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A Comprehensive Comparison of Fiscal and Monetary Policies: A Comparative Dynamics Approach

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Abstract. The purpose of the paper is to provide a comprehensive comparison of fiscal and monetary policies with different forms of public expenditure, including a job guarantee (JG) plan. Our key findings are as follows. First, expansionary fiscal policies (including JG) are effective in reflating the economy independently of the way in which they are funded. However, deficit monetization should be expected to be more effective in the short run, while bill-funded government spending is likely to be more effective in the long run. Second, expansionary monetary policies are reflationary in the short run. However, they may have deflationary effects on the economy in the medium to long run. Third, a lower reserve requirement can reflate the economy, but the expected impact is rather weak. Fourth, non-selective tax cuts are effective, but less effective than government spending. Fifth, the impact on the price level is harder to predict than the impact on output. Sixth, conventional spending outclasses JG in terms of GDP growth and inflation rate control, but the JG is a better option in terms of employment results and income distribution.

Keywords: Stock-Flow Consistent Models, Job Guarantee Plan, Fiscal Policy, Monetary Policy

JEL codes: B50; B52; E12; E16

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Contents

1. Introduction

The aim of the paper is to provide a comprehensive comparison of fiscal and monetary policies (in terms of employment and inflation achievements) with different forms of public expenditure, including a job guarantee (JG) plan. For this purpose, we develop and use a dynamic stochastic stock-flow consistent (SFC) macroeconomic model to compare the JG with alternative policy options. This is coherent with the view of the economy as a set of interconnected balance sheets, advocated by Hyman Minsky and the other JG proponents.

Several papers have focused on the impact of a JG plan on main macroeconomic variables in the last two decades (e.g Kadmos and O'Hara 2000, Sawyer 2003 and Seccareccia 2004). However, the only author using a complete macroeconomic model is Godin (2014), who develops a three-industry SFC model to compare the JG with conventional government spending. Unlike Godin (2014) we consider an open economy where a homogenous output is produced. This simplified rendition of the production process allows us to factor in a more detailed definition of the financial sector. Besides, it enables us to focus on a variety of alternative monetary and fiscal policy options. The impact on inflation and its interaction with real and financial variables are also explicitly considered, which is another key difference compared with existing literature.

The next sections are organised as follows. Section 2 provides first a general presentation of the model and then a more detailed (equation-by-equation) explanation of its component parts. Section 3 defines the model baseline and presents the experiments. Our preliminary results are discussed in sections 4. Section 5 provides concluding remarks.

2. The model

Our model depicts a financially sophisticated capitalistic economy. For the sake of simplicity, no impact of economic activity on the environment is considered, nor of environmental degradation on production possibilities. There are seven sectors or "economic units" (upper-class households, lower-class households, production firms, commercial banks, central bank, government, and foreign sector) and a variety of financial assets, including firms' securities (i.e. shares and/or corporate bonds). Output components are all expressed in monetary terms (i.e. at current prices) if not otherwise specified. The behavioural equations for households are in line with SFC literature (e.g. Lavoie and Godley 2001, Godley and Lavoie 2007), but differences in propensities to consume out of wealth components and across social groups are explicitly considered.

Households are disaggregated into upper-class households (notably, rentiers and managers) and lower-class households (workers). Lower-class members are the recipients of labour incomes net of managers' salaries. Their spending plans are influenced by consumption of the upper class. They can borrow to bridge the gap between disposable income and desired consumption. They hold their savings in form of cheque deposits and/or cash. Upper-class members are the recipients of remaining labour incomes and all financial incomes. They hold a variety of financial assets. The related portfolio equations are based on Tobinesque principles. There are two forms of narrow money, namely cash and current accounts (M1) and a form of near money, namely saving deposit accounts (M2) held with banks (which are financial assets with fixed nominal price). Saving deposits are the buffer stock of portfolio equations.

Investment decisions are based on a target capital to out ratio, taken as a proxy of the normal utilisation rate of plants. Building upon Minsky (1976, 1986) insights, we link the target ratio with the leverage ratio and the valuation ratio of production firms (which embody the "borrower's risk").

[1] The policy interest rate is set by the central bank. Commercial banks use a mark-up over the risk-free interest rate, which matches the policy rate. More precisely, the risk premium increases as the lender's risk grows, that is, as firms' leverage ratio increases. Consequently, while banks supply whatever loans are demanded at the set loan interest rate, the resulting deposits will in general differ from what households wish to hold. The banks hold government securities when *ex post* deposits exceed *ex post* loans. They demand advances (from the central bank) when *ex post* loans exceed *ex post* deposits.

The government sector buys products from the firms. It also provides transfers to the private sector, which are based on demographic factors and the scale of the welfare state, and are modelled to fluctuate with the unemployment rate. Tax rates are differentiated according to the sources of income and wealth.[2] Banks have no production costs and, unlike firms, distribute all the profits they make. There can be a reserve ratio between bank reserves and bank deposits, whether arising from legislation or from the prudential decisions of banks. The central bank acts as a lender of last resort for the banking sector. In addition, it purchases any government securities that are not subscribed to by the private investors over the period of analysis. However, the interest rate accruing on government securities is endogenous as it depends also on demand for securities of the private sector.

Looking at the labour market, the supply of labour (i.e. the labour force) adjusts to the demand for labour inputs in the medium to long run through entry into and exit from the labour force. The wage rate is determined using a *wage curve equation* mechanism (see Blanchflower and Oswald 1994) in which the level of real wages is positively related with the employment rate (or expressed as negatively related with the unemployment rate). From the wage curve equation, the rate of change of real wage related with changes in unemployment can be derived. The price level is defined by setting a mark-up over the unit cost of labour.

The formal model for the baseline scenario is made up of 88 equations (including accounting identities, equilibrium conditions and behavioural equations), subdivided in nine blocks. We use the model to analyse and compare the effects of an *employment of last resort* or *job guarantee* plan with alternative monetary and fiscal policies, including unconventional policies such as a quantitative easing plan and an overt monetary financing (OMF) of government spending.[3]

2.1 Production firms

The first equality comes from the standard national income identity (see the current account column of 'Production firms' sector in Tab. 3):

$$y = c + id + gov + tb \qquad (1)$$

where y is gross domestic product, c is consumer expenditure, id is private investment, gov is government expenditure on goods and services (including public investment), and tb is trade balance or net export. All variables are expressed in monetary terms (that is, at current prices), unless otherwise specified.

Firms aim to keep a certain average buffer of spare productive capacity over time. This is tantamount to defining the target real capital stock as a percentage of expected real output:

[1] On the valuation ratio, see also Davidson (1968) and Tobin and Brainard (1977).
[2] However, we attribute the same value to the two income tax rates in the baseline scenario. See Table 1.
[3] Overt monetary financing means that all the securities issued by the government to fund its budget deficit are purchased by the central bank.

$$k^T = \kappa \cdot \frac{E(y)}{E(p)} \tag{2}$$

where κ is the target capital to output ratio, p is the price level, and $E(\cdot)$ stands for expected value (see section 2.9 to see how expectations are defined).

Nominal depreciation allowances are a percentage of firms' capital stock:

$$da = \delta \cdot k_{-1} \cdot p \tag{3}$$

where δ is the depreciation rate of capital, k is its actual stock in real terms and p is the current price level.

For the sake of simplicity, we assume that amortisation funds exactly match depreciation allowances:

$$af = da \tag{4}$$

Gross investment covers both the target change in capital stock and its depreciation:

$$id = \gamma \cdot (k^T - k_{-1}) \cdot p + da \tag{5}$$

where γ is the speed of adjustment of current capital stock to its target value, k^T, which drives net investment plans (that is, investment net of capital depreciation).

For Minsky, gross investment plans of firms are linked with the ratio of the demand price of capital assets to the supply price of capital goods. This ratio can be approximated by the valuation ratio of the firms (or Tobin's q), as expressed by their stock market value to their replacement cost:

$$q = \frac{esr \cdot pe + lf}{k \cdot p} \tag{6}$$

where esr is the amount of shares issued by the firms, pe is their unit price on the stock market and lf is the stock of obtained loans.[4]

The demand for investment is also affected by the leverage ratio of production firms. The endogenous target capital to output ratio is therefore:

$$\kappa = \kappa_0 + \kappa_1 \cdot q_{-1} + \kappa_2 \cdot lev_{-1} \tag{7}$$

where $\kappa_1 > 0$ is the sensitivity of the target capital-output ratio to the valuation ratio and $\kappa_2 < 0$ is its elasticity to the leverage ratio (as defined by equation 64).

The real accumulation of capital over time is given by:

$$k = k_{-1} + \frac{id - da}{p} \tag{8}$$

From the current account column of 'Production firms' sector in Tab. 3, we derive corporate profits as total income minus interest payments, amortisation funds, and wages, namely:

$$f_f = y - rl_{-1} \cdot lf_{-1} - af - wb \tag{9}$$

[4] It is implicitly assumed that firms can record a positive or negative net wealth at the end of each period (see second to last row of Table 2). The reason is that capital gains made by the shareholders are necessarily matched by capital losses made by production firms (see last row of Table 1). As a result, the numerator of equation (6) is unlikely to match the denominator, although the two can be very close in practice.

where rl is the interest rate on bank loans, lf is the stock of loans obtained by the firms and wb is total wage bill.

Distributed profits are a share of total profit realised at the end of the previous period:

$$fd_f = (1-\theta) \cdot f_{f,-1} \tag{10}$$

where θ is the retention rate on firms' profits. It is an exogenous variable of the model, which is autonomously set by the firms.

Retained profits are:

$$fu_f = f_f - fd_f \tag{11}$$

At the beginning of each period, bank loans are provided according to firms' demand to finance production (initial finance). In the process of loan repayment, bank deposits are destroyed. However, some of the bank deposits remain in existence to satisfy households' desire to hold bank deposits, and hence some loans remain. At the end of each period, the recorded change in the stock of bank loans demanded by the firms will equal the portion of investment that was not funded by internal funds (i.e. amortisation funds plus retained profits) or new issues of shares and other securities (see the capital account column of 'Production firms' sector in Tab. 3):

$$lf = lf_{-1} + id - af - fu_f - \Delta esr \cdot pe \tag{12}$$

The number of new shares issued by the firms is calculated as a share of the investment:

$$esr = esr_{-1} + \chi \cdot \frac{id}{pe} \tag{13}$$

where χ is a positive coefficient.

2.2 Households

The disposable income of lower-class households can be derived from the second column of Tab. 3. It comprises non-management wages and transfers from the government (e.g. unemployment benefits), net of interest payments on personal loans and taxes:

$$ydw = wb \cdot (1-\Omega_r) + tr - rlh_{-1} \cdot lh_{-1} - taxw \tag{14}$$

where wb is total labour income, Ω_r is the share of management salaries to total labour income, tr is total transfers, rlh is the interest rate on personal loans, lh is the stock of loans obtained by lower-class households, and $taxw$ is taxes paid by them.

Similarly, the disposable income of upper-class households can be derived from the third column of Tab. 3. It includes managerial salaries and financial incomes, net of taxes:

$$ydr = wb \cdot \Omega_r + rm_{-1} \cdot m2h_{-1} + rb_{-1} \cdot bh_{-1} + fd_f + f_b - taxr \tag{15}$$

where rm is the rate of return on saving deposits, $m2h$ is the stock of saving deposits held by upper-class households, rb is the rate of return on government securities, bh is their stock, and $taxr$ is taxes paid by upper-class households.

Therefore, total disposable income of households is:

$$yd = ydw + ydr \tag{16}$$

Lower-class households can borrow to adjust their consumption plans to target levels. New personal loans (net of repayments) are defined as a *normal* percentage, ψ, of lower-class consumption. However, if consumption exceeds disposable income, new loans increase in such a way to bridge the gap:

$$lh = lh_{-1} \cdot (1 - rep_{-1}) + \max(\psi \cdot c_w, c_w - ydw) \tag{17}$$

where rep is the repayment rate of personal loans.

Real consumption of lower-class households depends on both expected disposable income and wealth components (cash and cheque deposits). Imitative consumption is considered too. As a result, the nominal level of consumption is:

$$cw = \left\{[\alpha_{1w} \cdot E(ydw) + \alpha_2 \cdot hw_{-1} + \alpha_3 \cdot m1w_{-1}] \cdot \frac{1}{E(p)} + \alpha_{im} \cdot \frac{cr_{-1}}{cw_{-1}}\right\} \cdot p \tag{18}$$

where hw and $m1w$ are the stocks of cash and cheque deposits held by lower-class households, respectively. Coefficient $\alpha_{im} > 0$ sets the strength of the imitative behaviour. The higher the upper- to lower-class consumption ratio in the previous period, the higher current consumption of lower-class households.

