: This table shows the transfer multipliers without COVID shocks. Panel A reports multipliers under sticky prices and distortionary labor taxes. Panels B reports multipliers under flexible prices and distortionary labor taxes. Panels C reports multipliers under flexible prices and non-distortionary lump-sum taxes. $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers ($t = 0$), 2–year ($t = 12$), and 4–year ($t = 24$) cumulative multipliers.

as is often also found in the government spending multiplier literature. In fact, now the impact multipliers are the same across the regimes, as was the case in our simple, analytical model, as different inflation dynamics do not affect real allocations. Moreover, output multipliers are now below 1, the Ricardian consumption multiplier is negative, and the HTM consumption multiplier is close to 4.35, the analytical model solution.[35] The cumulative multipliers are different from the impact multiplier in the monetary regime—unlike the simple, analytical model—due to dynamics of distortionary labor taxes.

To make this clear, Panel C of Table 5 shows the case where the increase in transfers are financed by lump-sum taxes on the Ricardian household. Then, all the multipliers are the same across the regimes and over horizons, as in the simple, analytical model.

3.4.2 Sensitivity Analysis

As our first sensitivity exercise, we do additional analysis related to the length of the transfer policy. So far, transfer policy duration coincided with the length of the COVID shocks—that is, six months. We now show results for three different durations of redistri-

[35]The solution for multipliers in the simple model that we derive would predict a Ricardian sector output multiplier of 0.644 and Ricardian consumption multiplier of -0.464. Note that the simple model imposes log utility and is also a one-sector environment.

bution policy: The program lasts for 2, 6, and 12 months. This exercise can be important, as our model features HTM households. Moreover, the timing of transfers can also matter because there are distortionary labor taxes in the model and also when the economy is at ZLB under the monetary regime. For the different durations of the program, we fix the present value of transfers to be the same, which implies that the amount of transfers each period is smaller when the program lasts longer.

Appendix Figures B.1 and B.2 present the responses of the variables with different duration of the redistribution program under the monetary and fiscal regimes, respectively. We find that the results are overall quite similar across different lengths of the redistribution policy, except for the responses of HTM household consumption. The second panel of the figures shows that the difference in HTM household consumption between the no-transfer and transfer cases, for obvious reasons, is more evenly distributed across time periods when the duration of the program is longer. Appendix Table B.2 presents the multiplier results under different duration of transfer policy. The multipliers are higher under the monetary regime when transfer is distributed over a longer duration. For the fiscal regime, the cumulative multipliers, which capture dynamics in the model, are relatively insensitive to the duration of transfer policy.[36]

We next do sensitivity analysis with respect to two assigned parameters. We first consider a cross-sector elasticity of substitution (ε) greater than 1, equal to 1.2. Our baseline parameterization was 0.8. Next, we consider a different parameterization of the tax rule response coefficient (ψ_L) under the M regime. Compared to our baseline choice of 0.6, we now set it at 0.1, such that labor tax rates respond less strongly to debt.[37] In these exercises, we keep the rest of the parameters the same as the baseline.[38]

Appendix Figure B.3 presents the responses of the variables with and without transfer policy when $\varepsilon = 1.2$, while Table B.4 presents the transfer multipliers when $\varepsilon = 1.2$. Overall, the results are similar to our baseline results. One noticeable difference is that as the sectoral goods are more substitutable now, the consumption multiplier for the HTM household is lower while that for the Ricardian household is higher.

Appendix Figure B.4 present the responses of the variables with and without transfer policy when $\psi_L = 0.1$ under the monetary regime, while Appendix Table B.5 presents the transfer multipliers when $\psi_L = 0.1$. The results are very similar to our baseline results. One noticeable difference is that as labor tax rates increase less strongly, under the

[36] Appendix Table B.3 presents welfare results. Consistent with the multiplier results, in the monetary regime, the longer duration transfer policy leads to welfare improvement for both the households.

[37] This is in line with the estimates in Bhattarai, Lee and Park (2016), which however did not have distortionary labor taxes.

