5. Conventional and unconventional economic policies in an econometric SFC model of the French economy

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INTRODUCTION

The 2008 and Covid crises have led to increasing public debts and to the launching of unconventional economic policies. Thanks to a complete description of the balance sheets of the domestic and foreign agents, stock-flow consistent (SFC) modelling was well equipped to evaluate their economic consequences. The founding works of Godley and Lavoie (Godley, 1999; Lavoie and Godley, 2001; Godley and Lavoie, 2007) on SFC modelling were simply calibrated. Since 2005, better calibrated or econometrically based SFC models have become more frequent. The Levy model of the United States (Godley et al., 2005) was a forerunner. A first version of an econometric SFC model of the French economy based on the accumulation accounts of INSEE and on the financial accounts of the Bank of France has been presented (Mazier and Reyes, 2022a). This provides the overall structure, the main equations and the basic properties of the model.

This chapter is based on the same model with some improvements. The determinants of the structure of the interest rates are more developed. The treatment of the central bank includes the description of interests received and paid. A key equation of the model, the rate of capital accumulation of firms, has been modified in order to introduce a demand effect. Also, a provisional version of the model with an endogenous public bonds interest rate is shown at the end of the chapter. These improvements do not change fundamentally the properties of the model but some inflexions can be noticed.

The chapter is organized as follows. A second part presents the overall structure of the model and the main equations with a focus on the new ones. A third section is devoted to the simulations on the past and to basic shocks with an evaluation of the value of the multipliers of this version compared with the previous one. A fourth section analyzes some forms of unconventional or

more conventional economic policies to finance public investment or social transfers. A fifth section studies the economic consequences of an imported inflationary shock and some possible policy responses. The next section gives some proposals towards endogenization of public bonds interest rate. A final part concludes.[1]

MODEL STRUCTURE AND MAIN EQUATIONS

The model is aggregate with a single product. Its structure is analogous to that of already existing national-level SFC models. Production in volume is determined by domestic and foreign demand. The general price level depends on a mark-up pricing rule and is a function of unit labor costs with an effect from demand pressures. Value added is split among the different agents depending on simple structural parameters. Its distribution between wages, profits and taxes is based on a wage-price-unemployment equation and on institutional relations. Exports and imports are analyzed for all goods and services determined by demand and relative prices. Financing methods via bank credit, bond and equity issuing, as well as financial investment behavior are described for each agent. Changes in assets and liabilities, as well as investment and changes in inventories, combined with the revaluation accounts for capital gains or losses, facilitate the transition of the accumulation accounts from one year to the next in an SFC manner. The balance sheet structure of domestic and foreign agents and the uses-resources table combined with the flow of funds can be found in Mazier and Reyes (2022a). Although not fully consistent with a post-Keynesian approach, a supply constraint is introduced, mainly for empirical reasons. This results in a simple production function that determines potential output and allows for computation of an output gap. Its impact on firms' accumulation rate and inflation appears significant and representative of demand pressure. Our focus in this chapter is on the equations that have changed from the previous version.

Firms

Non-financial firms have an accumulation rate of productive capital $\left(\frac{\Delta^{*}K_{t}^{F}}{K_{t-1}^{F}}\right)$ that depends on four variables, following a post-Keynesian logic: the share of profit in value added $\left(\frac{\Pi^{F}}{VA^{F}}\right)$ representative of firms' profitability; the output gap of the market sector representative of a demand effect; the real interest rate[2] $\left(r_{L}^{F}-\pi_{Y}\right)$ with a negative sign; and the debt structure here represented as the debt-to-own funds ratio $\left(\frac{L_{L}^{F}}{p_{E_{L}}^{F}E_{L}^{F}+WLTH^{F}}\right)$, also with a negative effect.

The output gap is defined in the model as $gap = \left(\frac{va^M - va^{pM}}{va^{pM}}\right)$, where va^M is the market sector's value added and va^{pM} the potential value added. In spite of its weaknesses this has been preferred to the capacity utilization rate, which is measured by INSEE based on firms' surveys and is limited to the manufacturing sector (www.insee.fr/en/statistiques/4636533). The two indicators are rather close (see Figure 5.1) but the stronger correlation between the accumulation rate and the output gap deserves to be highlighted. Potential value added is determined by a simple production function which is used as a pragmatic compromise in spite of its limits ($\ln\left(\frac{va^{Mp}}{N^M}\right) = 0.8 + 0.5\ln\left(\frac{K_1^M}{N^M}\right) + 0.014t - 0.01\,t_{1992-2019}$). The alternative solution in the post-Keynesian tradition would be the capacity utilization rate defined by $u = Y/Y^f$, where Y^f is full capacity output ($Y^f = K/v$) and v the potential capital output ratio. This gives $u = vY/K$. The utilization capacity rate u is closely related to a simple apparent productivity of the capital (Y/K). Figure 5.1 shows a poorer empirical correlation with this theoretical indicator.

