

# Fiscal Policy during a Pandemic

Miguel Faria-e-Castro \*

FRB St. Louis

March 2020

## Abstract

I use a dynamic stochastic general equilibrium model to study the effects of the 2019-20 coronavirus pandemic in the United States. The pandemic is modeled as a large negative shock to the utility of consumption of contact-intensive services. General equilibrium forces propagate this negative shock to the non-services and financial sectors, triggering a deep recession. I use a calibrated version of the model to analyze different types of fiscal policies: (i) government purchases, (ii) income tax cuts, (iii) unemployment insurance benefits, (iv) unconditional transfers, and (v) liquidity assistance to services firms. I find that government purchases yield the largest multipliers, above 1, but that there is substantial variation in terms of distributional effects among different tools. UI benefits generate the largest consumption boost for borrowers, while savers favor unconditional transfers. Liquidity assistance programs can be very effective, depending on the elasticity of intertemporal substitution of services.

JEL Codes: E6, G01

Keywords: fiscal policy, financial stability, pandemic

---

\*I thank, without implicating, Bill Dupor for a conversation that inspired this paper. The views expressed here are those of the author and do not necessarily reflect the views of the Federal Reserve Bank of St. Louis or the Federal Reserve System. First version: March 2020. Contact: [miguel.fariaecastro@stls.frb.org](mailto:miguel.fariaecastro@stls.frb.org)

# 1 Introduction

The on-going Covid-19 coronavirus pandemic is causing widespread disruption in the world's advanced economies. Monetary authorities were quick to react, with the Federal Reserve and other major central banks returning to their 2008-09 Financial Crisis toolkits. Following these steps, fiscal authorities around the globe are in the process of designing and approving stimulus packages to fight what may become a global depression.

In this paper, I adapt an otherwise standard DSGE model to simulate the macroeconomic effects of a pandemic, and to study the effects of different types of fiscal policy instruments. The pandemic is modeled as a sudden stop of a contact-intensive services sector. Through aggregate demand externalities, the shutdown of this sector propagates to the non-services sector. Through balance sheet linkages, it also propagates to the financial sector. The rise in unemployment leads to a wave of defaults, disrupting financial intermediation and amplifying the recession. The pandemic scenario is pessimistic: the shock lasts for three quarters (through the end of 2020), and results in about 20% unemployment rate.

I use a calibrated version of the model to study the effects of different types of discretionary fiscal policy: (i) an increase in non-service government purchases, (ii) an expansion of unemployment insurance, (iii) a decrease in the income tax, (iv) an unconditional transfer, (v) payment of wages by the government to service firms.

I find that government purchases generate the largest GDP multiplier, above 1, much thanks to the fact that the pandemic pushes the economy to the zero lower bound ([Christiano et al., 2011](#)). There is, however, considerable variation in the distributional effects of different policies. Borrowers, or less well-off agents that rely more on labor income, receive a larger consumption boost from policies that resemble cash transfers, such as an increase in UI benefits. I find that unconditional transfers of the type that are currently being proposed generate similar distributional effects, with the added benefit of a potentially less costly implementation. These results should be interpreted with caution: it is not obvious that a benevolent planner would like to necessarily increase economic activity during this type of situation. Increasing economic activity may be detrimental to fight the pandemic. This is one potential reason to look at consumption, rather than GDP multipliers. For this reason, I generally abstract from making welfare/normative statements in this paper.

Finally, I find that the ranking of different policies is relatively robust to different parametrizations, with one exception: depending on the elasticity of intertemporal substitution of the quarantined sector (interpreted as services in this paper), liquidity assistance to firms in this sector may generate the largest multipliers in terms of GDP and borrower consumption. This parameter is crucial to guide the choice of policies.



ployed. Let  $N_t^{n,b}$ ,  $N_t^{a,b}$  denote the mass of agents working in the  $n$ - and  $a$ -sectors, respectively, and  $1 - N_t^{a,b} - N_t^{n,b}$  denote the mass of unemployed agents.

To generate realistic default rates in the context of a representative agent model, I assume that the members of the borrower household are subject to a cash-in-advance constraint and liquidity shocks. The borrower family enters the period with a stock of debt to be repaid equal to  $B_{t-1}^b$ . Each member of the household is responsible for repaying an equal amount  $B_{t-1}^b$  at the beginning of the period. At this point, the only available resources are labor income, net government transfers, and a liquidity shock  $\varepsilon_t(i) \sim F^e, F^u$  where  $F^e, F^u$  are distributions with support in the real line.<sup>1</sup> Total cash in hand is therefore given by

$$\mathbb{1}[i \in N_t^{n,b}]w_t^n(1 - \tau_t^l) + \mathbb{1}[i \in N_t^{a,b}]w_t^a(1 - \tau_t^l) + \mathbb{1}[i \notin N_t^{n,b}, N_t^{a,b}]\text{ui}_t + T_t^b + \varepsilon_t(i)$$

where  $T_t^b$  is an unconditional transfer from the government, and  $ui_t$  is unemployment insurance. Default is liquidity-based: agent  $i$  compares cash-in-hand to the required repayment  $B_{t-1}^b$  and defaults if she has not enough resources to repay. This allows me to define three thresholds that determine default rates for each of the possible employment states,

$$\begin{aligned}\varepsilon_t^a &= B_{t-1}^b - w_t^a(1 - \tau_t^l) - T_t^b \\ \varepsilon_t^n &= B_{t-1}^b - w_t^n(1 - \tau_t^l) - T_t^b \\ \varepsilon_t^u &= B_{t-1}^b - \text{uit} - T_t\end{aligned}$$

The total default rate is then given by

$$F_t^b = N_t^{a,b} F^e(\varepsilon_t^a) + N_t^{n,b} F^e(\varepsilon_t^n) + (1 - N_t^{a,b} - N_t^{n,b}) F^u(\varepsilon_t^u)$$

After default decisions are made, the borrower household jointly takes all other relevant

<sup>1</sup>I allow the distribution of liquidity shocks to differ for employed and unemployed agents as this allows me to jointly match replacement rates and different default rates for employed and unemployed.

decisions at the household level. The borrower solves the following program,

$$V_t^b(B_{t-1}^b) = \max_{C_t^b, B_t^b} u(C_t^b) + \beta^b \mathbb{E}_t V_{t+1}^b(B_t^b)$$

s.t.

$$\begin{aligned} C_t^b + \frac{B_{t-1}^b}{\Pi_t}(1 - F_t^b) &= N_t^{a,b} w_t^a(1 - \tau_t^l) + N_t^{n,b} w_t^n(1 - \tau_t^l) + (1 - N_t^{a,b} - N_t^{n,b}) \text{ui}_t + T_t^b + Q_t^b B_t^b \\ B_t^b &\leq \Gamma \end{aligned}$$

where  $C_t^b$  is non-service consumption, a the first constraint is the budget constraint, and the second constraint is a borrowing constraint expressed in terms of a limit to total repayment.

### 2.1.2 Savers

Savers also supply labor to both sectors. They save in government bonds and bank deposits, and own all firms and banks in this economy. Additionally, they derive utility from consumption in the services sector,  $C_t^a$ . They solve the following problem,

$$V_t^s(D_{t-1}, B_{t-1}^g) = \max_{C_t^s, C_t^a, B_t^g, D_t} u(C_t^s) + \alpha_t \frac{(C_t^a)^{1-\sigma_a}}{1-\sigma_a} + \beta^s \mathbb{E}_t V_{t+1}^s(D_t, B_t^g)$$

s.t.

$$\begin{aligned} C_t^s + p_t^a C_t^a + Q_t(D_t + B_t^g) &= N_t^{a,s} w_t^a(1 - \tau_t^l) + N_t^{n,s} w_t^n(1 - \tau_t^l) \\ &+ (1 - N_t^{a,s} - N_t^{n,s}) \text{ui}_t + \frac{B_{t-1}^g + D_{t-1}}{\Pi_t} + (1 - \tau^k) \mathcal{P}_t + T_t - T_t^b \end{aligned}$$

where  $p_t^a$  is the price of  $a$ -sector goods in terms of the numeraire (final  $n$ -goods),  $D_t$  are bank deposits,  $B_t^g$  is government debt, and  $\Pi_t$  is the inflation rate in terms of non-service goods.  $\mathcal{P}_t$  are total profits from firms and banks, which are taxed at some flat rate  $\tau^k$ . I assume that deposits are safe, and so they pay the same return as government bonds.  $T_t$  is a lump-sum tax paid to the government. It is useful to define the stochastic discount factor of savers,

$$\Lambda_{t+1}^s = \beta^s \frac{u'(C_{t+1}^s)}{u'(C_t^s)}$$

Finally,  $\alpha_t$  is a shock to the utility derived from the consumption of services. This shock plays an important role in what follows. Demand for services is given by

$$C_t^a = \left[ \alpha_t \frac{1}{p_t^a u'(C_t^s)} \right]^{1/\sigma_a}$$

## 2.2 Financial Intermediaries

Financial intermediaries are based on a version of [Gertler and Karadi \(2011\)](#). There is a continuum of intermediaries indexed by  $j$  that take deposits from savers and originate loans to borrowers. Intermediation is subject to two important frictions: first, there is a market leverage constraint that imposes that the value of the intermediary's assets not exceed a multiple of its market value. Second, the intermediary must pay a fraction  $1 - \theta$  of its earnings as dividends every period. The intermediary problem is

$$\begin{aligned} V_t^k(D_{t-1}(j), B_{t-1}^b(j)) &= \max_{B_t(j), D_t(j)} (1 - \theta)\pi_t(j) + \mathbb{E}_t \Lambda_{t+1}^s V_{t+1}^k(D_t(j), B_t^b(j)) \\ \text{s.t.} \\ Q_t^b B_t^b(j) &= \theta \pi_t(j) + Q_t D_t(j) \\ \kappa Q_t^b B_t^b(j) &\leq \mathbb{E}_t \Lambda_{t+1}^s V_{t+1}^k(D_t(j), B_t^b(j)) \\ \pi_t(j) &= (1 - F_t^b) \frac{B_{t-1}^b(j)}{\Pi_t} - \frac{D_{t-1}(j)}{\Pi_t} \end{aligned}$$