[38] These different sensitivity analysis exercises thus will not match the targeted moments anymore.

monetary regime, the multipliers are somewhat higher.[39]

Finally, Appendix Table B.6 presents the transfer multipliers when we exclude $600 individual tax rebates in the CARES Act from our transfer experiment. The main motivation is the survey finding in Coibion, Gorodnichenko and Weber (2020) that on average, only about 40% of tax rebates appears to have been spent by households. The size of transfer change decreases from 26.8% to 15.7% when we exclude the individual tax rebates.[40] Table B.6 shows that the multipliers are essentially the same as before under the monetary regime. For the fiscal regime however, the multipliers are even bigger. This is another example of state dependence of multipliers, where the results differ by the size of the change in transfers. The decomposition shows that this is driven by the higher marginal effectiveness of transfers with COVID shocks in this regime.

4 Conclusion

Our paper makes clear that how transfers are ultimately financed is a first-order issue for their effectiveness. It arguably matters more than other factors identified in the literature, which typically reports moderate transfer multipliers. We show that inflation-financed transfers are significantly more effective than tax-financed transfers in boosting the economy and improving welfare. Such an inflation-financed transfer program can be implemented by a fiscal authority committing itself to no tax adjustments in the foreseeable future, coupled with an accommodative monetary authority. We call such a fiscal-monetary policy mix the fiscal regime—in contrast to the (conventional) monetary regime where monetary policy stabilizes inflation.

We first consider a simple two-agent model that permits analytical results and illuminates the mechanism through which redistribution generates inflation in the two policy regimes. In particular, the fiscal regime produces high and persistent inflation through the direct and the indirect (that we also called the interest rate or valuation) channels. In comparison, inflation is lower and shorter lived in the monetary regime. We then build on the analytical results and proceed to a quantitative analysis in a two-sector extension. Our quantitative exercise shows that inflation-financed transfers fight deflationary pressures in a COVID-recession-like environment, thereby preventing output and consumption from dropping significantly. Such inflation-induced expansionary effects are so large

[39] For the fiscal regime, the only reason the multiplier results are different from our baseline is that the monetary regime under no transfers now has different dynamics.

[40] Other than changing the size of the transfer increase, this does not affect our parameterization as we calibrate the economy in the absence of transfer policy.

that redistribution can in fact produce a Pareto improvement.

In future work, we can take additional steps in several directions. First, the model may be extended to feature a richer form of heterogeneity across sectors as well as households and, in addition, more elaborate matching between sectors and households. Although we expect that our main argument will hold in such a complex environment, it will be interesting to see whether such an extension affects the quantitative results significantly. Second, while our analysis suggests a clear path for the success of a redistribution policy, the Great Recession taught policymakers that generating inflation during, and in the aftermath of, a severe recession is easier said than done, possibly due to credibility problems. Relatedly, implementation would not be as straightforward in an environment where economic agents take into account the possibility of regime switching by policymakers when the recession is over, as suggested in this paper. We leave a more comprehensive analysis of such interesting issues for future research.

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APPENDIX

A Data Appendix

Employment and Total Hours. We use total employment and total hours data from U.S. Bureau of Labor Statistics. We define HTM sector as the sum of the following three sectors: Retail Trade (NAICS 44–45), Transportation and Warehousing (NAICS 48–49), and Leisure and Hospitality (NAICS 71–72).

Consumption and Inflation. We use real Personal Consumption Expenditure (PCE) data and PCE inflation from U.S. Bureau of Economic Analysis. We define HTM sector as the sum of the following three sectors: Transportation services, Recreation services, and Food services and accommodations.

We also use 2019 Consumer Expenditure Surveys (CEX) data to calibrate both Ricardian and HTM households' share parameters in the consumption baskets. We assume households in the top 80 percentile income distribution as Ricardian households and match their consumption share for transportation, entertainment, and food away from home. Similarly, we assume households in bottom 20 percentile income distribution as HTM households and match their consumption share for these three sectors.

Fiscal Variables. We use government current transfer payments (A084RC1Q027SBEA in FRED) to calibrate steady-state transfers to GDP ratio. We also use federal debt held by the public data (FYGFDPUN in FRED) to calibrate debt to GDP ratio. Finally, we use compensation of employees, paid: wages and salaries (A4102C1Q027SBEA in FRED), proprietors' income (PROPINC in FRED), and federal government current receipts: contributions for government social insurance (W780RC1Q027SBEA in FRED) data to calibrate steady-state labor tax revenue to GDP ratio. The sample period for these variables is from 1990Q1 through 2020Q1.