Real consumption of upper-class households depends on (expected) disposable income and wealth. Nominal consumption of the upper class is therefore:

$$cr = [\alpha_{1r} \cdot E(ydr) + \alpha_2 \cdot hr_{-1} + \alpha_3 \cdot m1r_{-1} + \alpha_4 \cdot m2h_{-1} + \alpha_5 \cdot bh_{-1} + \alpha_6 \cdot eh_{-1}] \cdot \frac{p}{E(p)} \tag{19}$$

where hr, $m1r$, $m2h$, bh and eh are the stocks of cash, cheque deposits, saving deposits, government securities and shares held by upper-class households, respectively.

Total demand for consumption goods is:

$$c = cw + cr \tag{20}$$

Notice that each income type and each wealth type are marked by a different propensity to consume. In line with the empirical evidence, we assume that: $\alpha_{1w} > \alpha_{1r} > \alpha_2 \geq \alpha_3 \geq \alpha_4 \geq \alpha_5 \geq \alpha_6$.

Besides, lower-class household propensity to consume out of income (α_{1w}) is a negative function of the interest rate on personal loans (because a higher cost of money leads households to reduce consumption) and the unemployment rate (because a higher unemployment is associated with higher uncertainty and perceived precariousness):[5]

$$\alpha_{1w} = \alpha_{10} + \alpha_{11} \cdot rlh_{-1} - \alpha_{12} \cdot un_{-1} \tag{21}$$

where $\alpha_{10}, \alpha_{11}, \alpha_{12} > 0$.

Net wealth of lower-class households increases as households save:

$$vw_n = vw_{n,-1} + ydw - cw \tag{22}$$

Gross wealth of lower-class households includes personal loans:

$$vw = vw_n + lh \tag{23}$$

[5] This mechanism reinforces upswings and downswings. The rationale is that the unemployed needs to save more, thus also affecting consumption plans of the employed through a variety of channels (conventions, uncertainty about future income flows, etc.).

Upper-class household wealth does not include personal loans, but it must consider revaluation effects on corporate share holdings (capital gains, cg):

$$vr = vr_{-1} + ydr - cr + cg \tag{24}$$

Total household wealth is therefore:

$$vh = vw + vr \tag{25}$$

Capital gains on shares are:

$$cg = esr_{-1} \cdot \Delta pe \tag{26}$$

where esr is the existing number of shares issued by the firms.

2.3 Commercial banks

Banks meet the demand for credit that is forthcoming at the market interest rates that they set. There is a sense in which the supply of loans meets the demand:

$$ls = lf + lh \tag{27}$$

Banks are willing to accept the deposits that the public wish to hold. This goes for both cheque accounts (M1), which are treated as bearing no interest, and saving deposit accounts (M2):[6]

$$m1s = m1h \tag{28}$$

$$m2s = m2h \tag{29}$$

Bank profits are received interests (on loans, government securities and reserves) minus interest paid on saving deposits and advances. From the sixth column of Tab. 3 we obtain:

$$f_b = rl_{-1} \cdot lf_{-1} + rlh_{-1} \cdot lh_{-1} + rb_{-1} \cdot bb_{-1} + rh_{-1} \cdot (hbd_{-1} + hbd^*_{-1}) +$$
$$-rm_{-1} \cdot m2s_{-1} - ra_{-1} \cdot ad_{-1} \tag{30}$$

where bb is the actual stock of government securities held by the banks, hbd is the required stock of reserves, hbd^* is the stock of free or extra reserves, and ad is the stock of advances from the central bank, while rb, rh and ra are the related rates of return.

Notice that the notional amount of government securities held by banks is defined by the following balance sheet identity (see the fifth column of Tab. 2):

$$bb_{not} = m1s + m2s - ls - hbd \tag{31}$$

The quantity of deposits is set by the willingness of households to hold them. They are the demand for bank deposits that the banks permit, in the sense that they do not change the interest rates on loans or on deposits.

There are two cases in terms of the relationship between the quantity of bank deposits and loans and reserves to be considered.

a) *Quantity of deposits exceed granted loans and reserves*. The net stock of notional securities is held as government securities and/or extra reserves:

[6] Clearly, this is a simplification. There are banks that pay some interest on cheque accounts, sometimes at an interest rate higher than on savings accounts.

$$if\ bb_{not} > 0\ then\ bb = \beta \cdot bb_{not}$$

$$else\ bb = 0 \tag{32}$$

$$if\ bb_{not} > 0\ then\ hbd^{*} = (1-\beta) \cdot bb_{not}$$

$$else\ hbd^{*} = 0 \tag{33}$$

where β is the share of government securities to total notional securities, and $(1-\beta)$ is the share of 'extra' reserves, that is reserves above those which the banks would seek to hold (for prudential reasons) and/or those which they are legally obliged to hold.

b) Accepted *deposits are less than granted loans and reserves*. In this case, commercial banks need advances from the central bank:

$$if\ bb_{not} \leq 0\ then\ ad = -bb_{not}$$

$$else\ ad = 0 \tag{34}$$

Banks hold reserves, and the demand for reserves may be derived from a legal reserve requirement or from banks precautionary demand for reserves:

$$hbd = \rho_1 \cdot m1s_{-1} + \rho_2 \cdot m2s_{-1} \tag{35}$$

where ρ_1 is the reserve ratio to cheque deposits and ρ_2 is the reserve ratio to saving deposits.

2.4 Government

The government sector levies taxes and spends. Taxes are based on the tax rates on labour income, capital income and wealth. More precisely, taxes paid by lower-class households are:

$$taxw = \tau_1 \cdot wb \cdot (1-\Omega_r) + \tau_3 \cdot m1w_{-1} \tag{36}$$

whereas taxes paid by upper-class households are:

$$taxr = \tau_0 + \tau_1 \cdot wb \cdot \Omega_r + \tau_2 \cdot \left(rm_{-1} \cdot m2h_{-1} + rb_{-1} \cdot bh_{-1} + fd_f + f_b\right) +$$
$$+ \tau_3 \cdot (vr_{-1} - hr_{-1}) \tag{37}$$

where τ_1 is the tax rate on labour incomes, τ_2 is the tax rate on capital incomes, and τ_3 is the average tax rate on household wealth. We include also an autonomous component, τ_0, that captures taxes unrelated with economic activity (e.g. property tax).

The total tax revenue for the government sector is therefore:

$$tax = taxw + taxr \tag{38}$$

Government transfers and other benefits depend on demographic factors and transfer rates. In our model, we assume that they vary with the unemployment rate:

$$tr = \tau_4 + \tau_5 \cdot un_{-1} \tag{39}$$

where τ_4 is the amount of transfers that do not depend on unemployment, where τ_5 is the component that does depend on the level of unemployment.

In addition to transfers, the government buys goods and services from the private sector. This additional government spending includes an autonomous component and a dependent component:

$$gov = \sigma_0 + \sigma_1 \cdot y_{-1} \quad (40)$$

where σ_0 is autonomous spending and σ_1 is the sensitivity of government spending to total income.

Government budget deficit is government spending on goods and services (including infrastructure investment) plus transfers plus interest payments minus taxes minus central bank profit:

$$def = gov + tr + rb_{-1} \cdot bs_{-1} - tax - f_{cb} \quad (41)$$

where bs is the supply of government securities and f_{cb} is the profit made by the central bank. New securities are issued every time the government records a budget deficit (we refer to the eight column of Tab. 3):

$$bs = bs_{-1} + def \quad (42)$$

Looking at balance sheet implications, the central government debt amounts to bs, while the central bank holds an amount of government securities that equals the monetised debt.

Government expenditure has, of course, to be (initially) financed and that is undertaken by the government drawing on its account with the central bank. The undertaking of the expenditure then places central bank money in the private sector in the form of commercial bank reserves and notes and coins, and the counterpart of the commercial bank reserves will be bank deposits (whether in cheque or savings accounts). The precise manner through which the government is able to draw on its account with the central bank differs over time and between countries. In the modelling here, it is always assumed that plans for government expenditure are indeed initially financed, so that the expenditure takes place. Further, the central bank does not place any impediments on the government in that regard. The central bank may enable the (initial) financing through overdraft facilities for the government or through purchase, directly or indirectly, of government securities. In our modelling, the focus is on the funding of government expenditure rather than the initial finance. The central bank purchases any government securities that are not subscribed to by the private sector over the period of analysis (although, to some extent, the rate of return is allowed to adjust to market conditions). Applying this to a shorter period (say a week) would also mean that central bank provides finance to the government through its purchase of government securities.

2.5 Portfolio decisions

Portfolio equations are based on Tobinesque principles. The portion of wealth held in the form of each financial asset is defined by an autonomous component, the rate of return on that asset (positive effect), the rates of return on other assets (negative effect), and the disposable income to net wealth ratio (negative effect, except for cash). The latter is a proxy of the liquidity preference of investors. As a result, the demand for government securities is:

$$bh = \lambda_{10} \cdot vr_{-1} + \lambda_{11} \cdot vr_{-1} \cdot rb_{-1} + \lambda_{12} \cdot vr_{-1} \cdot rm_{-1} + \lambda_{13} \cdot ydr_{-1} + \lambda_{14} \cdot vr_{-1} \cdot re_{-1} \quad (43)$$

where λ_{10}, is the autonomous share of government securities to total wealth held by upper-class households, whereas λ_{11}, λ_{12}, λ_{13} and λ_{14} link the share of government securities to total wealth with the rate of return on government securities, the rate of return on saving deposits, money demand for transactions, and the rate of return on shares, respectively.

Upper-class demand for cheque deposits depends on both broadly defined transactions needs and the interest rates accruing on alternative financial assets:

$$m1r = \lambda_{20} \cdot vf_{-1} + \lambda_{21} \cdot vr_{-1} \cdot rb_{-1} + \lambda_{22} \cdot vr_{-1} \cdot rm_{-1} + \lambda_{23} \cdot ydr_{-1} + \lambda_{24} \cdot vr_{-1} \cdot re_{-1} \quad (44)$$

where λ_{20}, is the autonomous share of cheque deposits to total wealth held by upper-class households, whereas λ_{21}, λ_{22}, λ_{23} and λ_{24} link the share of deposits to total wealth with the rate of return on government securities, the rate of return on saving deposits, money demand for transactions, and the rate of return on shares, respectively. In our experiments, we assume that the demand for cheque deposits is quite inelastic to both rates of return and transaction needs (see Table 1).

The demand price for equity and shares is:

$$pe = \frac{(\lambda_{30} \cdot vr_{-1} + \lambda_{31} \cdot vr_{-1} \cdot rb_{-1} + \lambda_{32} \cdot vr_{-1} \cdot rm_{-1} + \lambda_{33} \cdot ydr_{-1} + \lambda_{34} \cdot vr_{-1} \cdot re_{-1})}{ehr} \quad (45)$$

where λ_{30}, is the autonomous portion of shares to total wealth held by the households, whereas λ_{31}, λ_{32}, λ_{33} and λ_{34} link the portion of shares to total wealth with the rate of return on government securities, the rate of return on saving deposits, money demand for transactions, and the rate of return on shares, respectively. [7]

The nominal value of shares held by the households is:

$$eh = ehr \cdot pe \quad (46)$$

where the number of shares that can be subscribed is defined by firms' issues:

$$ehr = esr \quad (47)$$

Household demand for banknotes (cash) is proportional to their expected consumption expenditures, independently of the class they belong to:

$$hw = \lambda_{cw} \cdot cw \cdot \frac{ep}{p} \quad (48)$$

$$hh = \lambda_{cr} \cdot cr \cdot \frac{ep}{p} \quad (49)$$

$$hh = hw + hr \quad (50)$$

where λ_{cw} and λ_{cr} are positive coefficients.

Cheque deposits are the buffer stock of lower-class households:

$$m1w = vw - hw \quad (51)$$

Total demand for cheque deposits is therefore:

$$m1h = m1w + m1r \quad (52)$$

As a result, the saving deposit account is:

$$m2h = vr - hr - m1r - bh - eh \quad (53)$$

[7] Notice that λs are defined in such a way that: *a*) $\lambda_{i1} = -(\lambda_{i2} + \cdots + \lambda_{i4})$ for $i = 1,2,3$ (horizontal constraints on coefficients of rates of return for the i-th financial asset); *b*) $\lambda_{1j} + \lambda_{2j} + \lambda_{3j} = 0$ for $j = 1,2,3,4$ (vertical constraints for cross-asset coefficients of rates of return); and *c*) $\lambda_{10} + \lambda_{20} + \lambda_{30} < 1$ (vertical constraints for autonomous shares of assets to total wealth). The latter is lower than unity because households can also opt for cash and saving deposits.

The above identity can be derived from the third column of Tab. 2. Since right-hand components are all defined by behavioural equations, saving deposits are the buffer stock of financial assets in the portfolio of the upper class.

2.6 Central bank

In the baseline scenario, the central bank is the residual purchaser of government securities that are not demanded by commercial banks and households:

$$bcb = bs - bh - bb \tag{54}$$

As it refers to the end of the period, it is consistent with both a scenario where the private sector buys all the securities on the primary market and then sells the undesired portion of them to the central bank, and the opposite scenario where the central bank purchases all the issued securities, before selling a portion of them to firms and banks.