The value of the intermediary is equal to dividends paid today, a fraction  $1 - \theta$  of its earnings, plus the continuation value. The first constraint is a balance sheet constraint: assets must be financed with either retained earnings or deposits. The second constraint is a market leverage constraint: bank assets cannot exceed a multiple  $1/\kappa$  of ex-dividend bank value. Finally, the third constraint is the law of motion for earnings: the bank earns revenues for non-defaulted loans and must pay out previously borrowed deposits.

It is possible to show that the value function is homogeneous of degree one in earnings, thus allowing for aggregation. I.e, letting  $\pi_t$  be the relevant state variable, we can show that  $V_t^k(\pi_t(j)) = \Phi_t \theta \pi_t(j)$ , and that  $\Phi_t$  is the same for all banks. Define aggregate retained earnings as

$$E_t = \theta \left[ (1 - F_t^b) \frac{B_{t-1}^b(j)}{\Pi_t} - \frac{D_{t-1}(j)}{\Pi_t} \right] + \varpi$$

where  $\varpi$  is a small (gross) equity injection from savers. Then, we can work with a representative bank that has retained earnings equal to  $E_t$ .

The first-order condition for lending takes the form,

$$\mathbb{E}_t \frac{\Lambda_{t+1}^s}{\Pi_{t+1}} (1 - \theta + \theta \Phi_{t+1}) \left[ \frac{1 - F_{t+1}^b}{Q_t^b} - \frac{1}{Q_t} \right] = \mu_t \kappa$$

where  $\mu_t$  is the Lagrange multiplier on the leverage constraint, and  $\frac{\Lambda_{t+1}^s}{\Pi_{t+1}} (1 - \theta + \theta \Phi_{t+1}) \equiv \Omega_{t+1}$  is the bank's SDF. When the constraint binds  $\mu_t > 0$ , this generates excess returns on lending

over and above what would be warranted by pure credit risk. The constraint will typically bind when the bank is undercapitalized, i.e. when its value is low. Binding constraints allow the bank to recapitalize itself, by generating a positive wedge between the cost of borrowing  $1/Q_t$  and the return on lending  $(1 - F_{t+1}^b)/Q_t^b$ . This means that when banks are in bad shape, they tend to lend less and at higher interest rates.

## 2.3 Production

There are two sectors in this economy: non-services, and services.

### 2.3.1 Non-Services Sector

The  $n$ -sector is the largest sector in this economy, and  $n$ -sector final goods work as the numeraire. This sector operates like the single sector in a standard New Keynesian model.  $n$ -sector goods are produced by a continuum of producers that operate under monopolistic competition, and are subject to costs of adjusting their prices. The final-goods aggregator for  $n$ -sector intermediates is

$$Y_t = \left[ \int_0^1 Y_t(l)^{\frac{\epsilon-1}{\epsilon}} dl \right]^{\frac{\epsilon}{\epsilon-1}}$$

$n$ -sector firms operate a linear technology that produces variety  $l$  using labor,

$$Y_t(l) = A_t N_t^n(l)$$

where  $A_t$  is an aggregate TFP shock. They sell their good at price  $P_t(l)$  and face adjustment costs a la [Rotemberg \(1982\)](#),

$$d[P_t(l), P_{t-1}(l)] = Y_t \frac{\eta}{2} \left[ \frac{P_t(l)}{P_{t-1}(l)\Pi} - 1 \right]^2$$

where  $\eta$  measure the degree of nominal rigidity and  $\Pi$  is steady state inflation (indexing). From the aggregator, each producer faces a demand curve given by  $Y_t(l) = [P_t(l)/P_t]^{-\epsilon} Y_t$ , where  $P_t$  is the price level for  $n$ -sector goods. Standard derivations, and imposing a symmetric equilibrium in price-setting yield a New-Keynesian Phillips Curve

$$\eta \mathbb{E}_t \left\{ \Lambda_{t+1}^s \frac{Y_{t+1}}{Y_t} \frac{\Pi_{t+1}}{\Pi} \left( \frac{\Pi_{t+1}}{\Pi} - 1 \right) \right\} - \epsilon \left( \frac{\epsilon - 1}{\epsilon} - \frac{w_t^n}{A_t} \right) = \eta \frac{\Pi_t}{\Pi} \left( \frac{\Pi_t}{\Pi} - 1 \right)$$





where  $\xi^n, \xi^a$  are sector-specific constants. Wages comove with labor productivity  $A_t$ , and also respond to a measure of market tightness in each sector. Similar wage rules could be derived from more complicated models that make labor market frictions explicit ([Christiano et al., 2016](#); [McKay and Reis, 2016](#)). I assume that labor is rationed in equal proportion among savers and borrowers, so that

$$\begin{aligned} N_t^{b,a} &= N_t^{s,a} = N_t^a \\ N_t^{b,n} &= N_t^{s,n} = N_t^n \end{aligned}$$

## 2.4 Fiscal and Monetary Policy

### 2.4.1 Central Bank

The Central Bank (CB) follows a standard Taylor Rule subject to an explicit zero lower bound,

$$\frac{1}{Q_t} = \max \left\{ 1, \left( \frac{\Pi_t}{\bar{\Pi}} \right)^{\phi_\Pi} \left( \frac{p_t^a}{p_{t-1}^a} \right)^{\phi_a} \left( \frac{GDP_t}{\bar{GDP}} \right)^{\phi_{GDP}} \right\}$$

I allow the CB to respond to fluctuations in inflation in the  $n$  (numeraire) sector, and in the services sector. GDP is defined as

$$GDP_t = Y_t^n + p_t^a Y_t^a$$

### 2.4.2 Fiscal Authority

The fiscal authority has outflows related to non-service consumption  $G_t$ , unemployment insurance  $ui_t$ , and debt repayments  $B_{t-1}^g/\Pi_t$ . Its inflows are labor income/payroll taxes  $\tau_t^l(w_t^a N_t^a + w_t^n N_t^n)$ , capital income/profit taxes  $\tau^k \mathcal{P}_t$ , and debt issuance  $B_t^g$ , and lump-sum taxes  $T_t$ . Additionally, the fiscal authority can engage in a variety of other types of spending. Net spending of other types is denoted  $\mathcal{N}_t$ . The government budget constraint is

$$G_t + \frac{B_{t-1}^g}{\Pi_t} + ui_t(1 - N_t^a - N_t^n) + \mathcal{N}_t = \tau_t^l(w_t^a N_t^a + w_t^n N_t^n) + \tau^k \mathcal{P}_t + B_t^g + T_t$$

Lump-sum taxes adjust to ensure government solvency in the long-run. The adjustment rule is standard ([Leeper et al., 2010](#)),

$$T_t = \left[ \frac{B_{t-1}^g}{\bar{B}^g} \right]^{\phi_\tau} - 1$$

and  $\phi_\tau$  controls the speed of adjustment. A low value means that current spending is mostly deficit-financed.

**Discretionary Fiscal Policy** I assume that the fiscal authority has access to an additional set of instruments. Given their extraordinary nature, these interventions will be treated as one-time shocks that are completely unexpected, but once deployed their paths are perfectly anticipated. These components of  $\mathcal{N}_t$  are: (i) unconditional transfers to all agents in the economy,  $T_t^b$ , (ii) transfers to service-sector firms that are proportional to their wages,  $T_t^a w_t^a$ . Thus,

$$\mathcal{N}_t = T_t^b + T_t^a w_t^a G_t^a$$

Additionally, I assume that the government can also conduct one-time changes to existing fiscal instruments: (i) an increase in non-service consumption  $G_t$ , (ii) an increase in unemployment insurance transfers  $u_t$ , and (iii) a reduction in the income tax  $\tau_t^l$ .