A version without the output gap (*gap*), with a positive effect of the lagged rate of profit and a negative effect of financial profitability, was used in the previous version of the model, more in line with a Kaleckian logic. The results are not fundamentally different, as will be discussed more in detail below.

Without output gap (previous model)

$$\left(\frac{\Delta^* K_1^F}{K_{1-1}^F}\right) = 0.02 + 0.1\left(\frac{\Pi^F{}_{-1}}{p^F_{K_{1-1}} K^F_{1-2} + p^F_{K_{2-1}} K^F_{2-2}}\right) - 0.2\left(r_L^F - \pi_Y\right) - 0.01\left(r^F_{E_A} - \pi_Y\right)$$

$$-0.03\left(\frac{L_L^F}{p^F_{E_L} E_L^F + WLTH^F}\right)$$

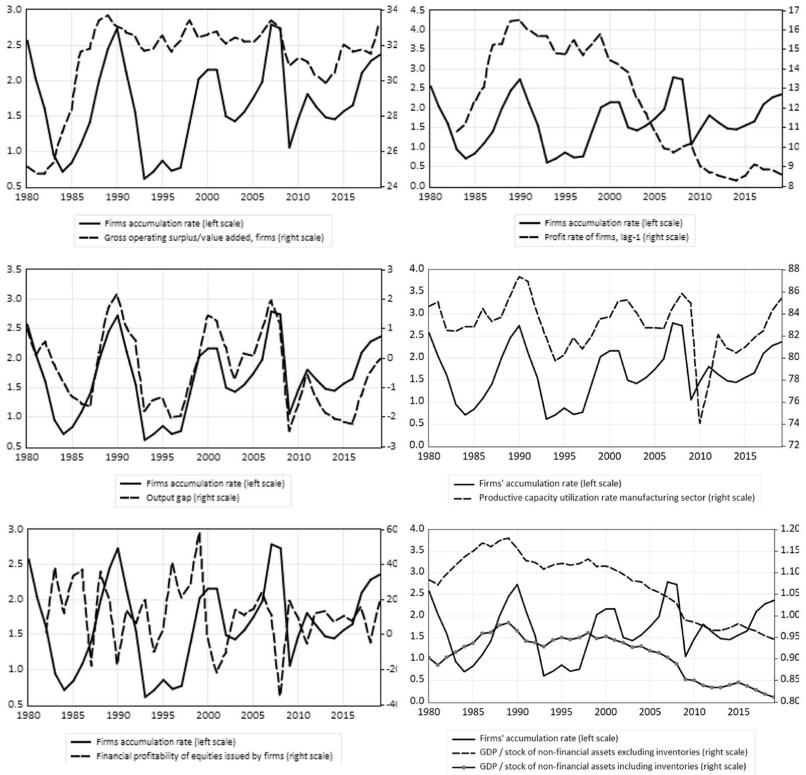
1983–2019 (5.9) (2) (2.2) (−2.3) (−4) $R^2 = 0.5$

With output gap (this model)

$$\left(\frac{\Delta^* K_1^F}{K_{1-1}^F}\right) = 0.08\left(\frac{\Pi^F}{VA^F}\right) + 0.3gap - 0.12\left(r_L^F - \pi_Y\right) - 0.01\left(\frac{L_L^F}{p^F_{E_L} E_L^F + WLTH^F}\right)$$

1983–2019 (17.2) (8.2) (−5.1) (−5.6) $R^2 = 0.81$

In financialized capitalism, firms tend to favor financial accumulation at the expense of productive accumulation. This translates into a financial accumulation rate that is an increasing function of the profit rate and of financial profitability of equities held, where indebtedness plays a supporting role. The change in firms' deposits and the flow of inter-firm credit are the subject of



Source: Elaboration by the authors using data from INSEE (detailed accounts of agents, comptes de patrimoine, comptes nationaux annuels) and Banque de France (comptes nationaux financiers), except output gap (IMF).

Figure 5.1 Firms' accumulation rate and its determinants (1980–2019)

a simplified model in which the real 10-year interest rate (with a negative sign) and the firms' indebtedness (as a liability) intervene respectively. Firms have an indebtedness behavior. In the medium term their debt structure, as a ratio of total non-financial capital, depends positively on the profit rate and negatively on the real interest rate. More than a debt behavior, it is an indebtedness norm, which reflects a given institutional relation between firms and banks. A split between bank debt and bonds is also made. Equities issued close the firms' account.

