Multiplier and Inequality Effects of Money-financed Stimulus

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Abstract

In the paper, we analyse an alternative policy of financing government spending in light of the economic downturn caused by the COVID-19 pandemic, namely "money-financed stimulus". We compare the efficacy of this policy with a conventional debt-financed stimulus. We analyse the financial multiplier arising by pursuing both the policies. The highlight of our paper is that we estimate the inequality in society which results by following the two stimulus policies. Our model takes into account a segmented labour market i.e. a formal labour and an informal labour. Informal labour markets are an important feature of emerging market economies. It occupies a considerable share and is characterised by little or no access to the financial market, with consumption being driven only by labour income. In such a set-up we find support that a money financed stimulus has higher fiscal multiplier than a debt-financed stimulus. In other words, a money-financed stimulus leads to a sharp increase in output. However, money-financed stimulus causes a high inequality in the society resulting due to consumption disparity between the formal and informal labour. On the other hand, debt-financed stimulus reduces the inequality. Hence, money-financed stimulus is a double-edged sword for the policymakers.

Keywords:Government Spending, Fiscal Multiplier, Informal Labour, Inequality

JEL Codes: E31; E52; E62

Statements and Declarations

The author declares that there is no potential conflicts of interest. No funding from any authority was sought for this research. Additionally, the research doesn't involve any human subjects.

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1 Introduction

The COVID-19 outbreak and the consequent economic fallout has left policymakers scurrying for policy options. One of the lessons of the pandemic has been the limitations of monetary policy. Central banks globally reacted to the crisis by rapidly cutting interest rates, however, with interest rates in advanced economies hitting the zero bound quickly, many central banks found themselves running out of ammunition in the very early stages of the crisis. In the case of emerging economies, rising term spreads despite aggressive interest rate cutting rendered monetary policy practically ineffective.

The attention therefore, quickly shifted to fiscal policy to stimulate the economy. There are broadly two issues that are associated with the use of fiscal policy (1) the effectiveness of such a policy in stimulating output and (2) the financing of widening fiscal deficits as a consequence of such policies. The use of fiscal policy as a tool to mitigate the impact of adverse shocks has its intellectual foundations in Keynesian economics. The Keynesian view held that in the presence of unemployed resources, an increase in government expenditure would result in an increase in aggregate output through the multiplier process.

This has been contested by the neoclassical view, which argued that an increase in government dissavings not compensated by an increase in private savings would cause real interest rates to rise, thus hurting growth. There is also the "Ricardian equivalence" stream of thought which asserts that fiscal deficits have minimal real effects as they leave the budget constraint of the private sector largely unaltered.

On the issue of financing the fiscal deficit, the debate has largely centred around the use of bond versus money financing of the deficit. Blinder et al. (1973) in their seminal work used a simple IS-LM framework to compare the long-run effects of money vs. bond financing of the deficits. In this framework, they showed that while both money and bond-financed deficits were expansionary, the expansion was higher under the latter. These conclusions were challenged by Infante and Stein (1976) who raised concerns about the stability conditions in the model. Milton Friedman, in his seminal 1948 article, advocated the case for money financed deficits. Essentially, an expansionary fiscal policy financed by a "helicopter drop" of money could help stimulate aggregate demand by (1) facilitating public works spending (2) consumer spending through rebates (3) stimulating investment through a fall in real interest rates caused due to rise in expected inflation. Finally, unlike debt-financed fiscal programs, a money-financed program does not increase future tax burdens. While bond financing can also achieve (1) and (2), the higher expected future taxes due to increased interest burden might end up negating the impact of the fiscal stimulus through the Ricardian equivalence principle. The reason the money financing option has long been discarded is because of the fear of inflation that such a monetary expansion might generate. However, recently there has been some rethinking on this issue. Auerbach and Obstfeld (2005) show that trading money for interest-bearing debt reduces future debt service requirements and hence a reduction in future tax burdens.

More recently, Galí (2014, 2019) shows that the impact of money financed deficit on the real economy is critically dependent on nominal rigidities in the economy. In a model with flexible prices, a money financed deficit leads to a large increase in prices which hinders economic activity and lowers welfare. However, in a model where there is nominal price rigidity, a money financed fiscal expansion has strong positive effects on output and a limited impact on inflation. He goes on to show that in such a milieu, the fiscal multipliers under money financing are higher than those obtained under bond financing. Intuitively, the interest expenses arising due to a bond-financed expansion lead to increased taxes in the future and under the conventional Ricardian equivalence argument results in little impact on output. By contrast, in a model of nominal rigidities, the gradual increase in prices results in a rise in expected inflation under a money-financed expansion. This, in turn, causes real interest rates to fall and aggregate demand to rise, resulting in higher multipliers. In the case of a debt-financed stimulus operating under an inflation-targeting regime, the rise in real interest rates subdues aggregate demand resulting in smaller multipliers.

This paper uses the Galí (2014, 2019) framework to study money and a debt-financed stimulus both from a multiplier and inequality perspective. Our model is calibrated to standard parameters in the literature. We consider the case of a fiscal stimulus in the form of a temporary increase in government purchase and evaluate the policy under both bond and money financing. Consider first the case of a bond-financed regime with the monetary authority following a Taylor rule. The rise in inflation due to the rise in aggregate demand causes the inflation targeting monetary authority to respond by raising the interest rate. The rise in the real rates reduces the consumption of the Ricardian agents while leaving the Non-Ricardian agents unaffected. The crowding out of private consumption of the Ricardian agents, in turn, means that the size of the fiscal multiplier is reduced. On the other hand, the consumption of the Non-Ricardian agents is unaffected by monetary policy, and the rise in wage dues to the positive demand shock causes their consumption to rise. This results in consumption inequality under this regime to fall. The fall in inequality increases with the number of Non-Ricardian agents. This follows from the work of Galí et al. (2007) (GLV (2007) henceforth), who argue the presence of Non-Ricardian consumer helps to resolve the so-called Government-Spending Puzzle. Blanchard and Perotti (2002) in the context of US data, using a vector autoregression (VAR) model provide evidence to support that innovation in government spending leads to a persistent rise in private consumption. However, standard DSGE models are unable to replicate this feature of the data as typically government expenditure has a contractionary effect on consumption in these models. Essentially, the rise in real interest rates under an inflation targeting regime crowds out private consumption. GLV in their paper, however, show that the presence of Non-Ricardian agents who are unimpacted by monetary policy experience an increase in consumption due to the rise in wages that accompany the demand shock. Interestingly, the impact on inequality is also a function of the stickiness in wages of the Non-Ricardian agents. The more flexible are their wages, the greater is the reduction in inequality.

