Redistribution and the Monetary–Fiscal Policy Mix*

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Abstract

We show that the effectiveness of redistribution policy is tied to how much inflation it generates, and thereby, to monetary-fiscal adjustments that ultimately finance the transfers. In the monetary regime, taxes increase to finance transfers while in the fiscal regime, inflation rises, imposing inflation taxes on public debt holders. We show analytically that the fiscal regime generates larger and more persistent inflation than the monetary regime. In a two-sector model, we quantify the effects of the CARES Act in a COVID recession. We find that transfer multipliers are larger, and that moreover, redistribution is Pareto improving, under the fiscal regime.

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1 Introduction

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 them 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 rebooting the economy and improving household welfare. They have raised several research questions. 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 policies?

In a dynamic general equilibrium model, one would have to take numerous factors into account to answer the above questions. 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.[1] 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. 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-

[1] 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.

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 simple flexible-price model that permits analytical results, which allows us to illuminate the fiscal theory mechanism 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.[2]

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 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

[2]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.

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.[3]

Specifically, 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.[4] Situating the model economy in a COVID-recession-like environment, we calibrate the size of transfers to match the transfer amount in the CARES Act and study how the economy responds to redistribution policy.

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. For instance, the four-year cumulative multiplier for aggregate output is 1.732 in the monetary regime while it is 5.552 in the fiscal regime. This multiplier is greater than unity even under the monetary regime, thanks to nominal 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 -0.002 in the monetary regime and 3.078 in the fiscal regime, while for the HTM households, it is 7.409 in the monetary regime and 13.652 in the fiscal regime.[5]

We isolate the role played by various model elements in driving our quantitative results 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 1.490 in the monetary regime, while it is 2.696 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 4.1 percentage points

[3] 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.

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

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

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).[6] Sims (2011) introduced long-term debt under this regime in a sticky price model, which Cochrane (2018) used to analyze inflation dynamics 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 consider the monetary regime. Our main contribution is to assess the effects of redistribution policy in such an environment and show how it depends on the monetary-fiscal policy mix.[7]

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 (2021) 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 (2022), Bianchi, Faccini,

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

[7]Motivated by the ARRA Act, Oh and Reis (2012) assess the effects of transfers in a model with incomplete consumption insurance, also considering only the monetary regime.

and Melosi (2021), and Motyovszki (2020). Bhattarai et al. (2022) study the effects of a one-time permanent capital tax rate change in a model that features capital-skill complementarity. Bianchi et al. (2021) 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 a 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). Beck-Friis and Willems (2017), in particular, show analytically that the government spending multiplier is greater under the fiscal regime than under the monetary regime in the linearized sticky price model.

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 and towards the

[8] Bianchi et al. (2021) show that inflating away a targeted fraction of debt will increase the effectiveness of the fiscal stimulus in a medium-scale model while Motyovszki (2020) considers a small-open economy environment. Bianchi and Melosi (2019) shows that the fiscal regime improves representative household's welfare. We show that the fiscal regime leads to a Pareto improvement in a two-agent model where the redistribution policy is aimed at combating asymmetric effects of a pandemic, and where the policy trade-off is on using distortionary labor taxes vs. inflation taxes to finance such redistribution. We find that a key driver of our welfare results is state-dependent effects of the redistribution policy, including those that come from non-linearity.

HTM households and point out that these effects depend critically on how the transfer policy is financed.

2.1.1 Households

Ricardian Households. The Ricardian households, of measure $1-\lambda$, take prices as given and 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

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

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 i_t is the nominal 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

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

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):

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

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

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

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

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

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

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

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

$$\frac{1 + i_t}{1 + \bar{i}} = \left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\phi}, \tag{2.7}$$

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

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.[9]

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 the resource constraint, $(1 - \lambda)C_t^R + \lambda C_t^H = Y_t$. The resource constraint, together with the HTM household budget constraint, implies that output is simply divided between the two types of households as:

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

[9] We abstract from government spending here, but present an extension with it in Appendix B.2.

2.2 Effects of Redistribution Policy

We now show the effects of transferring resources away from the Ricardian households and towards 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 $\left\{Y_t, C_t^R, C_t^H, \Pi_t, i_t, b_t, \tau_t\right\}$ 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. 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 determination of the rate of inflation is detailed in Section 2.2.2.

2.2.1 Output and Consumption

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

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

using Equations (2.4), (2.5), (2.9), and $L_t = \left(1-\lambda\right) L_t^R$. Equation (2.10) implicitly defines output as a function of transfers: $Y_t = Y\left(s_t\right)$. One can obtain the "transfer multiplier" as

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

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

An increase in transfers raises output, but not from 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 ($\chi = 0$),

[10]The channel is the same as the effect of government spending in a one-agent model. In fact, an increase in government spending has exactly the same effect on output and inflation as an increase in transfers of the same amount in this simple model. This result is shown in Appendix B.2.

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.

2.2.2 Inflation

We now turn to the rest of the variables, $\{\Pi_t, i_t, b_t, \tau_t\}_{t=0}^{\infty}$, with a focus on inflation determination, given a path of $\{s_t\}_{t=0}^{\infty}$. The equilibrium time path of $\{\Pi_t, i_t, b_t, \tau_t\}$ satisfies the system of difference equations (2.1), (2.6), (2.7) and (2.8), the terminal condition given by TVC (2.3), and the initial conditions, b_{-1} and i_{-1}.

The system can be simplified as:

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

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

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

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; $\bar{s}$ and $\bar{b}$ are the steady-state values of (exogenous) transfers and debt.[11] 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

[11] Online Appendix A provides detail.

nominal interest rate $(1 + i_{t-1})$ 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 i_{-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 $(s > \bar{s})$ affects 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

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

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.

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

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

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

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.

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 then 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.

To develop intuition, let us first consider a simple case in which transfers increase only for one period: $s_0 > \bar{s}$ and $s_t = \bar{s}$ afterwards. In this case, it is necessary that $b_1 = \bar{b}$; otherwise, the TVC would be violated. The GBC at $t = 1$ is then given as

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

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):

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

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 $\phi \to 1$.).[14] 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.[15]

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.[16] 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 solution under a multi-period redistribution program can be similarly obtained. Suppose $s_t = s_0 > \bar{s}$ for $0 \leq t \leq T$.[17] To obtain initial inflation, 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 $r_t > \bar{r}$. Equation (2.17) then generalizes to

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

which, like Equation (2.17), reveals both direct and indirect (valuation) channels.

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, however, generates *greater and more persistent inflation* than the monetary regime. The next section explores quantitative implications in a more general environment with sticky prices where such differential inflation

[14]An analytical proof under a mild sufficient condition is provided in Online Appendix A.5. In addition, we numerically verify this result in the simple and the quantitative model for a broad set of parameter values. Moreover, in Appendix B.1, we show that our results broadly hold even in the presence of a temporary shock that drives the real rate negative. For extensive analyses of the fiscal theory in a low interest environment, we refer the reader to Bassetto and Cui (2018), Brunnermeier, Merkel, and Sannikov (2020), and Miao and Su (2021).

[15]Under the fiscal regime, ϕ governs the size and persistence of inflation response in the ensuing periods via the Fisher relationship. When $\phi = 0$, inflation responds for two periods in this simple setup.

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

[17]Online Appendix A.5 provides the discussion of a general multi-period redistribution program in which $\{s_t\}_{t=0}^{T}$ is an arbitrary sequence.

dynamics result in distinct allocations and welfare levels – unlike in the simple model.[18]

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 describe the model succinctly below, with details in Online Appendix B.

3.1 Model

There are two distinct—Ricardian and HTM—sectors. Ricardian households work in the former, and the HTM households work in the latter. Each sector produces a distinct good, which is in turn produced in differentiated varieties. Prices of differentiated varieties are sticky. Firms in both sectors are owned by the Ricardian households. The government finances transfers to the HTM households by levying distortionary labor taxes on the Ricardian households. 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 a sequence of flow budget constraints

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

[18] Online appendix A also contains a simple model with sticky prices. Quantitatively, a priori, it is unclear if higher and more persistent inflation under the fiscal regime improves Ricardian household welfare in a sticky price model because while their consumption would not decrease as much, they 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.

where η_t^{ξ} is a preference shock.[19] Labor tax, $\tau_{L,t}^R w_t^R L_t^R$, constitutes one way in which the government finances transfers to the HTM household.

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

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

where $C_{R,t}^R$ and $C_{H,t}^R$ 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, $X_{R,t} \equiv \left(\frac{P_{R,t}^R}{P_t^R}\right)$, where $P_{R,t}^R$ is the *R*-sector's good price while P_t^R is the CPI price index of the *R*-household. Within each sector, differentiated varieties are produced under monopolistic competition. Thus, $C_{R,t}^R$ and $C_{H,t}^R$ are Dixit-Stiglitz aggregates of a continuum of varieties with an elasticity of substitution, $\theta > 1$.

Firms. Firms produce differentiated varieties using the linear production function, $Y_{R,t}(i) = L_{R,t}(i)$, and set prices according to the Calvo friction, where ω^R is the probability of not getting a chance to adjust prices. There is no price discrimination across sectors for varieties and we impose the law of one price.

3.1.2 Hand-to-Mouth Sector

Households. HTM households, of measure λ, solve the problem

$$\max_{\{C_t^H, L_t^H\}} \frac{\left(C_t^H\right)^{1-\sigma}}{1-\sigma} - \chi^H \frac{\left((1+\eta_t^{\xi}) L_t^H\right)^{1+\varphi}}{1+\varphi}$$

subject to the flow budget constraint

$$C_t^H = w_t^H L_t^H + Q_t s_t^H,$$

where η_t^{ξ} is a shock to disutility from labor, w_t^H is the real wage, and L_t^H is labor supply. Note that relative price, $Q_t \equiv \frac{P_t^R}{P_t^H}$, appears in transfers as for fiscal variables we use the CPI for the Ricardian household as deflator.

C_t^H is a CES aggregator of the consumption goods produced in the two sectors

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

where $1-\alpha$ is HTM households' consumption weight on the *HTM*-sector goods and $\zeta_{H,t}$ is a demand shock specific for *HTM*-sector goods.[20] Let us define for future use one of the relative

[19] The other notations are the same as before.

[20] We impose the same consumption basket across households motivated by the data, implying that $Q_t = 1$.

prices, $X_{H,t} \equiv \frac{P_{H,t}^H}{P_t^H}$, 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 with an elasticity of substitution, $\theta > 1$.

Firms. Firms produce differentiated varieties using the linear production function, $Y_{H,t}(i) = L_{H,t}(i)$, and set prices according to the Calvo friction, where ω^H is the probability of not getting a chance to adjust prices.