Banque de France

Interests and dividends paid and received by Banque de France are computed according to the corresponding assets. Profits are transferred to the government as tax. Bills and coins (H) are supplied by the central bank. Central bank deposits held by the government ($D_L^{CB_G}$) are isolated as they are used to study helicopter money (HM). Foreign bonds held by the central bank ($p_{B_A}^{CB_R} B_A^{CB_R}$), public bonds ($p_{B_A}^{CB_G} \Delta^* B_A^{CB_G}$), other domestic bonds ($p_{B_A}^{CB} \Delta^* B_A^{CB}$) and refinancing ($RF^{CB}$) correspond to different forms of quantitative easing. Equities issued by the central bank ($p_{E_L}^{CB} E_L^{CB}$) are exogenous. Central bank equilibrium is the unwritten identity.

$$\Delta^* H = \Delta^* H^F + \Delta^* H^B + \Delta^* H^H + \Delta^* H^R$$

$$D_L^{CB_G} = D_A^{G_{CB}}$$

$$p_{B_A}^{CB_R} B_A^{CB_R} = \varphi_{BA}^{CB} p_Y Y$$

$$p_{B_A}^{CB_G} \Delta^* B_A^{CB_G} = \gamma_{B_A}^{CB_G} p_Y Y$$

$$p_{B_A}^{CB} \Delta^* B_A^{CB} = \gamma_{B_A}^{B} p_Y Y$$

$$\Delta^* RF^{CB} = \varphi_{RF}^{CB} p_Y Y$$

$$p_G^{CB} \Delta^* G^{CB} + \Delta TRGT2 + \Delta^* RF^{CB} + \Delta^* D_A^{CB} + p_{B_A}^{CB_G} \Delta^* B_A^{CB_G} + p_{B_A}^{CB_R} \Delta^* B_A^{CB_R}$$

$$+ p_{B_A}^{CB} \Delta^* B_A^{CB} + \Delta^* L_A^{CB}$$

$$+ p_E^{CB} \Delta^* E_A^{CB} = \Delta^* H + \Delta^* RES + \Delta^* D_L^{CB} + \Delta^* D_L^{CB_G} + p_{E_L}^{CB} \Delta^* E_L^{CB} + Adj^{CB}$$

Interest Rates and Assets' Prices

The European Central Bank (ECB) key interest rate ($r_€$) and the 10-year interest rate on public bonds (i_{10yrs}) are exogenous in this version. Proposals are made

towards the end to endogenize the 10-year interest rate. Apparent (or implicit) interest rates are calculated for the various securities and are determined with simple margins with respect to the 10-year bonds interest rate or the ECB interest rate. The short-term interest rate on deposits (r_D) and the long-term interest rate on credit ($i^{LT_{cr}}$) are determined in the same manner. The price of public bonds ($p^G_{B_L}$) varies inversely with respect to that paid by the government (r^G_L). It plays a leading role in the determination of other prices of bonds such as bonds issued by firms ($p^F_{B_L}$), public bonds held by firms ($p^{F_G}_{B_A}$), private bonds held by households ($p^H_{B_A}$) or private bonds held by banks ($p^B_{B_A}$). Lastly, for each security (domestic private bonds, foreign bonds, public bonds), one price ($p^B_{B_L}$, $p^{B_R}_{B_A}$, $p^{R_G}_{B_A}$) must be obtained implicitly to guarantee flow-stock consistency by writing that the sum of the revaluation effects equals to zero.

$$r^F_A = 3.6 + 0.63\, r_€$$

$$r^H_A = 1.6 + 0.5\, r_€$$

$$r^F_L = 1.9 + 0.6\, i_{10yrs} + 0.2\, r_€$$

$$r^B_A = 0.4 + 0.5\, r^B_{A-1} + 0.4\, i_{10yrs}$$

$$r^B_L = 1.9 + 0.4\, i_{10yrs} + 0.7\, r_€$$

$$r^G_A = 2.5 + 1.6\, r_€$$

$$r^G_L = 1.1 + 0.75\, i_{10yrs} + 0.1\, r_€$$

$$r^H_L = 0.9 + 0.5\, i_{10yrs} + 0.4\, r_€$$

$$r^R_A = i_{10years} + \kappa^R_{r_A}$$

$$i^{LT_{cr}} = 0.93\, i_{10yrs}$$

$$r_D = 1.4 + 0.5\, r_€$$

$$\ln\left(p^{G}_{B_L}\right) = -0.39 + 0.1\ln\left(\frac{1}{r^{G}_{L}}\right)$$

$$\ln\left(p^{F}_{B_L}\right) = 0.8\ln\left(p^{F}_{B_{L-1}}\right) + 0.9\ln\left(p^{G}_{B_L}\right) - 0.7\ln\left(p^{G}_{B_{L-1}}\right)$$

$$p^{F_G}_{B_A} = \psi^{F_G}_{p_{BA}} p^{G}_{B_L}$$

$$p^{H}_{B_A} = \psi^{H}_{p_{BA}} p^{B}_{B_L}$$

$$\Delta\ln\left(p^{B}_{B_A}\right) = 0.2\,\Delta\ln\left(p^{B}_{B_{A-1}}\right) + 0.7\,\Delta\ln\left(p^{G}_{B_L}\right)$$