Transfer Distribution from CARES Act. We calibrate the size of transfer distribution using the transfer amounts specified in Coronavirus Aid, Relief and Economy Security Act (CARES Act), which came into operation in mid–April. In particular, we target the sum of three key components of the Act: $293 billion to provide one-time tax rebates to individuals; (ii) $268 billion to expand unemployment benefits; (iii) $150 billion in transfers to state and local governments. These three components of the CARES Act consist of around 3.4 percent of GDP. In a sensitivity analysis, we count only components (ii) and (iii) above.

B Appendix Tables and Figures

Appendix Table B.1: Data and Model Moments

	Time	Data	Model
Panel A: Targeted moments (percent deviation from January)			
Total Hours for retail, transportation, leisure/hospitality	April	-16.7%	-16.7%
	June	-18.8%	-18.8%
	August	-13.2%	-13.2%
Total Hours excluding retail, transportation, leisure/hospitality	April	-6.58%	-6.58%
	June	-8.57%	-8.57%
	August	-6.13%	-6.13%
PCE Inflation for recreation, transportation, food services	April	-0.99%	-0.99%
	June	-0.39%	-0.39%
	August	-0.37%	-0.37%
Panel B: Non-targeted moments (percent deviation from January)			
PCE Inflation excluding recreation, transportation, food services	April	-0.14%	-6.30%
	June	-0.06%	-2.29%
	August	0.74%	-0.12%
Real PCE for recreation, transportation, food services	April	-41.1%	-16.7%
	June	-37.6%	-18.8%
	August	-25.2%	-13.2%
Real PCE excluding recreation, transportation, food services	April	-7.74%	-9.98%
	June	-3.78%	-11.6%
	August	-1.06%	-8.69%
Real GDP (percent deviation from Q1)	Q2	-8.99%	-12.8%
	Q3	-2.25%	-0.07%

Notes: This table shows moments of the data and simulated series from the baseline model parameterized at the values in Table 1. Panel A shows targeted moments and Panel B shows non-targeted moments. Data moments are expressed as the percent deviation from the average values of outcome variables in January and February.

Appendix Table B.2: Multipliers with Different Transfer Distribution

	Monetary Regime			Fiscal Regime		
Transfer Duration	$k=1$	$k=3$	$k=6$	$k=1$	$k=3$	$k=6$
Panel A: Impact multiplier						
$\mathcal{M}_0^i(Y)$	1.074	1.175	1.862	2.047	3.983	6.799
$\mathcal{M}_0^i(Y_R)$	1.417	1.538	2.434	2.732	5.272	8.979
$\mathcal{M}_0^i(C^R)$	-0.301	-0.205	0.439	0.606	2.418	5.053
$\mathcal{M}_0^i(C^H)$	5.575	5.692	6.520	6.766	9.105	12.514
Panel B: 2-year cumulative multiplier						
$\mathcal{M}_{12}^i(Y)$	1.072	1.154	1.718	7.323	7.289	7.121
$\mathcal{M}_{12}^i(Y_R)$	1.414	1.450	2.080	8.998	8.884	8.629
$\mathcal{M}_{12}^i(C^R)$	-0.303	-0.217	0.326	5.630	5.607	5.453
$\mathcal{M}_{12}^i(C^H)$	5.572	5.641	6.277	12.865	12.796	12.578
Panel C: 4-year cumulative multiplier						
$\mathcal{M}_{24}^i(Y)$	1.035	1.126	1.749	7.778	7.739	7.550
$\mathcal{M}_{24}^i(Y_R)$	1.371	1.417	2.116	9.528	9.408	9.130
$\mathcal{M}_{24}^i(C^R)$	-0.338	-0.244	0.355	6.065	6.036	5.863
$\mathcal{M}_{24}^i(C^H)$	5.530	5.609	6.312	13.386	13.311	13.070

Notes: This table shows the transfer multipliers with different duration of transfer distribution under different regimes (monetary and fiscal regimes). $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. Panel A shows impact multipliers and Panels B and C present two-year and four-year cumulative multipliers, respectively. We consider three cases of different duration of transfer distribution: 2-month ($k=1$), 6-month ($k=3$), and 12-month ($k=6$).