## 2.5 Resource Constraints

The resource constraint for non-service goods is

$$\chi C_t^b + (1 - \chi) C_t^s + G_t + \Psi[\bar{c}_t(A_t)] = A_t N_t^n [1 - d(\Pi_t)]$$

where  $\Psi[\bar{c}_t(A_t)] \equiv \int_0^{\bar{c}_t(A_t)} c dG(c)$  are total operating costs paid by non-exiting service sector firms, expressed in terms of non-service goods. The resource constraint for service goods is

$$(1 - \chi) C_t^a = A_t G_t^a$$

A full list of equilibrium conditions is in [Appendix A](#).

## 3 Numerical Experiment

### 3.1 Model Calibration

The model steady state is calibrated to the US economy in the eve of the coronavirus pandemic. The model calibration is very preliminary at this stage, and is very much work in progress. The calibration is summarized on [Table 1](#).

In terms of functional forms, the utility of non-service consumption is isoelastic,  $u(C) = \frac{C^{1-\sigma}}{1-\sigma}$ . The distributions of liquidity shocks  $F^e, F^u$  are gaussian with mean zero and variances  $\sigma^e, \sigma^u$ , which are calibrated to match total average charge-off rates and default rates for





### 3.4 Pandemic Experiment

Figure 1 plots the response of selected variables to the  $\alpha_t$  shock. The path of the shock is plotted in the first panel. The shock causes a 40% drop in employment in the services sector (4th panel). The loss of these jobs affects borrowers, whose consumption falls by 5%. This drop in non-service consumption also leads to a drop in employment in the other sector, of about 3%. Combined, these drops in employment lead to a 15% contraction in GDP that lasts for the full three quarters. The 6th panel shows that this recession pushes the economy to the zero lower bound for the entire period. The bottom two panels show that the loss in employment leads to an increase in (quarterly) default rates, of 50%. This in turn affects the financial sector, and lending spreads rise. This further amplifies the drop in borrower consumption and rise in defaults. One thing to note is that while deep, the crisis is not very persistent. This is to be expected due to several reasons. First and foremost, the shock is assumed not to be persistent. Second, for simplicity, there are no slow-moving state variables on the production side of the economy (such as physical capital). The recession could be made more persistent by either adding capital (an additional state variable), or by imposing frictions/barriers to entry in the service sector.<sup>3</sup>

<sup>3</sup>A version of the model with limited entry is presented in Appendix B. While the dynamics are different, the main results are unchanged.

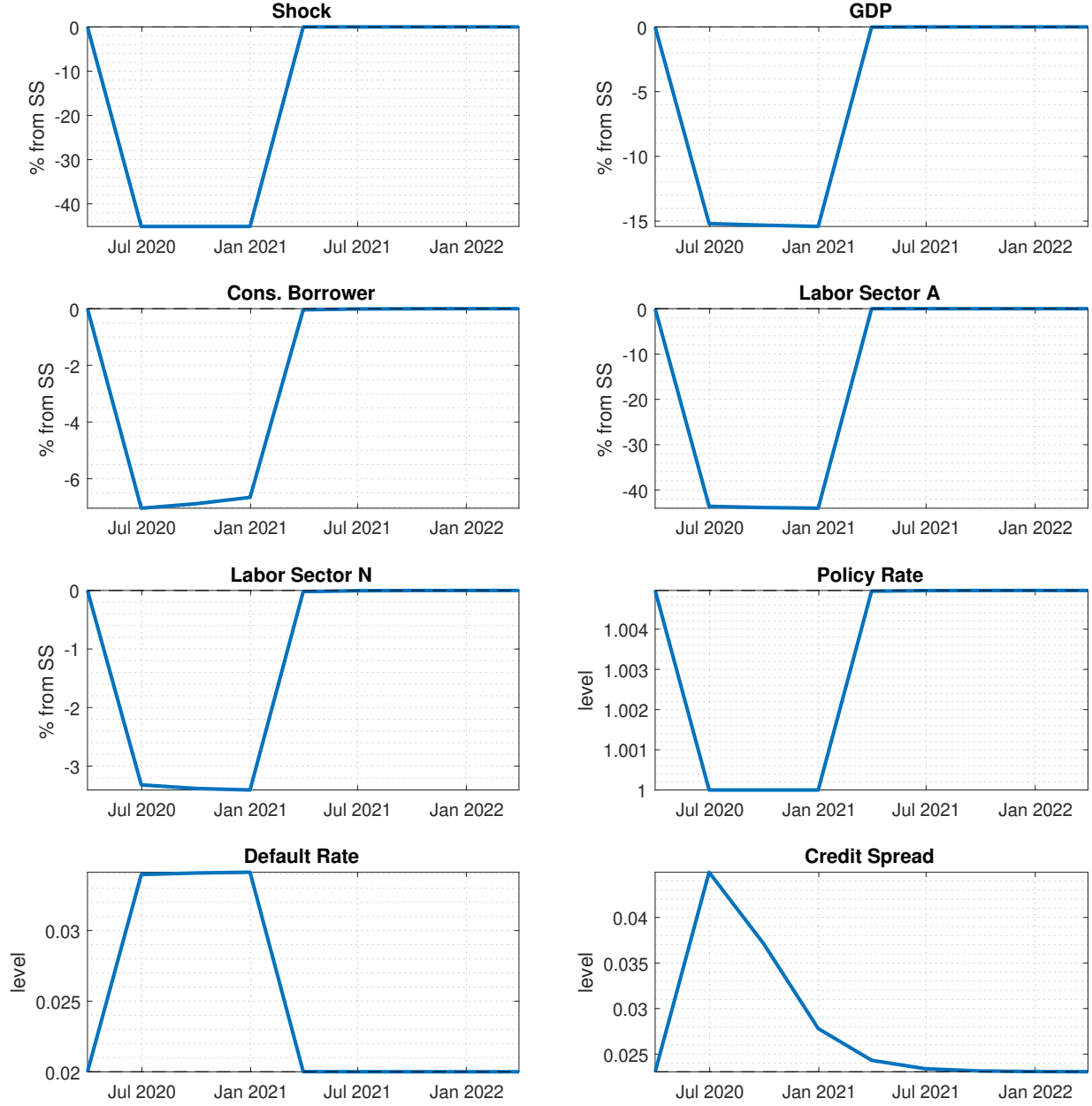


Figure 1: Response to a 60% negative shock to  $\alpha_t$  that lasts for 3 quarters and has zero persistence.

## 4 Fiscal Policy Response to the Pandemic

I consider, separately, the effects of deploying the following instruments:

- Increase in government consumption in sector  $n$ ,  $G_t$
- Labor income tax cut,  $\tau_t^l$

- Increase in unemployment insurance,  $ui_t$
- Unconditional transfers to all agents,  $T_t^b$
- Transfers to service sector firms,  $T_t^a$

In all cases, I consider a one-time impulse with zero persistence for each instrument. The impulse arrives at the beginning of 2020Q2, as the pandemic starts. This is a very rough and simplistic exercise, but the point is to try to isolate the different effects of these policies. A richer analysis would consider policy packages consisting of multiple instruments, and more persistent policies. That is work in progress.

The model responses are nonlinear, and computed with perfect foresight. This means that shocks are completely unanticipated, but once they hit, their path is perfectly anticipated.

I choose the impulses so that the resulting deficits are somewhat comparable, of similar magnitudes. I focus on packages that involve an increase in the deficit on impact of \$1 trillion, or roughly 5% of GDP. The size and intensity of the interventions certainly matters, since the model features nonlinearities such as the zero lower bound. A deeper exploration into the ideal size of each impulse is left for further research. At the end of this section, I present tables with present-value fiscal multipliers, which partly account for differing sizes of the interventions.

Next, I describe in more detail the effects of these policies. Many of them generate similar effects from a qualitative perspective. The quantitative effects are different, however. For a summary of the quantitative effects, feel free to skip to the next section where I compare measures of fiscal multipliers.

## 4.1 The Effects of Different Policies

**Government Consumption of Non-Services** This is comparable to the traditional increase in  $G_t$  in one-sector New Keynesian models. I assume that it is not feasible for the government to purchase services directly: this would be roughly equivalent to a transfer to those firms, which is considered separately.

Figure 2 plots the effects of this policy on selected variables. The blue line corresponds to the crisis absent intervention (as in Figure 1), while the orange line includes the intervention. The key effect of the policy is seen in the 5th panel: a large increase in government consumption helps sustain employment in the non-service sector. This, in turn, moderates somewhat the drop in borrower consumption and in GDP. Finally, the fact that employment does not fall by as much also helps contain default rates and, via the banking system, credit spreads.