$$\Delta p^{B}_{B_L} = -\left(\frac{B^{F}_{L-1}}{B^{B}_{L-1}}\right)\Delta p^{F}_{B_L} + \sum_{i}\left(\frac{B^{i}_{A-1}}{B^{B}_{L-1}}\right)\Delta p^{i}_{B_A} \quad \text{for } i = B,\ CB,\ G,\ H,\ R$$

$$\Delta p^{B_R}_{B_A} = \left(\frac{B^{R}_{B_{L-1}}}{B^{B_R}_{B_{L-1}}}\right)\Delta p^{R}_{B_L} - \sum_{i}\left(\frac{B^{i_R}_{B_{A-1}}}{B^{B_R}_{B_{L-1}}}\right)\Delta p^{i_R}_{B_A} \quad \text{for } i = F,\ CB,\ G,\ H$$

$$\Delta p^{R_G}_{B_A} = \left(\frac{B^{G}_{L-1}}{B^{R_G}_{A-1}}\right)\Delta p^{G}_{B_L} - \sum_{i}\left(\frac{B^{i_G}_{A-1}}{B^{R_G}_{A-1}}\right)\Delta p^{i_G}_{B_A} \quad \text{for } i = F,\ B,\ CB$$

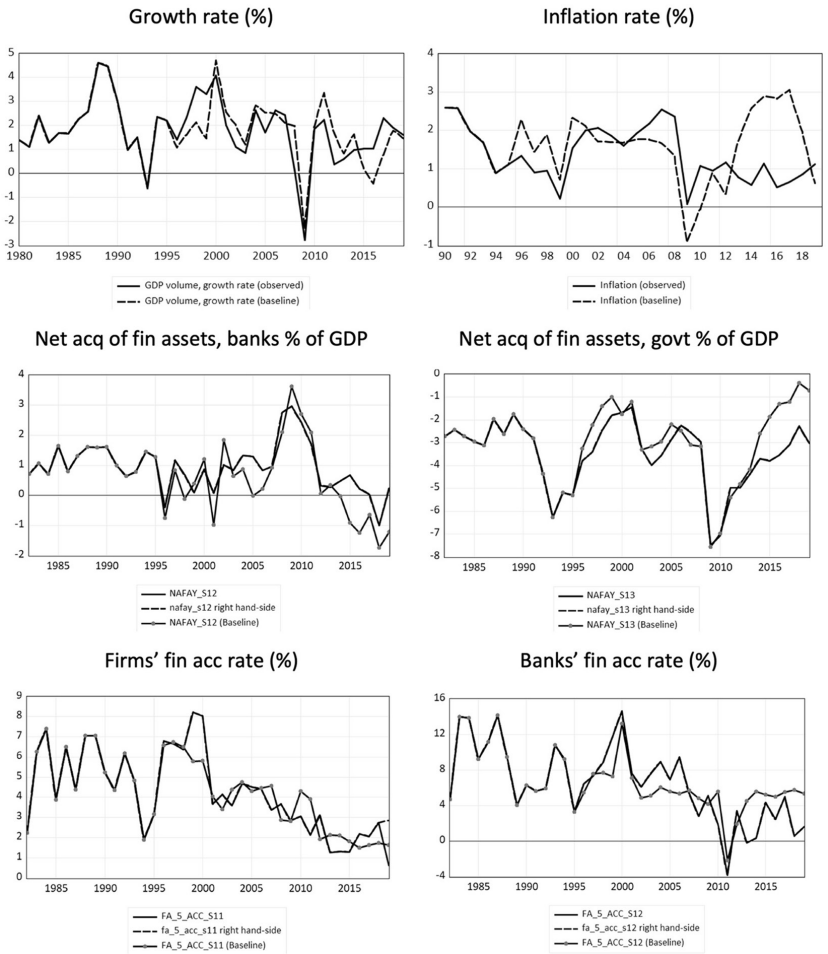
Simulations and Basic Shocks

Figure 5.2 allows for a comparison between the observed and simulated evolution of a sample of series in the model, which includes the output gap in the specification for firms' non-financial accumulation rate. The model performs rather well. The gap between the observed series and the baseline lies within reasonable limits, with a few exceptions.

BASIC SHOCKS AND MODEL COMPARISON

We compare the multiplier effects of two model specifications, one with no output gap in firms' accumulation rate and the other that includes it. Two shocks are examined, first a permanent increase of public investment of 1 percent of gross domestic product (GDP) and second an increase of 1 percent in the growth rate of wage per worker.