The supply of cash equals central bank's holdings of government securities plus the stock of money issued to fund OMF government spending plus the supply of advances, plus foreign reserves, minus reserves held by commercial banks (see the sixth column of Tab. 2):[8]

$$hs = bcb + as + hf - (hbs + hbs^*) \tag{55}$$

Cash is held by households, and does not yield interest to the holder. Bank reserves can yield interest to the banks (paid by central bank), as currently is this case in many countries. Advances are granted on demand:

$$as = ad \tag{56}$$

Central bank profit includes the seigniorage income flow on government securities and received interests on advances, minus interest paid on reserves:

$$f_{cb} = rb_{-1} \cdot bcb_{-1} + ra_{-1} \cdot as_{-1} - rh_{-1} \cdot (hbs_{-1} - hbs^*_{-1}) \tag{57}$$

Like advances, legal and voluntary reserves are supplied on demand:

$$hbs = hbd \tag{58}$$

The same goes for extra reserves:

$$hbs^* = hbd^* \tag{59}$$

2.7 Interest rates

The rate of return on equity and shares is the ratio of distributed profits (dividends) and capital gains at the end of the period to total holdings of shares at the beginning of the period:

$$re = \frac{fd_f + cg}{eh_{-1}} \tag{60}$$

The rate of return on government securities is defined using an endogenous mark-up over the policy rate:

$$rb = r^* + \mu b \tag{61}$$

[8] An inflow (outflow) of foreign reserves gives rise to an increase (reduction) of monetary base. For the sake of simplicity, we neglect sterilisation operations.

We discuss the determinants of the mark-up on government bonds when presenting equation (69).

While the *borrower's risk* is embodied in the valuation ratio of firms, the *lender's risk* is reflected in the mark-up over the free-risk interest rate on loans. For the sake of simplicity, we define the interest rate on loans as a linear function of firms' leverage ratio:[9]

$$rl = r^* + \mu l \tag{62}$$

where the mark-up, reflecting the lender's risk premium, is:

$$\mu l = \mu l_0 + \mu l_1 \cdot lev_{-1} \tag{63}$$

where μ_0 is an autonomous component and μ_1 is the sensitivity of the risk premium to firms' leverage ratio. The latter is defined as:

$$lev = \frac{lf}{esr \cdot pe + lf} \tag{64}$$

Taken together, equations (62)-(63)-(64) imply that commercial banks increase the interest rate on loans as the risk of insolvency of firms increases.

In principle, a higher policy rate, hence a higher interest rate on loans, depresses the economy in the short run (mostly due to the change in income distribution), but it raises the long-run steady-state level of output. However, the depressing effect is dominated by the boosting effect if the investment is highly elastic to the valuation ratio. In other words, a policy rate cut (increase) is associated with a long-lasting boom (slump) when firms' demand for capital goods is strongly influenced by the stock market. By contrast, the boom (slump) is only short-lived if firms' investment decisions are mostly based on *real accumulation* plans. As the behaviour of firms is defined by the institutional structure of the economy they operate in, our model suggests that the net effect of the interest rate manoeuvre cannot be determined in the abstract. In fact, it is mediated by many institutional factors.

The interest rate on personal loans to households is modelled using an exogenous mark-up:

$$rlh = r^* + \mu lh \tag{65}$$

Similarly, the rate of return on saving deposits is:

$$rm = r^* + \mu m \tag{66}$$

The interest rate on advances from the central bank is:

$$ra = r^* + \mu a \tag{67}$$

The rate of return on reserves is:

$$rh = r^* + \mu h \tag{68}$$

These equations are general formulations based on mark-ups and mark-downs on the policy rate of interest. Reflecting current practice, the policy rate is treated as the interest rate paid by the central bank on reserves, and hence $\mu h = 0$ is used in our experiments.

The yield of government securities depends on demand for securities of the private sector. The reason is that it is assumed that the central bank opts for the 'best bid' when purchasing financial assets. This means that, while the central bank is always available to buy government securities that the private

[9] This is a simplification relative to the original Minskyan formulation, in which the lender's risk accelerates as the leverage ratio increases, so that: $d(\mu l)/d(lev) > 0$ and $d^2(\mu l)/d(lev^2) > 0$.

sector is not willing to hold, it does so by using the lowest price for a buy and the highest price for a sell. As a result, the mark-up over the policy rate can be sensitive to demand conditions:

$$\mu b = \mu b_0 - \mu b_1 \cdot bpr_{-1} \tag{69}$$

where μb_0 is an autonomous component, μb_1 captures the effect of private demand on bond yield, and bpr is the share of government securities demanded by the private sector, that is:

$$bpr = \frac{bh+bb}{bs} \tag{70}$$

While the rate of return on firms' shares is determined by market forces, the structure of the mark-ups is defined exogenously in such a way that:

$$0 = \mu h \leq \mu a \leq \ \mu m < \mu b_0 < \mu l \leq \mu lh$$

As a result, reserves have the lowest rate of return (zero), whereas loans to firms and households are marked by the highest mark-up over the policy rate.

2.8 Labour market

The total wage bill paid by production firms to the workers (including managers) is:

$$wb = w \cdot nd \tag{71}$$

where w is the money wage rate and nd is labour demand. The latter depends on the production scale and the average product per unit of labour in the private sector, pr:

$$nd = \frac{(y/p)}{pr} \tag{72}$$

The labour supply is treated as greater than or equal to labour demand, and hence there is generally unemployment and not over employment. Labour supply depends on an autonomous growth rate of the population and demographic change, but it also adjusts to firms' demand for labour inputs:

$$ns = ns_{-1} \cdot (1 + gl) + v \cdot (nd_{-1} - ns_{-1}) \tag{73}$$

where v is the speed of adjustment, while gl defines the autonomous or structural rate of growth of the labour force.

The actual unemployment rate is:

$$un = 1 - \frac{nd}{ns} \tag{74}$$

The nominal wage rate is determined through a linearised wage equation that links the expected percentage change in the real wage rate with the unemployment rate (in excess of the non-inflationary rate):

$$\frac{\frac{w}{ep} - \frac{w_{-1}}{p_{-1}}}{\frac{w_{-1}}{p_{-1}}} = -\omega \cdot (un_{-1} - nun)$$

hence:

$$w = [1 - \omega \cdot (un_{-1} - nun)] \cdot \frac{ep}{p_{-1}} \cdot w_{-1} \tag{75}$$

where ω is wage sensitivity to unemployment rate gap with its non-inflationary rate, nun. Equation (75) holds that the lower the unemployment rate and the higher the expected price level, the higher the nominal wage rate.

Notice that equation (75) implies that the workers have some bargaining power vis-a-vis the firms. Arguably, this is not the case for low-skilled workers who perceive the legal or *de facto* minimum wage rate. This is one of the most important factors that have flattened the Phillips curve in the last few decades. Besides, changes in the wage rate are smoothed by labour market institutions and contracts. Therefore, in our experiments we replace equation (75) with the three-equation system below:

$$w = \beta_w \cdot w_l + (1 - \beta_w) \cdot w_h \tag{75B}$$

$$w_h = \gamma_w \cdot w_0 + (1 - \gamma_w) \cdot [1 - \omega \cdot (un_{-1} - nun)] \cdot \frac{ep}{p_{-1}} \cdot w_{h,-1} \tag{76}$$

$$w_l = \rho_l \cdot w_{h,-1} \tag{77}$$

where w_h is the average wage rate perceived by skilled workers who are paid above the minimum (call it, high wage rate), w_0 is the initial or normal wage rate, γ_w is a coefficient accounting for wage adjustment inertia, w_l is the minimum wage rate, ρ_l is the is the minimum wage rate as a percentage of the high wage rate, w is the average wage rate, and β_w is the percentage of low-wage (or unskilled) workers to total employees.[10]

2.9 Price level and inflation expectations

Leaving aside the production of public goods, the general price level (p) equals the unit price of private output (p_f), which is set by the firms using a mark-up over the unit cost of labour:

$$p = p_f = \frac{w}{pr} \cdot (1 + \mu p) \tag{78}$$

The inflation rate is annual percentage change in the price level:

$$\pi = \frac{p}{p_{-1}} - 1 \tag{79}$$

We opt for a regressive specification of inflation expectations. This method provides the most accurate approximation of how economic agents make their decisions when central banks explicitly set their inflation target (e.g. Lima and Setterfield 2008, Sorić et al. 2019). Unlike adaptive expectations, regressive expectations are not systematically wrong. Stochastic or 'rational' expectations would bring about a stabilising effect on the model, because they do not depend on past inflation rates (and are correct on average). However, they would possibly be at odds with both experimental findings and the multiple-equilibria nature of our model. Therefore, we define inflation expectations as follows:

$$E(\pi) = \pi_{-1} + \psi_0 + \psi_1 \cdot [\pi^T - \pi_{-1}] \tag{80}$$

where $\psi_0$and ψ_1 are non-negative coefficients, and π^T is the normal or target inflation rate (e.g. the target rate set by the central bank or the average inflation rate over the last 5 years).

Accordingly, the expected price level at period t is:

[10] The percentage of narrowly-defined low-wage workers is around 3% in the United States. Although there are differences across the states, the minimum hourly wage rate is usually identified with 7.25 USD per hour. The average wage rate is approximately 24 USD (Source: United States Department of Labour, https://www.dol.gov/general/topic/wages/minimumwage).

$$E(p) = p_{-1} \cdot [1 + E(\pi)] \quad (81)$$

Unlike inflation expectations, the expected disposable income of households is not anchored with an institutional value announced and pursued by the central bank. Therefore, there is no reason to assume regressive expectations here. For the sake of simplicity, we assume that expectations about wages and salaries are purely adaptive. Therefore, we set $E(ydw) = ydw_{-1}$ and $E(ydr) = ydr_{-1}$ in our simulations. Similar considerations go for the demand level expected by private firms, which is: $E(y) = y_{-1}$.[11] Notice that expectations influence output through consumption and investment demand (equations 2, 18, 19). When the price level is projected to outgrow disposable income, consumption is affected, and so are investment (both directly and indirectly) and national income.

2.10 Foreign sector

For the sake of simplicity, we assume that foreign products are imported by domestic firms (either to be sold to their consumers or to be used as intermediate goods). Based on a long-standing tradition in international economics modelling, we define import and export as logarithmic functions:

$$\log(im) = m_0 + m_1 \cdot \log(exr_{-1}) + m_2 \cdot \log(y_{-1}) + m_3 \cdot \log(p_{-1}) \quad (82)$$

$$\log(x) = x_0 + x_1 \cdot \log(exr_{-1}) + x_2 \cdot \log(y_{F,-1}) + x_3 \cdot \log(p_{-1}) \quad (83)$$

where $m_1, x_3 \leq 0$ and $m_2, m_3, x_1, x_2 \geq 0$ are coefficients defining the sensitivity of import and export to nominal exchange rate, income, and domestic price level, respectively.

The nominal exchange rate, exr, is defined as the *quantity of domestic currency per one unit of foreign currency*. Therefore, the higher the exchange rate, the weaker the domestic currency (with respect to the board of foreign currencies) and the higher net export. Foreign income (expressed in domestic currency), y_F, is simply defined as:

$$y_F = y_{F,-1} \cdot (1 + g_F) \quad (84)$$

where the growth rate, g_F, is expected to reduce over time, because of both the slowing down of world population and climate-related effects on consumption and production:

$$g_F = g_{F,-1} \cdot (1 - g_S) \quad (85)$$

For the sake of simplicity, we assume that trade surpluses (deficits) give rise to inflows (outflows) of foreign reserves to the same extent, with no significant impact on the exchange rate.[12] The net stock of foreign reserves held by the domestic central bank is:

$$hf = hf_{-1} + tb \quad (86)$$

where:

[11] A more sophisticated definition of adaptive expectations would include an autonomous term and an adjustment to previous errors, such as: $E(y) - E(y_{-1}) = \psi'_0 + \psi'_1 \cdot [y_{-1} - E(y_{-1})]$. However, the effect on our findings would be negligible. Therefore, we assume that $\psi'_0 = 0$ and $\psi'_1 = 1$, hence $E(y) = y_{-1}$, in our simulations.

[12] A floating exchange rate is usually regarded as a prerequisite of monetary sovereignty by MMT advocates. Therefore, our simplifying assumption about the exchange rate may seem at odds with MMT principles. However, our short- to medium-run findings are not much affected by the chosen exchange rate regime, for we impose no constraints on foreign reserves availability. Our choice is also coherent with the relative stability of the US dollar, despite the trade deficit recorded by the US economy since the mid-1990s. Finally, this allows us to test the reaction of the economy following a shock to the exchange rate (see section 4.2).

$$tb = x - im \tag{87}$$

is the trade balance (or net export). The latter matches the current account balance in our model, because we assume that reserves pay no interest.