In the case of money financed deficit, the central bank responds to the higher spending by increasing the money supply. Under Calvo pricing, the gradual adjustment in prices means that expected inflation rises and the real interest rate falls in response to the monetary injection that accompanies the fiscal stimulus. The reduction in the real interest rate stimulates a large expansion of consumption for the Ricardian agents, which contrasts with the crowding out of that variable observed under bond financing. The rise in consumption of both the Ricardian and Non-Ricardian household results in a larger multiplier under this regime. However, the fall in the real interest rate under this regime results in a large increase in consumption of the Ricardian agents, which contributes to an increase in inequality.

The remainder of this paper is organized as follows. Section 2 describes the model framework. Section 3 details the parameters used for benchmark model. Section 4 presents and discusses the results, and Section 5 concludes.

2 Model Framework

Our model extends the New Keynesian model with wage and price rigidity along with differentiated households to provide an analysis of the effects of a money-financed and debt-financed fiscal stimulus. For simplicity, we restrict the analysis to a closed economy with no endogenous capital accumulation. The Ricardian households have access to the financial market. Non-Ricardian households can use only monetary holdings to transfer resource intertemporally. The government is responsible for both fiscal and monetary policy.

2.1 The Fiscal and Monetary Policy Framework

In our model government combines both fiscal and monetary policy, and operates them in a coordinated manner. The government finances its expenditures through: (a) issuing of nominally riskless one-period bonds (B_t) with a nominal interest rate i_t and (b) issuing of money (M_t) (non-interest rate bearing). The consolidated budget constraint of the government is given by

$$P_t G_t + B_{t-1}(1 + i_{t-1}) + M_{t-1} = B_t + M_t \tag{1}$$

where, G_t is the real purchases of government.

In real terms,

$$G_t + \frac{\tilde{B_{t-1}}(1 + i_{t-1})}{\pi_t} = \tilde{B}_t + \frac{\Delta M_t}{P_t} \tag{2}$$

We write $\frac{B_t}{P_t}$ as $\tilde{B}_t$, which is the outstanding real debt, π_t is the inflation rate, and $\frac{\Delta M_t}{P_t}$ is the period $t's$ seigniorage.

At steady state with zero inflation, no trend growth, and constant government purchases G, and debt B, the government budget constraint (2) gives

$$G + \tilde{B}(1 + i) = \tilde{B} \tag{3}$$

We approximate a first-order level of seigniorage around the steady state using the work of Galí (2019). Below, we briefly summarise the derivation. The level of seigniorage around the steady state as a ratio of steady state output can be written as

$$\frac{\Delta M_t}{P_t}\frac{1}{Y} = \frac{\Delta M_t}{M_{t-1}}\frac{P_{t-1}}{P_t}\frac{M_{t-1}}{P_{t-1}}\frac{1}{Y}$$

$$\frac{\Delta M_t}{P_t}\frac{1}{Y} = \frac{\Delta M_t}{M_{t-1}}\frac{1}{\pi_t}\frac{L_{t-1}}{Y}$$

where $L_t \equiv \frac{M_t}{P_t}$ denotes real balances, and $\pi_t \equiv \frac{P_t}{P_{t-1}}$ denotes price inflation

$$\frac{\Delta M_t}{P_t}\frac{1}{Y} = \chi \Delta m_t \tag{4}$$

where $m_t \equiv log(M_t)$, and $\chi \equiv \frac{L}{Y}$ is the inverse income velocity of money, evaluated at the steady state. Intuitively, (4) tells us that level of seigniorage is proportional to money growth. However, we must note that it holds only up to a first order approximation.

Dividing (2) by steady state output, (Y), and using the above result in (4), we obtain

$$\frac{G_t}{Y} + \frac{\tilde{B_{t-1}}(1+i_{t-1})}{\pi_t Y} = \frac{\tilde{B}_t}{Y} + \chi \Delta m_t \tag{5}$$

We write the deviations of net government debt from their steady state values as a fraction of steady state output as $b_t \equiv (\tilde{B}_t - \tilde{B})/Y$. Similarly, deviations of government purchases from their steady state values as a fraction of steady state output can be written as $\hat{g}_t \equiv (G_t - G)/Y$. Taking a first-order approximation of the consolidated budget constraint (5) around the zero inflation steady state, gives the evolution of net government debt as

$$\hat{b_t} = \frac{1}{\beta} b(\hat{i}_{t-1} - \pi_t) + \hat{g}_t + \frac{1}{\beta}\hat{b}_{t-1} - \chi \Delta m_t \tag{6}$$

where, $\hat{i}_t \equiv log(\beta(1+i_t))$, $\pi_t \equiv p_t - p_{t-1}$. $b \equiv \frac{\tilde{B}}{Y}$ is the steady state ratio of net government debt to output.

For our study, we consider two monetary policy regimes. In money-financed stimulus, the government purchases is financed by money creation. While debt-financed fiscal stimulus is a conventional policy, where the fiscal authority issues debt in order to finance the stimulus.

1. **Money financing**: In periods of normalcy, the government purchases are constant and equal to G. However, in periods of downturn, like the current economic slowdown, there is an increase in expenditure from the normal times, i.e. $\hat{G}_t \equiv G_t - G$. This deviations is the "stimulus". We assume the stimulus as a fraction of steady state output and denoted by $\hat{g}_t \equiv (G_t - G)/Y$. It follows an exogenous process

$$\hat{g}_t = \rho_g \hat{g}_t + \epsilon_t^g \tag{7}$$

   where $\rho_g \in [0;1)$ is the persistence of the fiscal intervention. In the policy of money-financed stimulus an increase in government purchases is financed entirely through seigniorage. Formally,

$$\chi \Delta m_t = \hat{g}_t \tag{8}$$

   i.e., the growth rate of the money supply is proportional to the fiscal stimulus, inheriting the latter's exogeneity. By (6), the debt ratio evolves under this regime as

$$\hat{b_t} = \frac{1}{\beta} b(\hat{i}_{t-1} - \pi_t) + \frac{1}{\beta}\hat{b}_{t-1} \tag{9}$$

2. **Debt financing**: In a conventional debt-financed stimulus, the deficits incurred as a result of the fiscal stimulus are financed by the issuance of new debt. Under this policy regime, the debt ratio

evolves according to the equation

$$\hat{b_t} = \frac{1}{\beta} b(\hat{i}_{t-1} - \pi_t) + \hat{g}_t + \frac{1}{\beta}\hat{b}_{t-1} - \chi \Delta m_t \tag{10}$$

The interest rate rule followed by the central bank is given by

$$\hat{i_t} = \phi_\pi \pi_t \tag{11}$$

where, ϕ_π is weight of the central bank's response of inflation deviations from the zero long-term target.

2.2 Households

The economy consists of a continuum of infinitely lived households indexed by $i \in [0,1]$. A fraction s of households are Ricardian while the remaining fraction $(1-s)$ are Non-Ricardian.