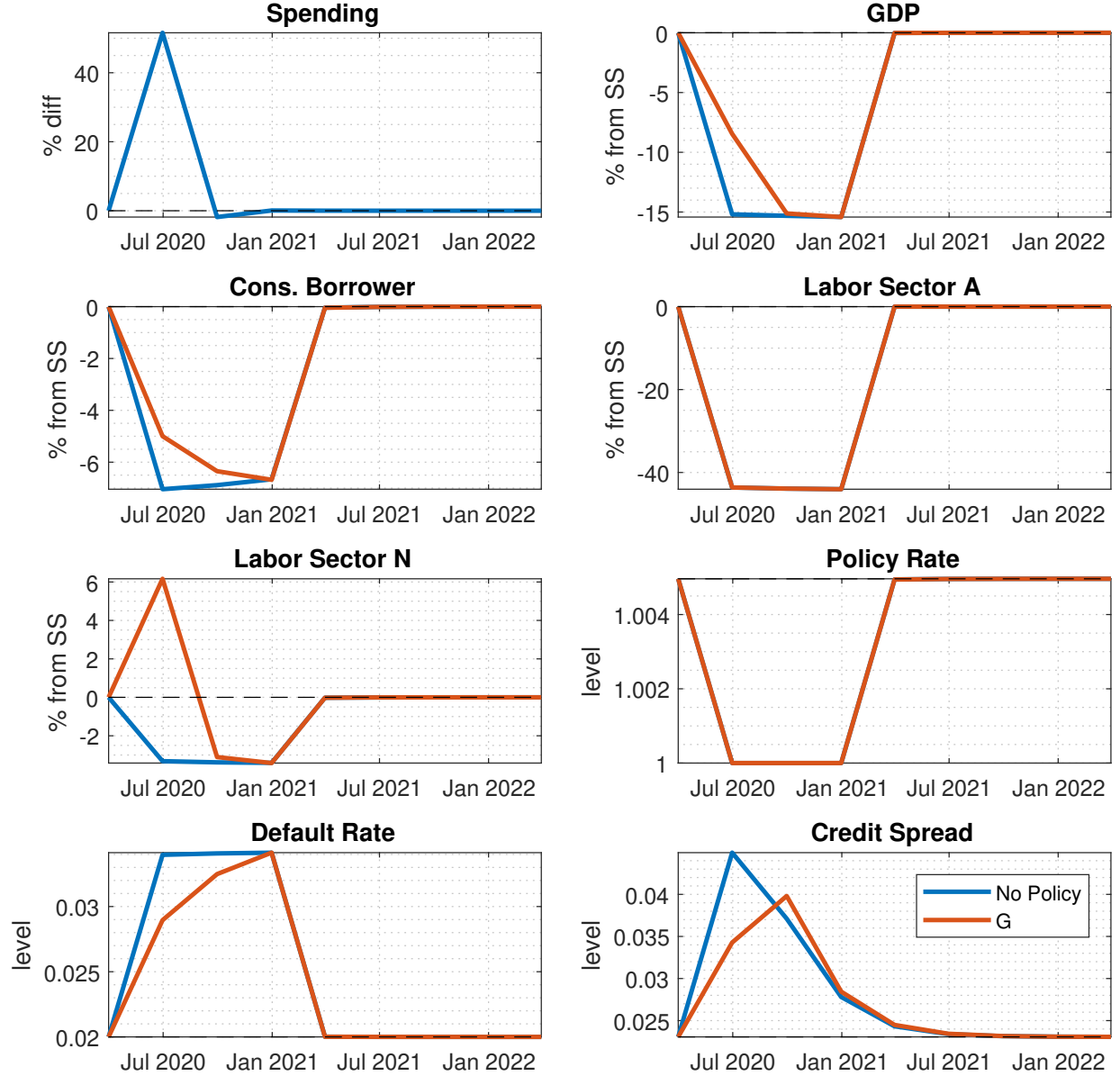


Figure 2: Response to a ~\$200 bn increase in  $G_t$ , government consumption of non-service goods.

**Labor Income Tax Cuts** To achieve a total deficit of the same size, the intervention consists of a one time tax cut of 50%, i.e. the tax rate is cut by half. The effects of the income tax cut look relatively similar, in Figure 3, with the main exception being that they do not stimulate labor in the non-service sector by as much as the more targeted policy of government consumption. Tax cuts still help sustain borrower income, which in turn results in a slightly lower drop in GDP and a decrease in default rates. One important thing to notice is that this model may underestimate the effectiveness of tax cuts: due to the assumption of labor market rationing, there are no direct benefits from removing labor market distortions.



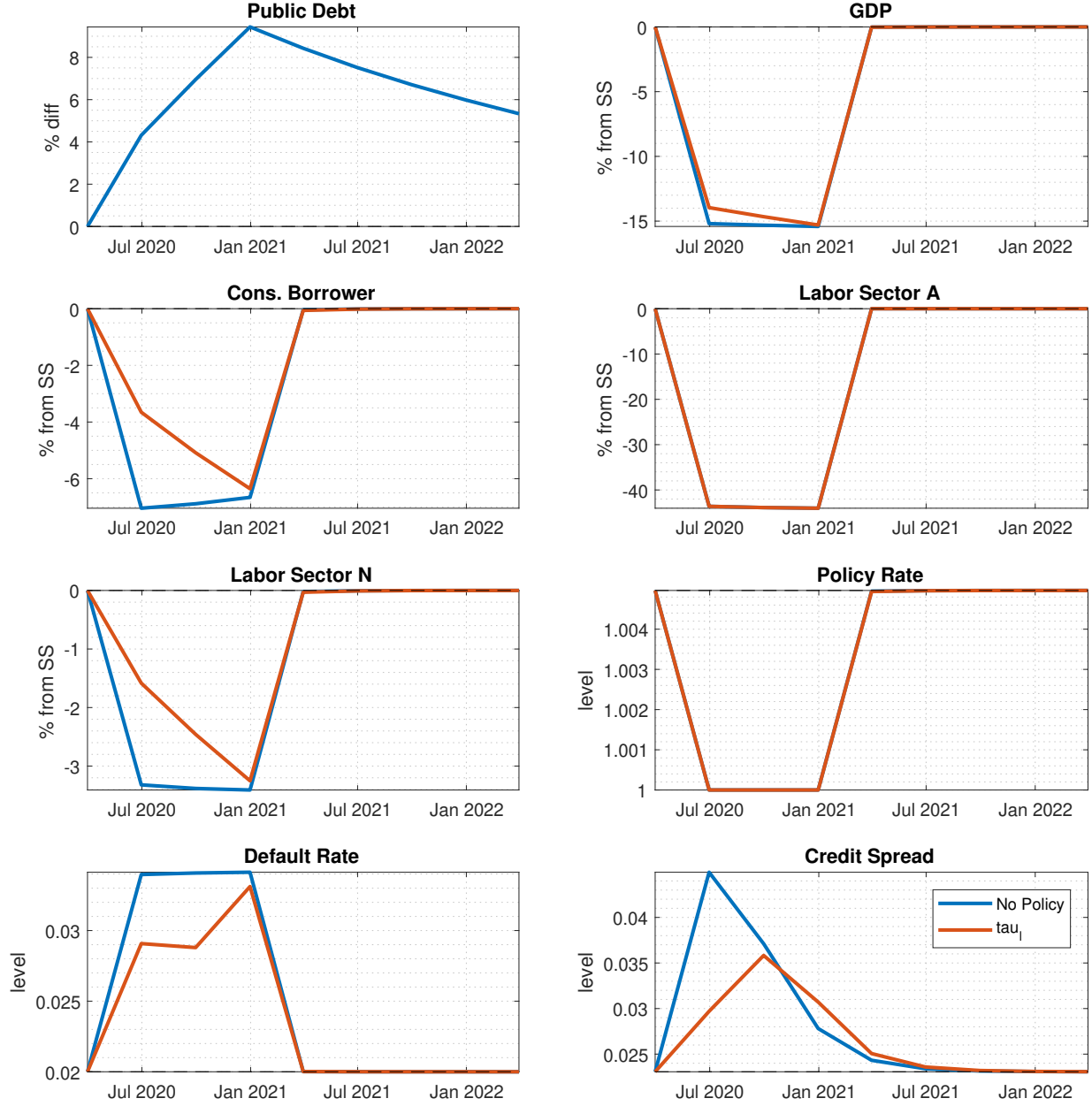


Figure 3: Response to a ~\$200 bn income tax cut.

**Unemployment Insurance** Next, we consider a one-time increase in unemployment insurance payments. To achieve a \$200 bn intervention, unemployment insurance transfer per agent is raised by 75%. The effects are noticeably larger on borrower consumption as seen in Figure 4, which is now sustained on impact. This is somewhat predictable: income tax cuts benefit agents who remain employed, at a time when a large fraction of agents become unemployed. With unemployment insurance, it's the opposite: it helps unemployed agents at a time when a large fraction of agents becomes unemployed. The rise in borrower con-



**Unconditional Transfers** Figure 5 plots the effect of a transfer that is given to everyone in this economy, including savers. The effects are similar to those of the payroll tax cut, which is not surprising as the incidence is effectively the same.