The increase in public investment has a greater effect on economic growth in the short term in the model, including a demand effect in the accumulation rate of firms. This is due to the larger increase of the rate of non-financial



Note: Simulations start in 1996.
Source: Observed series were elaborated by the authors using data from INSEE (detailed accounts of agents, comptes de patrimoine, comptes nationaux annuels) and Banque de France (comptes nationaux financiers), except output gap (IMF). Baseline is the results of the model.

Figure 5.2 Model performance; selected series, observed versus simulated

accumulation of firms, but this accumulation boom does not last long as the output gap decreases with the increase in capital stock. In the long term the multiplier effect of the two models is similar. The evolution of the price level is also similar in both; it increases by about 2.5 percent after 10 years. The trade

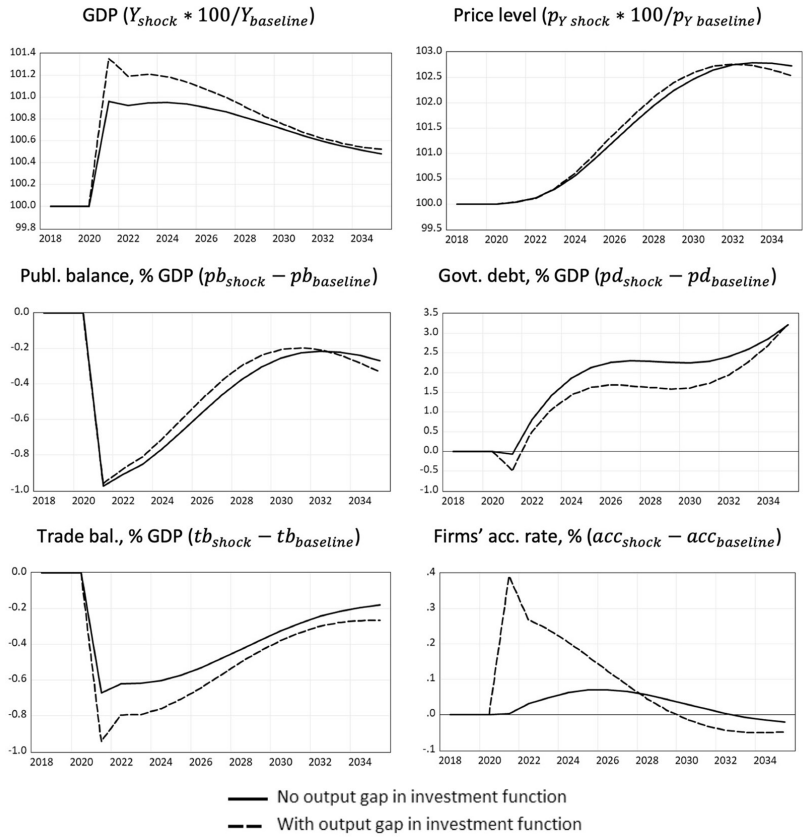


Figure 5.3 *Public investment increases permanently by 1 percent of GDP between 2021 and 2035*

balance worsens more in 2021 in the model with the output gap effect due to the more sustained growth. Similarly, public finances worsen less and public debt increases less (Figure 5.3).

A 1 percent increase in the growth rate of wage per worker has a small initial positive impact on GDP but after two years (model with output gap effect on investment) or four years (model without the gap effect) the impact of the wage increase becomes negative. This suggests that the French economy is under a moderate wage-led regime in the short term and in a profit-led regime in the longer term. The reversal is reflected also in the trade balance, which initially tends towards deficit then shifts in the opposite direction. Similarly, the public balance improves in the medium term (0.5 percent of GDP) thanks to the

increase in resources, but this surplus is progressively reduced. The increase in wages induces an inflationary drift (1.8 percent in the medium term). It makes inflation rise proportionally more than it makes GDP fall in the medium term (hence, nominal GDP increases), thus reducing debt-to-GDP ratios, especially that of the government (−4 percent of GDP in the medium term). But a reversal appears in the long term. Even if differences exist between the two versions of the model, the results are rather similar and not in favor of a wage-led policy which would be reduced to a simple wage increase (Figure 5.4).

Unconventional Monetary and Fiscal Policy

Various forms of unconventional economic policies can be considered: HM, public indebtedness and repurchase by the central bank, cancellation of a part of the public debt held by the central bank, recapitalization of the central bank's own funds, taxation of wealthy households and redistribution. HM can take several forms, either as a distribution of central bank money directly to households or businesses, or as a distribution to the government. If the purpose is to avoid a distribution of banknotes, one way is to assume that all households and firms have an account with the central bank. This is possible and corresponds to the project of development of central bank digital currency. Here we are only interested in the second form of HM, i.e. via the state and its account with the central bank. Two uses of HM are distinguished: one to finance public investments, the other to finance social transfers. These unconventional economic policies have been analyzed in Mazier and Reyes (2022a, 2022b).