3.1.3 Government

The government flow budget constraint is given by $B_t + T_t^L = (1+i_{t-1})B_{t-1} + P_t^R s_t$, 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 with "smoothing", given by

$$\frac{1+i_t}{1+\bar{i}} = \max\left\{\frac{1}{1+\bar{i}}, \left(\frac{1+i_{t-1}}{1+\bar{i}}\right)^{\rho_1}\left(\frac{1+i_{t-2}}{1+\bar{i}}\right)^{\rho_2}\left[\left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\phi}\left(\frac{Y_t}{\bar{Y}}\right)^{\phi_x}\left(\frac{Y_t}{Y_{t-1}}\right)^{\phi_{\Delta y}}\right]^{(1-\rho_1-\rho_2)}\right\},$$

$$\tau_{L,t}^R - \bar{\tau}_L^R = \rho_L(\tau_{L,t-1}^R - \bar{\tau}_L^R) + (1-\rho_L)\psi_L\left(\frac{b_{t-1}-\bar{b}}{\bar{b}}\right),$$

where $\Pi_t = (1-\lambda)\Pi_t^R + \lambda\Pi_t^H$ is the average inflation, Y_t is aggregate output which is defined later, and the zero lower bound on the nominal rate applies.[21] As in the simple model, the monetary regime will feature large enough monetary and tax rule response coefficients, ϕ and ψ_L, such that government debt sustainability does not need to be 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. The policy rules feature smoothing, as given by ρ_1, ρ_2, and ρ_L, and the monetary policy rule features feedback to output (given by ϕ_x) and output growth (given by $\phi_{\Delta y}$).[22]

3.1.4 Market Clearing, Aggregation, Resource Constraints

Given wages and prices, labor and good markets clear in equilibrium. Define economy-wide consumption as $C_t = (1-\lambda)\,C_t^R + \lambda Q_t C_t^H$. Then, an aggregate resource constraint is given by $Y_t = C_t = X_{R,t}Y_{R,t} + X_{H,t}Q_t Y_{H,t}$. Lastly, by aggregating firms' production functions, we

[21] Whether we define the price index in the monetary policy rule as population weighted as above, or as consumption basket share weighted (using α as the weight for Π_t^R), does not matter quantitatively.

[22] The monetary policy rule specification follows Coibion and Gorodnichenko (2011). As we do not have productivity shocks in the model, we do not include an output "gap" term in the rule.

can derive aggregate sectoral outputs, $(1-\lambda)\, L_t^R = Y_{R,t}\Xi_{R,t}$ and $\lambda L_t^H = Y_{H,t}\Xi_{H,t}$, where $\Xi_{j,t}$ for $j \in \{R, H\}$ is the price dispersion term arising from sticky prices.[23]

3.2 Data and Calibration

We pick parameter values based on long-run averages or from the literature 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 A.

The 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 0.3 and the inverse of the elasticity of intertemporal substitution (σ) to be 1.0, following Gertler and Karadi (2011). We set the elasticity of substitution across firms to be four ($\theta = 4$), which corresponds to a recent estimate of average markup of 33 percent (Hall, 2018). We assume that the Ricardian and HTM goods are substitutes by setting the elasticity (ϵ) as 2.0, to ensure that our results are not being driven by the assumption of complementarity in consumption of sectoral goods. We pick the Calvo parameters for the Ricardian sector as $\omega^R = 0.75$ and for the HTM sector as $\omega^H = 0.80$, which are consistent with estimates in Carvalho, Lee, and Park (2021).[24] Finally, the steady-state gross inflation 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).[25] 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 and food away from home.[26]

For the steady-state of fiscal variables, we use federal debt, federal receipts, and current government transfer payments data from 1990:Q1 through 2020:Q1. We use post-Volcker estimates in Coibion and Gorodnichenko (2011) to set the Taylor rule parameters under the monetary regime. We also use the tax rule estimates in Bhattarai, Lee, and Park (2016) for the tax rule parameters under the monetary regime.

[23] All model details and equilibrium condition derivations are in Online Appendix B.

[24] HTM-sector includes Transportation, Recreational, and Food services, and Ricardian sector is the rest of the economy. We take sectoral averages for the price infrequency estimates based on Carvalho, Lee, and Park (2021), which imply a 8-month and 10-month duration of price changes for the Ricardian and HTM sector respectively.

[25] Using the Panel Study of Income Dynamics data, Aguiar, Bils, and Boar (2020) estimate 23% of HTM households whose net worth is less than two months their labor earnings.

[26] 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 shares, which is why we modeled the same consumption basket for the two households.

Table 1: Calibration

	Value	Description	Sources
Households			
β	0.9932	Time preference	2-month frequency
σ	1.0	Inverse of EIS	Gertler and Karadi (2011)
φ	0.3	Inverse of Frisch elasticity	Gertler and Karadi (2011)
χ	3.08	Ricardian Labor supply disutility	$\bar{L}^R = 0.3$ (BLS Data)
χ^H	3.53	HTM Labor supply disutility parameter	$\bar{L}^H = 0.25$ (BLS Data)
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	4.0	Elasticity of substitution across firms	Steady-state markup: 33% (Hall, 2018)
ε	2.0	Elasticity of substitution between Ricardian and HTM goods	Assigned
ω^R	0.75	Calvo parameter for Ricardian sector	Carvalho et al. (2021)
ω^H	0.80	Calvo parameter for HTM sector	Carvalho et al. (2021)
Government			
$\frac{\bar{b}}{6\bar{Y}}$	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			
ρ_1	(1.12, 0.0)	Interest rate smoothing lag 1	Coibion and Gorodnichenko (2011)
ρ_2	(-0.18, 0.0)	Interest rate smoothing lag 2	Coibion and Gorodnichenko (2011)
ϕ_π	(1.58, 0.0)	Interest rate response to inflation	Coibion and Gorodnichenko (2011)
ϕ_x	(0.11, 0.0)	Interest rate response to output	Coibion and Gorodnichenko (2011)
$\phi_{\Delta y}$	(2.21, 0.0)	Interest rate response to output growth	Coibion and Gorodnichenko (2011)
ρ_L	(0.84, 0.0)	Labor tax smoothing	Bhattarai et al. (2016)
ψ_L	(0.1, 0.0)	Labor tax rate response to debt	Bhattarai et al. (2016)
Shocks			
η_t^H	(-9%, 17%, 17%)	Size of HTM labor disutility shock	Total hours for retail, transportation, leisure/hospitality
η_t^ξ	(-7%, -22%, -21%)	Size of Ricardian preference shock	Total hours excluding retail, transportation, leisure/hospitality
$\zeta_{H,t}$	(-4%, -0.9%, 3%)	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 used for our baseline simulation. See Section 3.2 for details.

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.[27] 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 with transfer policy, of total hours for both the HTM and Ricardian sectors and inflation for the HTM sector, as given in Appendix Figure A.1. In our baseline calibration, we assume that the three shocks in the model are over after three periods.

In particular, we set the size of HTM sector labor disutility 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 Ricardian 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.[28] 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 C.1.

Moreover, Panel B of Appendix Table C.1 shows that our calibration is not completely off regarding the match with several non-targeted moments. For example, aggregate consumption and output dynamics in the model are close to that in the data. In terms of sectoral consumption, the model dynamics is close to the real PCE sectoral data initially.[29]

3.3 Quantitative Results

We now present quantitative results on 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

[27] In a sensitivity analysis in Section 3.4.2, we drop the tax rebate component of the CARES Act while calibrating the transfer increase.

[28] While this intuitively describes our estimation procedure, we match jointly the data with all shocks.

[29] In terms of a non-targeted moment that we do not match as well, our calibration implies a bigger drop in inflation in the Ricardian sector than the data. A change in model parameters and/or calibration strategy to match this moment will however, adversely affect the currently good non-targeted fit with respect to aggregate consumption, as well as potentially make the ZLB not binding in the monetary regime, which would be counterfactual.

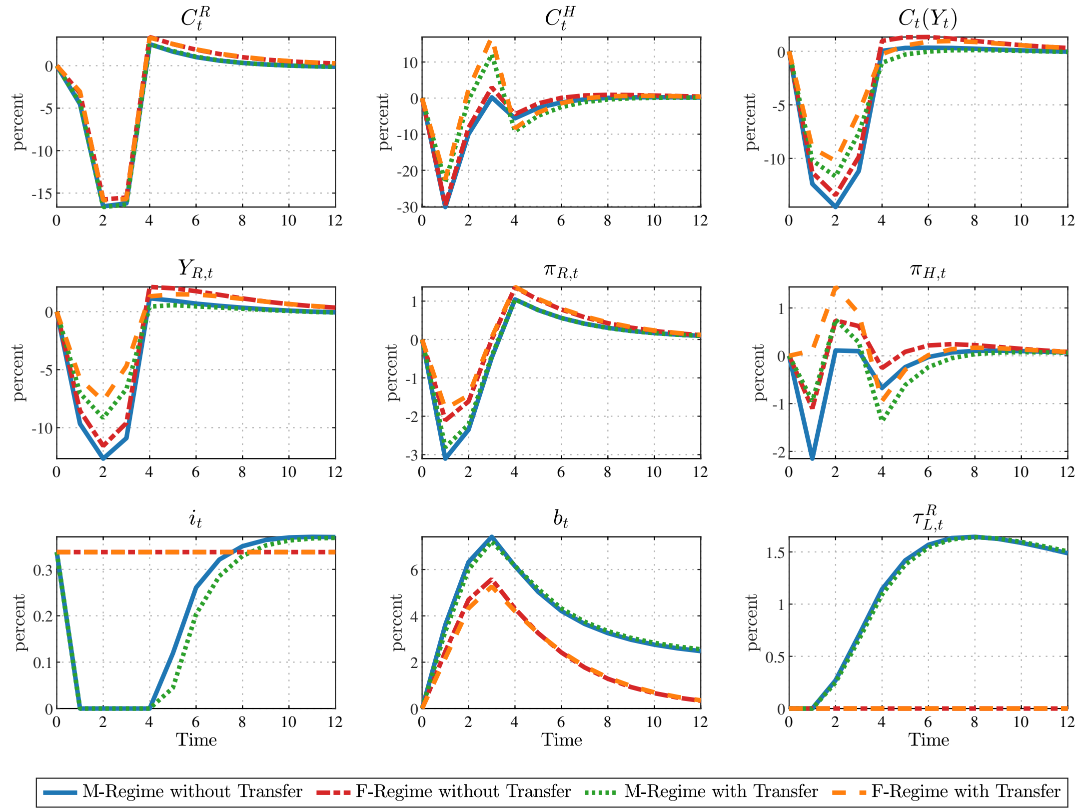

Figure 1: Redistribution Policy with Different Policy Regimes

Notes: This figure shows dynamics of key variables in response to the COVID shocks under different regimes. Blue solid lines represent the 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. The unit is percent deviation from the steady-state level of each variable, except for the bottom left panel, where we show the level of the net interest rate.

illustrate the effects of an increase in transfers for the two regimes. These results are in Figure 1, which presents four different scenarios: the monetary regime with and without transfers to the HTM households and the fiscal regime with and without transfers. Throughout, the duration of the redistribution policy is three periods (six months), which coincides with the duration of the shocks.[30]

Let us first look at the benchmark case, where the policymakers just stick to the *usual* macro policy (i.e. monetary regime) *without* redistribution. In this benchmark, the COVID shocks generate significant short-run contractions in aggregate output and household con-

[30]We solve the model non-linearly under perfect foresight, and non-linearity is important for the quantitative results. All the model variables converge back to the steady state in the long run. Initial debt is also at steady state, so that we can focus on debt dynamics due to COVID shocks. In Section 3.4.4, we consider a case where initial debt is above steady state.

sumption 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 endogenously binds in our model during the pandemic, without us calibrating it as a target.

Now, let us introduce the redistribution program to the monetary regime, the results of which are shown by the dotted green lines in Figure 1.[31] 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 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.

Transfers (directly) increase HTM household consumption and decrease Ricardian household consumption (due to both the resulting increase in the tax rate and the mechanism outlined in the simple model) relative to the benchmark. 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, Ricardian household consumption does not appear to drop compared to the benchmark case as the indirect positive effect of the redistribution on Ricardian household consumption countervails the direct negative effect.

Let us now turn to the fiscal regime where neither the tax rate nor the nominal interest rate changes. The effect of the redistribution program under this regime is shown by the dashed orange lines in Figure 1. Redistribution is more expansionary under this regime than under the monetary regime. Consequently, aggregate and Ricardian sector output and consumption of both types do not drop as much as in the monetary regime—as shown by the orange lines that are located above the green lines in the first four panels of Figure 1.

As in the simple model, the fifth and sixth panels of Figure 1 reveal that 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. Furthermore, 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

[31] As we discussed before, transfers increase by 26.8 percent in total and are evenly distributed over 3 periods.