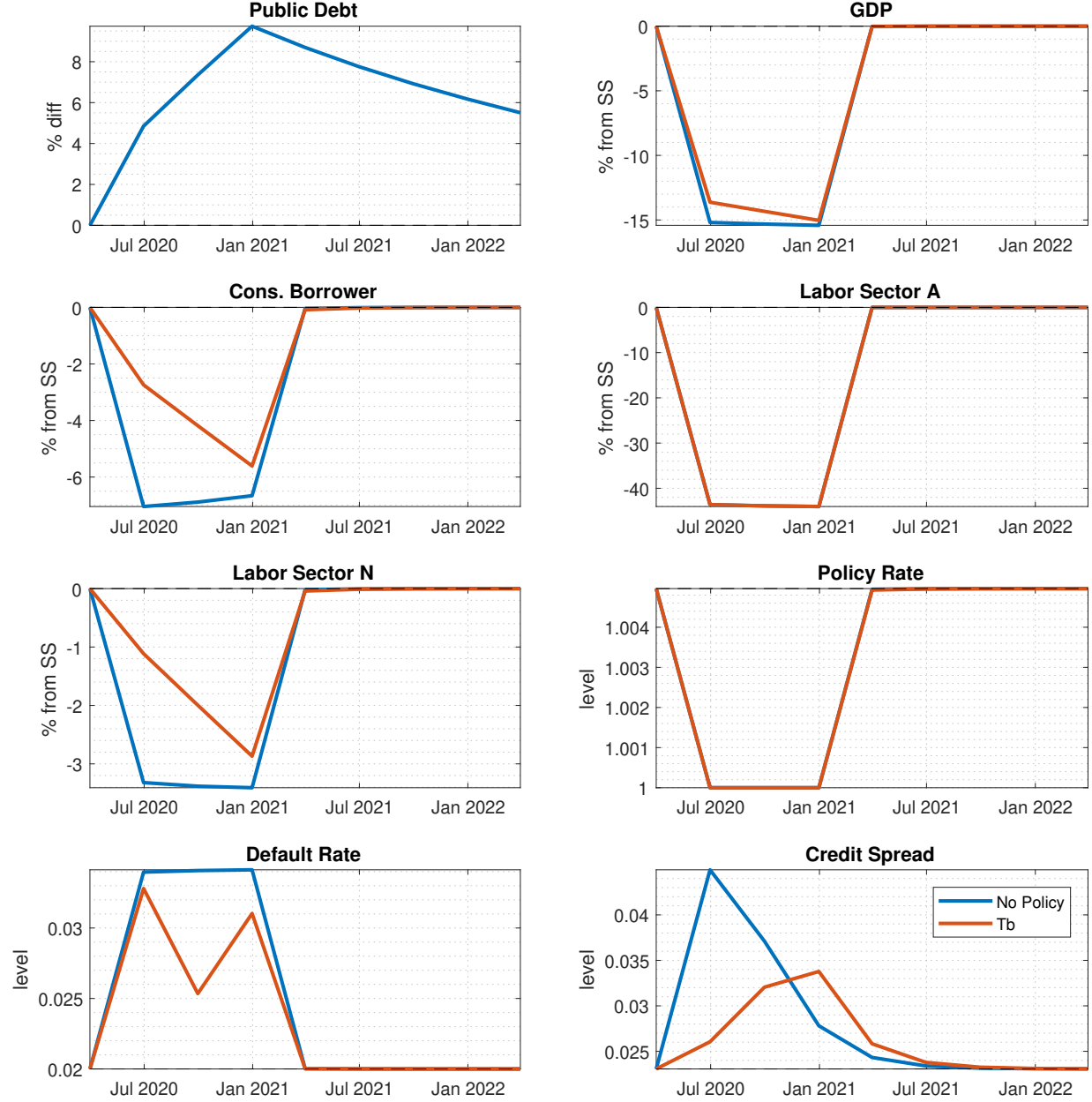


Figure 5: Response to a ~\$200 bn unconditional transfer.

**Liquidity Assistance to Service Firms** Figure 6 shows the effects of a per-wage subsidy to firms in the service sector. Unlike other interventions, this one is able to reduce the decline in service employment for one period. The GE effects are reflected in borrower consumption and labor in the no-service sector. This experiment is not totally fair to this policy, to the

extent that this is the only policy that explicitly targets the  $a$ -sector, but does so for only one period, while agents expect the negative demand shock to last for an extra two periods. The remaining two periods without assistance affect the value of service firms,  $V_t(A_t)$ , which does not rise by as much as it would should the assistance last for the duration of the pandemic.

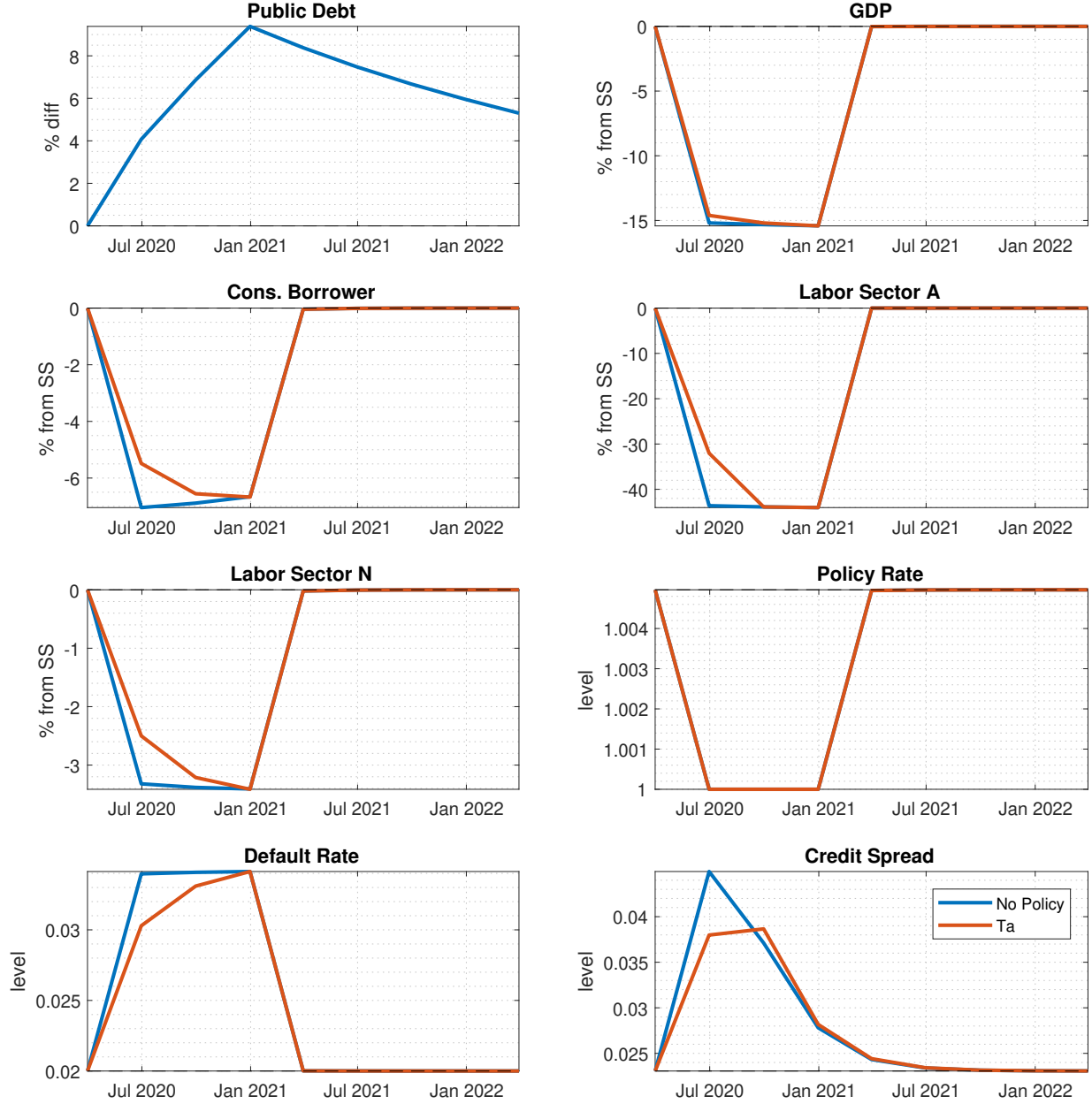


Figure 6: Response to a ~\$200 bn transfer to service firms.

## 4.2 Fiscal Multipliers

While the sizes of the interventions are calibrated to be of around \$200 bn, or 5% of total GDP, there are dynamic and general equilibrium effects that influence the path of government expenditure and revenue, and that differ across instruments. One common way to control for these effects, along with the size of the intervention, is to compute present value discounted multipliers as in [Mountford and Uhlig \(2009\)](#) or [Ramey \(2011\)](#),

$$\mathcal{M}_T(\omega) = \frac{\sum_{t=1}^T \prod_{j=1}^t R_j^{-1} (\text{GDP}_t^{\text{Stimulus}} - \text{GDP}_t^{\text{No Stimulus}})}{\sum_{t=1}^T \prod_{j=1}^t R_j^{-1} (\text{Spending}_t^{\text{Stimulus}} - \text{Spending}_t^{\text{No Stimulus}})}$$

The multiplier is computed for a given instrument  $\omega \in \{G_t, \tau_t^l, \text{ui}_t, T_t^b, T_t^a\}$  and at a given horizon  $T$ . Since the effects of shocks are not very persistent in this model, I set  $T$  equal to 20 quarters. Since the discount rate  $R_j$  differs across the economies with stimulus and no stimulus, it is not obvious which one to use. I use the interest rate in the no stimulus economy so as to keep the comparison between different tools as fair as possible.