Appendix Table B.3: Long-run Welfare Gains

	Monetary Regime			Fiscal Regime		
Transfer Duration	$k=1$	$k=3$	$k=6$	$k=1$	$k=3$	$k=6$
Ricardian Household	-0.011	-0.012	-0.002	0.079	0.070	0.063
HTM Household	0.048	0.074	0.090	0.172	0.198	0.202

Notes: This table shows the long-run welfare gains for the models with different regimes and horizons of transfer distributions. The numbers represent the percentage point deviations from the welfare gains under monetary regime without transfers. We consider three cases of different duration of transfer distribution: 2-month ($T=1$), 6-month ($T=3$), and 12-month ($T=6$).

Appendix Table B.4: Transfer Multipliers ($k = 3$, $\varepsilon = 1.2$)

	Monetary Regime				Fiscal Regime			
	$\mathcal{M}_t^M(Y)$	$\mathcal{M}_t^M(Y_R)$	$\mathcal{M}_t^M(C^R)$	$\mathcal{M}_t^M(C^H)$	$\mathcal{M}_t^F(Y)$	$\mathcal{M}_t^F(Y_R)$	$\mathcal{M}_t^F(C^R)$	$\mathcal{M}_t^F(C^H)$
Impact Multipliers	1.086	1.262	-0.105	4.983	5.222	6.119	4.474	7.671
2-Year Cumulative Multipliers	1.072	1.220	-0.123	4.983	9.306	10.475	8.951	10.469
4-Year Cumulative Multipliers	1.044	1.189	-0.153	4.964	9.885	11.112	9.588	10.859

Notes: This table shows the transfer multipliers for the models under monetary and fiscal regimes when $\varepsilon = 1.2$. $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers, two-year, and four-year cumulative multipliers when government distributes transfers equally over 6 months.

Appendix Table B.5: Transfer Multipliers ($k = 3$, $\psi_L = 0.1$)