We introduce a labour packer which hires Ricardian labour, n^f, and Non-Ricardian labour, n^i, to form a homogeneous labour service, h, and rents it to intermediate goods firms at wage rate, W_t. The labour aggregation takes in two stages. First, they use a common CES technology to produce Ricardian and Non-Ricardian type labour services.

$$sn_t^f = \left(\int_0^s n_t^f(j)^{\frac{\epsilon_w - 1}{\epsilon_w}} dj\right)^{\frac{\epsilon_w}{\epsilon_w - 1}}, \ (1-s)n_t^i = \left(\int_s^1 n_t^i(j)^{\frac{\epsilon_w - 1}{\epsilon_w}} dj\right)^{\frac{\epsilon_w}{\epsilon_w - 1}}$$

Labour packer minimizes costs and thus demand for individual variants are

$$n_t^f(j) = \left(\frac{W_t^f(j)}{W_t^f}\right)^{-\epsilon_w} sn_t^f, \ \ n_t^i(j) = \left(\frac{W_t^i(j)}{W_t^i}\right)^{-\epsilon_w} (1-s)n_t^i \tag{12}$$

where the wages to the labour service of the individual labour type are given by

$$W_t^f = \frac{1}{s^{\frac{1}{\varepsilon_w}}} \left(\int_0^s W_t^f(j)^{1-\varepsilon_w} dj\right)^{\frac{1}{1-\varepsilon_w}} \tag{13}$$

$$W_t^i = \frac{1}{(1-s)^{\frac{1}{\varepsilon_w}}} \left(\int_0^s W_t^i(j)^{1-\varepsilon_w} dj\right)^{\frac{1}{1-\varepsilon_w}}$$

In the second stage, the packer determines the demand for the aggregate amount of Ricardian and Non-Ricardian labour, respectively. Here, the packer aggregates Ricardian and Non-Ricardian labour using aggregation technology given in (14) to produce a composite labour service, h_t, defined as

$$h_t = (sn_t^f)^s((1-s)n_t^i)^{1-s} \tag{14}$$

where, s is share of the Ricardian labour. The cost minimization problem for the competitive packer involves minimizing the objective function below

$$\min_{n_t^f, n_t^i} W_t^f sn_t^f + W_t^i(1-s)n_t^i$$

subject to (14). Optimization yields the following labour demand function

$$n_t^f = \frac{W_t}{W_t^f} h_t \tag{15}$$

$$n_t^i = \frac{W_t}{W_t^i} h_t \tag{16}$$

where W_t is the aggregate wage in the economy.

For j^{th} Ricardian household, the utility function is given by

$$U_t^f = \mathrm{E}_0 \sum_{t=1}^{\infty} \beta^t \left[log(c_t^f(j)) + ln(l_t^f(j)) - \frac{n_t^f(j)^{1+\rho}}{1+\rho} \right] \tag{17}$$

where, ρ is inverse Frisch elasticity.

Similarly, the utility function for j^{th} Non-Ricardian household is given by

$$U_t^i = \mathrm{E}_0 \sum_{t=1}^{\infty} \beta^t \left[log(c_t^i(j)) + ln(l_t^i(j)) - \frac{n_t^i(j)^{1+\rho}}{1+\rho} \right] \tag{18}$$

where $c_t^f(j)$ and $c_t^c(j)$ are the consumption of Ricardian and Non-Ricardian agents, respectively. $l_t^k = \frac{M_t^k}{P_t}$, $k \in (f, i)$ denotes holdings of real money balances. As monopolistic competitors, both households choose their wage and supply differentiated labour to the labour packer, which then combines them into a uniform labour input for the intermediate firms.

Ricardian households have an equal share in intermediate goods firms and receive nominal dividends of Π_t, where Π_t is the per head profits from the intermediate sector. They can smooth consumption using a nominal one-period private discount bond, B_t, which pays a nominal interest rate, i_t, every period. Their budget constraint is therefore given by

$$c_t^f(j) + \frac{B_t}{P_t} + \frac{M_t^f(j)}{P_t} \leq \frac{W_t^f(j) n_t^f(j)}{P_t} + \frac{\Pi_t}{P_t} + \frac{M_{t-1}^f(j)}{P_t} + (1 + i_{t-1}) \frac{B_t}{P_t} \tag{19}$$

where P_t is the aggregate price index.

The Non-Ricardian households do not own shares in firms. They can only use money to transfer resources intertemporally. Thus, their budget constraint is given by

$$c_t^i(j) + \frac{M_t^i(j)}{P_t} \leq \frac{W_t^i(j) n_t^c(j)}{P_t} + \frac{M_{t-1}^i(j)}{P_t} \tag{20}$$

The Ricardian household maximizes its utility (17), subject to its budget constraint, (19) and labour demand (12). Its utility maximization problem is given by

$$\max_{c_t^f, B_t, W_t^f, l_t^f} L = \sum_{t=0}^{\infty} \beta^t \left[log(c_t^f(j)) + log(l_t^f(j)) - \frac{n_t^f(j)^{1+\rho}}{1+\rho} \right] + \\ \beta^t \eta_t^f \left[\frac{W_t^f(j) n_t^f(j)}{P_t} + \frac{\Pi_t}{P_t} + (1 + i_{t-1}) \frac{B_{t-1}}{P_t} + \frac{M_{t-1}^f(j)}{P_t} - c_t^f(j) - \frac{B_t}{P_t} - \frac{M_t^f(j)}{P_t} \right] \tag{21}$$

It is assumed that Ricardian labour is subject to nominal wage rigidity (of Calvo (1983)). Each period they are allowed to optimally adjust their wage with probability $(1-\theta_w^f)$. If not allowed to optimally adjust, their nominal wage must be kept fixed.

Let $\hat{c}_t^f \equiv log(c_t^f/c^f)$, $\hat{l}_t^f \equiv log(l_t^f/l^f)$, $\hat{w}_t^f \equiv log(w_t^f/w^f)$, and $\hat{i}_t \equiv log((1+i_t)\beta)$. The equilibrium FOCs for the Ricardian households around the steady state are given as follows.

$$\hat{c}_t^f = \hat{c}_{t+1}^f - (\hat{i}_t - \pi_{t+1}) \tag{22}$$

Equation 22 is the standard consumption Euler equation for the Ricardian household. Equation 23 is the money demand schedule.

$$\hat{l}_t^f = \hat{c}_t^f - \eta \hat{i}_t \tag{23}$$

where, $\eta = \frac{\beta}{1-\beta}$

The wage Phillips equation for the Ricardian household is

$$\pi_t^{wf} = \pi_{t+1}^{wf} - \frac{(1-\theta_w^f)(1-\beta\theta_w^f)}{\theta_w^f(1+\rho\epsilon_w)}\hat{\nu}_t^{wf} \tag{24}$$

where,

$$\pi_t^{wf} = \hat{w}_t^f + \pi_t - \hat{w}_{t-1}^f \tag{25}$$

$$\hat{\nu}_t^{wf} = \hat{w}_t^f - (-\hat{c}_t^f + \rho \hat{n}_t^f) \tag{26}$$

The Non-Ricardian household maximizes its utility, (18), subject to its budget constraint, (20) and labour demand, (12). The utility maximization problem for Non-Ricardian household gives

$$\max_{c_t^i, W_t^i, l_t^i} L = \sum_{t=0}^{\infty} \beta^t \left[log(c_t^i(j)) + log(l_t^i(j)) - \frac{n_t^i(j)^{1+\rho}}{1+\rho} \right] + \beta^t \eta_t^i \left[\frac{W_t^i(j) n_t^i(j)}{P_t} + \frac{M_{t-1}^i(j)}{P_t} - c_t^i(j) - \frac{M_t^i(j)}{P_t} \right] \tag{27}$$

Similarly, Non-Ricardian agent is also subject to nominal wage rigidity of the type Calvo (1983). Each period they are allowed to optimally adjust wages with probability $(1-\theta_w^i)$, failing which nominal wage must be kept fixed.