2.11 Quantitative monetary policies

The central bank can and does purchase financial assets from the private sector (Lavoie and Fiebiger 2018). Quantitative policies, such as the so-called *quantitative easing* (QE), aim to buy financial assets mainly from non-bank financial companies, like pension funds (McLeay et al. 2014). Since banks are defined as institutions whose liabilities (deposits) are treated as generally accepted means of payments, in our model non-bank financial intermediaries are included in the upper-class sector. As a result, the central bank purchases of financial assets are modelled as being directly from the upper class. While this change is likely to overestimate the quantitative effects of QE policies on the real economy (because it shortens the intermediation chain), there should be no qualitative differences. Under QE, the central bank sets the amount of government securities to be bought from the upper class, and then equation (54) becomes:

$$bcb' = \max(\varepsilon \cdot bs_{-1}, bcb) \tag{54B}$$

where ε is the target ratio of government securities to total supply of government securities that the central bank seeks to acquire. This ratio can be defined as a linear function of the policy rate, because it increases as the economy approaches the zero lower bound:

$$\varepsilon = \varepsilon_0 - \varepsilon_1 \cdot r^*_{-1} \tag{88}$$

where ε_0 and ε_1 are positive coefficients. Equation (88) holds that, *ceteris paribus*, the target share of government securities purchased by the central bank increases as the policy rate reduces.

As a result, upper-class households' net holdings of government securities and bank deposits at the end of the period may have to adjust to fit central bank purchasing programmes:

$$bh' = \min(bh, bs - bb - bcb) \tag{43B}$$

$$m1r' = \max(m1r,\ m1r + \lambda_m \cdot [bh' - (bs - bb - bcb)]) \tag{44B}$$

$$m1h' = m1w + m1r' \tag{52B}$$

$$m2h' = \max(m2h,\ m2h + (1 - \lambda_m) \cdot [bh' - (bs - bb - bcb)]) \tag{53B}$$

where λ_m defines the share of cheque deposits that households end up holding at the end of the period following the quantitative programme, whereas $(1 - \lambda_m)$ is the share of saving deposits.

When upper-class households reduce their holdings of government securities, cheque deposits will increase to the same extent, thereby affecting reserves too. The implicit assumption is that the central bank can *force* the private sector to accept a higher amount of liquidity than initially planned (in exchange for less liquid assets) if the interest rate on deposits and reserves is low enough.[13]

Notice that, when the central bank launches a quantitative programme, equations (69) and (70) must be modified. The share of government securities actually held by the private sector is no longer a good

[13] For the sake of simplicity, we neglect corporate securities and we only focus on government securities in our experiments.

indicator of the potential demand for them. On the contrary, the mark-up over the policy rate is now a negative function of the amount of securities purchased by monetary authorities:[14]

$$\mu b = \mu b_0 - \mu b_2 \cdot bpcb_{-1} \tag{69B}$$

where μb_2 captures the effect of monetary policy on bond yield, and $bpcb$ is the share of government securities held by the central bank, that is:

$$bpcb = \frac{bcb}{bs} \tag{70B}$$

2.12 Job guarantee plan

The JG is a policy proposal based on Minsky's insights (e.g. Minsky 1965).[15] It holds that the state should act as an employer of last resort to achieve full employment and it is claimed that it would stabilise the inflation rate as well. It was mainly developed by the advocates of the Modern Money Theory or MMT starting from the mid-1990s (e.g. Mitchell 1998, Mosler 1997, Wray 2007). In its basic form, the government offers a fixed-wage rate job to anyone willing and able to work. This creates a buffer stock of public workers that expands as the demand for labour of the private sector shrinks (typically, during a recession) and reduces as the private demand for labour increases (typically, during a boom). The wage rate is set to a level that guarantees a reasonable living standard for the workers (see Wray et al. 2020, who propose a uniform wage of 15 USD per hour for the United States). This allows, first, to set the minimum wage of the economy (including some basic benefits) and, second, not to crowd-out private firms, except for the most inefficient.

There have been few formal models incorporating the JG programme. A noteworthy exception is Godin (2014), who uses a multi-sectoral dynamic model to assess the validity of the critiques to the JG. Building upon a structuralist view, he finds that a JG programme is more efficient at tackling functional inequality (measured by the adjusted wage share to total income) than traditional public expenditure. However, the latter is more effective when the goal is to attain growth. Besides, the JG is found to be less inflationary than standard government spending, although the risk of attaining low-wage full employment is stressed.

Since most public goods are not sold to the public, it can be assumed that there is no market price for them. Therefore, their value (in national accounts) equals their production cost.[16]

Clearly, some model equations must be amended to consider the job guarantee programme. First, lower-class household disposable income and government deficit become, respectively:

$$ydw = wb \cdot (1 - \Omega_r) + tr - rlh_{-1} \cdot lh_{-1} - taxw \ + wb_g - tar_g \tag{14B}$$

$$def = gov + tr + rb_{-1} \cdot bs_{-1} - tax - f_{cb} + wb_g - cha \tag{41B}$$

[14] Provided that the central bank purchases more securities than those unsubscribed by the private sector, that is: $bcb' > bcb$.

[15] The JG literature has raised several controversies since its inception. Three main criticisms can be identified. First, Sawyer (2003) argues that JG is not different from other policy options as a means to stimulate aggregate demand. Second, a JG scheme can bring about inflationary effects and/or boost government deficit, particularly when it is associated with capacity constraints (e.g. Kadmos and O'Hara 2000, Sawyer 2003). Third, Seccareccia (2004) acknowledges that a JG plan can assure full employment. However, he argues that the economy might tend towards a low-wage equilibrium, because of both inflationary tendencies and political constraints.

[16] For the sake of simplicity, only non-durable goods and services are considered.

where:

$$cha = \tau_g \cdot wb_g \tag{89}$$

$$wb_g = w_g \cdot ng \tag{90}$$

$$w_g = \rho_g \cdot w_{-1}, \qquad \text{with: } \rho_l < \rho_g < 1 \tag{91}$$

$$ng = \min\left(ng_{-1} + \gamma_g \cdot (nn - ng_{-1}), nn\right), \qquad \text{with: } nn = ns - nd \tag{92}$$

where cha is the revenue from charges that are possibly associated with the new services provided thanks to the JG programme, τ_g is the share of services funded by charges ($25\% \pm 5\%$ in our model), wb_g is the wage bill paid to the workers, w_g is the related wage rate, ρ_g is the ratio of JG wage rate to private wage rate ($60\% \pm 10\%$ in our model), ng is the number of JG employees, and γ_g is the speed of adjustment of the JG programme size to changes in labour market conditions.[17]

Therefore, the adjusted wage share to total disposable income is:

$$\Omega = \frac{wb \cdot (1 - \Omega_r) + wb_g}{yd} \tag{93}$$

We use it as a measure of functional income distribution.

Second, the demand of firms for labour is now calculated using labour productivity and expected real output of the private sector only:

$$nd = \frac{y - wb_g}{pr \cdot ep} \tag{72B}$$

JG proponents usually argue that those employed on JG plan do not add to any inflationary pressures, because, when demand in the private sector revives, those on JG are 'released'. Besides, the wage for JG workers is fixed and not influenced by demand. In other words, the Phillips curve is deemed to perfectly horizontal. Since this is a controversial point, we test the model using both equation (74) and the following:

$$un = 1 - \frac{nd + ng}{ns} \tag{74B}$$

When equation (74) is used, the JG plan has no effect on the wage curve. By contrast, when equation (743B) is used, the JG plan pushes up wages as the unemployment rate falls.

Notice that the JG also allows setting the minimum wage rate in equation (77):

$$w_h = w_g \tag{94}$$

We can now define the change in the general price level as a weighted average of the change in the unit price of private goods and the change in charges:[18]

$$p = p_{-1} + \Delta p_f \cdot \left(1 - \frac{wb_g}{y}\right) + \Delta cha \cdot \frac{wb_g}{y} \tag{95}$$

If there is sufficient productive capacity to provide job-guarantee employment, and all those without work intend to accept the job, then there would be no unemployment in the system in the medium

[17] The minimum hourly wage (7.25 USD) is currently around 30% of the average wage rate in the United States. The minimum wage proposed by the JG advocates (15 USD) is around 60% of the average wage rate.

[18] Notice that we have used the public goods to total output ratio of the *past period* in our simulations to calculate the weights in equation (95). This allows avoiding excess simultaneity.

run.[19] The tendency to full employment brings about two opposite effects on wages and prices. On the one hand, it may push upwards the market wage rate. Besides, the propensity to consume increases and so does current aggregate demand – see equation (21). On the other hand, public goods are usually "cheaper" than private goods. Despite we assumed a lower product per worker, the lower wage rate and the zero-profit policy keep the unit price of public goods down. This helps counter inflation tendencies as the share of government output to privately-produced goods increases.

2.13 Redundant equation

The redundant equation of the model is the equality between supply of cash, defined by equations (55), and demand for cash, defined by equation (50):

$$hs = hh$$

The equation above is not included because of the *Walrasian Law*, which states that 'any properly constructed model contains one equation that is redundant, in the sense that it is logically implied by the others' (Godley and Lavoie 2007, p. 107). Indeed, it has been used to test the accounting coherence of the model by checking that the equation does hold under every scenario.

3. Solution method and experiments

3.1 Model solution

The model is run through 100 periods on an annual basis. Parameters and initial values of variables are either borrowed from the literature or given reasonable values based on the time series for the United States. However, the model is not intended to apply only to the US, but rather a general industrialised economy. Key coefficients of driving behavioural equations are assigned a range of values, as opposed to a single value. Shaded rows in Table 1 show that stochastic coefficients are the propensity to consume out of income, the target capital to output ratio, the share of managerial salaries to total wages and salaries, the unemployment elasticity of the real wage rate, the public to private wage ratio, and the autonomous component of export and the percentage of new public services funded by charges. Monte Carlo simulations are used to define the sensitivity range of model results under alternative scenarios or experiments.[20] Model files and the code structure are displayed by Figure 1.[21] Results for each experiment are compared with the model baseline, which has been empirically validated through an auto- and cross-correlation analysis of the main output components. Figure 2 shows that the model replicates well the key statistical properties of observed time series for the United States economy (1960-2019).

3.2 Presentation of experiments

Eight policy options are tested and discussed in the next sections, namely:

1. An increase in government spending funded by some combination of government securities and money issues (σ_0 from 5 to 8, we refer again to Table 1).
2. A cut in the policy rate (r^* from 0.02 to 0.01).

[19] An additional assumption here is that the unemployed accept to work at (or below) the minimum wage. Notice that those who were relatively highly paid, before being fired, may decide to use time looking for other jobs.
[20] More precisely, we perform 100 Monte Carlo simulations for each scenario. We calculate and report both across-run means and standard deviations.
[21] We used *R* to develop the model. The model code (reproducing the baseline scenario and the experiments) is available upon request.

3. A reduction in the reserve requirement (ρ_1 and ρ_2 set at 0).
4. A quantitative easing programme (ε_0 from 0 to 0.50).
5. An increase in government spending along with monetisation, that is, a combination of policy (1) and policy (4).[22]
6. An "employer of last resort" policy or "job guarantee" plan (up to 1.5% of current output, see note 25).
7. A tax cut funded by government securities and money issues (τ_0 from 0 to -3).
8. A currency devaluation or depreciation (exr from 1 to 1.5).

We run the model from scratch and we allow variables to stabilise before introducing alternative scenarios. Shocks are all run starting in period 60 from the baseline case. In the next section, we first present and comment all the experiments above. This helps understand how the basic model behaves following shocks. We then focus on the impact of a job guarantee programme on key macroeconomic variables. We compare it with an intervention of government spending.

4. Findings

4.1 General results

Figures 3 and 4 display the impact of eight alternative policy options on GDP and price level, respectively. Figure 5 displays the related changes in liquidity holdings of the private sector (cash, deposits and reserves). Due to the theoretical nature of the model, we focus on qualitative results. We show that a job guarantee (JG) plan is more effective than conventional spending in supporting employment and tackling functional income inequality, although the associated multiplier is lower. The effects of JG are presented in section 4.2. By contrast, key findings associated with other policy options are commented hereafter.

4.1.1 Expansionary fiscal policies. These policies – see quadrants (a) and (b) of Figures 3 and 4 – are effective in reflating the economy independently of the way in which they are funded. However, deficit monetization should be expected to be more effective in the short run, for it improves income distribution, thus supporting consumption. By contrast, government security-funded government spending is more effective in the long run, for it entails higher interest payments to the private sector (because of both higher interest rates and higher savings).

Unsurprisingly, expansionary fiscal policies bring about an increase in cash and deposits held by the households, hence in bank reserves – quadrants (a) and (b) in Figure 5.

4.1.2 Expansionary monetary policies. These policies – see quadrants (c) and (e) – are reflationary in the short run, be they conventional (policy rate manoeuvre) or unconventional (quantitative easing). This happens because of a balance-sheet effect, whereby the propensity to spend of the private sector is enhanced by the higher liquidity holdings. More precisely, a lower interest rate is associated with a higher propensity to consume out of income and lower interest repayments on household loans. This boosts consumption, investment (as firms record both higher profits and a higher utilisation rate of existing plants) and output. Since money is endogenous, there can be no money multiplier effect instead. However, both policies may have deflationary effects on the economy in the medium to long run, due to the fall in net interest payments to the private sector. In principle, a lower reserve requirement can reflate the economy, as it makes banks' balance sheets *more* liquid, but the expected

[22] Looking at its qualitative impact, option (5) is akin to an 'overt monetary financing' (OMF) to government spending. However, the amount of government securities newly purchased by the central bank under (5) is much higher than the increase in government deficit.

impact is negligible compared with other policy options – see quadrant (d), where we used a different scale.