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	1.923	1.863	0.119	7.828	2.949	2.726	1.166	8.788
4-Year Cumulative Multiplier	1.732	2.023	-0.002	7.409	5.552	5.429	3.078	13.652

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 4–year ($t = 24$) cumulative multipliers when the government distributes transfers evenly over 6 months.

drop in the monetary regime. This mechanism is not relevant for the fiscal regime.

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 benchmark), 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 4–year ($t = 24$) cumulative multipliers, which allows for a consideration of dynamic effects in the model. These dynamic effects are important for our analysis as the model features several sources of endogenous persistence, including policy rules.

Note that in calculating these multipliers, our benchmark case, as in Section 3.3.1, is always the monetary regime without transfers.[32] This is the most relevant case to study, as we want to answer the question: Given a transfer policy we want to implement, what are the differences between using labor taxes or inflation taxes to finance the increase in debt?

Table 2 shows that aggregate output and Ricardian sector output multipliers are both above 1 in the monetary regime. Similarly, the C^H multiplier is above the simple model benchmark of $(1/\lambda)$, which would be 4.35 according to our calibration. The binding ZLB, sticky prices, and the COVID shocks contribute to the greater multipliers in this quantitative model—as detailed below in Section 3.4.1.

[32] Although in calibrating the model, we use the monetary regime with transfer policy to match the data.

Table 3: Welfare Gains

	Monetary Regime		Fiscal Regime	
	Long-run	Short-run ($t = 4$)	Long-run	Short-run ($t = 4$)
Ricardian Household	-0.014	-1.465	0.011	-1.214
HTM Household	0.076	6.277	0.118	7.774

Notes: This table shows long- and short-run welfare gains resulting from the redistribution, compared to the monetary regime without transfer distribution. The values are the difference in the welfare measure ($\mu^i_{t,k}$) between the transfer cases (under the two regimes) and the the monetary regime without transfers.

Table 2 also shows that those multipliers are even higher in the fiscal regime. In fact, uniquely, even the C^R multiplier is now positive in the fiscal regime for all horizons. The fact that the 4-year cumulative multiplier for C^R is positive in the fiscal regime distinguishes it from the monetary regime where it is negative.[33] 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 redistribution program. 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 $\left\{\bar{C}^i, \bar{L}^i\right\}$ 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.[34] 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.

[33] In the simple model where inflation is neutral, we showed analytically that this multiplier is negative.
[34] It measures welfare gains at the point when the agents are $2 \times t$ months old since the initial COVID shocks.

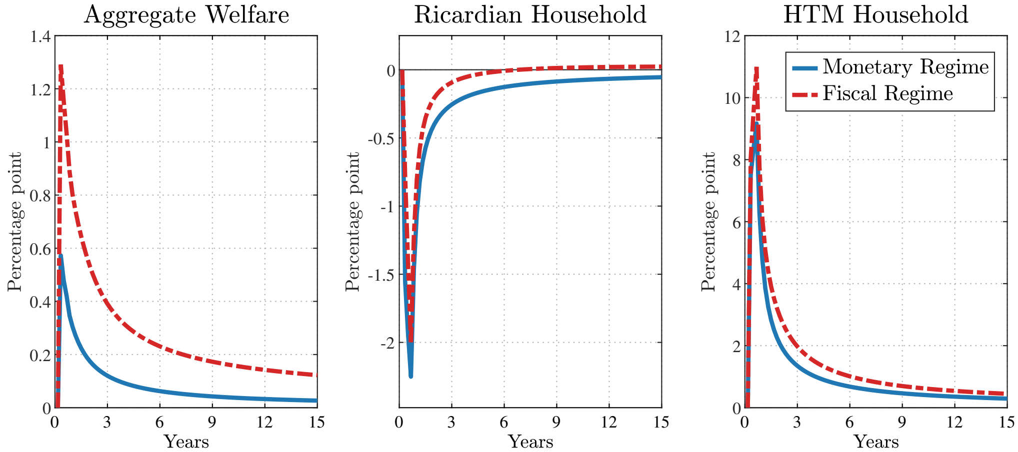

Figure 2: Short-Run Welfare Gains Comparison

Notes: This figure presents the short-run welfare gains resulting from the redistribution, compared to the economy without transfer redistribution. The values are the difference in the welfare measures ($\mu^i_{t,k}$) between the transfer cases (under monetary and fiscal regimes) and the without-transfer case under the monetary regime as a function of time.

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 0.118 percentage point and increases the Ricardian households' lifetime welfare by 0.011 percentage point, compared to the benchmark. 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.[35] Despite this caveat on the quantitative magnitudes, our key qualitative finding is that of a Pareto improvement (only) under the fiscal regime, compared to the benchmark case of no transfer policy in the monetary regime.

Transfers and how they are financed matter much more in the short run. Figure 2 presents the aggregate and both households' welfare gains over time. The redistribution program, regardless of the policy regimes, increases the welfare of the HTM households significantly in the short run. The gains, however, are even bigger when the program is inflation-financed. For example, the HTM households' welfare gains over the first 8 months (at t=4) from such redistribution amount to 7.774 percentage points of the steady-state consumption under the fiscal regime and 6.277 percentage points under the monetary regime, as reported in Table 3. The Ricardian households would suffer welfare losses with redistribution in the short run, but

[35] 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 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	1.923	1.863	0.119	7.828	2.949	2.726	1.166	8.788
Covid Effect with Transfer	-11.628	-7.422	-2.567	-41.289	-12.571	-8.178	-2.403	-45.856
Transfer Effect without Covid	2.670	2.464	-0.911	14.394	4.640	4.083	-0.028	19.920
Covid Effect without Transfer	-10.881	-6.821	-3.597	-34.723	-10.881	-6.821	-3.597	-34.723
Panel B: 4-Year Cumulative Multipliers								
Total Effect	1.732	2.023	-0.002	7.409	5.552	5.429	3.078	13.652
Covid Effect with Transfer	-10.954	-7.083	-7.786	-21.321	-8.340	-4.779	-5.558	-17.447
Transfer Effect without Covid	1.490	1.703	-1.107	9.991	2.696	2.805	-0.256	12.359
Covid Effect without Transfer	-11.196	-7.403	-8.891	-18.739	-11.196	-7.403	-8.891	-18.739

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 (3.1). $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers ($t = 0$) as well as 4–year ($t = 24$) cumulative multipliers.

the losses are relatively milder under the fiscal regime: at t=4, the losses are 1.214 percentage points under the fiscal regime and 1.465 percentage points under the monetary regime.

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

$$\mathcal{M}_t^i(Y) = \underbrace{\left(\frac{\sum_{h=0}^t \beta^h(\tilde{Y}_h^i - \tilde{Y}_{\text{no shock},h}^i)}{\sum_{h=0}^t \beta^h s_h}\right)}_{\text{COVID Effect with Transfer}} + \underbrace{\left(\frac{\sum_{h=0}^t \beta^h(\tilde{Y}_{\text{no shock},h}^i - \bar{Y})}{\sum_{h=0}^t \beta^h s_h}\right)}_{\text{Transfer Effect without COVID Shocks}} - \underbrace{\left(\frac{\sum_{h=0}^t \beta^h(Y_h^M - \bar{Y})}{\sum_{h=0}^t \beta^h s_h}\right)}_{\text{COVID Effect without Transfer}} \tag{3.1}$$

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 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.

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 (3.1). For example, this component of the 4-year cumulative multiplier for output is 2.696 under the fiscal regime, while it is only 1.49 under the monetary regime. The main reason for these results is the high and persistent effects on inflation in the fiscal regime.

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 4-year cumulative transfer multipliers for output and Ricardian consumption 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, 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 Ricardian 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.[36] Table 4 shows that the large difference in the 4-year cumulative 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 (3.1) through counterfactual exercises.

For reference, Panel A of Table 5 first re-reports the second component in the presence of the two features.[37] We then remove nominal rigidities (in Panel B) and further remove distor-

[36]We can see this in the fifth panel of Figure 1. 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).

[37]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	2.670	2.464	-0.911	14.394	4.640	4.083	-0.028	19.920
4-Year Cumulative Multiplier	1.490	1.703	-1.107	9.991	2.696	2.805	-0.256	12.359
Panel B: Without COVID shocks under flexible price								
Impact Multipliers	0.184	0.931	-0.747	3.230	0.184	0.931	-0.747	3.230
4-Year Cumulative Multiplier	-0.115	0.63	-1.095	3.094	0.184	0.931	-0.747	3.230
Panel C: Without COVID shocks under flexible price and lump-sum tax adjustment								
Impact Multipliers	0.184	0.931	-0.747	3.230	0.184	0.931	-0.747	3.230
4-Year Cumulative Multiplier	0.184	0.931	-0.747	3.230	0.184	0.931	-0.747	3.230

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.

tionary labor taxes (in Panel C). The last version is quite close to our 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, 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 closer to 4.35, the analytical model solution.[38] 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.

Finally, to further explore the mechanisms that underlie the multipliers, and in particular to emphasize the role of heterogeneity, we now analyze an alternative model economy with a representative Ricardian household. For this exercise, for a clear comparison, we start the economy from steady-state and without the COVID shocks.

[38]The simple model 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.

Table 6: Transfer Multipliers and Inflation Volatility without COVID Shocks

	Monetary Regime			Fiscal Regime		
	$\mathcal{M}_t^M(Y)$	$\mathcal{M}_t^M(C^R)$	$Var^M(\Pi_t)$	$\mathcal{M}_t^F(Y)$	$\mathcal{M}_t^F(C^R)$	$Var^F(\Pi_t)$
Panel A: Baseline Model						
Impact Multipliers	2.670	-0.911	1	4.640	-0.028	1.975
4-Year Cumulative Multiplier	1.490	-1.107		2.696	-0.256	
Panel B: Representative Agent Model						
Impact Multipliers	0.043	0.043	0.042	0.575	0.575	0.598
4-Year Cumulative Multiplier	-0.303	-0.303		0.683	0.683	
Panel C: Representative Agent Model with Lump-sum Tax						
Impact Multipliers	0	0	0	0.575	0.575	0.598
4-Year Cumulative Multiplier	0	0		0.683	0.683	

Notes: This table shows the transfer multipliers and inflation volatility due to the transfer distribution under the monetary and fiscal regimes *without* COVID shocks. $Var^i(\Pi_t)$ represent (normalized) volatility of inflation due to transfer distribution under i regime, which is normalized to 1 for the volatility under the monetary regime of the baseline model. Panel A, B, and C show the results under the baseline model, under the representative model with distortionary labor taxes, and under the representative model with lump-sum tax adjustment, respectively.

First, our simple model suggests that under the fiscal regime, inflation should be less volatile in the representative agent economy than in the baseline economy due to lack of interest rate channel. That is indeed what we find in Table 6, comparing Panel A with Panel B. In addition, inflation volatility is lower in the representative agent economy also in the monetary regime. What is the mechanism? Under the monetary regime in a representative agent economy, the only reason inflation even responds at all to a transfer shock is due to distortionary labor taxes that lead to a failure of Ricardian equivalence. This generates a positive, but very small, response of inflation. As Panel C shows, once we remove distortionary labor taxes, there is no effect on inflation in the monetary regime.[39]

Next, given lower inflation responses, with sticky prices, we expect lower output multipliers, which is also what we find for both the monetary and fiscal regimes, comparing Panel A with Panel B.[40] The upshot is that the TANK economy has higher inflation volatility and output multipliers than the representative agent economy for both policy regimes.