HM to finance public investment (a permanent increase in public investment of 1 percent of GDP) leads to a recovery with a public debt falling gradually until reaching −10 percent of GDP in the long term. However, central bank financial wealth decreases by 13 percent of GDP and bank reserves increase by 12 percent of GDP. Furthermore, rest-of-the-world financial wealth increases by 11 percent of GDP which means an equivalent deterioration of the domestic net financial assets, mainly due to a decline of the trade balance induced by the loss of price competitiveness and the volume effect of the recovery. According to supporters of this policy, a central bank could continue working with negative own funds. This could be the case if the procedure is punctual and limited, but more problematic in the context of sustained policy. Financial markets could push interest rates up. The size of bank reserves would facilitate capital outflows or slippages in the securities and/or real-estate markets. In the French case, as in the case of countries in the Eurozone without a central bank properly speaking, such policy would contradict European treaties. It could only be undertaken after a series of time-consuming negotiations whose outcomes would be uncertain.

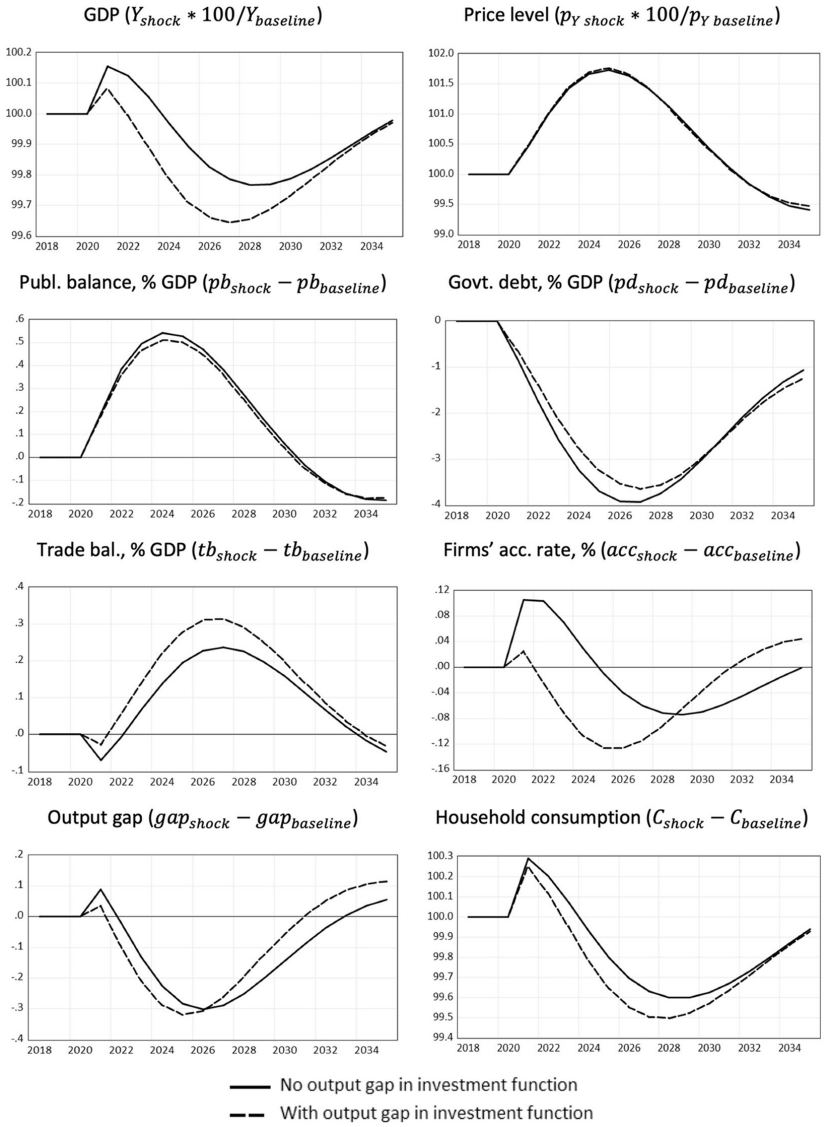


Figure 5.4 Growth rate of wage per worker increases permanently by 1 percent between 2021 and 2035

Another answer is given. As the central bank can create its own currency, its recapitalization would be easy and costless. This point can be examined

with the model. Recapitalization of the central bank can be done in a simple way. The central bank issues new equities which are bought by the government thanks to a distribution of HM to the government. In the non-financial sphere (GDP and price) nothing changes. At the monetary and financial level the equities issued by the central bank are increased but the wealth of the central bank is reduced by the same amount. All in all, the own funds of the central bank (equities issued plus wealth) remain unchanged. However, two other evolutions must be noted. The government wealth is increased since the government holds the new equities issued by the central bank. For the public sector as a whole (government and central bank) this means that its wealth is constant. This gives a more positive estimate of the financial situation of the public sector. But simultaneously the bank reserves, which can be interpreted as a debt of the central bank towards the commercial banks, increase by the same amount. As has already been noted, these increasing bank reserves could facilitate capital outflows and slippages in the financial markets. Overall, the results show that the recapitalization of the central bank raises problems. It cannot be done as simply as it is sometimes said (i.e. with a "simple click").