Different monetary policies are predicted to deliver different effects on liquidity holdings of the private sector. A policy rate cut may well increase the demand for cash in the short run, due to the related increase in the propensity to consume. However, quadrant (c) of Figure 5 shows that the positive effect is short-lived. The liquidity shrinks as the economy shrinks in the medium run. By contrast, quantitative policies increase cash, bank deposits, and reserves – quadrant (e) in Figure 5. Notice, however, that they all decline in the very long run, as the steady state of the economy shifts downwards (because of lower interest payments from the government to the private sector). Finally, the experiment on the reserve requirement tells a quite conventional story. A reduction in the reserve ratios goes along with an increase in liquidity held by the private sector, apart from total reserves – quadrant (d) in Figure 5. The effect is expected to be very weak though.

4.1.3 Tax cuts. Non-selective or generalised tax cuts are effective, but less effective than government spending, particularly in the short to medium run. Intuitively, the point it that a share of the higher private disposable income is saved – quadrant (f). However, for the same reason (higher accumulation of wealth, hence higher interest payments and wealth effects), tax changes can imply a strong effect in the very long run. The effects on liquidity held by the private sector are similar to those produced by government spending – quadrant (f) of Figure 5.

4.1.4 Currency devaluation. Like tax cuts, currency devaluation has an expansionary effect on average – see quadrant (i). However, the net impact on output and price level depend on the pass-through to import/export prices.[23] Once again, cash, deposits and reserves grow as net export and the economy as a whole grow – quadrant (i) of Figure 5.

4.1.5 Additional remarks. It is worth noticing that the impact on the price level is usually weaker but harder to predict (that is, the related sensitivity range is higher) than the impact on output, because the change in prices is more affected by alternative combinations of behavioural equation coefficients. The demand for liquid assets adjusts endogenously to the real economy.

4.2 Job guarantee vs. government spending

Figure 6 displays the effects of a JG programme and a government-spending plan, respectively. The former is completely funded by issuing monetary base, whereas the latter is funded by selling government securities to the private sector (with the central bank purchasing the residual amount). In order to compare the two options, we set both policy sizes to 1.5% of pre-shock GDP. We find that standard spending is associated, *ceteris paribus*, with a higher multiplier compared with the JG. This is due to a number of factors: first, the higher inflation rate associated with the JG discourages consumption and investment – see quadrants (a) and (b); second, the higher flow of interest payments received by the private sector (because of higher interest rates and savings) allows traditional spending to generate more output in the medium run. However, the higher inflation rate is a 'side effect' brought about by the higher effectiveness of the JG in supporting employment. The dashed line in quadrant (c) shows that JG is more effective than standard spending when the wage rate paid under the programme is fixed, even though the related resources are limited. The dotted line shows that JG

[23] For a thorough analysis of this point, we refer to Carnevali et al. (2020).

would be even more effective in terms of employment if the wage rate paid under the programme was free to adjust to labour market conditions.[24]

Let us turn to the indebtedness ratios. The JG delivers lower government deficit and debt *levels* in the medium run (see Figure 7). The reason is two-fold: first, conventional spending is associated with a higher debt service; second, newly provided JG services can be partly covered by charges (25% on average in our experiments). Besides, when looking at the stock of debt, the higher inflation rate associated with JG can help improve public finance. While JG always delivers a lower (comparative) level of government deficit, conventional spending can still be associated with lower deficit and debt to GDP ratios, because of its higher multiplier. This is the case shown by quadrant (d). Quadrant (e) shows that the impact on the leverage ratio is higher under conventional spending because economic growth leads firms to demand for more loans (a well-known Minskian result). For the same reason, the JG is predicted to be a better option to keep the foreign deficit under control – quadrant (f). Finally, quadrant (g) shows that the JG can be associated with a higher adjusted wage share to total income, especially when the share of managerial salaries is high.[25] Incidentally, this is also the reason the JG scheme can be more inflationary.

The findings above are confirmed even when we allow the government sector to spend whatever it takes to achieve and maintain full employment over time.[26] Figure 7 compares unemployment rates and government budget indicators, under a conventional government spending policy and a JG scheme (excluding additional charges), respectively. The latter is, on average, more effective in reducing unemployment. However, it is less efficient in terms of public finance, because of the lower multiplier – although the final effect will depend also on the autonomous spending decisions made by both domestic and foreign private agents, and the level at which the JG wage rate is set.

Similar conclusions are achieved when an external (negative) shock to aggregate demand (e.g. a fall in export) is tested, along with the reaction of the government using the options above – see Figure 8. Conventional spending outclasses JG in terms of GDP growth and GDP per inflation rate. By contrast, the JG is a better option in terms of employment and functional income distribution.

Summing up, our experiments show that a JG plan is possibly more inflationary than a standard expansionary fiscal policy, even when it is not associated with capacity constraints (as advocated by Kadmos and O'Hara 2000). More precisely, this happens *if* the wage curve is sensitive to the employment level. This side effect should be carefully assessed, as it could lead the policy makers to lean towards a low-wage equilibrium (as argued by Seccareccia 2004), where the JG only provides low-quality jobs. Besides, a JG should be expected to be less effective than traditional policies in stimulating aggregate demand, because it is marked by a lower multiplier (as shown by Sawyer 2003, and Godin 2014). However, if inflationary pressures are kept under control, the JG program is shown to be more efficient at both reducing unemployment and tackling functional inequality (measured by the adjusted wage share) than traditional public expenditure (in line with Godin 2014). As a result, the choice of the best policy tool should not be done in the abstract. On the contrary, it should be based

[24] We assume here that the government can spend up to 1.5% of the pre-shock GDP. The wage rate paid by the government cannot outstrip the wage rate paid by private firms. It reduces as unemployment (hence applicants) increases. Notice that this alternative scheme is explicitly rejected by the JG advocates, because it misses one of the goals of the JG, which is to set the minimum wage.

[25] However, conventional spending is associated with a higher *unadjusted* wage share.

[26] We assume that government keeps increasing conventional public expenditure as long as the unemployment rate is higher than zero. We compare this scenario with an alternative scenario where the government hires approximately 98% of labour-force members who are not employed by the private sector.

on the specific institutional setting, with the awareness that there are always trade-offs between different targets.

5. Concluding remarks

We have analysed the impact of a JG scheme on a variety of macroeconomic variables, and we have compared it with the impact of standard government spending and other policy options. Our key findings are as follows. First, expansionary fiscal policies are effective in reflating the economy independently of the way in which they are funded. However, deficit monetization should be expected to be more effective in the short run, while bill-funded government spending is more effective in the long run. Second, expansionary monetary policies are reflationary in the short run. However, they may have deflationary effects on the economy in the medium to long run. Third, a lower reserve requirement can reflate the economy, but the expected impact is rather weak. Fourth, non-selective tax cuts are effective, but less effective than government spending. Fifth, the impact on the price level is harder to predict than the impact on output. Sixth, conventional spending outclasses JG in terms of GDP growth and GDP per inflation rate, but the JG is a better option in terms of employment results and (a more equal) income distribution. A JG plan also reduces the absolute impact on government budget, particularly when it is associated with charges for JG-related services and lower interest rates on government debt. However, deficit and debt to GDP ratios can be (comparatively) higher, because conventional spending is marked by a higher multiplier. To conclude, the choice of the best policy tool should depend on the specific target pursued by the policy-makers and the broad institutional setting of the economy.

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Charts and tables

Tab. 1. Key to symbols, coefficient values and initial values of variables

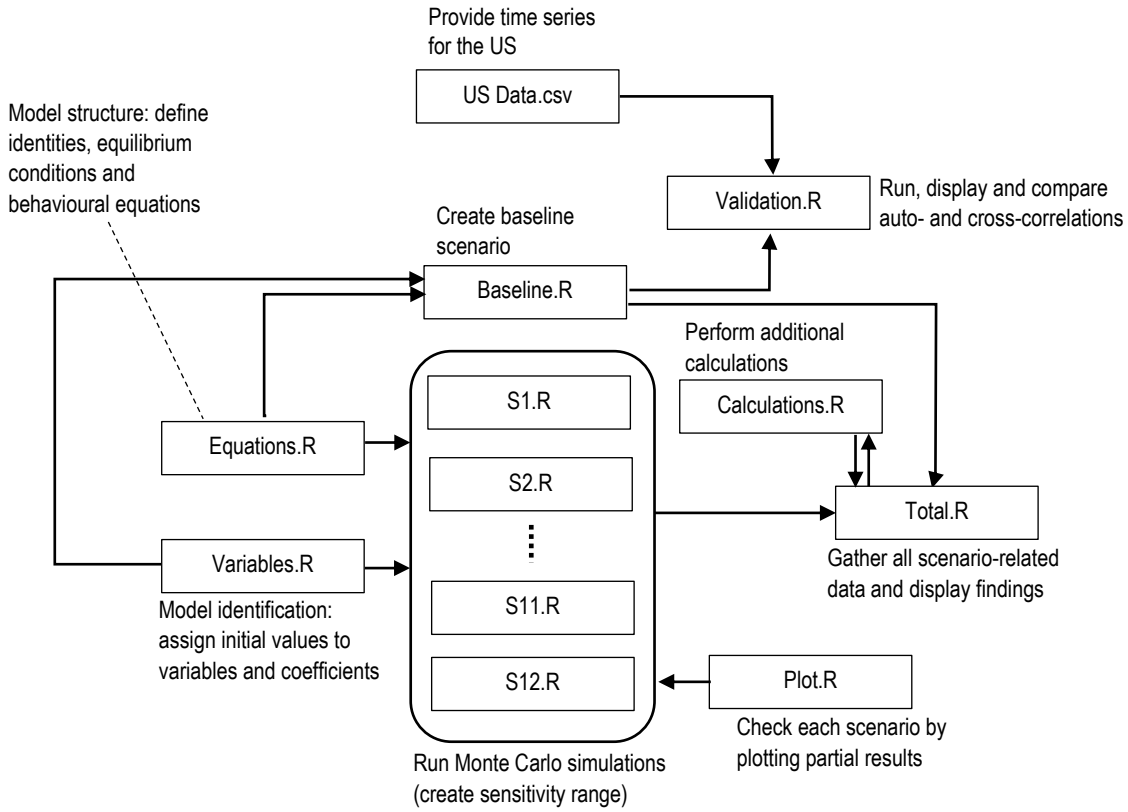
Symbol	Description	Type	Value / Range
α_1	Propensity to consume out of income	En	0.75
α_{10}	Autonomous component of propensity to consume	X	0.75±0.05
α_{11}	Sensitivity of propensity to consume to interest rate	X	1.00
α_{12}	Sensitivity of propensity to consume to unemployment rate	X	0.05
α_2	Propensity to consume out of cash	X	0.15
α_3	Propensity to consume out of cheque deposits	X	0.10
α_4	Propensity to consume out of saving deposits	X	0.05
α_5	Propensity to consume out of government securities	X	0.01
α_6	Propensity to consume out of shares and other firms' securities	X	0.01
α_g	Share of JG goods to total goods consumed by households	X	0.005
ρ_g	Ratio of government wage rate to private sector wage rate	X	0.75
β	Share of notional securities held as government securities by banks	X	0.50
β_w	Percentage of minimum wage workers to total	X	0.03
χ	Target percentage of investment to be funded by share issues	En	0.001
δ	Depreciation rate of capital	X	0.10
γ	Reaction speed of adjustment of capital to its target value	X	0.15
γ_g	Speed of adjustment of JG programme to market conditions	X	0.40
γ_w	Speed of adjustment of money wage rate	X	0.50
κ	Capital-Output ratio	X	1.00
κ_0	Autonomous component of capital-output ratio	X	1.00±0.05
κ_1	Sensitivity of capital-output ratio to Tobin q	X	0.10±0.05
κ_2	Sensitivity of capital-output ratio to leverage ratio	X	-0.10±0.05
λ_{10}	Parameter in portfolio equation of government securities	X	0.15
λ_{11}	Parameter in portfolio equation of government securities	X	0.20
λ_{12}	Parameter in portfolio equation of government securities	X	0
λ_{13}	Parameter in portfolio equation of government securities	X	-0.10
λ_{14}	Parameter in portfolio equation of government securities	X	0
λ_{20}	Parameter in portfolio equation of cheque deposits	X	0.40
λ_{21}	Parameter in portfolio equation of cheque deposits	X	-0.05
λ_{22}	Parameter in portfolio equation of cheque deposits	X	0
λ_{23}	Parameter in portfolio equation of cheque deposits	X	0.20
λ_{24}	Parameter in portfolio equation of cheque deposits	X	0
λ_{30}	Parameter in portfolio equation of firms' securities	X	0.10
λ_{31}	Parameter in portfolio equation of firms' securities	X	-0.15
λ_{32}	Parameter in portfolio equation of firms' securities	X	0
λ_{33}	Parameter in portfolio equation of firms' securities	X	-0.10
λ_{34}	Parameter in portfolio equation of firms' securities	X	0
λ_c	Cash to consumption ratio	X	0.18
λ_m	Share of cheque deposits that households hold following QE	X	0.50
μa	Mark-up of rate of return on CB advances	X	0.005
μb	Mark-up of rate of return on government securities	En	0.01
μb_0	Coefficient of rate of return on government securities	X	0.01
μb_1	Coefficient of rate of return on government securities	X	0.0025
μb_2	Coefficient of rate of return on government securities	X	0.015
μh	Mark-up of rate of return on reserves	X	0
μl	Mark-up of interest rate on loans	En	0.02
μl_0	Coefficient of interest rate on loans	X	0.02
μl_1	Coefficient of interest rate on loans	X	0
μlh	Mark-up of interest rate on personal loans	X	0.02
μm	Mark-up of rate of return on saving deposits	X	0.01
μp	Mark-up over labour cost	X	0.163
ν	Speed of adjustment of labour supply to labour demand	X	0.20
Ω	Adjusted wage share to total income	En	0
Ω_{r}	Share of managerial wages and salaries to total wages and salaries	X	0.50±0.05
ω	Speed of adjustment of un to nun	X	0.01±0.005
ϕ	Personal loans to disposable income ratio	X	0.03
ψ_0	Coefficient of price expectations function	X	0