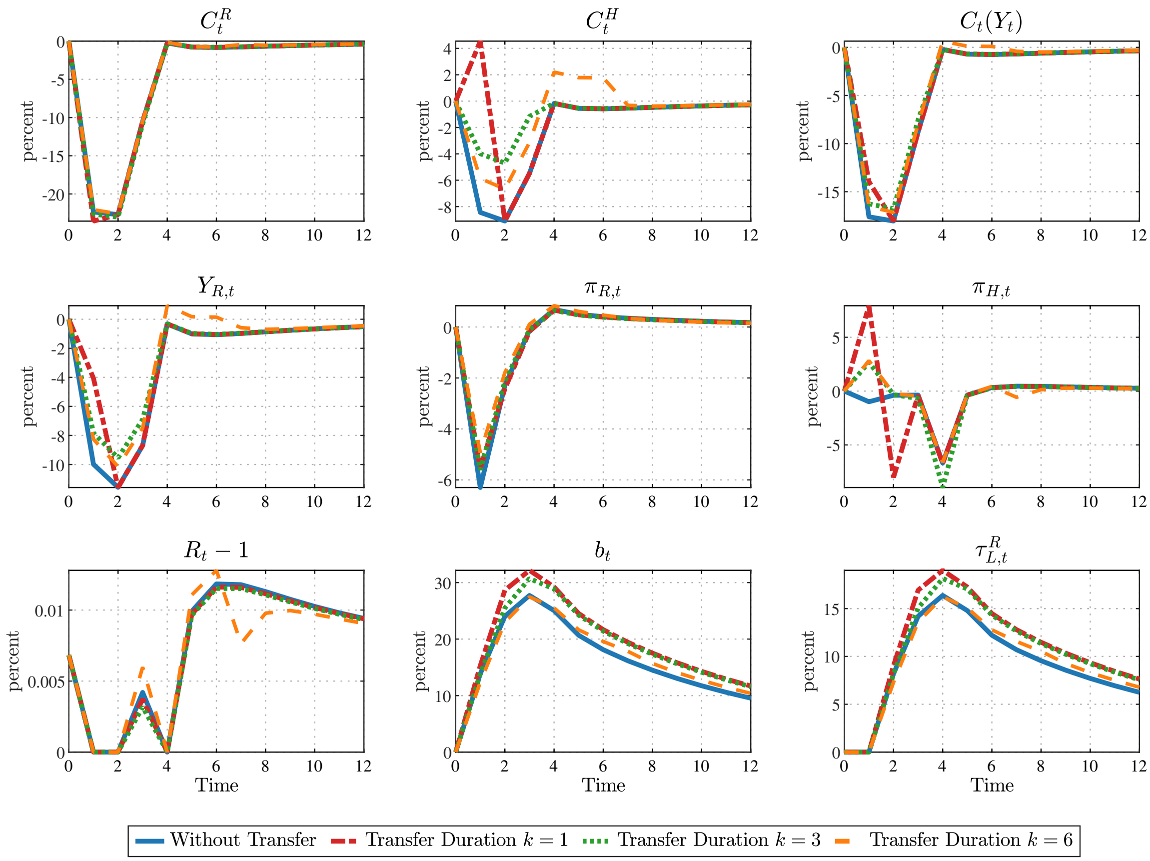
	Monetary Regime				Fiscal Regime			
	$\mathcal{M}_t^M(Y)$	$\mathcal{M}_t^M(Y_R)$	$\mathcal{M}_t^M(C^R)$	$\mathcal{M}_t^M(C^H)$	$\mathcal{M}_t^F(Y)$	$\mathcal{M}_t^F(Y_R)$	$\mathcal{M}_t^F(C^R)$	$\mathcal{M}_t^F(C^H)$
Impact Multipliers	1.184	1.549	-0.196	5.703	4.023	5.324	2.456	9.154
2-Year Cumulative Multipliers	1.262	1.577	-0.114	5.766	6.957	8.497	5.290	12.415
4-Year Cumulative Multipliers	1.262	1.577	-0.114	5.766	7.363	8.971	5.677	12.881

Notes: This table shows the transfer multipliers for the models under monetary and fiscal regimes when $\psi_L = 0.1$. $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers, two-year, and four-year cumulative multipliers when government distributes transfers equally over 6 months.

Appendix Table B.6: Transfer Multipliers ($k = 3$, Excluding $600 Individual Tax Rebates)