Traditional public indebtedness to finance public investment can be combined with repurchase of public bonds by the central bank, which can be seen as an illustration of Modern Monetary Theory (Kelton, 2020). Repurchasing the public bonds by the central bank is simply described in the model by adding an add-factor in the corresponding equation. The real effects in terms of growth and inflation are similar in all cases. The deterioration of the nation's financial wealth is the same (12 percent of GDP in the long term with a permanent shock). The banks hold less public bonds and their reserves increase largely. The results appear close to the case where there is no repurchase by the central bank. Compared to the case of HM an opposition appears at the level of the financial situation of the various sectors. The financial wealth of the government improves in case of HM and decreases in case of repurchase by the central bank. Conversely, central bank financial wealth decreases in case of HM while it is stable in case of central bank repurchase. However, the impact of the repurchase of public bonds by the central bank can be underestimated in the current version, where interest rates are exogenous.

A proposal put forward by some authors (e.g. Scialom and Bridonneau, 2020) is to cancel part of the large amount of government securities held by the central bank in order to lighten budget constraints, thus providing room for maneuver to better finance the low-carbon transition. This policy can be studied in the model in a simple way. A first gap-filling variable is introduced in the flow-stock equation generating the stock of public debt held by the central bank. The same negative shock is introduced in the flow-stock equation generating the stock of total debt. Lastly, another gap-filling variable equation indicates that the cancellation concerns only public bonds. This partial cancel-

lation of public debt held by the central bank has no effect on the real economy. Public debt falls initially but central bank wealth falls as much and remains lower than in the baseline. For supporters of this policy, the reduction of public debt would loosen the constraints and would open the way to an increase in public investment to finance the energy transition. The combination of these two measures, partial cancellation of debt and increase in public investment, leads to a sustained recovery with rising inflation. Thanks to the cancellation, public debt remains under control despite the initial increase in the public deficit. The counterpart of these evolutions is a persistent and marked deterioration of central banks' wealth. These results raise the same reservations as those formulated about HM. Insofar as the amounts of cancellation are high, it is difficult to believe that this marked deterioration of central banks' own funds can remain without consequences.

Another possible use of HM is to finance social transfers to households for a one-shot or permanent increase. The results are similar to the previous ones, a recovery and a moderate price increase. Government balance deteriorates but without rising public debt thanks to the HM distribution and recovery. The counterpart is a deterioration of central bank wealth and an increase in bank reserves. If the measure is punctual and limited in time this would not be a problem. However, it seems difficult to sustain this measure on a permanent basis as it is illustrated by a permanent distribution of HM to finance social transfers equivalent to 1 percent of GDP (Figure 5.5). Production is persistently higher with a price drift still rather moderate. Government debt in percentage of GDP decreases but central bank wealth falls dramatically and bank reserves rise considerably. Last, the rising rest-of-the-world financial wealth reflects a sharp decrease of domestic financial wealth.

Taxation of the Rich and Social Transfers

Last, we analyze a simple incomes policy based on taxation of the rich to finance social transfers. This policy can be justified since income inequality has increased considerably over the past four decades and the top incomes have benefited from important tax relief measures. This incomes policy can be simulated in three steps. First, we consider a one-off increase in the tax rate of households affecting all income brackets. This is characterized by an increase of 10 billion euros in (4 percent of) the income taxes paid by households (solid line in Figure 5.6). Unsurprisingly, this increase in income taxation has a negative effect on economic activity but slightly improves public finances. Second, if the increase only concerns wealthy households, they will not reduce their expenditures but they will save less to pay taxes. This can be introduced in the model by adding to the initial shock a second one including a 0.5 percent increase in the volume of household consumption and an additional