Again, $\hat{c}_t^i \equiv log(c_t^i/c^i)$, $\hat{l}_t^i \equiv log(l_t^i/l^i)$, $\hat{w}_t^i, and \equiv log(w_t^i/w^i)$. We obtain a similar set of first-order conditions for the Non-Ricardian households. Equation (28) is the money demand schedule and (29) is the wage Phillips equation.

$$\hat{l}_t^i = \hat{c}_t^i - \beta(\hat{c}_{t+1}^i + \pi_t) \tag{28}$$

$$\pi_t^{ic} = \pi_{t+1}^{ic} - \frac{(1-\theta_w^i)(1-\beta\theta_w^i)}{\theta_w^i(1+\rho\epsilon_w)}\hat{\nu}_t^{wi} \tag{29}$$

where,

$$\pi_t^{wi} = \hat{w}_t^i + \pi_t - \hat{w}_{t-1}^i \tag{30}$$

$$\hat{\nu}_t^{wi} = \hat{w}_t^i - (-\hat{c}_t^i + \rho \hat{n}_t^i) \tag{31}$$

2.3 Final Goods Firm

There is a final goods firm which aggregates the intermediate goods, $y_t(z)$, according to a CES technology and sells the composite good y_t in a perfectly competitive market. Formally, this can be represented by

$$y_t = \left(\int_0^1 (y_t(z))^{\frac{\varepsilon_p - 1}{\varepsilon_p}} dz \right)^{\frac{\varepsilon_p}{\varepsilon_p - 1}} \tag{32}$$

where $\varepsilon_p > 1$ is the elasticity of substitution of goods. The demand function of intermediate firm's products is given by:

$$y_t(z) = \left(\frac{P_t(z)}{P_t} \right)^{-\varepsilon_p} y_t \tag{33}$$

The aggregate price index P_t is given by:

$$P_t = \left(\int_0^1 (P_t(z))^{(1-\varepsilon_p)} dz \right)^{\frac{1}{1-\varepsilon_p}} \tag{34}$$

2.4 Intermediate goods sector

The intermediate goods sector is characterized by monopolistically competitive firms. Each intermediate goods firm produces a differentiated good $z \in [0, 1]$ using the production function

$$y_t(z) = h_t(z)^{1-\alpha} \tag{35}$$

where $y_t(z)$ is output, and $n_t(z)$ is the aggregate labour input to firm z. α is a production function parameter.

2.4.1 Marginal Cost

To obtain the marginal cost of intermediate goods firms, we perform the minimisation of its cost subject to the constraint of producing adequate amount of goods to meet demand. The cost minimization problem of the intermediate goods firm is

$$\min W_t h_t(z) \tag{36}$$

subject to (35). The marginal cost, $\nu_t^p(z)$, of the intermediate goods firm z is

$$\nu_t^p(z) = \frac{W_t}{(1-\alpha) h_t(z)^{-\alpha}} \tag{37}$$

2.4.2 Profit Maximisation

The intermediate goods' firms operate in monopolistic competition and are subject to staggered price setting as in Calvo (1983). A firm has to determine its demand for production factors and its price if allowed to set it. The probability of price adjustment is given at all time by $(1 - \theta_p)$. If not allowed to adjust its price a firm must keep the price unchanged. These firms maximize the discounted sum of real profits

$$\mathrm{E}_0 \sum_{t=1}^{\infty} \frac{\beta^t \eta_t}{P_t} \left[P_t(z) y_t(z) - W_t h_t(z) \right] \tag{38}$$

subject to the downward-sloping demand function of the final good producer. The first-order condition gives the standard price Phillips equation for the firm

$$\pi_t = \beta \pi_{t+1} + \frac{(1-\theta_p)(1-\beta\theta_p)}{\theta_p} \hat{\nu_t}^p \tag{39}$$

where, $\hat{\nu_t}^p = \hat{w}_t + \alpha \hat{h_t}$

2.5 Aggregation

We consider all firms and households to be similar and drop the j and z subscript. The aggregate money demand around the steady state is given as

$$\hat{l}_t = s\hat{l_t}^f + (1-s)\hat{l_t}^i \tag{40}$$

Similarly, aggregate consumption and labour can be written as 41, and 42, respectively.

$$\hat{c}_t = s\hat{c_t^f} + (1-s)\hat{c_t}^i \tag{41}$$

$$\hat{n}_t = s\hat{n_t^f} + (1-s)\hat{n_t}^i \tag{42}$$

In the above equations, s, is the share of Ricardian labour. The aggregate demand is a weighted sum of both Ricardian and Non-Ricardian agents.

The market clearing condition in given by

$$\hat{y}_t = \hat{c}_t + \hat{g}_t \tag{43}$$

2.6 Gini Index for Inequality

We use a consumption-based Gini index of inequality, given by

$$e_t = (1-s) - (1-s)\frac{c_t^i}{c_t} \tag{44}$$

where, $(1-s)$ is the share of the Non-Ricardian labour in the economy. Intuitively, for a given $\frac{c_t^i}{c_t}$, as the share of Non-Ricardian labour rises, the inequality rises. Also, for a given, $(1-s)$, as the consumption of Non-Ricardian labour goes up, inequality falls. The emerging economies, often present the case where the share of Non-Ricardian labour is very high. Hence, for reducing inequality, the focus of any stimulus policy should be to increase the consumption of the Non-Ricardian households.

2.7 Fiscal Multiplier

The effectiveness of an increase in government spending in stimulating output under the different stimulus policies is calculated using the cumulative output multiplier,
$(1 - \hat{g}_t)\sum_{t=0}^{\infty}(\hat{y}_t)$[1].