ψ_1	Coefficient of price expectations function	X	0.01
ρ_1	Reserves to cheque deposits parameter	X	0.025
ρ_2	Reserves to saving deposits parameter	X	0.005
ρ_g	Ratio of JG wage rate to private wage rate	X	0.60 ± 0.10
ρ_l	Ratio of minimum wage rate to high wage rate	X	0.35
σ_0	Autonomous component of government spending	X	5.00
σ_1	Dependent component of government spending	X	0.15
τ_0	Autonomous component of tax revenues	X	0
τ_1	Tax rate on labour incomes	X	0.20
τ_2	Tax rate on capital incomes	X	0.20
τ_3	Tax rate on wealth	X	0.005
τ_4	Other transfers	X	2.00
τ_5	Unemployment benefits (relative to unemployment rate)	X	5.00
τ_g	Share of JG costs of production funded by charges	X	0.25 ± 0.05
θ	Profit retention rate	X	0.02
ε	Target share of government securities held by CB	En	0
ε_0	Autonomous component of target share of securities held by CB	X	0
ε_1	Sensitivity of target share of government securities to interest rate	X	0
ad	Demand for advances	En	0
af	Amortization funds	En	0
as	Supply of advances from CB	En	0
bb	Government securities held by commercial banks	En	0
bb_{not}	Notional amount of government securities held by banks	En	0
bcb	CB holdings of government securities	En	0
bh	Household holdings of government securities	En	0
bpr	Share of government securities purchased by private sector	En	1.00
bs	Government securities issued by the Treasury	En	0
c	Demand for consumption goods by households	En	0
cha	Charges associated with JG plan	En	0
cg	Capital gains on firms' shares	En	0
c_{gov}	Consumption of public goods	En	0
da	Depreciation allowances	En	0
def	Government deficit	En	0
eh	Firms' equity, shares and securities held by households	En	0
ep	Expected price level	En	1.00
esr	Number of securities issued by firms	En	0
fb	Bank profits	En	0
fcb	Central bank profit	En	0
fdf	Distributed profits of firms (dividends)	En	0
ff	Profits of firms	En	0
fuf	Undistributed profits of firms (retained profits)	En	0
g_F	Growth rate of foreign income	En	0.053
gl	Structural rate of growth of labour force	X	0.02
g_S	Deceleration rate of foreign income	X	0.03
gov	Government spending	En	0
hbd	Reserve requirement: demand	En	0
hbd^*	Extra reserves demanded by banks	En	0
hbs	Reserve requirement: supply	En	0
hbs^*	Extra reserves supplied by the CB	En	0
her	Number of securities held by households	En	0
hh	Household holdings of cash	En	0
hs	Supply of cash	En	0
Id	Investment	En	0
jg	Job guarantee spending	En	0
k	Stock of capital	En	0
kt	Target stock of capital	En	0
lev	Leverage ratio of firms	En	1.00
lf	Demand for bank loans	En	0
lh	Personal loans to households	En	0
ls	Supply of bank loans	En	0
$m0$	Coefficient of import function	X	-2.1
$m1$	Coefficient of import function	X	-0.5
$m2$	Coefficient of import function	X	0.5

$m3$	Coefficient of import function	X	0
$m1h$	Cheque deposits held by households	En	0
$m1s$	Supply of cheque deposits	En	0
$m2h$	Saving deposits held by households	En	0
$m2s$	Supply of saving deposits	En	0
nd	Labour demand	En	0
ng	People hired by the government (under job guarantee)	En	0
ns	Labour supply	En	0
nun	Non-inflationary rate of unemployment	X	0
nvh	Household net wealth	En	0
p	General price level	En	1.00
p_f	Unit price of private output	En	1.00
pe	Unit price of firms' securities	En	1.00
π	Inflation rate	En	0
π^T	Target or normal inflation rate	X	0
prf	Product per worker in private sector	X	1.00
prg	Product per worker in government sector	X	0.75
q	Valuation ratio (Tobin q)	En	0.80
r^*	Policy rate	X	0.02
ra	Rate of interests on CB advances	En	0.025
rb	Rate of return on government securities	En	0.03
re	Rate of return on firms' securities	En	0.02
rep	Repayment rate on personal loans	X	0.01
rh	Rate of interest on reserves	En	0.02
rl	Rate of interest on banks loans	En	0.04
rlh	Interest rate on personal loans	En	0.04
rm	Rate of interest on saving deposits	En	0.03
tax	Total tax revenue	En	0
tb	Trade balance	En	0
tr	Total transfers	En	0
un	Unemployment rate	En	0
vh	Household wealth	En	0
w_0	Normal value of money wage rate of skilled workers	X	0.86
w_h	Money wage rate of skilled workers	En	0.86
w_l	Minimum wage rate	En	0.301
wb	Wage bill	En	0
wg	Wage rate paid by the government	En	0.645
x_0	Coefficient of export function	X	-2.1$\pm$0.05
x_1	Coefficient of export function	X	0.5
x_2	Coefficient of export function	X	0.5
x_3	Coefficient of export function	X	0
y	Total income	En	40.00
y_F	Foreign income	En	40.00
yd	Disposal income of households	En	0

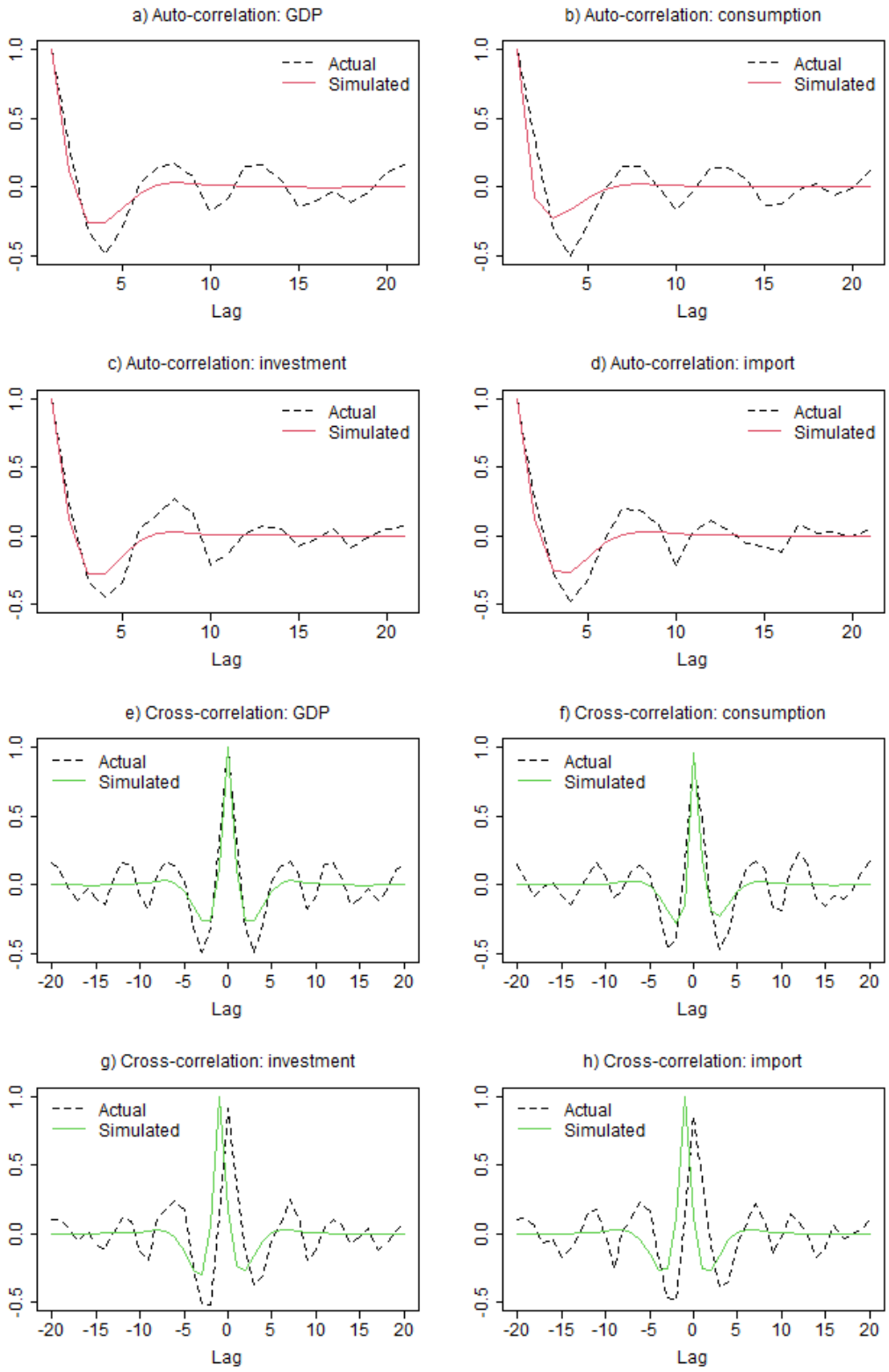
Note: En = endogenous variables; X = exogenous variables and parameters. Shaded areas show coefficient that are assigned a range of values.

Fig. 1. Files and coding structure of the model



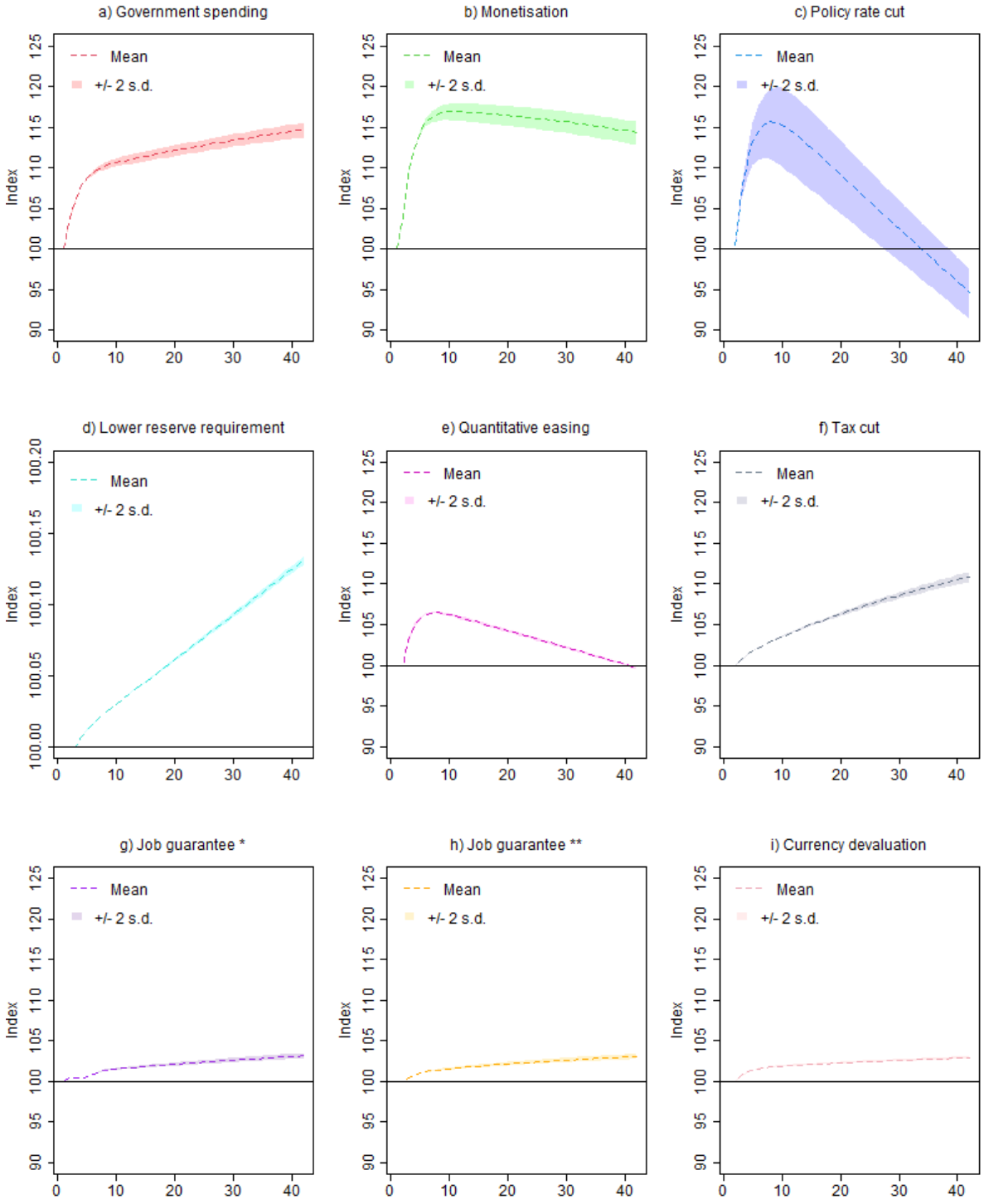
Note: outgoing arrows show files that are used as inputs or sources from other files