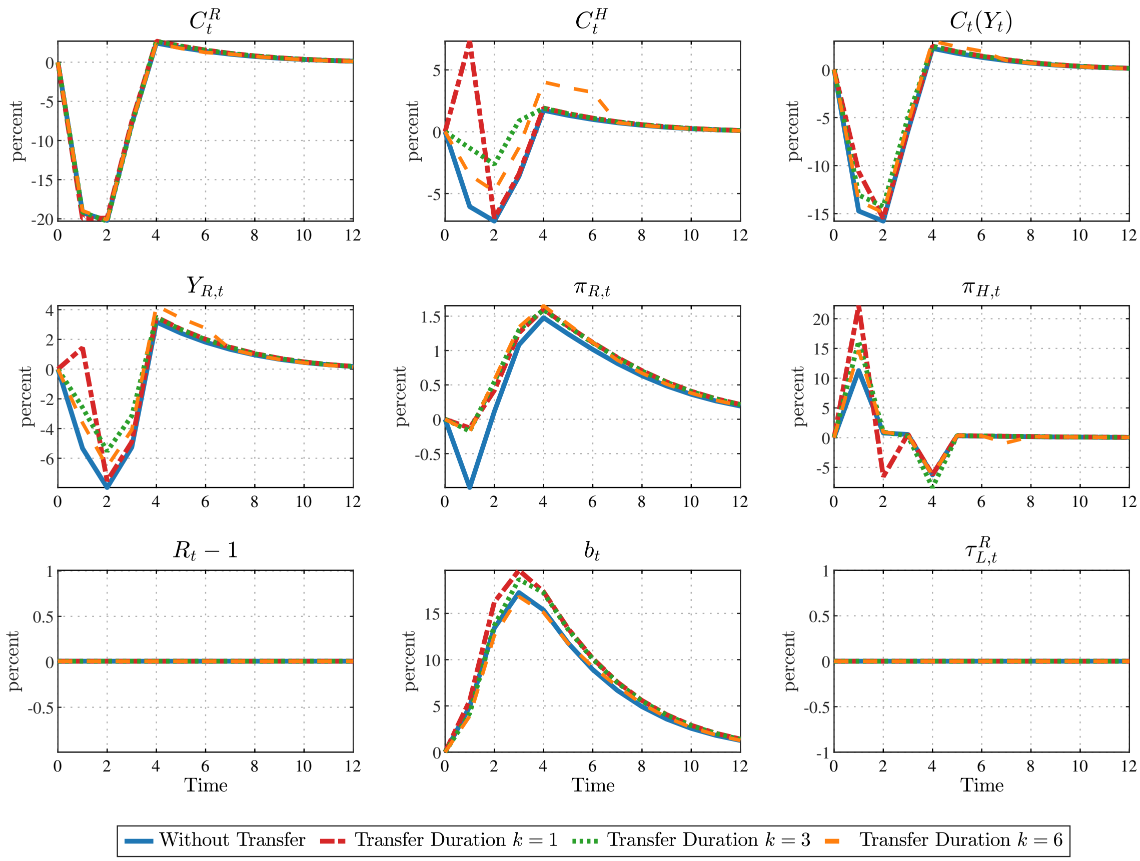
	Monetary Regime				Fiscal Regime			
	$\mathcal{M}_t^M(Y)$	$\mathcal{M}_t^M(Y_R)$	$\mathcal{M}_t^M(C^R)$	$\mathcal{M}_t^M(C^H)$	$\mathcal{M}_t^F(Y)$	$\mathcal{M}_t^F(Y_R)$	$\mathcal{M}_t^F(C^R)$	$\mathcal{M}_t^F(C^H)$
Panel A: Impact Multipliers								
Total Effect	1.173	1.532	-0.206	5.689	5.775	7.625	4.096	11.272
COVID Effect with Transfer	-25.878	-11.478	-28.329	-17.855	-22.039	-6.278	-24.755	-13.148
Transfer Effect without COVID	0.738	0.862	-0.601	5.120	1.500	1.754	0.127	5.996
COVID Effect without Transfer	-26.314	-12.149	-28.724	-18.423	-26.314	-12.149	-28.724	-18.423
Panel B: 2-Year Cumulative Multipliers								
Total Effect	1.154	1.448	-0.216	5.641	11.376	13.807	9.490	17.549
COVID Effect with Transfer	-24.280	-14.629	-25.850	-19.139	-14.546	-2.840	-16.610	-7.790
Transfer Effect without COVID	1.010	1.180	-0.341	5.433	1.498	1.751	0.124	5.993
COVID Effect without Transfer	-24.424	-14.897	-25.975	-19.346	-24.424	-14.897	-25.975	-19.346
Panel C: 4-Year Cumulative Multipliers								
Total Effect	1.127	1.415	-0.242	5.609	12.172	14.735	10.251	18.463
COVID Effect with Transfer	-25.136	-15.627	-26.668	-20.12	-14.631	-2.939	-16.691	-7.887
Transfer Effect without COVID	0.963	1.125	-0.386	5.379	1.504	1.758	0.130	6.000
COVID Effect without Transfer	-25.299	-15.917	-26.811	-20.350	-25.299	-15.917	-26.811	-20.350

Notes: This table shows the transfer multipliers for the models under monetary and fiscal regimes when we exclude $600 individual tax rebates from our transfer experiment. The total value of transfer distribution to GDP ratio decreases from 26.8% to 15.7% when we exclude the individual tax rebates. $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers, 2-year, and 4-year cumulative multipliers when government distributes transfers equally over 6 months.