[39]For the fiscal regime, this change makes no difference as labor taxes are constant. Also an alternate intuition for why the transfer increase is more inflationary in the TANK economy under the monetary regime is that a transfer increase in the TANK economy is similar to a government spending increase in a representative agent economy. Then, we are essentially comparing effects of government spending vs. transfers in a representative agent economy, and where it is well-understood that government spending is inflationary.

[40]Notice that Ricardian consumption and output multipliers are identical in the representative agent economy.

3.4.2 Alternative Calibrations with Different Transfer Policies

We consider three alternative calibration strategies for transfer policy.[41] Appendix Tables C.2 and C.3 present the results from these alternative calibration exercises.

Alternative calibration with transfer excluding one-time tax rebate First, we calibrate the size of the transfer increase in the model by excluding the one-time $600 individual tax rebates in the CARES Act. 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. Panel A of Appendix Table C.2 shows that the multipliers are essentially the same as before under the monetary regime. For the fiscal regime however, the multipliers are even bigger. Panel A of Appendix Table C.3 shows that welfare results are robust to this alternative calibration of transfer policy, with a Pareto improvement only in the fiscal regime.

Alternative calibration with transfer excluding unemployment benefit Second, we calibrate the size of the transfer increase in the model by excluding the unemployment insurance benefits extended in the CARES Act. The main motivation is the fact that our model does not feature classical unemployment due to search and matching frictions. The size of transfer change decreases from 26.8% to 16.7% when we exclude unemployment benefits. Panel B of Appendix Table C.2 shows that the multipliers are essentially the same as before under the monetary regime while for the fiscal regime, the multipliers are even bigger. Panel B of Appendix Table C.3 shows that welfare results are robust to this alternative calibration of transfer policy, with a Pareto improvement only in the fiscal regime.

Alternative calibration with one-time tax rebate to both Ricardian and HTM Third, we consider the case where the one-time tax rebate components are distributed equally to both the HTM and Ricardian households. The main motivation is the fact that in the data, these tax rebates might not have been as targeted to the HTM households as assumed in our model. For this analysis, we continue to assume that the unemployment insurance benefits and transfers to state and local governments continue to be only distributed to HTM. As expected, Panel C of Appendix Table C.2 shows that the multipliers are overall lower than before for both regimes. Importantly, the fiscal regime continues to feature higher multipliers than the monetary regime. Moreover, Panel C of Appendix Table C.3 shows that even this case, welfare results are robust,

[41] When we make changes here, we re-calibrate the model to match the same targets as before.

with a Pareto improvement only in the fiscal regime.[42]

3.4.3 Model Extensions

We now present results based on some model extensions. The details of the extended models are in Online Appendix B.3.

Adding Government Spending As one model extension, we consider government spending on goods in the model, which does not enter utility. First, we simply introduce steady-state government spending, where we set the steady-state government spending to output ratio ($\frac{\bar{G}}{\bar{Y}}$) to be 0.15, in line with the US data average from 1990Q1 through 2020Q1. We then report the transfer multiplier results in Panel A of Appendix Table C.4 and the welfare results in Panel A of Appendix Table C.5. Overall, the results are overall very similar to the case without steady-state government spending. Our key results that transfer multipliers are larger, and that there is a Pareto improvement, in the fiscal regime continue to hold in this extension.

Next, we allow government spending to increase from steady-state following the COVID shocks, exactly analogous to our main experiment of a transfer increase. This allows us to compute government spending multipliers and welfare effects of increases in government spending, which we report in Panels B of Appendix Tables C.4 and C.5 respectively. The results are overall very similar to transfer multipliers, and in particular, government spending multipliers are larger and there is a Pareto improvement in the fiscal regime. This reinforces the point we made earlier in the analytical model that transfer shocks and government spending shocks have similar propagation and implications in our model.

Finally, for the monetary regime, we re-do the transfer increase with COVID shocks experiment allowing government spending to decrease, as opposed to labor taxes increasing.[43] Thus, government spending follows

$$\frac{G_t - \bar{G}}{\bar{G}} = \rho_G \left(\frac{G_{t-1} - \bar{G}}{\bar{G}} \right) + (1 - \rho_G)\psi_G \left(\frac{b_{t-1} - \bar{b}}{\bar{b}} \right) + \varepsilon_{G,t},$$

where we calibrated the parameters of this rule to the same values as for our baseline labor tax rate rule. Appendix Table C.6 presents the transfer multipliers and welfare results, which

[42]Finally, given possible mismatch between model frequency and timing of transfer receipts in the real world, in Panel D of Appendix Table C.2 we consider the case where the transfer in the first period is only half of the transfer increase in the next two periods, while imposing that the total amount of transfer increase is still 26.8% of the steady state level of transfer. Our results are robust to this alternate path of transfer increase.

[43]This government spending adjustment is relevant only for the monetary regime as under the fiscal regime, the thought experiment is that of no standard fiscal adjustment at all.

are very similar to those in Appendix Tables C.4 and C.5 for the labor tax rate adjustment.[44]

Money-in-the-Utility Function Our quantitative model is cash-less. As an extension, we now introduce (non-interest bearing) cash into the economy, where we follow Chari, Kehoe, and McGrattan (2002) by introducing a money-in-the-utility function for Ricardian households. The motivation is that this allows us to consider a classical channel through which inflation can affect model dynamics and welfare via real balances.

In this model extension, Ricardian households solve the problem

$$\max_{\{C_t^R, L_t^R, b_t^R, \frac{M_t}{P_t^R}\}} \sum_{t=0}^{\infty} \beta^t \left[(1-\sigma)^{-1} \left(\nu \left(C_t^R\right)^{\frac{\eta-1}{\eta}} + (1-\nu) \left(\frac{M_t}{P_t}\right)^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta(1-\sigma)}{\eta-1}} - \chi(1+\varphi)^{-1} \left(L_t^R\right)^{1+\varphi} \right]$$

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

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

The optimality condition over real balances, $m_t^R = \frac{M_t^R}{P_t}$, gives rise to a money-demand equation shown in Online Appendix B.3.2. Due to non-separability in the utility function, real balances now will affect model dynamics in the monetary regime. In the fiscal regime however, as our baseline parameterization is that of a constant nominal rate, this extension does not affect model dynamics.

Consistent with Chari et al. (2002), we set $\nu = 0.94$ and $\eta = 0.40$ and for concreteness, solve the model without COVID shocks. Appendix Table C.8 reports that the multipliers continue to be higher in the fiscal regime. As we explained above, for the fiscal regime, the results here are identical to those in Table 4 for the case of no COVID shocks, while they are similar but slightly smaller than those in Table 4 for the monetary regime.

Inflationary Cost-Push Shocks An important caveat to our quantitative results so far is the assumption that other than COVID shocks, there are no other shocks in the economy. To address this shortcoming partially, and to make our analysis more relevant for current events, we now introduce an inflationary shock (ξ_t^π) directly into the firm's optimal prices. Further details of this extension are in Online Appendix B.3.3. This is akin to cost-push shocks in standard sticky price models in the literature. We assume $\xi_t^\pi = \rho_\pi \xi_{t-1} + \varepsilon_{\pi,t}$ and set $\rho_\pi = 0.5$, such that these shocks persistently impinge on the model even after the COVID shocks are

[44]For completeness, in Appendix Table C.7, we also present results on government spending multipliers with such a rule and show that they are qualitatively similar to those here.

over, and consider two cases for the shock size, a 10%-shock and a 20%-shock. We then re-calibrate the model to match the same data as in our baseline analysis.

Appendix Table C.9 reports the transfer multiplier results. Compared to our baseline results in Table 2, the multipliers are slightly higher in the monetary regime and slightly lower in the fiscal regime. The main reason is that as we explained before, in a deflationary environment, higher inflation is beneficial in the monetary regime where the interest rate is stuck at the ZLB. This allows the real rate to decline and as a result we see that qualitatively a new result appears with the 4-year Ricardian consumption multiplier turning slightly positive. Our main result that transfer multipliers are higher in the fiscal regime continue to hold with this extension that incorporates inflationary shocks.[45] For this extension, Appendix Table C.10 reports the welfare results. As in our baseline results in Table 3, transfer policy is Pareto improving only in the fiscal regime.

3.4.4 Sensitivity Analysis

Alternative Calibration with Above Steady State Initial Debt Our baseline calibration was based on initial government debt at the steady-state. This is our preferred specification as it allows us to focus on debt dynamics following the COVID crisis induced by shocks. Moreover, the fiscal regime is inflationary with any positive outstanding debt, even without shocks, which further introduces a new component to model dynamics and can make interpretation harder.[46]

Nevertheless, to assess the robustness of our results, we now recalibrate the model with initial government debt above its steady-state level. In particular, we set debt at time 0—one period before the first wave of COVID shocks hit the model economy—to be 10% higher than the steady-state. Panel A of Appendix Table C.11 shows the transfer multipliers under this new calibration while Panel A of Appendix Table C.12 shows the corresponding welfare results. The results are the same as those from our baseline calibration.

Notice that, in our baseline calibration, we use the average US debt-to-GDP ratio from 1990Q1 through 2020Q1 to calibrate steady-state debt-to-GDP ratio (50.9%). As an alternative sensitivity analysis, we set this variable to match the average US debt-to-GDP ratio from 2010Q1 through 2020Q1 (71.8%) and calibrate the COVID shocks allowing time-0 debt to be 10% higher than its steady-state value. In this case, the debt-to-GDP ratio at time 0 in the model exactly matches the 2019Q4 debt-to-GDP ratio in the data. As shown in Panel B of Appendix Tables C.11 and C.12, the results for multipliers and welfare gains from this alternate

[45] The impulse responses for this model extension are in Appendix Figure C.1.

[46] This is shown analytically in the linearized sticky price model in Bhattarai et al. (2014).

calibration are the same as those from our baseline calibration.[47]

Different Duration of Binding ZLB In our main analysis, the duration of binding ZLB under the monetary regime is four periods and essentially coincides with the duration of shocks, which is three periods. We now do a sensitivity check on how our multiplier results get affected if we increase the persistence of the Ricardian household's discount factor shock by modelling it as an AR(1) process, which in turn increases the duration of binding ZLB. The results are reported in Appendix Table C.14, where we progressively increase the duration of binding ZLB from four to eight periods. The results show that multipliers do not change much in the monetary regime with increased duration of binding ZLB, but they do increase further in the fiscal regime. This is another example of higher degree of state dependence in the fiscal regime: As a longer ZLB is more deflationary and recessionary, the effectiveness of increasing transfers in the fiscal regime is higher.

Size and Sign Dependence of Transfer Multipliers We now explore further the state dependence of transfer multipliers in our model in terms of the size and sign of transfer change. That is, we compute transfer multipliers for transfer increases and decreases and of varying magnitudes. To clarify the new nature of this state-dependence, we do so by computing the model for the case without COVID shocks, as our focus so far has been on state-dependence generated by COVID shocks.[48] Appendix Figure C.2 presents the impact and 4-year cumulative multipliers for different sign/sizes of transfer shocks. As we can see, within a regime, transfer increases and decreases do not have exactly symmetric effect. Moreover, for the same regime and sign, the multipliers also depend on the size. For transfer increases, output multipliers increase with size of the transfers. Thus, there is size and sign related state dependence in transfer multipliers, which is only possible to see due to our non-linear solution method.

Only Discount Factor Shocks We calibrated our model with three types of shocks, Ricardian household discount factor shocks, HTM labor disutility shock, and HTM sector specific demand shock, and jointly matched dynamics of three variables in the data. As a sensitivity check, we now compute multipliers in our model while feeding-in only the Ricardian household discount factor shock, which is a canonical demand shock in sticky price models.[49] Appendix Table C.15 shows these results. Focusing on 4-year multipliers, they are quite similar to our baseline results, with some higher effects in the fiscal regime.