Fig. 2. Auto- and cross-correlations of cyclical components of GDP, consumption, investment and import



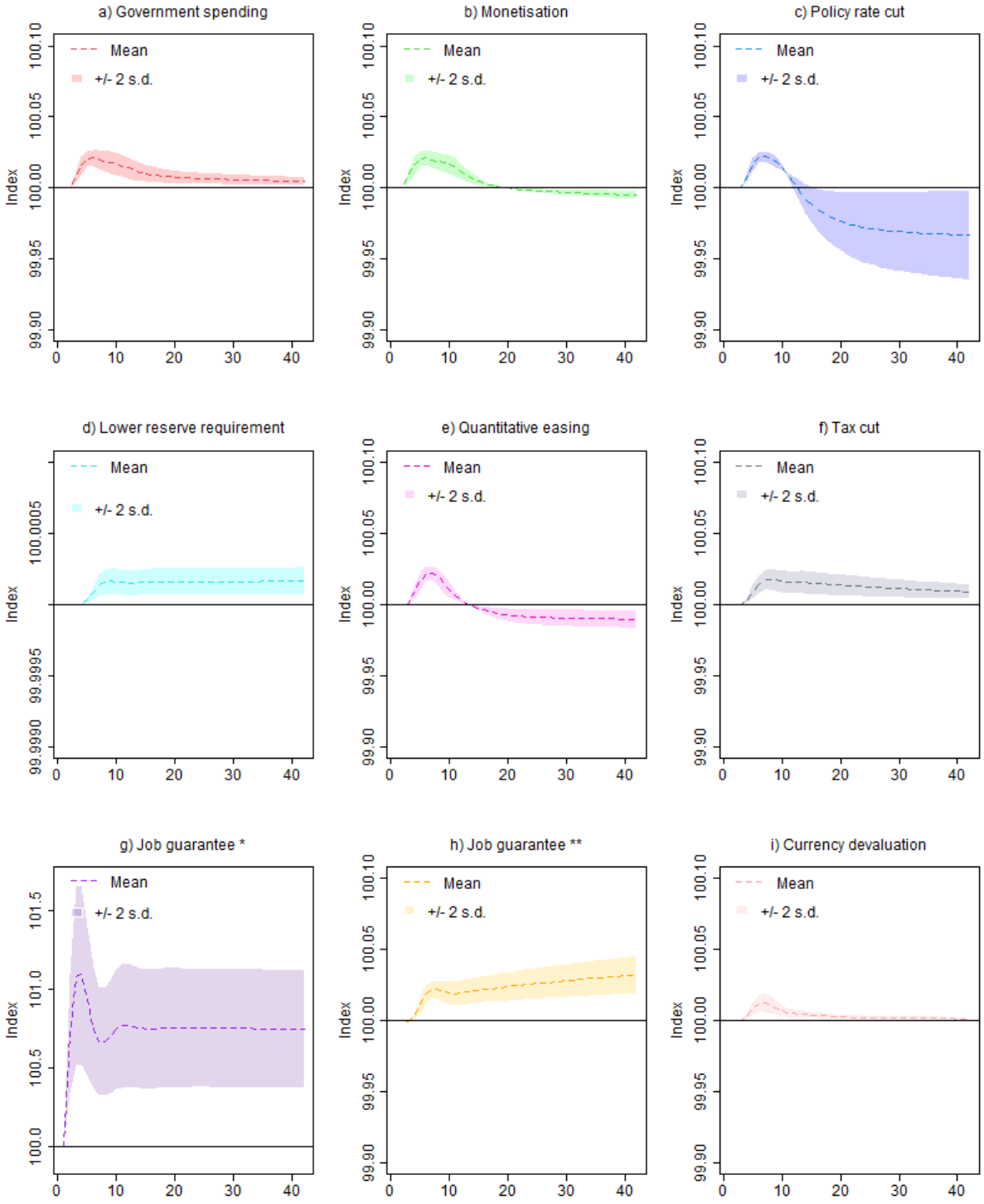
Note: simulated series vs. US time series for 1960-2019 (source: Federal Reserve dataset, April 2020). Variables are all expressed in logarithms and de-trended using a Hodrick-Prescott filter.

Fig. 3. Impact of different policy options on GDP (values relative to baseline x 100)



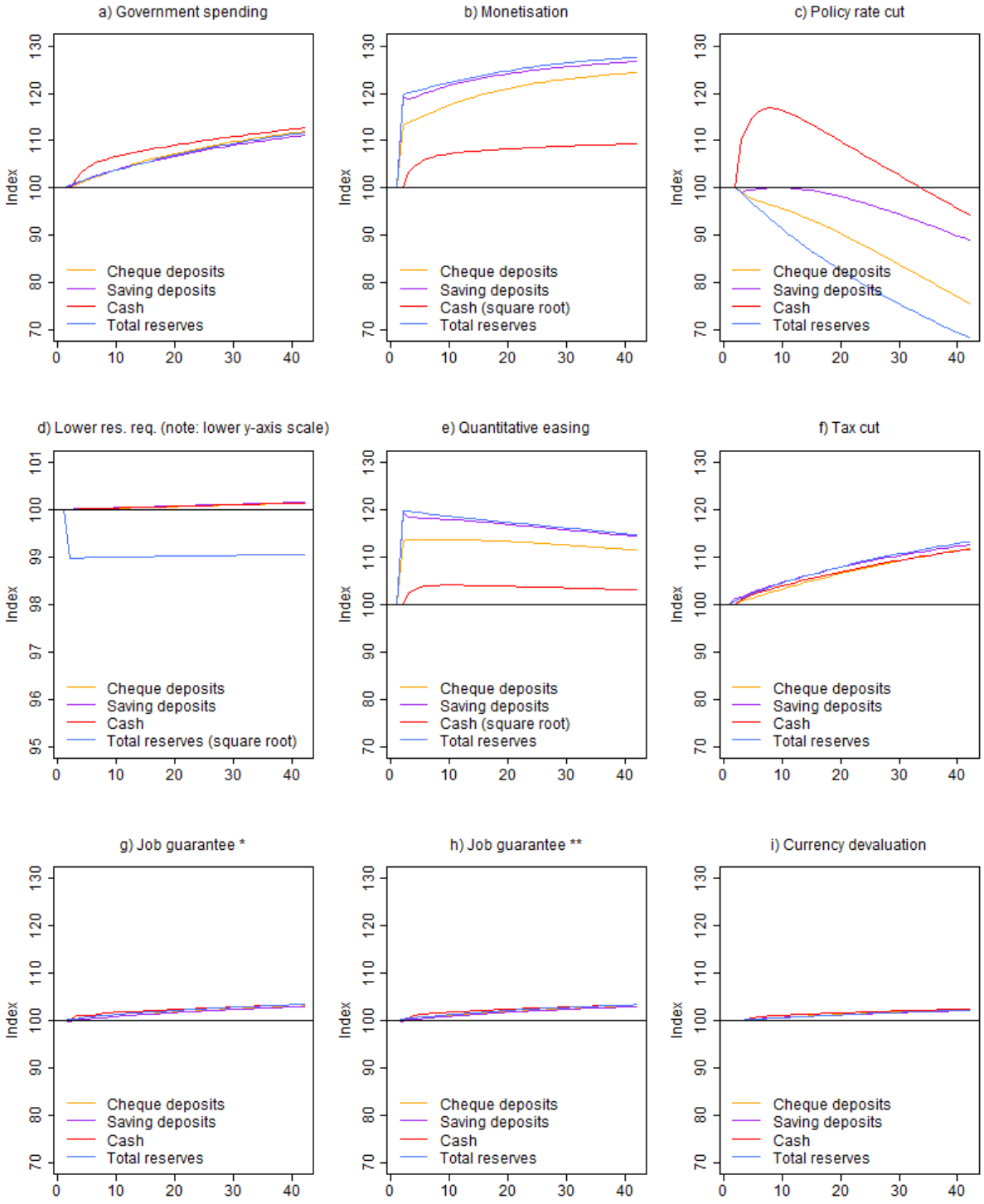
Note: * JG with exogenous wage rate; ** Alternative job plan with endogenous wage rate. A flatter wage curve is used in both experiments, excluding government workers from employment calculations.

Fig. 4. Impact of different policy options on price level (values relative to baseline x 100)



Note: * JG with exogenous wage rate; ** Alternative job plan with endogenous wage rate. A flatter wage curve is taken in both experiments, excluding government workers from employment calculations.

Fig. 5. Impact of different policy options on endogenous money: deterministic values (relative to baseline x 100)



Note: * JG with exogenous wage rate; ** Alternative job plan with endogenous wage rate. A flatter wage curve is used in both experiments, excluding government workers from employment calculations.

Fig. 6. Impact of Job Guarantee vs. conventional spending on selected variables

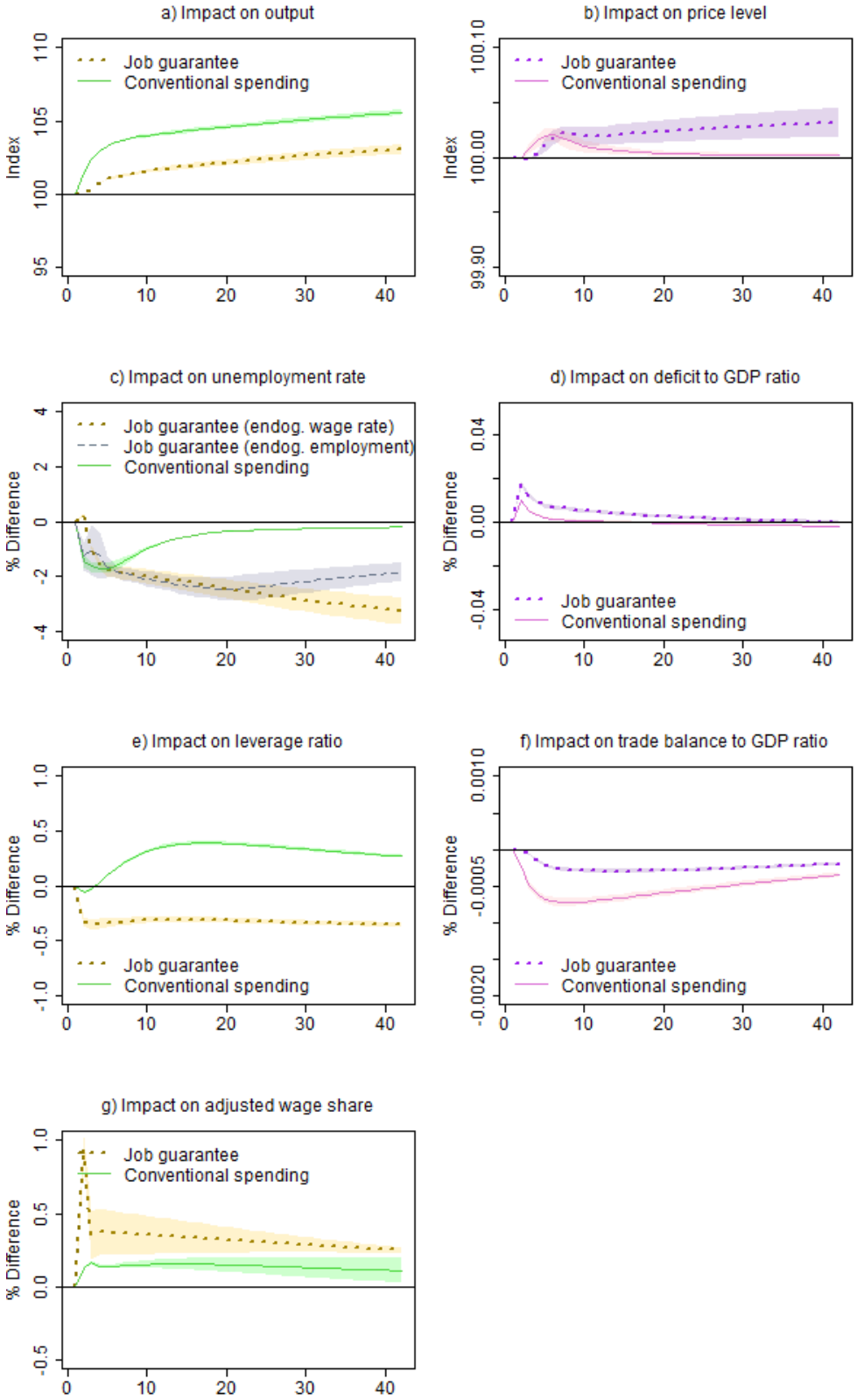


Fig. 7. Impact of conventional spending and job guarantee on unemployment rate and government budget, if the policy makers pursue full employment and they face no spending constraint