Instrument	Description	$\mathcal{M}_{20}(\omega), \text{GDP}$	$\mathcal{M}_{20}(\omega), C_t^b$	$\mathcal{M}_{20}(\omega), C_t^s$
$G$	Govt. Consumption	1.1555	0.3108	0.0001
$\tau_t^l$	Income Tax	0.6215	1.2412	0.0009
$\varsigma$	UI	0.7281	1.4568	-0.0002
$T_t^b$	Uncond. Transfer	0.5834	1.1647	0.0011
$T_t^a$	Liquidity Assist.	0.2062	0.4030	0.0001

Table 2: Fiscal multipliers.

Table 2 compares multipliers for GDP, borrower consumption, and saver consumption of non-service goods. The measure that yields the largest GDP multiplier is government consumption. It is well known that it is “hard to beat” government consumption in this class of models ([Oh and Reis, 2012](#)), especially in the absence of very strong links between the balance sheets of households and the financial system. Income tax cuts, increases in unemployment insurance and unconditional transfers all deliver somewhat similar results. UI performs the best as it is the most well-targeted, while unconditional transfers perform the worst of those three as it is the least well-targeted. Liquidity assistance to firms seems to be the worst-performing policy, subject to the caveats pointed out in the previous subsection.

It is also interesting to look at the effects of fiscal policy on (non-service) consumption of different agents. Savers react relatively little to fiscal policy as they are unconstrained. Savers are “Ricardian”, in the sense that they purchase public debt and pay lump-sum taxes,

and therefore react to changes in the present value of government liabilities. Note however that the GE effects are strong enough to offset the usual fall in consumption for savers. Naturally, they react more positively to the unconditional transfer, and more negatively to the increase in unemployment insurance, which is the closest instrument to a targeted transfer to borrowers in this environment.

When it comes to borrowers, the most effective policy by far is UI. As argued above, it is the most well-targeted policy for borrowers, as it arrives at a time when unemployment surges. Income tax cuts and unconditional transfers are also effective, but less so as they are less well-targeted. Borrowers also benefit from liquidity assistance to firms, as this helps sustain employment in the service sector. Finally, purchases of non-service goods have the least impact on borrower consumption.

### 4.3 Liquidity Assistance and the Elasticity of Intertemporal Substitution of Services

Perhaps surprisingly, liquidity assistance policies to the services sector yield the lowest multipliers among the instruments considered, both in terms of GDP and borrower consumption. This is related to the price-elasticity of demand for services, which in turn is determined by the parameter  $\sigma_a$ . To understand why this is the case, consider the market clearing condition for services

$$\left[ \alpha_t \frac{(C_t^s)^\sigma}{p_t^a} \right]^{1/\sigma_a} = G \left\{ \underbrace{p_t^a A_t - w_t^a + T_t^a w_t^a + FV_t}_{=\bar{c}_t} \right\} \quad (1)$$

where  $FV_t$  is the expected continuation value of a services producer. Consider a positive change in liquidity assistance  $\Delta T_t^a > 0$  for a given  $\alpha_t$ . Everything else constant, this raises the value of the firm  $\Delta \bar{c}_t > 0$ , which in turn leads to less default in the current period and a greater mass of firms operating,  $\Delta G_t^a > 0$ . This, however, lowers  $p_t^a$  in such a way that it offsets any increases in quantity, i.e. total value  $p_t^a A_t N_t^a$  increases by less. The value of  $\sigma_a$  determines by how much total value is offset. Applying the Implicit Function Theorem to 1, we can compute the derivative of the price with respect to the injection,

$$\frac{\partial p_t^a}{\partial T_t^a} = \frac{-g(\bar{c}_t)}{g(\bar{c}_t) + \frac{1}{\sigma_a} \frac{C_t^{\sigma/\sigma_a} \alpha_t^{1/\sigma_a}}{(p_t^a)^{1/\sigma_a + 1}}}$$

For the multiplier to be larger, this derivative should not be small in absolute value. Lower values of  $\sigma_a$  achieve this, as they make the price less responsive to quantities.

Table 3 reports values for the multipliers of liquidity assistance for different values of  $\sigma_a$ , showing the result: higher levels of EIS result in smaller price fluctuations and, therefore, in greater GDP and — via general equilibrium — consumption effects of this policy. While not reported, the multipliers for the other policies do not change much with different values of  $\sigma_a$ .<sup>4</sup> Lower values of  $\sigma_a$  invert the policy ranking, and make liquidity assistance the preferred policy in terms of both GDP and borrower consumption stabilization. The policy/crisis experiment for  $\sigma_a = 0.25$  is plotted in Figure 7, where the more sizable effects are evident.

$\sigma_a$	$\mathcal{M}_{20}(\omega)$ , GDP	$\mathcal{M}_{20}(\omega)$ , $C_t^b$	$\mathcal{M}_{20}(\omega)$ , $C_t^s$
0.25	2.3508	1.0711	-0.0478
0.50	1.1673	0.7192	-0.0001
0.75	0.5493	0.5145	-0.000
1.00	0.2062	0.4030	0.0001
1.50	-0.1661	0.2765	0.0000

Table 3: Fiscal multipliers for Liquidity Assistance as a function of  $\sigma_a$ .

<sup>4</sup>For each value of  $\sigma_a$ , I adjust the realization of the shock so that the fall in employment in the services sector is comparable across experiments.

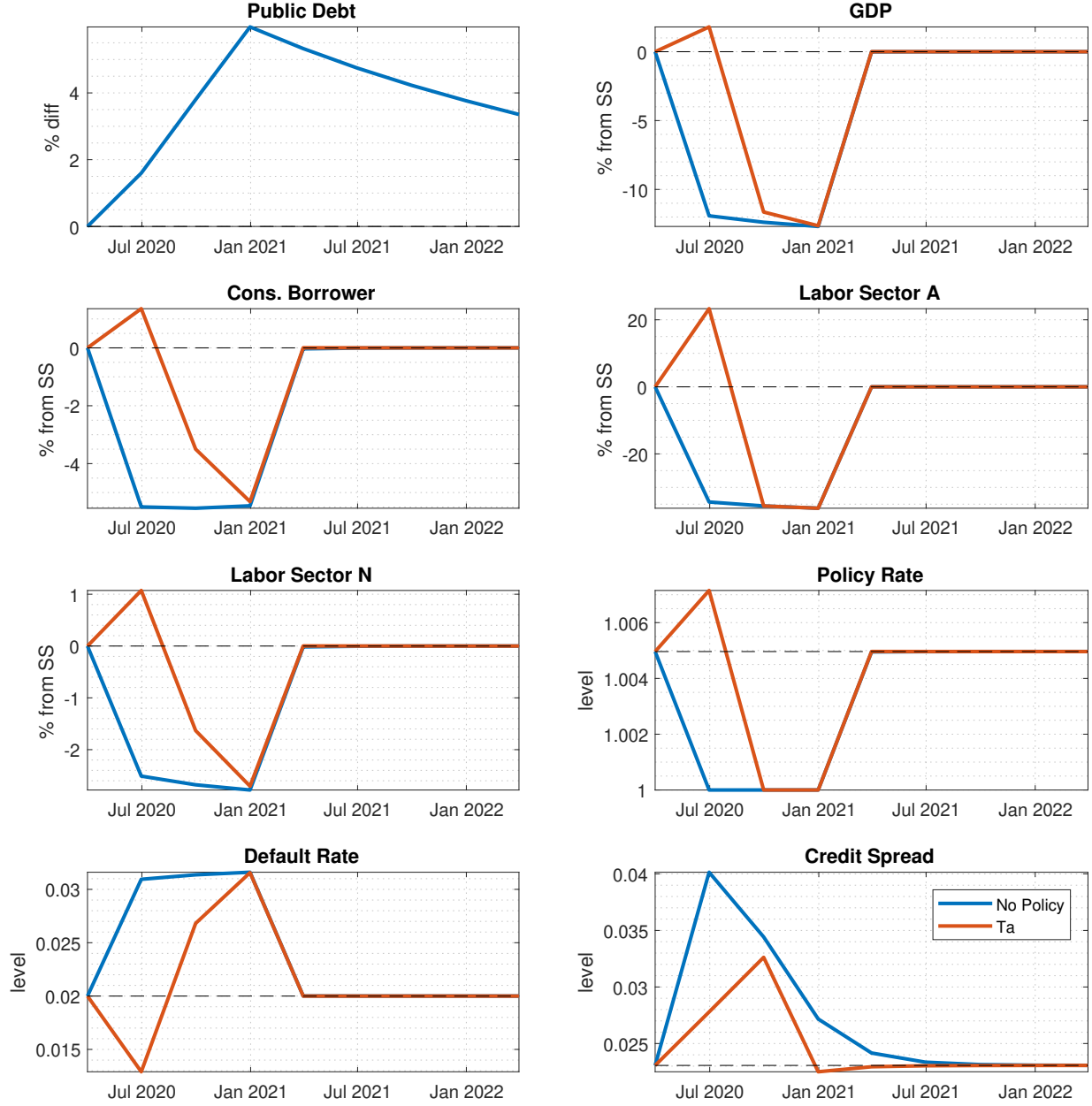


Figure 7: Response to a ~\$200 bn transfer to service firms,  $\sigma_a = 0.25$ .