[47] That our simulation features shocks makes a difference to some aspect of our results, as shown in Appendix Table C.13. If we start the economy with a high initial debt, and do not consider shocks to replicate the COVID recession, then multipliers are lower than the baseline calibration (without shocks).

[48] In addition, an analysis of a decrease in transfers during a COVID-recession might not be very compelling.

[49] In this exercise, we do not recalibrate the model with only this shock.

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 find that inflation-financed transfers (fiscal regime) are significantly more effective than tax-financed transfers (monetary regime) in both boosting the economy and improving welfare.

We first consider a simple two-agent model that permits analytical results and illuminates the mechanisms through which redistribution generates inflation in both policy regimes. We then proceed to a quantitative analysis and show 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 that redistribution can in fact produce a Pareto improvement.

The result that inflating away public debt can be a win-win solution for both the recipients and the sources of the transfers in a deep recession is encouraging, yet it is not without caveats. Most importantly, we have assumed that there will be no further shocks in the post-COVID crisis period. High inflation is however, generally costly for social welfare and the fiscal regime might not necessarily be desired in normal situations. Therefore, our results should not be taken literally as a suggestion of a permanent interest rate peg by the Fed and no fiscal adjustment ever by the Treasury as such a policy recommendation might not hold in a richer stochastic model with various recurring shocks. Generally, our perfect foresight non-linear solution method misses the role future uncertainty can have on current private sector behavior, which is shown to be important for the effects of CARES Act in Bayer et al. (2020).

In future work, we can empirically explore whether fiscal policy significantly affects inflationary expectations, along the lines found recently in a randomized control trial by Coibion, Gorodnichenko, and Weber (2021). In addition, a comparative analysis in future of the Covid recession and the Great Recession is potentially interesting as inflation dynamics were quite different between the two: inflation remained relatively subdued post Great Recession, compared to the present time. Our results suggest that state dependency must have played a role as the size of fiscal expansions as well as the persistence and the size of the contractionary shocks differed significantly in these two episodes. Finally, fiscal regime based policy 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. We leave a more comprehensive analysis of such interesting issues for future research.

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Appendix A Data Description

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).

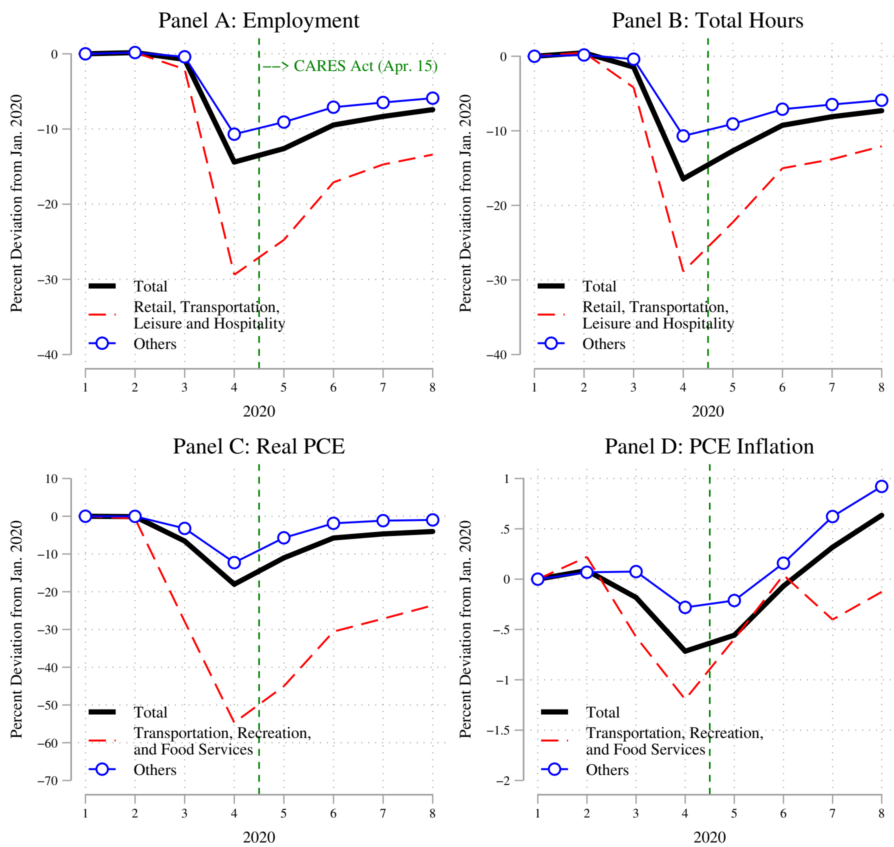
Consumption and Inflation. We use real Personal Consumption Expenditure (PCE) data and PCE inflation from U.S. Bureau of Economic Analysis. We define HTM sector as the sum of the following three sectors: Transportation services, Recreation services, and Food services and accommodations.

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.

Employment, Inflation, and Consumption Dynamics in 2020 Appendix Figure A.1 presents dynamics of employment, hours, inflation, and consumption based on such a two-sector de-



Appendix Figure A.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

composition of the U.S. economy. We show with the vertical dashed line when transfer payments from the CARES Act started to get mailed. 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.

Appendix B Simple Model Extension

In this appendix, we extend our simple model presented in Section 2 with government spending and preference shocks.

B.1 Simple Model with Preference Shocks

Consider the simple model with preference shocks, ξ_t. The system of equilibrium equations can be summarized as:

$$
\begin{aligned}
\frac{C_{t+1}^R}{C_t^R} &= \beta \frac{\exp\left(\xi_{t+1}\right)}{\exp\left(\xi_t\right)} \frac{1+i_t}{\Pi_{t+1}} \\
\chi\left(C_t^R + \frac{s_t}{1-\lambda}\right)^{\varphi} C_t^R &= 1 \\
b_t &= \frac{1+i_{t-1}}{\Pi_t} b_{t-1} - \tau_t + s_t \\
\frac{1+i_t}{1+\bar{i}} &= \left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\phi} \\
\tau_t - \bar{\tau} &= \psi\left(b_{t-1} - \bar{b}\right)
\end{aligned}
$$

We first consider the case of infinite Frisch elasticity. Appendix Figure B.1 shows the IRFs to transfer shocks and Appedix Figure B.2 shows the variable responses to transfer shocks under different size of preference shocks. Next, we consider the case of $\varphi = 2$. Appendix Figure B.3 shows the IRFs and Appedix Figure B.4 shows the variable responses to transfer shocks under different size of preference shocks with $\varphi = 2$.

They show that the fiscal regime leads to higher inflation (in total, even if not for both periods in all cases) than the monetary regime under transfer increases, when such shocks hit that drive interest rate to negative temporarily. In fact, for infinite Frisch elasticity, the following proposition shows that total inflation is higher in the fiscal regime compared to the monetary regime.

Proposition 1. $\log \frac{\Pi_0^M}{\bar{\Pi}} + \log \frac{\Pi_1^M}{\bar{\Pi}} < \log \frac{\Pi_0^F}{\bar{\Pi}} + \log \frac{\Pi_1^F}{\bar{\Pi}}$ *with infinite Frisch elasticity.*

Proof. Consider the system of equilibrium conditions:

$$
\frac{\Pi_{t+1}}{\bar{\Pi}} = \frac{C_t^R}{C_{t+1}^R} \frac{1+\xi_{t+1}^{\beta}}{1+\xi_t^{\beta}} \left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\phi}
$$

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

$$b_0 - \bar{b} = \frac{1}{\beta}\left(\frac{\bar{\Pi}}{\Pi_0} - 1\right)\bar{b} + (s_0 - \bar{s}).$$

Note that with infinite Frisch ($\varphi = 0$), $C_t^R = \bar{C}^R$ for all t. Under M-regime with one-time shock ($s_0 = (1+\xi_0^s)\,\bar{s}$, $\xi_{t>0}^{\beta} = 0$, $s_{t>0} = \bar{s}$):

$$\frac{\Pi_0^M}{\bar{\Pi}} = \left(1+\xi_0^{\beta}\right)^{\frac{1}{\phi}} \quad \text{and} \quad \frac{\Pi_1^M}{\bar{\Pi}} = 1$$

$$\log\frac{\Pi_0^M}{\bar{\Pi}} + \log\frac{\Pi_1^M}{\bar{\Pi}} = \frac{1}{\phi}\log\left(1+\xi_0^{\beta}\right) \approx \frac{1}{\phi}\xi_0^{\beta} < 0$$

Under F-regime with one-time shock ($s_0 = (1+\xi_0^s)\,\bar{s}$, $\xi_{t>0}^{\beta} = 0$, $s_{t>0} = \bar{s}$) and $\phi = 0$, $\psi = 0$: then, $b_{t>0} = \bar{b}$ and

$$\begin{aligned}
\frac{\Pi_1^F}{\bar{\Pi}} &= \frac{1}{1+\xi_0} \\
\frac{\Pi_0^F}{\bar{\Pi}} &= \frac{1}{1-\beta\left(\frac{1}{1+\xi_0^{\beta}} - 1 + \xi_0^s\frac{\bar{s}}{\bar{b}}\right)} = \frac{1+\xi_0^{\beta}}{1+(1+\beta)\,\xi_0^{\beta} - \beta\frac{\bar{s}}{\bar{b}}\xi_0^s\left(1+\xi_0^{\beta}\right)}
\end{aligned}$$

$$b_0 - \bar{b} = \xi_0^s\bar{s} + (s_0 - \bar{s})$$

Then,

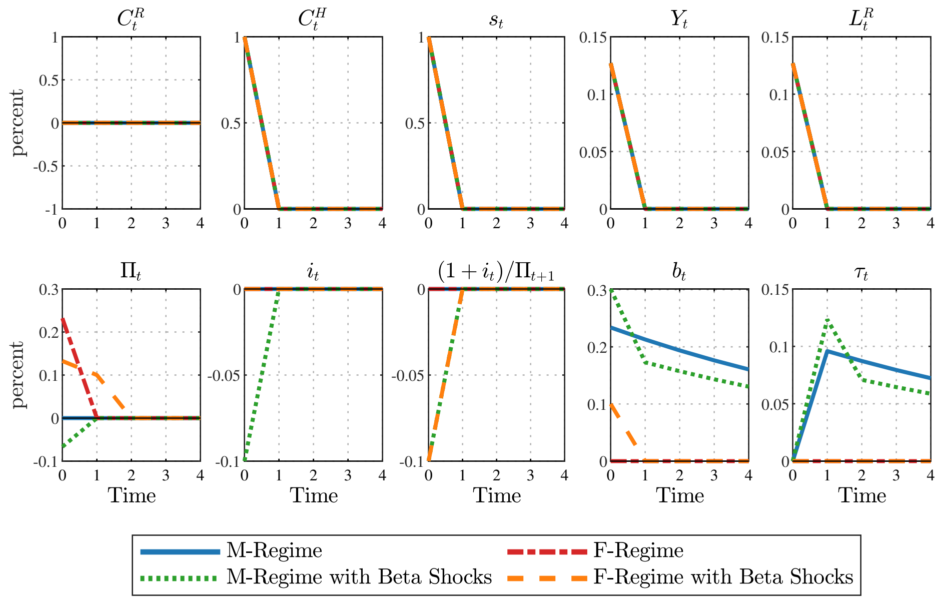
$$\begin{aligned}
\log\frac{\Pi_0^F}{\bar{\Pi}} + \log\frac{\Pi_1^F}{\bar{\Pi}} &= -\log\left(1+\xi_0^{\beta}\right) + \log\left(\frac{1+\xi_0^{\beta}}{1+(1+\beta)\,\xi_0^{\beta} - \beta\frac{\bar{s}}{\bar{b}}\xi_0^s\left(1+\xi_0^{\beta}\right)}\right) \\
&= -\log\left(1+(1+\beta)\,\xi_0^{\beta} - \beta\frac{\bar{s}}{\bar{b}}\xi_0^s\left(1+\xi_0^{\beta}\right)\right) \\
&\approx -(1+\beta)\,\xi_0^{\beta} + \beta\frac{\bar{s}}{\bar{b}}\xi_0^s\left(1+\xi_0^{\beta}\right).
\end{aligned}$$

Then, $-1 < \xi_0^{\beta} < 0$ and $\xi_0^s > 0$, $\log\frac{\Pi_0^F}{\bar{\Pi}} + \log\frac{\Pi_1^F}{\bar{\Pi}} > 0$.