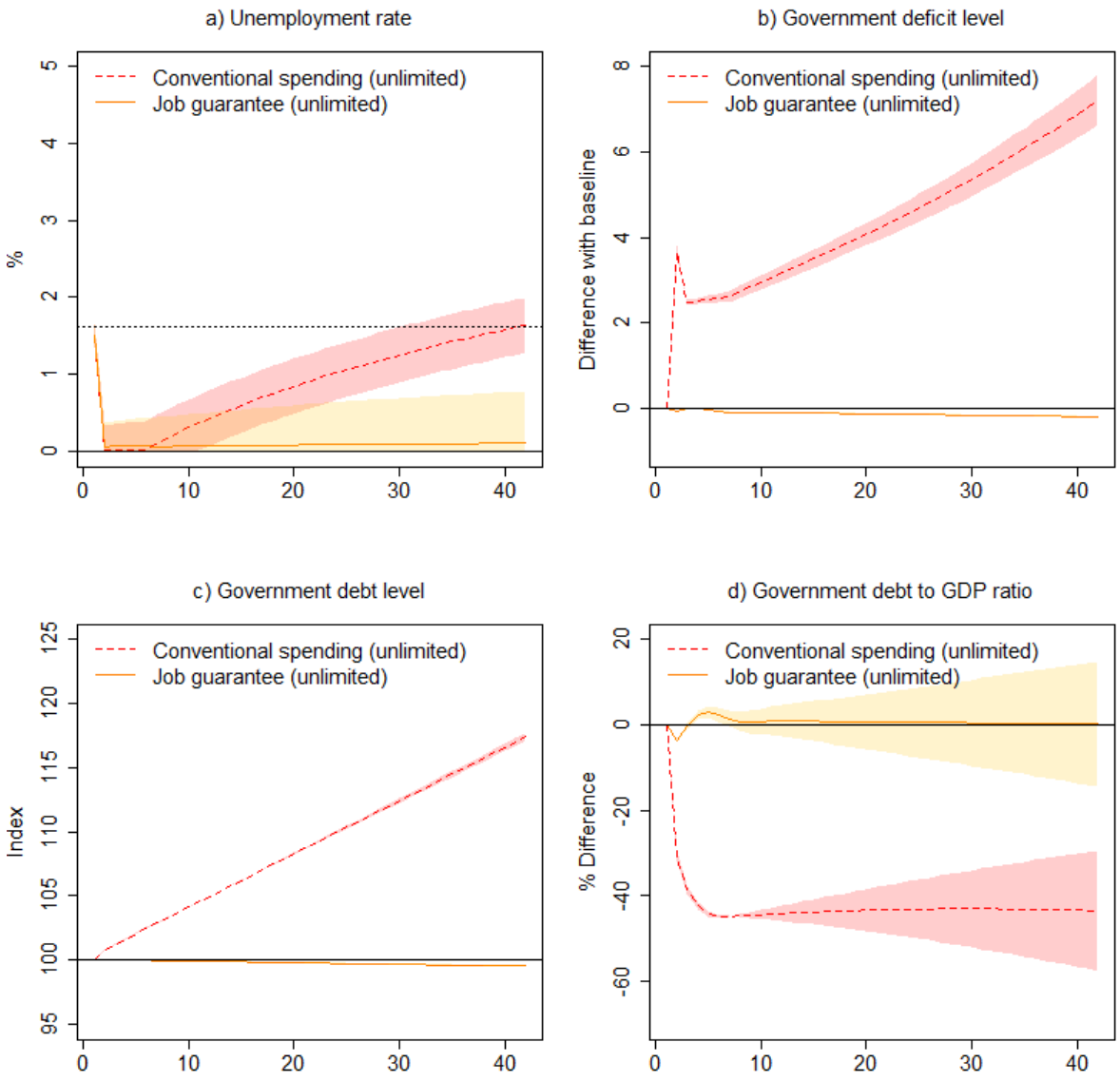
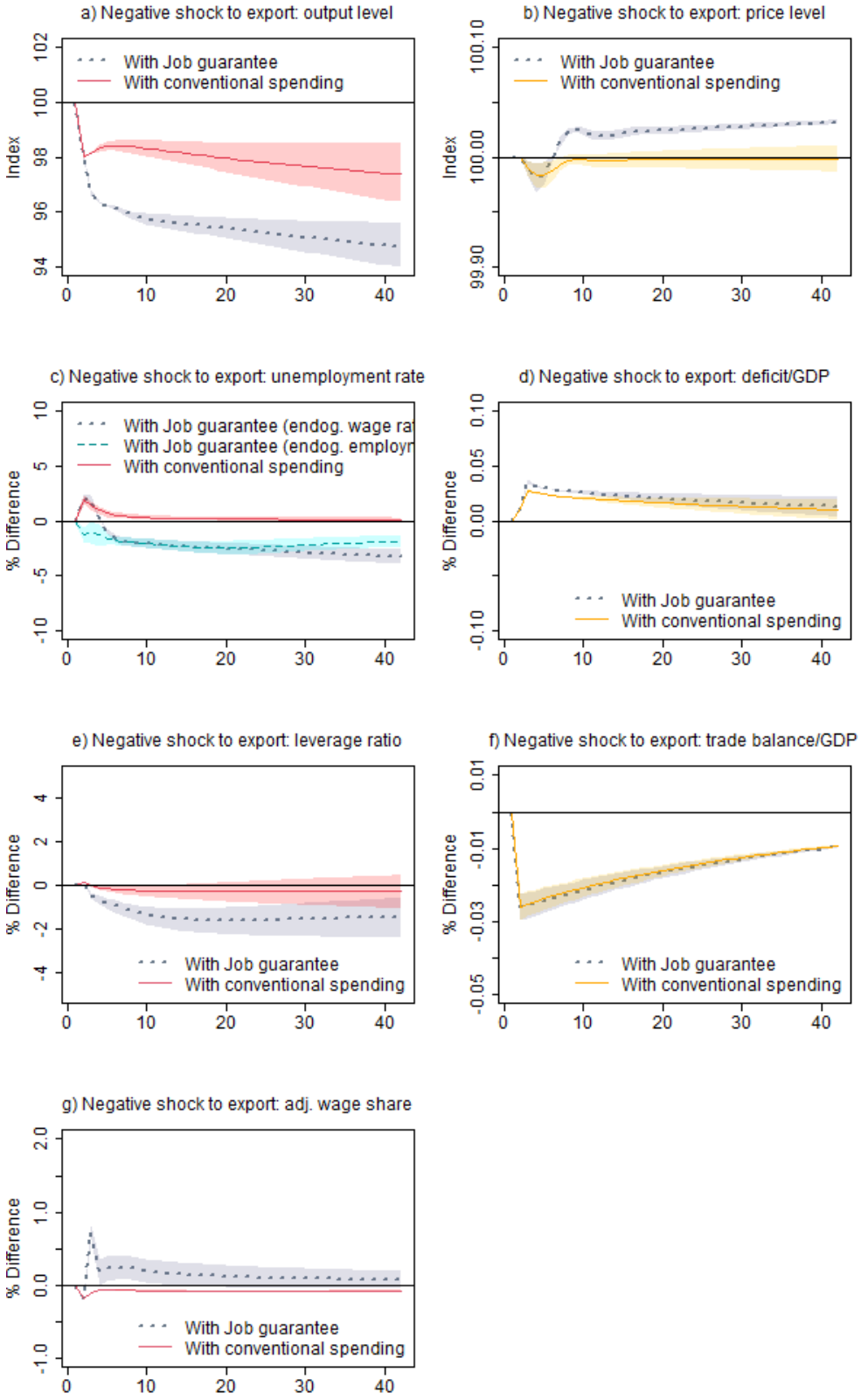


Fig. 8. Reaction following a negative shock to export



Tab. 2. Nominal balance sheet

	Lower-class households	**Upper-class households**	**Production firms**	**Commercial banks**	**Central bank**	**Government**	**Foreign sector**	**Σ**
Cash	$+hw$	$+hr$			$-hs$			0
Account deposits	$+m1w$	$+m1r$		$-m1s$				0
Saving deposits		$+m2h$		$-m2s$				0
Loans	$-lh$		$-lf$	$+ls$				0
Reserve requirement				$+hbd$	$-hbs$			0
Extra reserves				$+hbd^*$	$-hbs^*$			0
Advances				$-ad$	$+as$			0
Capital stock			$+k$					$+k$
Shares		$+ehr \cdot pe$	$-esr \cdot pe$					0
Government securities		$+bh$		$+bb$	$+bcb$	$-bs$		0
Foreign reserves (net)					$+hf$		$-hf$	0
Balance (net worth)	$-vw_n$	$-vr$	$-vf$	0	0	$+gdeb$	$+fdeb$	$-k$
Σ	0	0	0	0	0	0	0	0

Notes: A '+' before a magnitude denotes an asset, whereas '–' denotes a liability (except for Balance's entries, where signs are reversed).

Tab 3. Transactions-flow matrix

	Lower-class households	Upper-class households	Production firms		Commercial banks	Central bank	Government	Foreign sector	Σ
			Current	Capital					
Consumption	$-cw$	$-cr$	$+c$						0
Investment			$+id$	$-id$					0
Government spending			$+gov$				$-gov$		0
Export			$+x$					$-x$	0
Import			$-im$					$+im$	0
Memo: national income			$[y]$						
Taxes on income and wealth	$-taxw$	$-taxr$					$+tax$		0
Other taxes and charges	$-cha$						$+cha$		0
Transfers	$+tr$						$-tr$		0
Wage bill	$+(1-\Omega_r)\cdot wb$	$+\Omega_r \cdot wb$	$-wb_f$				$-wb_g$		0
Interests on loans	$-rl_{-1}\cdot lh_{-1}$		$-rl_{-1}\cdot lf_{-1}$		$+rl_{-1}\cdot ls_{-1}$				0
Repayments on loans	$-rep\cdot lh_{-1}$				$+rep\cdot lhs_{-1}$				0
Interests on saving deposits		$+rm_{-1}\cdot m2h_{-1}$			$-rm_{-1}\cdot m2s_{-1}$				0
Return on government securities		$+rb_{-1}\cdot bh_{-1}$			$+rb_{-1}\cdot bb_{-1}$	$+rb_{-1}\cdot bcb_{-1}$	$-rb_{-1}\cdot bs_{-1}$		0
Seigniorage income						f_{cb}	$+f_{cb}$		0
Entrepreneurial profit		$+fd_f$	$-f_f$	$+fu_f$					0
Amortisation funds			$-af$	$+af$					0
Bank profit		$+f_b$			$-f_b$				0
Change in cash	$-\Delta hw$	$-\Delta hr$			$+\Delta hs$				0
Change in loans	$+\Delta lh$			$+\Delta lf$	$-\Delta ls$				0
Change in account deposits	$-\Delta m1w$	$-\Delta m1r$			$+\Delta m1s$				0
Change in saving deposits		$-\Delta m2h$			$+\Delta m2s$				0
Change in shares		$-\Delta eh\cdot pe$		$+\Delta esr\cdot pe$					0
Change in government securities		$-\Delta bh$			$-\Delta bb$	$-\Delta bcb$	$+\Delta bs$		0
Change in reserve requirement					$-\Delta hbd$	$+\Delta hbs$			0
Change in extra reserves					$-\Delta hbd^*$	$+\Delta hbs^*$			0
Change in advances					$+\Delta ad$	$-\Delta as$			0
Change in foreign reserves (net)						$-\Delta hf$		$+\Delta hf$	0
Σ	0	0	0	0	0	0	0	0	0
Memo: capital gains		$-\Delta pe\cdot eh_{-1}$		$+\Delta pe\cdot esr_{-1}$					

Notes: A '+' before a magnitude denotes a receipt or a source of funds, whereas '–' denotes a payment or a use of funds. No interest rate on government securities held by central bank, bank reserves and advances.