3 Numerical Analysis

The goal of the present study is not so much to offer a realistic quantitative analysis of the effects of a money-financed fiscal stimulus but to get a better understanding of its qualitative implications. We follow the literature for common parameters. For baseline calibration, the discount factor, β, is set to 0.99, implying a real interest rate of 2%. Using the share of regular labour as an indicator of Ricardian households, we set s to 0.72 in our baseline calibration. The inter-temporal elasticity of consumption, σ, is set to 1, implying a log consumption in the utility function. For baseline calibration the Calvo probability of price stickiness, θ_p, is 0.25. It is consistent with empirical evidence for India. For Ricardian labour, the Calvo parameter, θ_w^f, is set to 0.75 reflecting high wage rigidity, whereas for Non-Ricardian labour we set θ_w^i to 0.25 reflecting comparatively flexible wages. The difference in wage rigidity has support in literature which shows that Non-Ricardian labour is flexible labour, which is hired when needed and let go in times of downturn[2]. In the case of debt-financing, for the monetary policy rule, we set the elasticity of interest rates to inflation, ϕ_π, at 1.47 (Banerjee and Basu (2017)). We assume inverse of Frisch elasticity of labour supply of 2 (Banerjee and Basu (2017)). Parameter of α is set to 0.29. The persistence parameter, $\hat{g}_t$, of the government expenditure shock is chosen at 0.5 for baseline calibration. We set steady-state inverse income velocity of money (χ) and the interest semi-elasticity of money demand (η) to 1/3 and 6, respectively, following Galí (2019). The target debt ratio, b, is taken to be 2.4, again following Galí (2019). The calibration parameters are summarised in Table 1.

4 Results

We begin by first discussing the dynamic response of consumption, output, interest rate, inflation and inequality to a government expenditure shock of 1 standard deviation under the two stimulus regimes, namely, money-financed and debt-financed stimulus. We then compare the fiscal multipliers for different shares of Non-Ricardian labour and different values of the government expenditure shock persistence. Finally, we discuss the inequality which results in the economy by pursuing the different stimulus policies.

4.1 Impulse Response Functions

Figure 1 shows the IRFs for key variables under a 1 standard deviation of government expenditure shock. The persistence of the government expenditure shock for the plots is taken as 0.5. For money-financed

[1] Follow Galí (2014) for a detailed discussion of its derivation.

[2] Saha et al. (2013), Chaurey (2015).

stimulus, the consumption rises for both Ricardian and Non-Ricardian households. The output also rises sharply in response to the stimulus. The money supply increases in the short run as a result of the policy intervention; however, it decreases later during the adjustment process, with real rates coming back to steady state-values. In the case of a debt-financed stimulus, there is a very small rise in aggregate consumption driven by the rising consumption of Non-Ricardian labour. Under this policy, the central bank's focus on inflation stabilization leads to an interest rate response that strongly offsets the increase in aggregate demand triggered by greater spending.

The underlying mechanism is the changes in the real interest rate. In the case of money-financed stimulus, the expected inflation rises due to staggered pricing. Hence, the real interest rate falls, leading to a large increase in consumption for the Ricardian household compared to Non-Ricardian households. This leads to a rise in inequality. In the case of debt-financed stimulus, the real interest rises. The central bank responds to inflation by increasing the interest rate. The consequent rise in the real rates reduces the consumption of the Ricardian agents while leaving the Non-Ricardian agents unaffected. Non-Ricardian agents are unaffected by monetary policy and therefore, their consumption rises due to the rise in their wages on account of the positive demand shock. Hence, debt-financed stimulus leads to a fall in inequality.

4.2 Fiscal Multiplier

In Figure 2, we plot the fiscal multiplier under the two policies while varying the shares of Non-Ricardian households. Our objective here is to understand how the multiplier under the two regimes varies when we change the share of Non-Ricardian labour in the economy. Our results indicate that fiscal multipliers remain consistently higher under money-financed stimulus. Interestingly, we find that under a money-financed stimulus, the multiplier declines as the share of Non-Ricardian labour increases. It is almost halved when the share of Non-Ricardian labour is around 80% of the total workforce. On the other hand, the multiplier appears to rise slightly with the share of Non-Ricardian labour, under a debt-financed stimulus. Intuitively, under a money-financed stimulus, the reduction in the real interest rate stimulates a large expansion of consumption for the Ricardian agents, which in turn drives up aggregate consumption. With the rise in Non-Ricardian agents, this effect is diminished, contributing to the fall in the multiplier. In case of debt-financed stimulus, the rise in the real rates crowds out consumption of the Ricardian agents. However, the rise in real wages due to the demand shock stimulates the consumption of the Non-Ricardian agents. This effect gets magnified with the rise in Non-Ricardian agents leading to a rise in the multiplier. In Figure 3, we plot the fiscal multiplier for increasing persistence of government purchasing shock. The share of Non-Ricardian labour is kept at the benchmark value. We notice that while the fiscal multiplier under debt finance remains largely unimpacted, under money finance it slightly decreases with an increase in the persistence of the shock. The findings from Figure 3 is similar for one obtained by Galí (2019).

4.3 Gini Index of Inequality

In this subsection, we plot the inequality arising from the two policies using a consumption-based inequality index. The results here are interesting and bring to light the inequality consequences of the two policies. It suggests that money-financed stimulus leads to higher inequality in the economy. Under money-financed stimulus, the rise in inequality is caused due to a steep rise in the consumption of Ricardian households due to a fall in the real interest rates. In Figure 4, we see that higher the share of Non-Ricardian agents, higher is the inequality. On the other hand, Figure 5 shows that debt-financed stimulus leads to a fall in inequality. In case of a debt-financed stimulus, the consumption of the Non-Ricardian agents is unaffected by monetary policy. Due to the demand shock, their wages rise and hence, the consumption rises. The rise in real interest rates reduces the consumption of the Ricardian agents. Hence, the inequality falls. Taking different shares of Non-Ricardian households, we find that the results are robust, with debt-financing faring better in all the scenarios. This result points to the inference that although money-financed stimulus seems to do a better job in achieving higher fiscal stimulus, those gains are shadowed by increasing inequality in the economy. Although a conventional debt-financed stimulus fails to generate a high fiscal stimulus, it ensures that inequality in the economy falls.

Figure 6 presents the inequality response for varying persistence of government expenditure shock. It shows that inequality remains higher for money-financed stimulus compared to debt-financed stimulus. For money-financed stimulus, at higher persistence of the government expenditure shock, there is a sharp rise in inequality. The mechanism for the same can be attributed to changes in the real interest rate. For money-financed stimulus, the real interest rapidly falls as the persistence rises. This causes the consumption of the Ricardian agents to steeply rise compared to Non-Ricardian agents, hence increasing inequality. For the debt-financed stimulus, the increase in real interest rates limits the rise in consumption of the Ricardian agents. However, the rising real wages increases the consumption of the Non-Ricardian agents leading to declining inequality.