Clearly, this parameter is crucial in determining the ranking of policies, either in terms of GDP impact or consumption stabilization. What is then a reasonable value for  $\sigma_a$ ? Interpreting the quarantine sector as a contact-intense services sector, it encompasses a wide variety of services, ranging from grocery shopping to restaurants or haircuts. Most types of shopping should have a relatively high EIS, i.e. it does not matter if they are done today or in the future. Many other services, however, should in principle have a low EIS: i.e., going to a restaurant on a date, going to the gym, etc. Ultimately, the ranking of the policies depends crucially on the “aggregate” EIS for the sector that is quarantined.



## 5 Caveats and Discussion

In the context of a simple DSGE model, and for an intervention of a fixed size equal to 5% of GDP, purchases of non-service goods seems to be the most effective tool (among those considered) to fight a pandemic that leads to a shutdown of the service sector. There is considerable variation in terms of the redistributive effects of different policies, however. An increase in unemployment insurance benefits seems to be the best targeted tool, if the objective is to stabilize consumption of less-well off agents. Unconditional transfers are likely to be less costly in terms of implementation and deliver somewhat similar (weaker) results. Liquidity assistance programs can be very effective, as long as the EIS of the quarantined sector is high.

The analysis in this note is very simple, takes many shortcuts, and abstracts from many important things. Many of these caveats were already mentioned in the main analysis, but are worth repeating. First, for the sake of comparison, I consider only one-time “fiscal impulses”. In practice, fiscal policy packages are likely to be persistent and implemented over a certain horizon. As discussed, this is especially important for the case of liquidity assistance to service sector firms, and potentially for unemployment insurance. Second, these impulses are of a fixed size. In practice, size does matter and multipliers can be nonlinear ([Brinca et al., 2019](#)). Third, I consider each policy separately, in single-instrument packages. There can be strong complementarities and substitutabilities between policies. In a previous paper ([Faria-e-Castro, 2018](#)), I argue that there were strong complementarities between financial sector bailouts and transfers to households during the 2008-09 Financial Crisis and subsequent recession. None of that is considered here. Fourth, the absence of an endogenous labor supply decision tends to underestimate the effects of an income tax cut and overestimate the effects of UI, as it does not consider the efficiency gains/losses from these policies. Fifth, the macroeconomic scenario caused by the pandemic is possibly too extreme, with a complete shut-down of the services sector for three full quarters, and a GDP contraction of 15% per quarter. I completely abstract from the possibility that fiscal policy can be deployed to reduce the duration and intensity of the shock caused by the pandemic. Finally, I also abstract from the fact that stimulating economic activity may actually be *detrimental* in fighting the pandemic.

There are also other important caveats that were not previously discussed. There are implementation lags that can be made worse by attempts to better target policies. Better targeted policies may additionally entail extra costs associated with bureaucracy. It may sometimes be better to undertake a slightly worse policy whose implementation requires less information and time, i.e. unconditional transfers vs. expansion of unemployment insurance

eligibility. Also, I completely abstract from other potential policies that have been part of the debate: the role of state fiscal policy, health insurance, debt forgiveness and restructuring, moratoria on debt (and bill) repayments, etc. For a detailed discussion of some of these policies, see [Dupor \(2020\)](#).

Household-banking interactions are extremely simplified and abstract from many important feedback effects. In particular, I abstract from endogenous collateral, which can have a large effect on the consumption response to shocks and stimuli. As I show in previous research, many interventions that look like transfers to borrowers serve as implicit recapitalizations of the banking system, and can have very strong spillovers to other sectors. For this reason, I am likely understating the effects of this type of interventions. Finally, I abstract from any direct intervention in the financial system. This is the main reason why I abstract from unconventional monetary policy as well as the extraordinary measures taken by the Federal Reserve to restore confidence in financial markets. I also abstract from linkages between the financial system and the corporate sector. These are likely to be very important, especially at a time when corporate debt is at unprecedented levels in the US. This would be a natural first step in terms of extending the model.

## References

- BAAS, T. AND F. SHAMSAKHR (2017): “Times of crisis and female labor force participation-Lessons from the Spanish flu,” .
- BARON, M. (Forthcoming): “Countercyclical Bank Equity Issuance,” *Review of Financial Studies*.
- BRINCA, P., M. F. E CASTRO, M. H. FERREIRA, AND H. HOLTER (2019): “The Nonlinear Effects of Fiscal Policy,” Working Papers 2019-15, Federal Reserve Bank of St. Louis.
- CHRISTIANO, L., M. EICHENBAUM, AND S. REBELO (2011): “When Is the Government Spending Multiplier Large?” *Journal of Political Economy*, 119, 78 – 121.
- CHRISTIANO, L. J., M. S. EICHENBAUM, AND M. TRABANDT (2016): “Unemployment and Business Cycles,” *Econometrica*, 84, 1523–1569.
- DRAUTZBURG, T. AND H. UHLIG (2015): “Fiscal Stimulus and Distortionary Taxation,” *Review of Economic Dynamics*, 18, 894–920.
- DUPOR, B. (2020): “Possible Fiscal Policies for Rare, Unanticipated, and Severe Viral Outbreaks,” *Economic Synopses*, 1–2, federal Reserve Bank of St. Louis.
- FARIA-E-CASTRO, M. (2018): “Fiscal Multipliers and Financial Crises,” Working Papers 2018-23, Federal Reserve Bank of St. Louis.
- FORNARO, L. AND M. WOLF (2020): “Covid-19 Coronavirus and Macroeconomic Policy:Some Analytical Notes,” CREI/UPF and University of Vienna.
- GERTLER, M. AND P. KARADI (2011): “A model of unconventional monetary policy,” *Journal of Monetary Economics*, 58, 17–34.
- LEEPER, E. M., M. PLANTE, AND N. TRAUM (2010): “Dynamics of fiscal financing in the United States,” *Journal of Econometrics*, 156, 304–321.
- MCKAY, A. AND R. REIS (2016): “Optimal Automatic Stabilizers,” Discussion Papers 1618, Centre for Macroeconomics (CFM).
- MOUNTFORD, A. AND H. UHLIG (2009): “What are the effects of fiscal policy shocks?” *Journal of Applied Econometrics*, 24, 960–992.
- OH, H. AND R. REIS (2012): “Targeted transfers and the fiscal response to the great recession,” *Journal of Monetary Economics*, 59, S50–S64.

- RAMEY, V. A. (2011): “Identifying Government Spending Shocks: It’s All in the Timing,” *Quarterly Journal of Economics*, 126, 1–50.
- ROTEMBERG, J. (1982): “Sticky Prices in the United States,” *Journal of Political Economy*, 90, 1187–1211.
- TAYLOR, J. B. (2018): “Fiscal Stimulus Programs During the Great Recession,” Economics Working Paper 18117, Hoover Institution.

## A Full List of Equilibrium Conditions

Borrowers ( $\lambda_t$  is the Lagrange multiplier on the borrowing constraint),

$$\begin{aligned}
\varepsilon_t^a &= \frac{B_{t-1}^b}{\chi \Pi_t} - w_t^a(1 - \tau_t^l) \\
\varepsilon_t^n &= \frac{B_{t-1}^b}{\chi \Pi_t} - w_t^n(1 - \tau_t^l) \\
\varepsilon_t^u &= \frac{B_{t-1}^b}{\chi \Pi_t} - \text{ui}_t \\
F_t^b &= N_t^a F^e(\varepsilon_t^a) + N_t^n F^e(\varepsilon_t^n) + (1 - N_t^a - N_t^n) F^u(\varepsilon_t^u) \\
m_{t+1}^b &\equiv \beta^b \frac{u'(C_{t+1}^b)}{u'(C_t^b)} \\
Q_t^b - \lambda_t &= \mathbb{E}_t \frac{m_{t+1}^b}{\Pi_{t+1}} (1 - F_{t+1}^b) \\
C_t^b + \frac{B_{t-1}^b}{\chi \Pi_t} (1 - F_t^b) &\leq (w_t^a N_t^a + w_t^n N_t^n) (1 - \tau_l) + (1 - N_t^a - N_t^n) \text{ui}_t + Q_t^b B_t^b / \chi + T_t^b \\
Q_t^b B_t^b \chi &\leq \Gamma \perp \lambda_t \geq 0
\end{aligned}$$