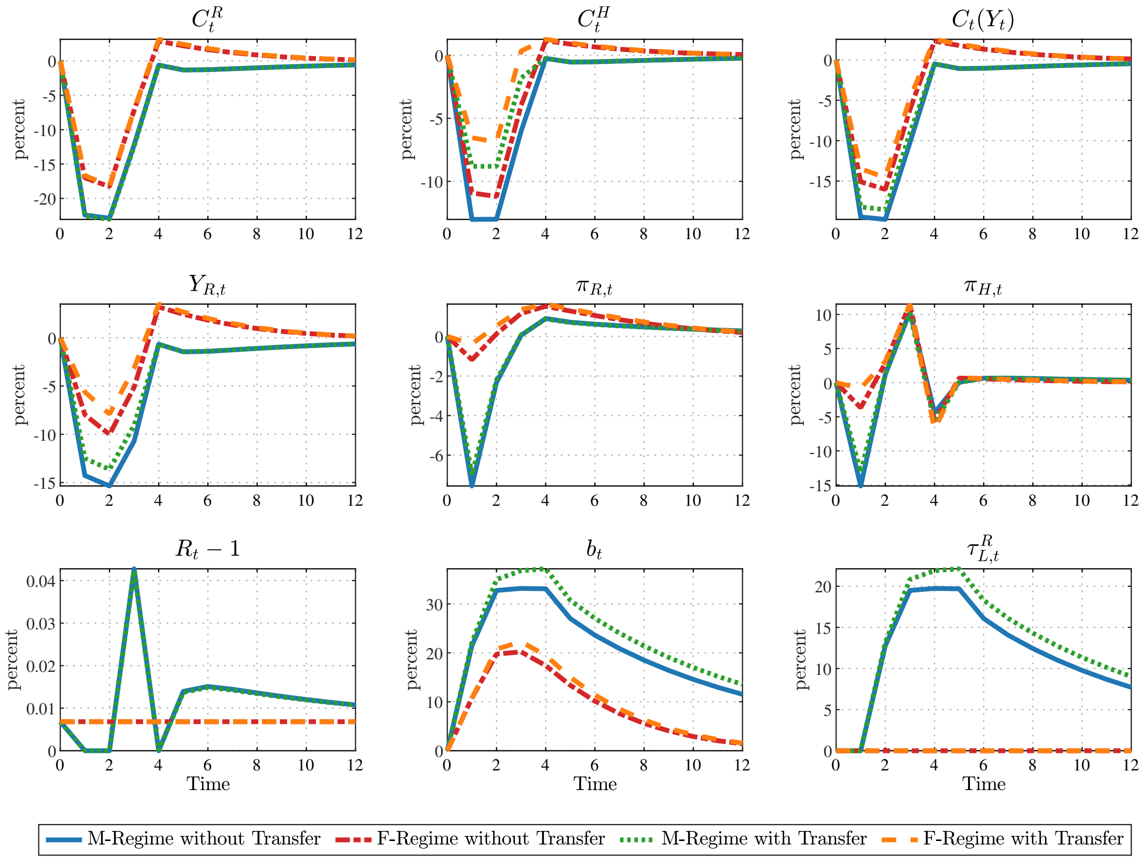
Appendix Figure B.1: Monetary Regime: Different Duration of Redistribution Policy

Notes: This figure shows dynamics of key variables in response to the COVID shocks under monetary regime with different duration of transfer distribution. Blue solid lines represent the baseline model without transfers. Red dashed lines represent the case of one-time transfer distribution. Green dotted lines represent the case where the transfers are distributed over three-period (6 months) and orange dashed lines represent the case where the transfers are distributed over six-period (12 months). We set the total present value of transfer amounts are the same across different duration of distribution policy.