Figure 7 notes that inequality is a function of the stickiness of wages of the Non-Ricardian agents too. If their wages are flexible, then they rise steeply leading to higher consumption and hence a reduction in inequality. Consistent with this intuition, we observe in Figure 7 that as the wage stickiness of the Non-Ricardian labour rises, the inequality increases. The result is similar across both the regimes. However, for debt-financed stimulus, the inequality remains lower compared to money-financed stimulus.

5 Conclusion

In this paper, we analyse the policy of money-financed stimulus to finance government spending in light of unprecedented economic downturns. We compare it with conventional debt-financed stimulus. We compare the fiscal multipliers and inequality, which results from following two different stimulus policies. We find that money-financed stimulus generates higher fiscal multiplier compared to a debt-financed fiscal stimulus. The findings are robust for a varied share of Non-Ricardian agents. However, we do find that the fiscal multiplier from money-financed stimulus falls at a higher share of Non-Ricardian agents. The key point noted in this paper is that although one gains from a higher fiscal multiplier from a money-financed stimulus, it results in a higher inequality in the economy. A debt-financed stimulus lowers inequality. Inequality also depends on the wage stickiness of the Non-Ricardian labour. The more flexible their wages are, lower is the inequality. This result has important policy considerations, especially during an unprecedented economic crisis which requires innovative stimulus policies. The policymakers have to choose between a money-financed stimulus, which is a double-edged sword, or a conventional debt-financed stimulus, which would decrease inequality at the cost of a far lower fiscal multiplier.

Tables

Table 1

Parameters for Benchmark Model

Parameter description		Value	Source
Calvo probability of price stickiness	θ_p	0.25	Banerjee and Basu (2017)
Share of labour in production function	α	0.29	Annual Survey of Industries data
Discount factor	β	0.99	Real interest rate of 2%
Inter-temporal elasticity of consumption	σ	1	
Persistence of govt. expenditure shock	ρ_a	0.5	
Elasticity of Substitution among labour	ϵ_w	7	Laxton and Pesenti (2003)
Share of Ricardian households	s	0.72	Annual Survey of Industries data
Calvo probability of Ricardian labour stickiness	θ_w^f	0.75	
Calvo probability of Non-Ricardian labour stickiness	θ_w^i	0.25	
Inverse of Frisch elasticity	ρ	2	Banerjee and Basu (2017)
Inverse income velocity of money	χ	1/3	Galí (2019)
Interest rate semi-elasticity of money demand	η	6	Galí (2019)
Target debt ratio	b	2.4	Galí (2019)
Inflation coeff. in Taylor rule	ϕ_π	1.47	Banerjee and Basu (2017)

Figures

Figure 1

IRFs following a Govt. Expenditure Shock of 1σ

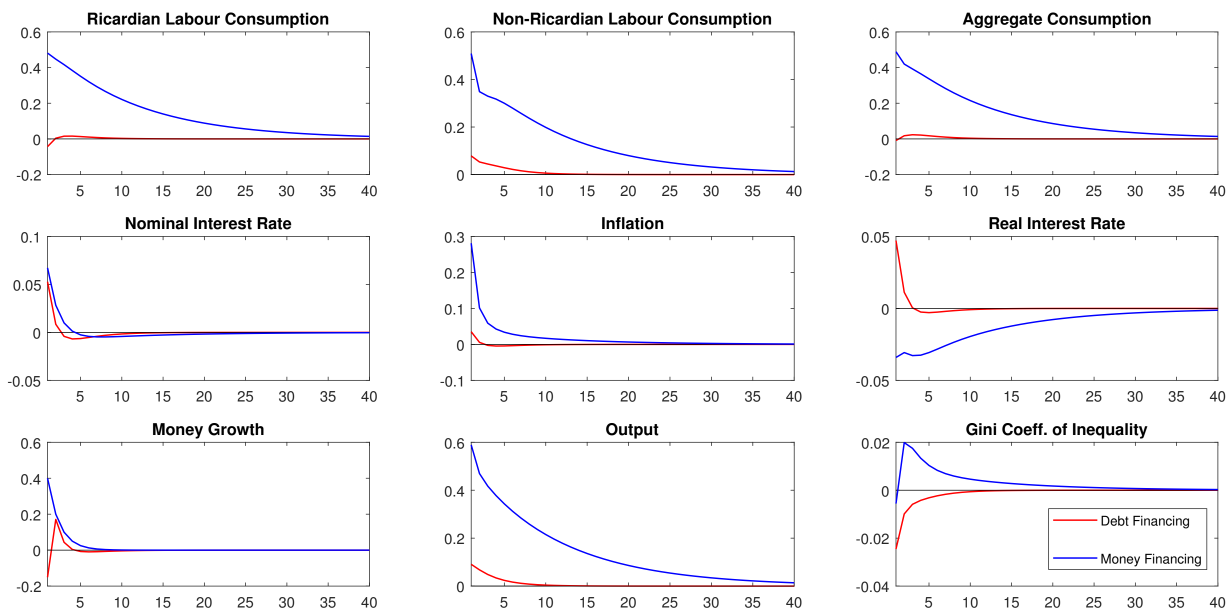


Figure 2

Fiscal Multiplier: Money-Financed and Debt-Financed Stimulus vs. Non-Ricardian Labour Share

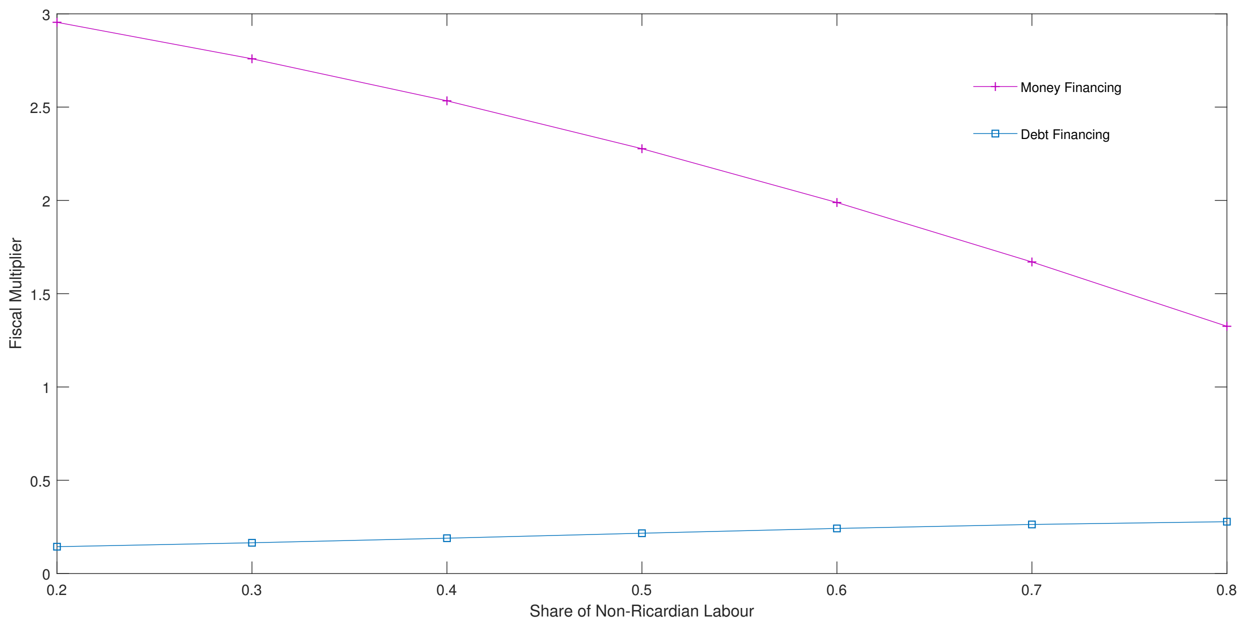


Figure 3

Fiscal Multiplier: Money-Financed and Debt-Financed Stimulus vs. Government Expenditure Shock Persistence