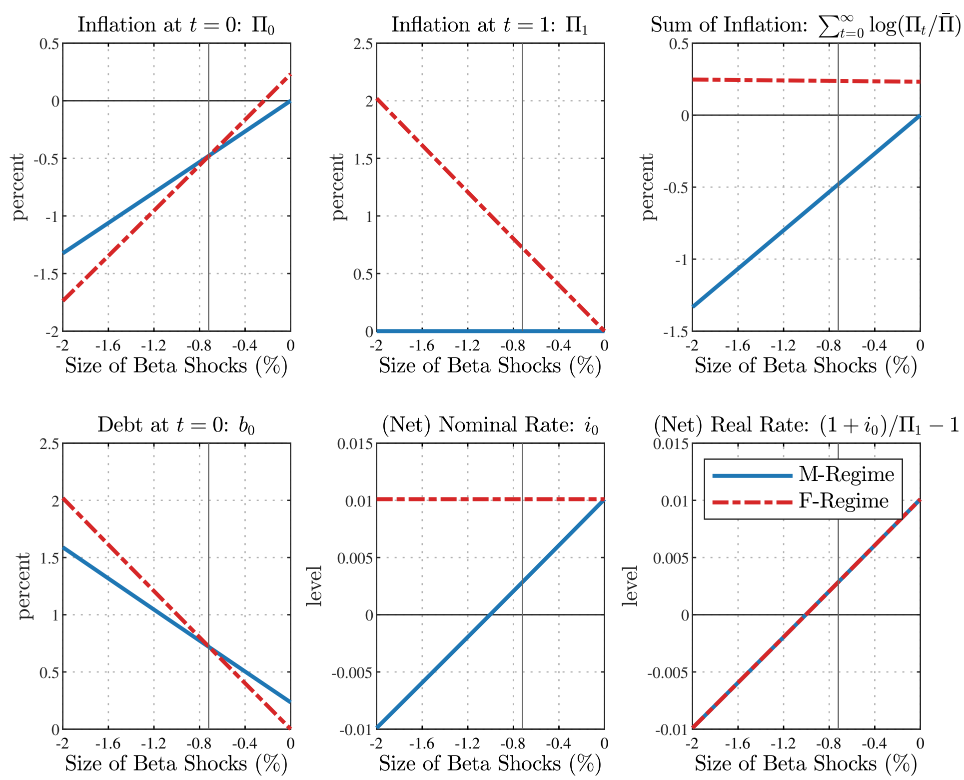
Thus,

$$\log\frac{\Pi_0^F}{\bar{\Pi}} + \log\frac{\Pi_1^F}{\bar{\Pi}} > 0 > \log\frac{\Pi_0^M}{\bar{\Pi}} + \log\frac{\Pi_1^M}{\bar{\Pi}}$$

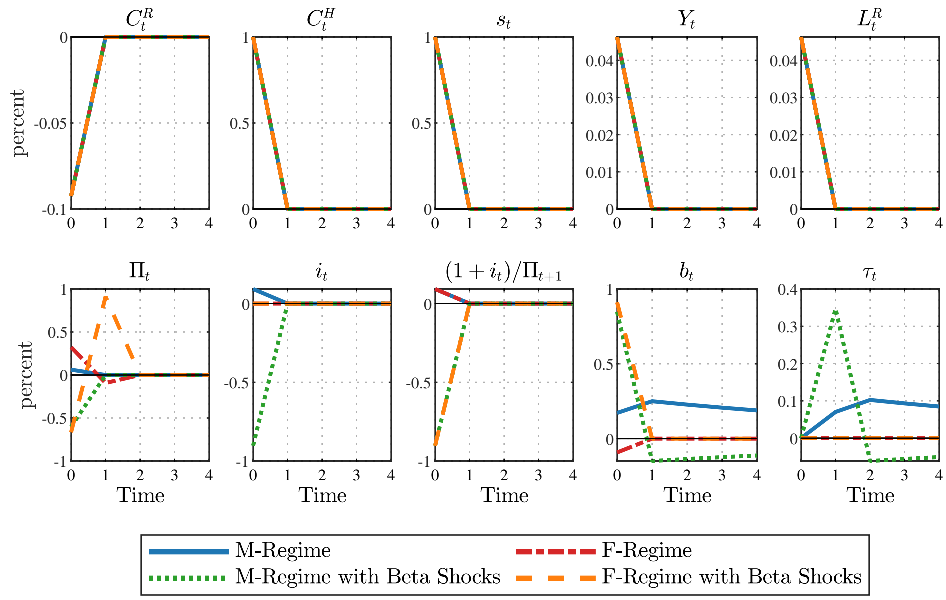
□



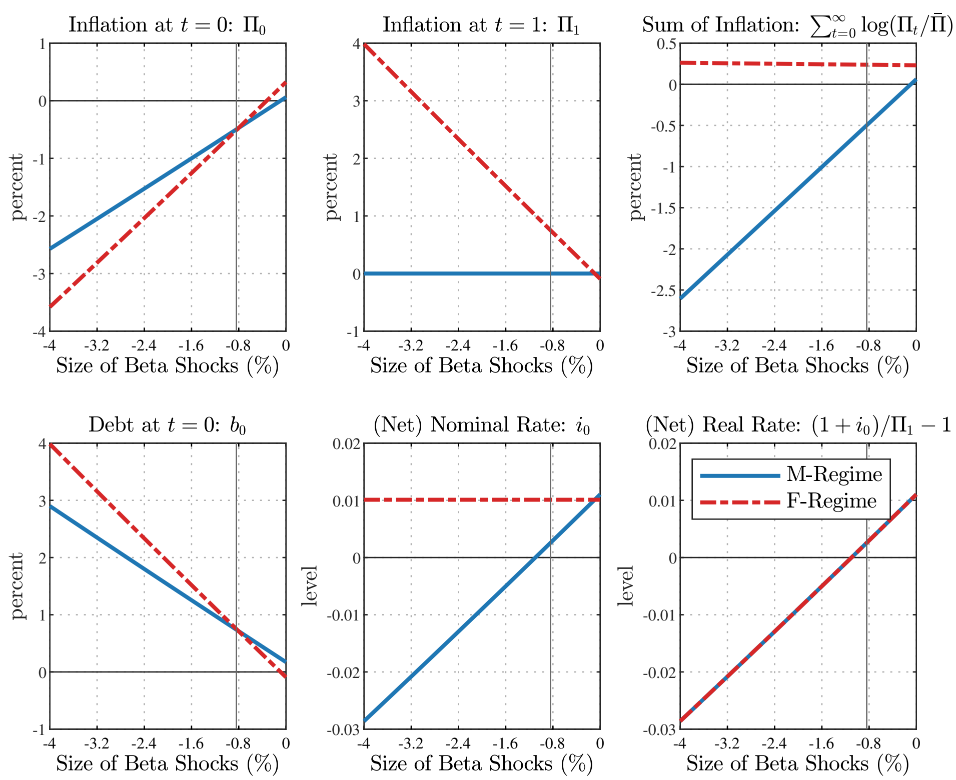
Appendix Figure B.1: IRFs with $\varphi = 0$ (Infinite Frisch elasticity)



Appendix Figure B.2: Variable Responses by Different Size of Beta Shocks with $\varphi = 0$ (Infinite Frisch elasticity)



Appendix Figure B.3: IRFs with $\varphi = 2$ (Frisch elasticity): $T_{\text{transfer}} = 1, T_{\text{beta shock}} = 1$



Appendix Figure B.4: Variable Responses by Different Size of Beta Shocks with $\varphi = 2$ (Frisch elasticity): $T_{\text{transfer}} = 1, T_{\text{beta shock}} = 1$

B.2 Government Spending Shocks in the Simple Model

For the effects of government spending shocks in the simple model, we point out how transfer and government spending changes are isomorphic. The system of equilibrium equations is:

$$
\begin{aligned}
\frac{C_{t+1}^R}{C_t^R} &= \beta \frac{1+i_t}{\Pi_{t+1}} \\
\chi \left(C_t^R + \frac{s_t + G_t}{1-\lambda} \right)^{\varphi} C_t^R &= 1 \\
b_t &= \frac{1+i_{t-1}}{\Pi_t} b_{t-1} - \tau_t + s_t + G_t \\
\frac{1+i_t}{1+\bar{i}} &= \left(\frac{\Pi_t}{\bar{\Pi}} \right)^{\phi} \\
\tau_t - \bar{\tau} &= \psi \left(b_{t-1} - \bar{b} \right).
\end{aligned}
$$

We see that exogenous changes in s_t and G_t have the identical effects on the model dynamics.

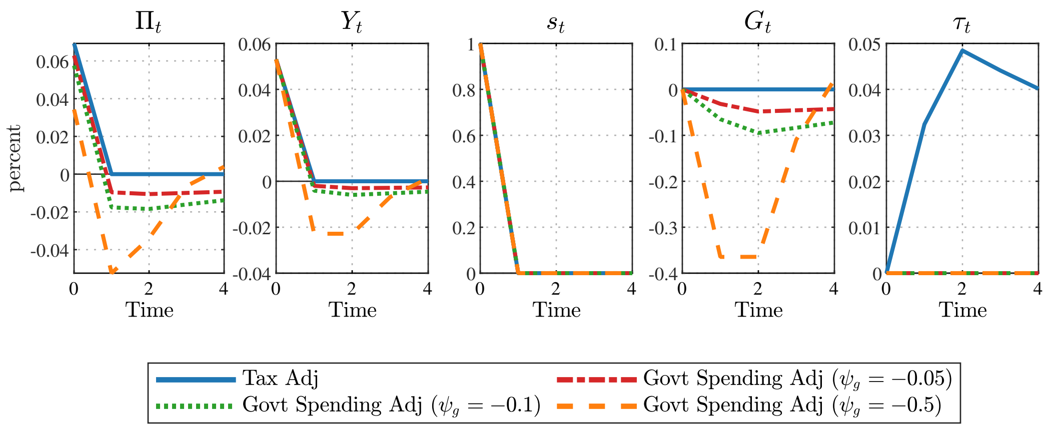
B.3 Government Spending Feedback Rule in the Simple Model

We consider endogenous feedback rules for government spending and present numerical results below for a few parameterizations. The government spending rule then is

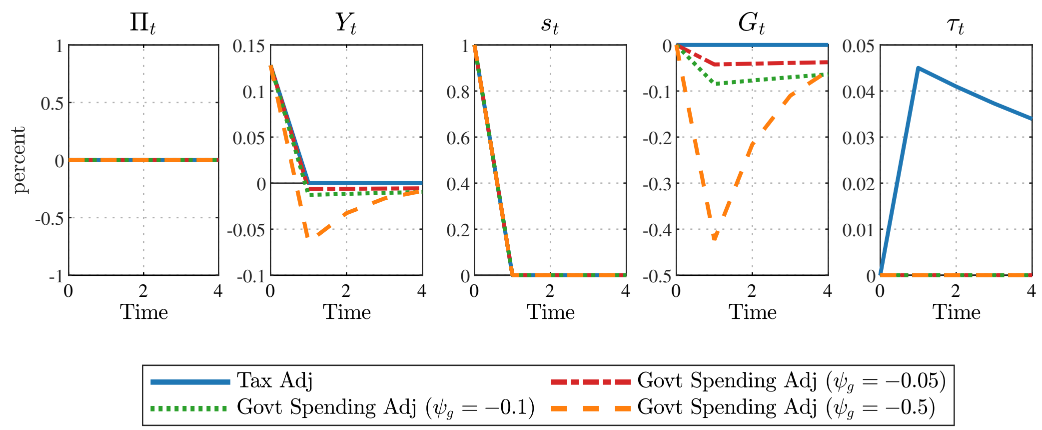
$$
G_t - \bar{G} = \psi_G \left(b_{t-1} - \bar{b} \right)
$$

Under the fiscal regime, $\psi_G = 0$ by definition (i.e. no primary surplus adjustment in this regime), so whether government spending or taxes adjust (or more precisely, do not adjust at all) in the model does not matter.