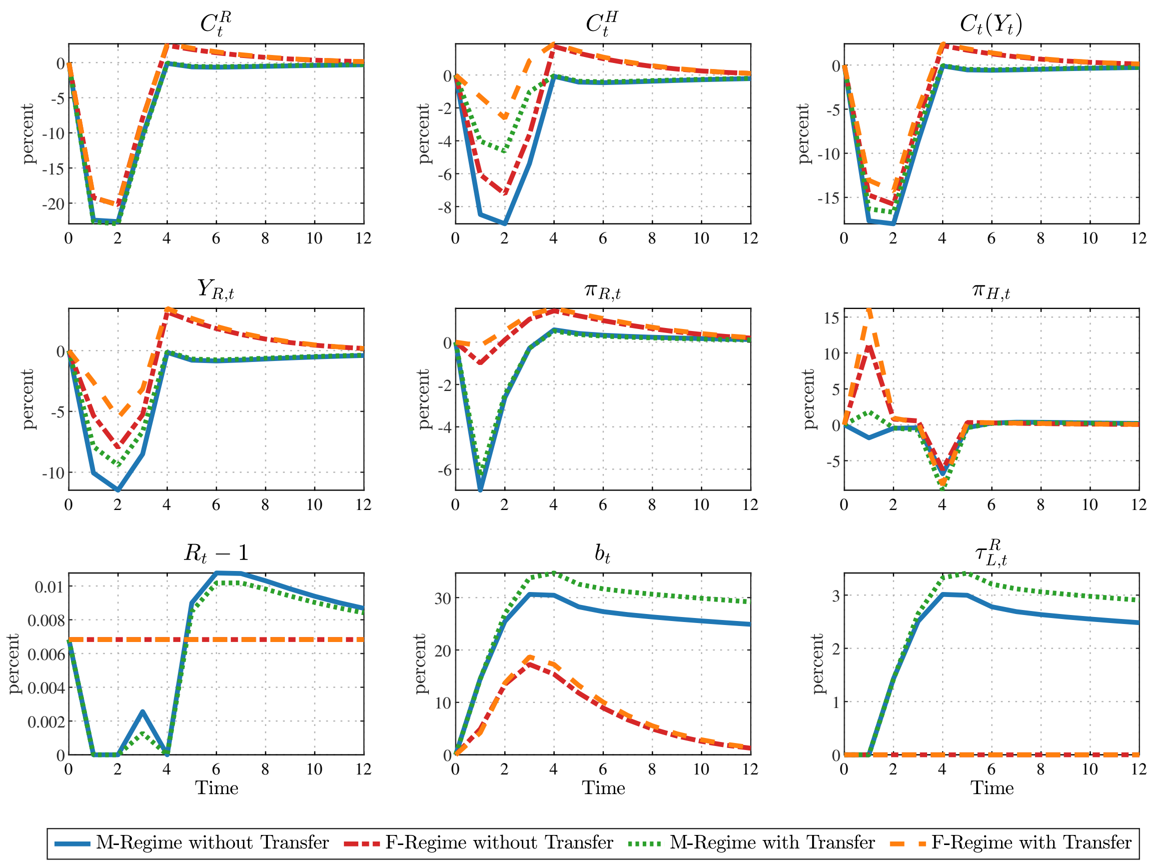
Appendix Figure B.2: Fiscal Regime: Different Duration of Redistribution Policy

Notes: This figure shows dynamics of key variables in response to the COVID shocks under fiscal regime with different duration of transfer distribution. Blue solid lines represent the baseline model without transfers. Red dashed lines represent the case of one-time transfer distribution. Green dotted lines represent the case where the transfers are distributed over three-periods (6 months) and orange dashed lines represent the case where the transfers are distributed over six-periods (12 months). We set the total present value of transfer amounts are the same across different duration of distribution policy.



Appendix Figure B.3: Redistribution Policy with Different Policy Regimes ($\varepsilon = 1.2$)

Notes: This figure shows dynamics of key variables in response to the COVID shocks under different regimes when $\varepsilon = 1.2$. Blue solid lines represent the baseline case: the monetary regime without transfers. Red dashed lines, green dotted lines, and orange dashed lines represent respectively the fiscal regime without transfers, the monetary regime with transfers, and the fiscal regime with transfers.



Appendix Figure B.4: Redistribution Policy with Different Policy Regimes ($\psi_L = 0.1$)

Notes: This figure shows dynamics of key variables in response to the COVID shocks under different regimes when $\psi_L = 0.1$. Blue solid lines represent the baseline case: the monetary regime without transfers. Red dashed lines, green dotted lines, and orange dashed lines represent respectively the fiscal regime without transfers, the monetary regime with transfers, and the fiscal regime with transfers.