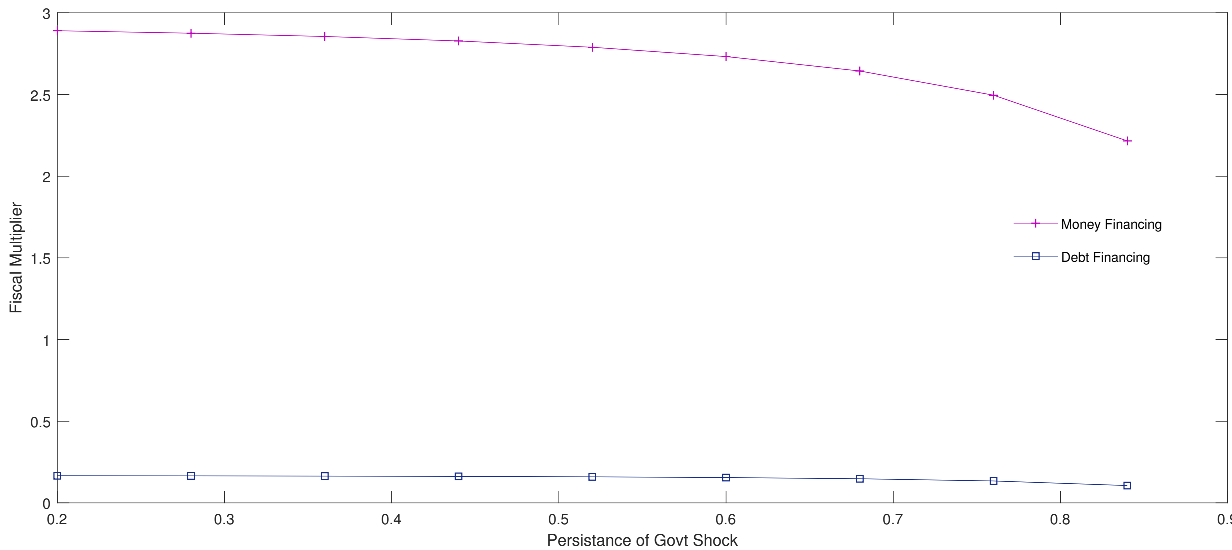


Figure 4

IRFs: Inequality in Money-Financed Stimulus for different Non-Ricardian Labour Share

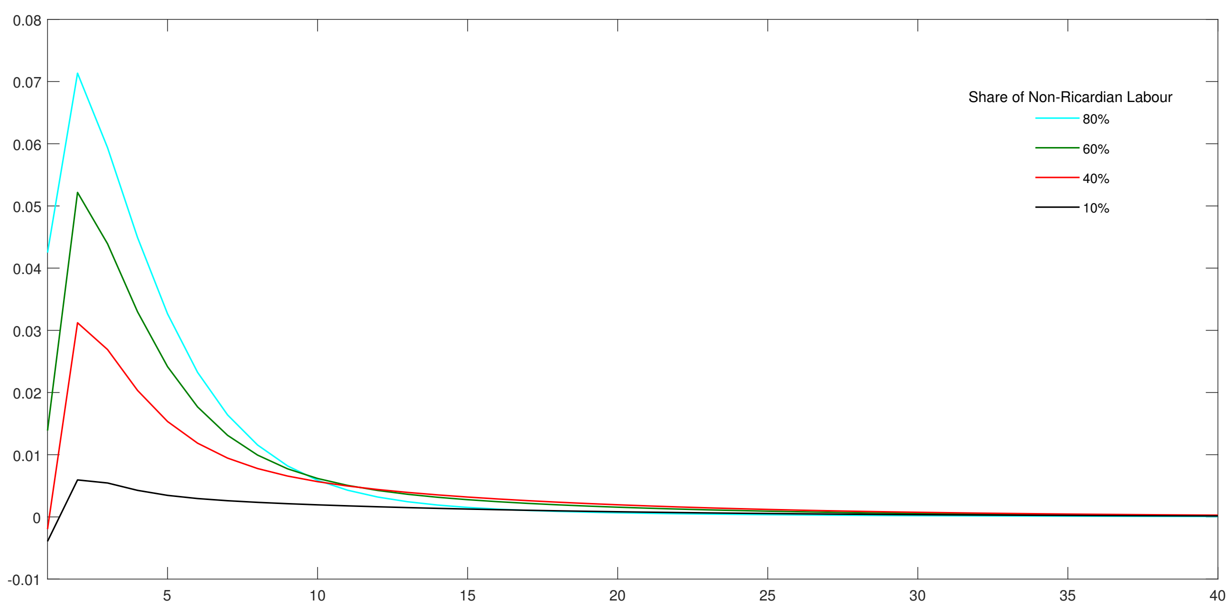


Figure 5

IRFs: Inequality in Debt-Financed Stimulus for different Non-Ricardian Labour Share