Under the monetary regime, $\psi_G < 0$. That is, although an increase in transfer is *not* met by a decrease in government spending of *the equal size in all periods* (like in the previous bullet point), government spending does decrease gradually. So we should expect to see a qualitatively similar result as before. Figure B.5 illustrates the result in the simple model. We can see that inflation and output increase by less in the government spending adjustment case than in tax adjustment case, broadly confirming our statement above and your conjecture. For a comparison, Appendix Figure B.6 shows the IRFs with Infinite Frisch elasticity.



Appendix Figure B.5: IRFs under the Monetary Regime with Government Spending Adjustment: Frisch Elasticity = 1/2



Appendix Figure B.6: IRFs under the Monetary Regime with Government Spending Adjustment: Infinite Frisch Elasticity

Appendix C Additional Tables and Figures

Appendix Table C.1: Data and Model Moments

	Time	Data	Model
Panel A: Targeted moments (percent deviation from January)			
Total Hours for retail, transportation, leisure/hospitality	April	-16.4%	-16.4%
	June	-18.7%	-18.7%
	August	-12.9%	-12.9%
Total Hours excluding retail, transportation, leisure/hospitality	April	-6.62%	-6.62%
	June	-8.64%	-8.64%
	August	-6.26%	-6.26%
PCE Inflation for recreation, transportation, food services	April	-0.95%	-0.95%
	June	-0.20%	-0.20%
	August	0.08%	0.08%
Panel B: Non-targeted moments (percent deviation from January)			
PCE Inflation excluding recreation, transportation, food services	April	-0.15%	-2.81%
	June	-0.10%	-4.96%
	August	0.56%	-5.37%
Real PCE for recreation, transportation, food services	April	-40.7%	-23.4%
	June	-38.1%	-0.46%
	August	-27.7%	12.1%
Real PCE excluding recreation, transportation, food services	April	-7.79%	-4.37%
	June	-3.75%	-16.6%
	August	-0.44%	-16.4%
Real PCE	April	-12.3%	-10.2%
	June	-8.50%	-11.7%
	August	-4.21%	-7.64%
Real GDP (percent deviation from Q1)	Q2	-8.93%	-8.06%
	Q3	-2.06%	-2.12%

Notes: This table shows moments of the data and simulated series from the baseline model. 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 2020.

Appendix Table C.2: Transfer Multipliers Under Alternative Calibrations

	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: Alternative calibration excluding one-time tax rebates (15.8% transfer increases)								
Impact Multipliers	1.957	1.901	0.120	7.967	3.371	3.101	1.579	9.238
4-Year Cumulative Multiplier	1.785	2.107	-0.015	7.678	7.459	7.167	4.565	16.932
Panel B: Alternative calibration excluding unemployment benefit components (16.7% transfer increases)								
Impact Multipliers	1.953	1.898	0.120	7.954	3.312	3.049	1.519	9.180
4-Year Cumulative Multiplier	1.780	2.099	-0.014	7.652	7.186	6.920	4.350	16.470
Panel C: Alternative calibration with tax rebates to both Ricardian and HTM households								
Impact Multipliers	1.332	1.294	0.078	5.435	2.167	2.001	0.938	6.190
4-Year Cumulative Multiplier	1.236	1.453	0.020	5.217	4.582	4.436	2.722	10.672
Panel D: Alternative calibration with transfer distribution starting from April 2020								
Impact Multipliers	1.774	1.959	0.255	6.748	3.5	3.41	2.011	8.374
4-Year Cumulative Multiplier	1.723	2.105	0.029	7.267	5.538	5.503	3.109	13.491

Notes: This table shows the transfer multipliers for the models under monetary and fiscal regimes when we re-calibrate the baseline model. $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers and 4-year cumulative multipliers when government distributes transfers equally over 6 months.

Appendix Table C.3: Welfare Gains Under Alternative Calibrations

	Monetary Regime		Fiscal Regime	
	Long-run	Short-run ($t = 4$)	Long-run	Short-run ($t = 4$)
Panel A: Excluding one-time tax rebates (15.8% transfer increases)				
Ricardian Household	-0.009	-0.897	0.013	-0.693
HTM Household	0.046	3.752	0.083	5.010
Panel B: Excluding unemployment benefit components (16.7% transfer increases)				
Ricardian Household	-0.009	-0.950	0.012	-0.742
HTM Household	0.048	3.983	0.086	5.263
Panel C: Tax rebates to both Ricardian and HTM households				
Ricardian Household	-0.016	-1.039	0.004	-0.831
HTM Household	0.084	4.365	0.124	5.630
Panel D: Alternative calibration with transfer distribution starting from April 2020				
Ricardian Household	-0.014	-1.493	0.012	-1.236
HTM Household	0.073	6.183	0.115	7.657

Notes: This table shows long- and short-run welfare gains resulting from the redistribution, compared to the models without redistribution. The values are the difference in the welfare measure ($\mu_{t,k}^i$) between the transfer cases (under the two regimes) and the benchmark case (the monetary regime without transfers).

Appendix Table C.4: Transfer and Government Spending Multipliers with Tax Adjustment

	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: Transfer Multipliers with steady-state govt spending								
Impact Multipliers	1.875	1.836	0.079	7.757	2.915	2.689	1.108	8.829
4-Year Cumulative Multiplier	1.669	2.039	-0.010	7.165	5.655	5.575	3.032	14.243
Panel B: Government Spending Multipliers								
Impact Multipliers	1.218	1.068	0.026	0.847	2.386	2.027	1.251	1.826
4-Year Cumulative Multiplier	1.138	1.068	-0.182	1.186	5.414	4.814	3.261	8.185

Notes: This table shows the transfer multipliers for the models under monetary and fiscal regimes when we re-calibrate the baseline model. $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers and 4-year cumulative multipliers when government distributes transfers equally over 6 months.

Appendix Table C.5: Welfare Gains with Tax Adjustment

	Monetary Regime		Fiscal Regime	
	Long-run	Short-run ($t = 4$)	Long-run	Short-run ($t = 4$)
Panel A: Welfare gains with transfer shocks and steady-state govt spending				
Ricardian Household	-0.017	-1.954	0.015	-1.618
HTM Household	0.073	6.111	0.119	7.939
Panel B: Welfare gains with government spending shocks				
Ricardian Household	-0.015	-1.138	0.01	-0.504
HTM Household	0.006	0.779	0.069	2.456

Notes: This table shows long- and short-run welfare gains resulting from the redistribution, compared to the models without redistribution. The values are the difference in the welfare measure ($\mu_{t,k}^i$) between the transfer cases (under the two regimes) and the benchmark case (the monetary regime without transfers).

Appendix Table C.6: Transfer Multipliers and Welfare Gains with Government Spending Adjustment in the Monetary Regime

Panel A: Transfer Multipliers	$\mathcal{M}_t^M(Y)$	$\mathcal{M}_t^M(Y_R)$	$\mathcal{M}_t^M(C^R)$	$\mathcal{M}_t^M(C^H)$
Impact Multipliers	1.866	1.833	0.066	7.759
4-Year Cumulative Multiplier	1.65	2.054	-0.022	7.143

Panel B: Welfare gains	Long-run	Short-run ($t = 4$)
Ricardian Household	-0.015	-1.973
HTM Household	0.072	6.05

Notes: This table shows the transfer multipliers and welfare gains for the model with government spending adjustment under monetary regime. Panel A reports impact multipliers and 4-year cumulative multipliers when government distributes transfers equally over 6 months. Panel B shows long- and short-run welfare gains resulting from the redistribution, compared to the model without redistribution. The values are the difference in the welfare measures ($\mu^i_{t,k}$) between the with-transfer case and the without-transfer case under monetary regime.

Appendix Table C.7: Government Spending Multipliers with Government Spending Adjustment

	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: Government Spending Multipliers								
Impact Multipliers	1.194	1.051	0.001	0.828	2.464	2.100	1.338	1.878
4-Year Cumulative Multiplier	1.275	1.226	-0.013	1.221	5.299	4.62	1.904	9.497

Notes: This table shows the transfer multipliers for the models under monetary and fiscal regimes when we re-calibrate the baseline model. $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers and 4-year cumulative multipliers when government distributes transfers equally over 6 months.

Appendix Table C.8: Transfer Multipliers with Money-In-the-Utility

	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: MIU								
Impact Multipliers	2.211	2.067	-1.203	13.388	4.640	4.083	-0.028	19.920
4-Year Cumulative Multiplier	1.043	1.284	-1.463	9.246	2.696	2.805	-0.256	12.359

Notes: This table shows the transfer multipliers for the models under monetary and fiscal regimes when we re-calibrate the baseline model. $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers and 4-year cumulative multipliers when government distributes transfers equally over 6 months.

Appendix Table C.9: Transfer Multipliers with Inflationary Cost-Push 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: 10% Shock								
Impact Multipliers	1.947	1.874	0.158	7.803	2.915	2.691	1.16	8.662
4-Year Cumulative Multiplier	1.795	2.033	0.102	7.337	5.364	5.197	2.824	13.678
Panel B: 20% Shock								
Impact Multipliers	1.977	1.882	0.197	7.802	2.857	2.629	1.122	8.537
4-Year Cumulative Multiplier	1.865	2.025	0.203	7.307	5.089	4.863	2.51	13.528

Notes: This table shows the transfer multipliers for the models under monetary and fiscal regimes when we re-calibrate the baseline model. $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers and 4-year cumulative multipliers when government distributes transfers equally over 6 months.

Appendix Table C.10: Welfare Gains with Inflationary Cost-Push Shocks

	Monetary Regime		Fiscal Regime	
Transfer Distribution	Long-run	Short-run ($t = 4$)	Long-run	Short-run ($t = 4$)
Panel A: Welfare gains with 10% Inflationary Shocks				
Ricardian Household	-0.012	-1.45	0.011	-1.248
HTM Household	0.075	6.372	0.119	7.825
Panel B: Welfare gains with 20% Inflationary Shocks				
Ricardian Household	-0.011	-1.413	0.01	-1.243
HTM Household	0.076	6.496	0.12	7.823

Notes: This table shows long- and short-run welfare gains resulting from the redistribution, compared to the models without redistribution. The values are the difference in the welfare measure ($\mu^i_{t,k}$) between the transfer cases (under the two regimes) and the benchmark case (the monetary regime without transfers).