Banks ( $\mu_t$  is the Lagrange multiplier on the leverage constraint),

$$\begin{aligned}
\mathbb{E}_t \frac{m_{t+1}^s}{\Pi_{t+1}} (1 - \theta + \theta \Phi_{t+1}) \left[ \frac{1 - F_{t+1}^b}{Q_t^b} - \frac{1}{Q_t} \right] &= \mu_t \kappa \\
\mathbb{E}_t \frac{m_{t+1}^s}{\Pi_{t+1}} (1 - \theta + \theta \Phi_{t+1}) &= \Phi_t (1 - \mu_t) Q_t \\
Q_t^b B_t^b &= E_t + Q_t^d D_t \\
\kappa Q_t^b B_t^b &\leq \Phi_t E_t \perp \mu_t \geq 0 \\
E_t &= \Pi_t^{-1} \theta ((1 - F_t^b) B_{t-1}^b - D_{t-1}) + \varpi
\end{aligned}$$

Savers,

$$m_{t+1}^s \equiv \beta^s \frac{u'(C_{t+1}^s)}{u'(C_t^s)}$$

$$Q_t = \mathbb{E}_t \frac{m_{t+1}^s}{\Pi_{t+1}}$$

$$C_t^a = \left[ \alpha_t \frac{1}{p_t^a u'(C_t^s)} \right]^{1/\sigma_a}$$

Non-services sector,

$$\eta \frac{\Pi_t}{\Pi} \left( \frac{\Pi_t}{\Pi} - 1 \right) + \epsilon \left[ \frac{\epsilon - 1}{\epsilon} - \frac{w_t^n}{A_t} \right] = \eta \mathbb{E}_t m_{t+1}^s \frac{Y_{t+1}^n}{Y_t^n} \frac{\Pi_{t+1}}{\Pi} \left( \frac{\Pi_{t+1}}{\Pi} - 1 \right)$$

$$Y_t^n = A_t N_t^n \left[ 1 - 0.5 \eta \left( \frac{\Pi_t}{\Pi} - 1 \right)^2 \right]$$

$$C_t = C_t^s + C_t^b$$

$$C_t + G_t + \Psi(\bar{c}_t) = Y_t^n$$

$$w_t^n = \xi^n A_t (N_t^n)^\zeta$$

Services sector,

$$\bar{c}_t = A_t p_t^a - w_t^a + w_t^a T_t^a + \mathbb{E}_t m_{t+1}^s [G_{t+1}^a \bar{c}_{t+1} - \Psi[\bar{c}_{t+1}]]$$

$$N_t^a = G_t^a$$

$$G_t^a = \int_0^{\bar{c}_t} dG(c)$$

$$\Psi[\bar{c}_t] = \int_0^{\bar{c}_t} c dG(c)$$

$$w_t^a = \xi^a A_t (N_t^a)^\zeta$$

$$(1 - \chi) C_t^a = A_t N_t^a$$

Government and Central Bank

$$\begin{aligned}
& G_t + \frac{B_{t-1}^g}{\Pi_t} + (1 - N_t^a - N_t^n)u_t + T_t^b + T_t^a w_t^a G_t^a \\
& = (w_t^n N_t^n + w_t^a N_t^a) \tau^l + \tau^k [Y_t^n (1 - d_t) - w_t^n N_t^n + (p_t^a - w_t^a) N_t^a - \Psi(\bar{c}_t)] + Q_t B_t^g + T_t \\
& T_t = \left( \frac{B_{t-1}^g}{\bar{B}^g} \right)^{\phi_\tau} - 1 \\
& \frac{1}{Q_t} = \max \left\{ 1, \left( \frac{\Pi_t}{\bar{\Pi}} \right)^{\phi_\Pi} \left( \frac{p_t^a}{p_{t-1}^a} \right)^{\phi_a} \left( \frac{GDP_t}{\bar{GDP}} \right)^{\phi_{GDP}} \right\} \\
& GDP_t = Y_t^n + p_t^a Y_t^a
\end{aligned}$$

## B Model with Limited Entry

Instead of assuming that  $1 - G_t^a$  service firms enter the economy every period to replace firms that exit, the mass of entrants is limited by some parameter  $\varsigma$ . This means that the mass of service-sector firms in the economy is now a state variable, given by  $f_t$ . The law of motion for this state variable is

$$f_t = f_{t-1} G_t^a + \varsigma$$

and the labor market clearing condition for this sector is now given by

$$N_t^a = f_t$$

Finally, the resource constraint for the  $n$ -good is now given by

$$C_t + G_t + f_{t-1} \Psi[\bar{c}_t] = Y_t^n$$

Other than this, nothing else changes in the model. Figure 8 plots the crisis path in this alternative version of the model. Qualitatively, the main results hold, but the crisis is now more persistent due to the presence of this new slow-moving state variable. I set  $\varsigma = 2\%$  to match a business entry rate of 8% yearly. Table 4 presents the result for the fiscal multipliers of different instruments. While the numbers are different, the same qualitative analysis holds.

Instrument	Description	$\mathcal{M}_{20}(\omega)$ , GDP	$\mathcal{M}_{20}(\omega)$ , $C_t^b$	$\mathcal{M}_{20}(\omega)$ , $C_t^s$
$G$	Govt. Consumption	1.1540	0.3081	-0.0000
$\tau_t^l$	Income Tax	0.6152	1.2306	-0.0001
$\varsigma$	UI	0.7281	1.4568	-0.0004
$T_t^b$	Uncond. Transfer	0.5789	1.1576	0.0002
$T_t^a$	Liquidity Assist.	0.1758	0.5115	-0.0266

Table 4: Fiscal multipliers for model with limited entry.

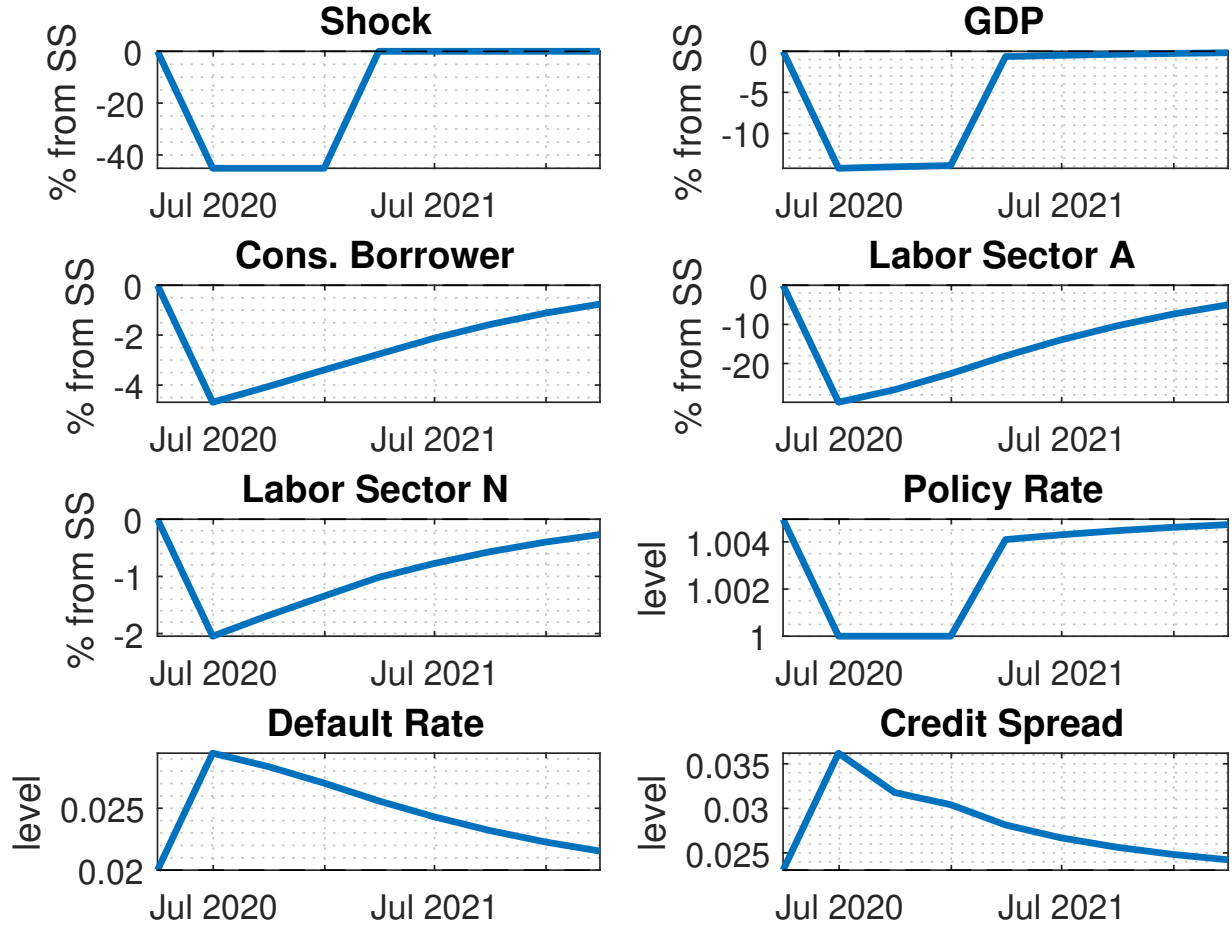


Figure 8: Pandemic crisis in the model with limited entry.