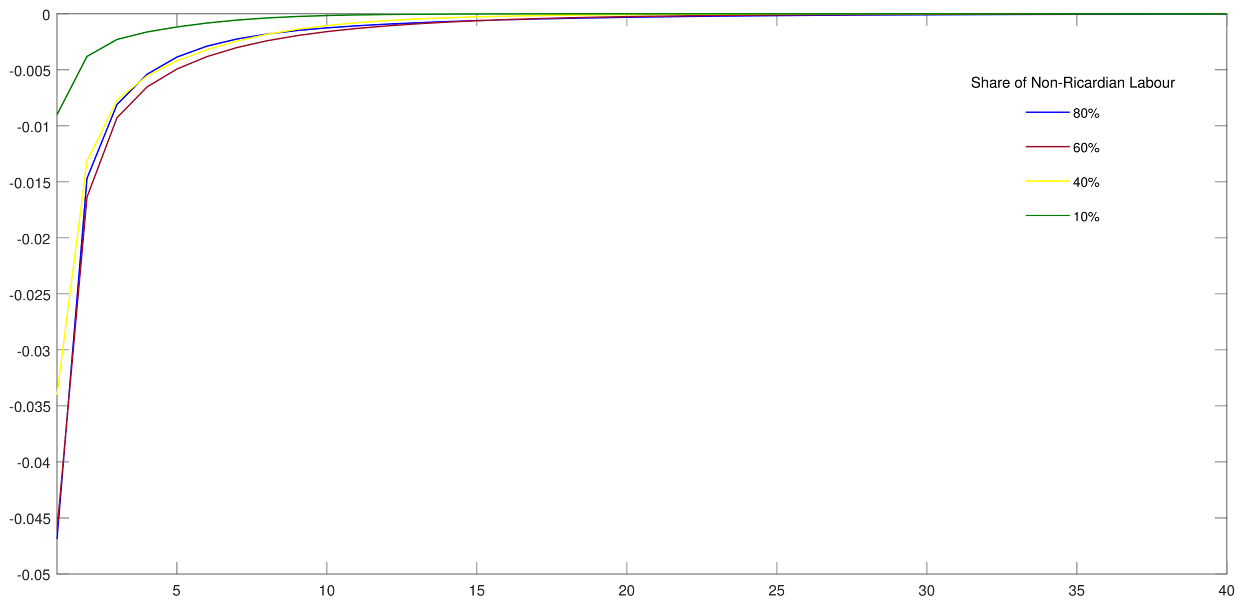


Figure 6

Inequality: Money-Financed and Debt-Financed Stimulus vs. Government Expenditure Shock Persistence

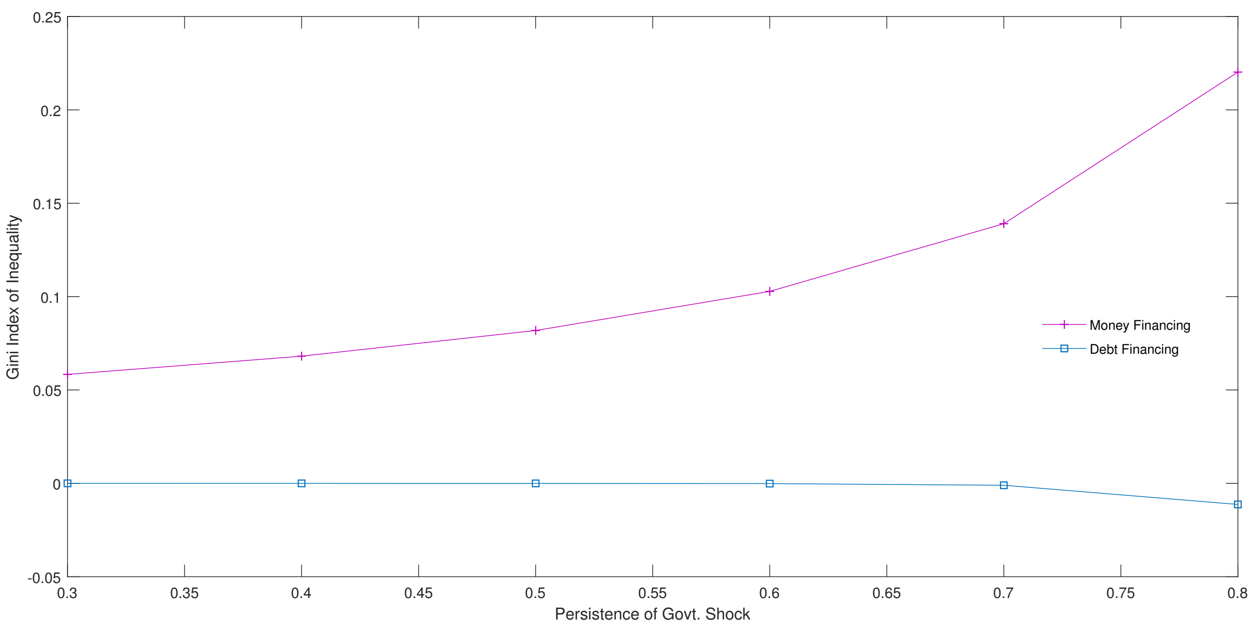
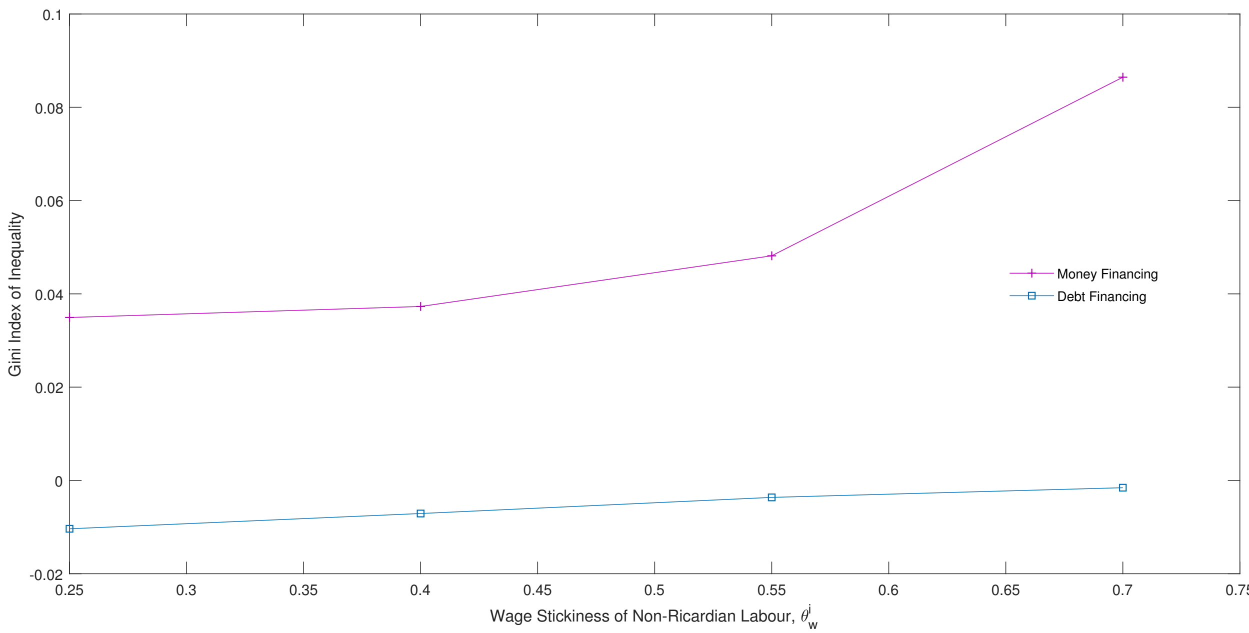


Figure 7

Gini Index of Inequality vs. Wage Stickiness of Non-Ricardian Labour



Simulations are made under baseline parametrization, with $s = 0.30$

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