Appendix Table C.11: Transfer Multipliers Under Two Alternative Calibrations

	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: Alternative calibration with above steady state initial debt (50.9%)								
Impact Multipliers	1.938	1.86	0.133	7.849	6.759	5.988	4.921	12.777
4-Year Cumulative Multiplier	1.8	2.012	0.065	7.478	15.638	14.768	10.319	33.049
Panel B: Alternative calibration with above steady state initial debt (71.8%)								
Impact Multipliers	1.824	1.732	0.113	7.426	5.916	5.168	4.187	11.576
4-Year Cumulative Multiplier	1.732	1.913	0.08	7.141	13.325	12.329	8.747	28.311

Notes: This table shows the transfer multipliers for the models under monetary and fiscal regimes when we re-calibrate the baseline model. In Panel A, we calibrate the COVID shocks in the baseline model under the monetary regime with time-0 government debt which is 10% higher than the steady-state (50.9% of debt-to-GDP). In Panel B, we calibrate the COVID shocks in the baseline model under the monetary regime with time-0 government debt which is 10% higher than the alternative steady-state (71.8% of debt-to-GDP which matches the average US debt-to-GDP ratio from 2010Q1 through 2020Q1). $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers and 4-year cumulative multipliers when government distributes transfers equally over 6 months.

Appendix Table C.12: Welfare Gains Under Two Alternative Calibrations

	Monetary Regime		Fiscal Regime	
Transfer Distribution	Long-run	Short-run ($t = 4$)	Long-run	Short-run ($t = 4$)
Panel A: Alternative calibration with above steady state initial debt (50.9%)				
Ricardian Household	-0.013	-1.436	0.066	-1.498
HTM Household	0.078	6.365	0.25	14.015
Panel B: Alternative calibration with above steady state initial debt (71.8%)				
Ricardian Household	-0.014	-1.646	0.094	-1.359
HTM Household	0.08	6.478	0.241	12.776

Notes: This table shows long- and short-run welfare gains resulting from the redistribution, compared to the models without redistribution. The values are the difference in the welfare measure ($\mu_{t,k}^i$) between the transfer cases (under the two regimes) and the benchmark case (the monetary regime without transfers). In Panel A, we calibrate the COVID shocks in the baseline model under the monetary regime with time-0 government debt which is 10% higher than the steady-state (50.9% of debt-to-GDP). In Panel B, we calibrate the COVID shocks in the baseline model under the monetary regime with time-0 government debt which is 10% higher than the alternative steady-state (71.8% of debt-to-GDP which matches the average US debt-to-GDP ratio from 2010Q1 through 2020Q1).

Appendix Table C.13: Transfer Multipliers with Above Steady State Initial Debt (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: Impact Multipliers								
Baseline	2.670	2.464	-0.911	14.394	4.640	4.083	-0.028	19.920
Above steady state initial debt	2.385	2.190	-0.808	12.836	3.903	3.428	-0.027	16.770
Panel B: 4-Year Cumulative Multipliers								
Baseline	1.490	1.703	-1.107	9.991	2.696	2.805	-0.256	12.359
Above steady state initial debt	1.426	1.608	-0.974	9.285	2.403	2.492	-0.246	11.075

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

Appendix Table C.14: Transfer Multipliers with Different Duration of Binding ZLB Periods

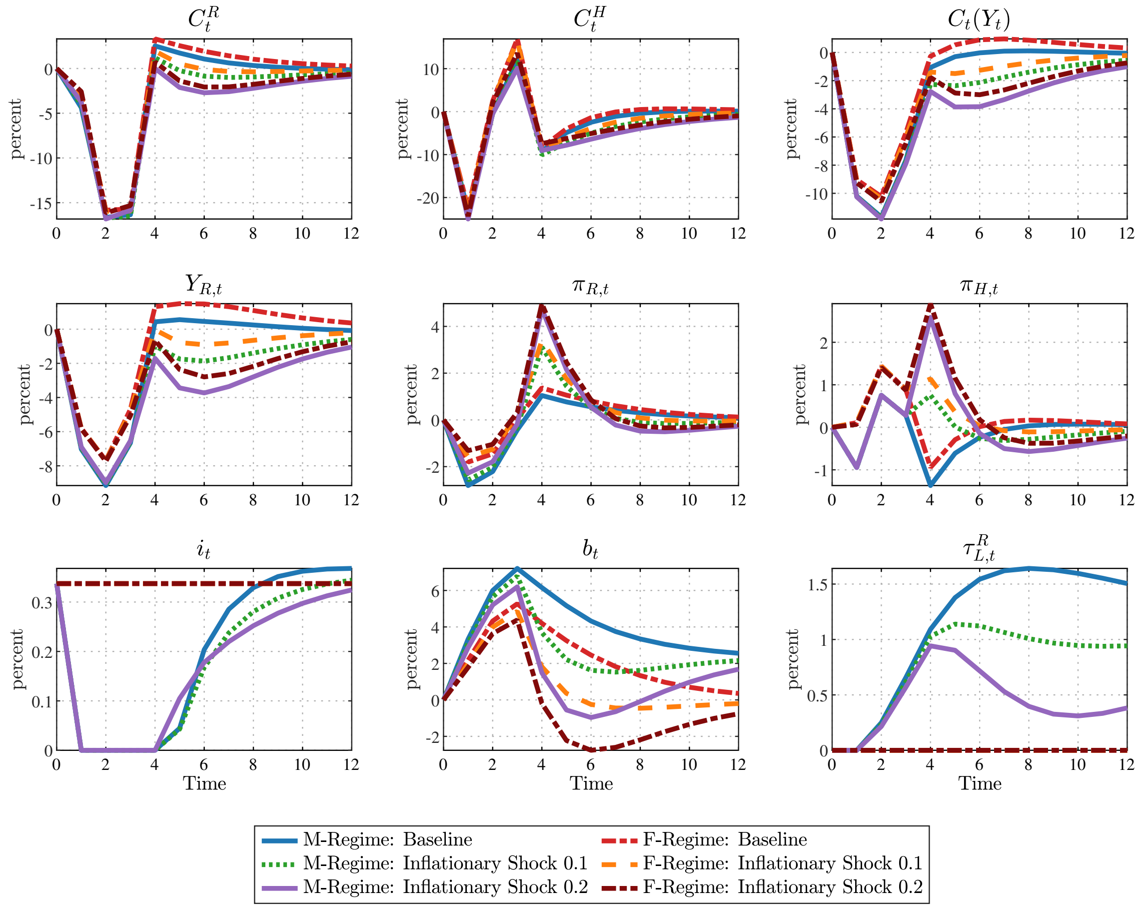
	Monetary Regime				Fiscal Regime			
	$\mathcal{M}_t^M(Y)$	$\mathcal{M}_t^M(Y_R)$	$\mathcal{M}_t^M(C^R)$	$\mathcal{M}_t^M(C^H)$	$\mathcal{M}_t^F(Y)$	$\mathcal{M}_t^F(Y_R)$	$\mathcal{M}_t^F(C^R)$	$\mathcal{M}_t^F(C^H)$
Panel A: ZLB Duration: 4 Periods (Baseline)								
Impact Multipliers	1.923	1.863	0.119	7.828	2.949	2.726	1.166	8.788
4-Year Cumulative Multiplier	1.732	2.023	-0.002	7.409	5.552	5.429	3.078	13.652
Panel B: ZLB Duration: 5 Periods								
Impact Multipliers	1.85	1.8	0.059	7.71	3.461	3.134	1.703	9.218
4-Year Cumulative Multiplier	1.529	1.773	-0.052	6.705	6.57	6.207	4.263	14.124
Panel C: ZLB Duration: 6 Periods								
Impact Multipliers	1.759	1.733	0	7.514	4.1	3.656	2.408	9.639
4-Year Cumulative Multiplier	1.337	1.569	-0.118	6.098	7.927	7.325	5.826	14.805
Panel D: ZLB Duration: 7 Periods								
Impact Multipliers	1.628	1.648	-0.063	7.165	5.071	4.461	3.537	10.091
4-Year Cumulative Multiplier	1.125	1.388	-0.202	5.469	10.079	9.189	8.366	15.684
Panel E: ZLB Duration: 8 Periods								
Impact Multipliers	1.567	1.607	-0.099	7.019	5.419	4.751	3.955	10.212
4-Year Cumulative Multiplier	1.027	1.315	-0.264	5.253	10.87	9.896	9.323	15.935

Notes: This table shows the transfer multipliers for the models under monetary and fiscal regimes with different different periods of ZLB. We introduce different degrees of the persistence in preference shocks to generate different ZLB duration (persistence of preference shocks in Panel A: 0.0, in Panel B: 0.2, in Panel C: 0.4, in Panel D: 0.6, in Panel E: 0.65). $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers and 4-year cumulative multipliers when government distributes transfers equally over 6 months.

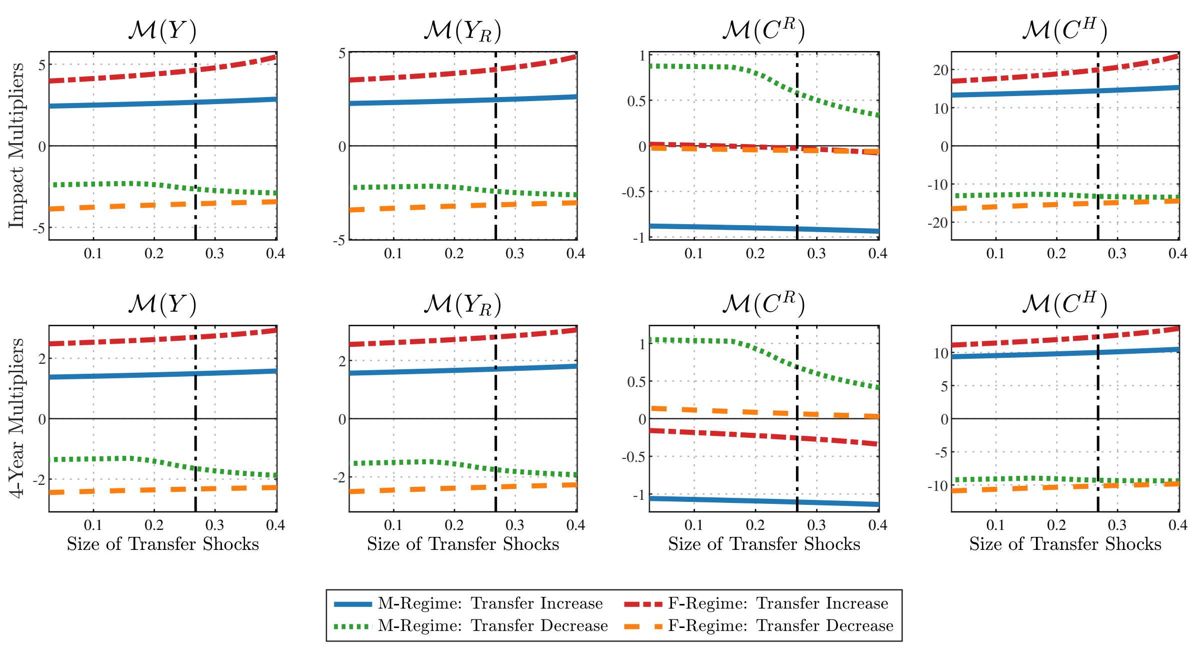
Appendix Table C.15: Transfer Multipliers Without HTM Labor Supply Shocks and HTM Sector-Specific Shocks

	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: Only Preference Shocks								
Impact Multipliers	3.083	2.746	0.066	12.961	5.518	4.691	1.629	18.25
4-Year Cumulative Multiplier	1.791	1.703	0.094	7.348	6.453	5.768	4.085	14.205

Notes: This table shows the transfer multipliers for the models under monetary and fiscal regimes when we re-calibrate the baseline model. $\mathcal{M}_t^i(X)$ represent the cumulative transfer multiplier of variable X at t-horizon under i regime. We report impact multipliers and 4-year cumulative multipliers when government distributes transfers equally over 6 months.



Appendix Figure C.1: Redistribution Policy with Inflationary Shocks



Appendix Figure C.2: Impact and Cumulative Multipliers by Different Transfer Size/Sign without COVID Shocks