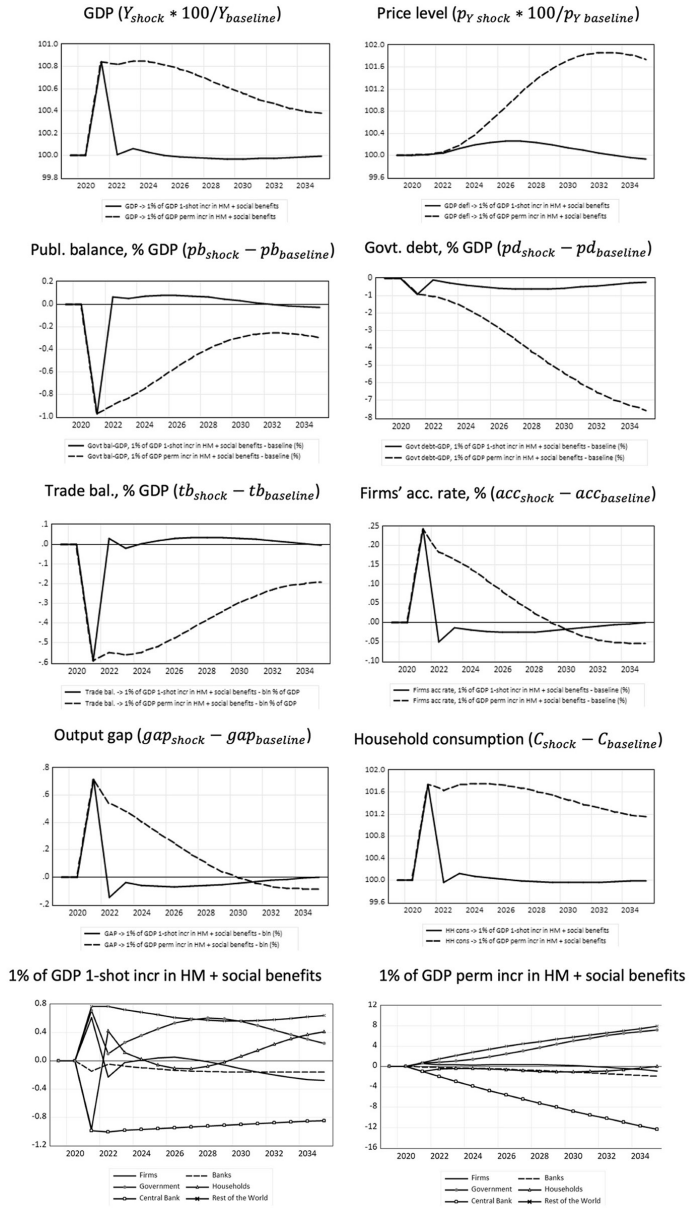
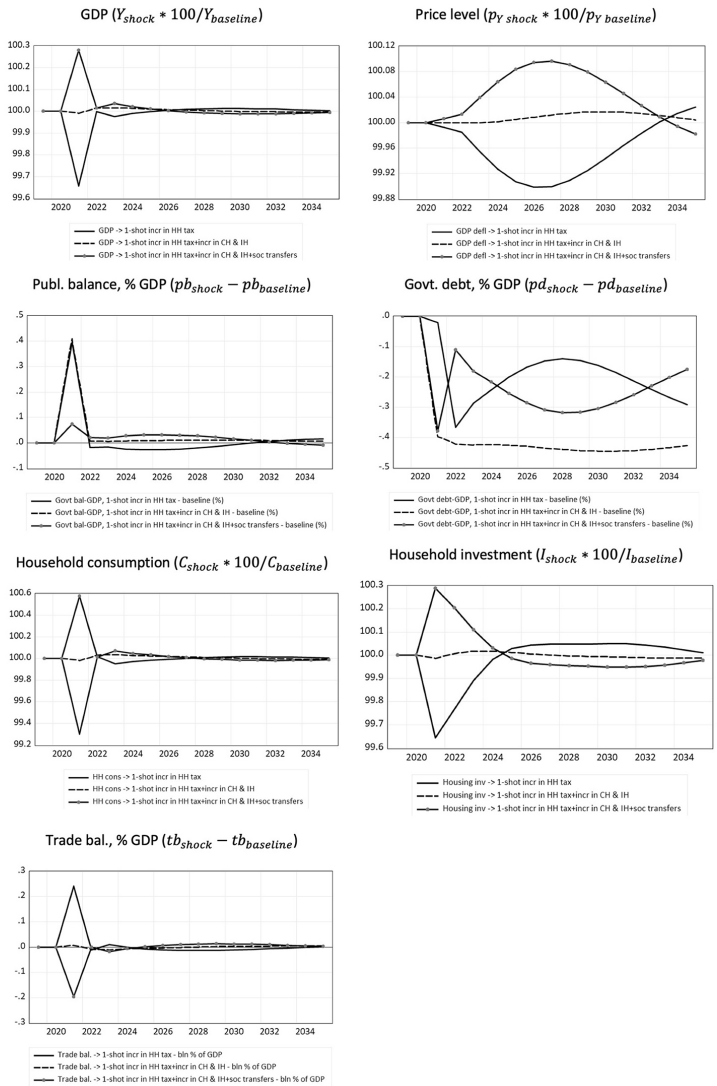


Figure 5.5 *Increase in helicopter money with social transfers 1 percent of GDP, one-off versus permanent shock*



Note: Solid line = taxes on households increase by 10 billion euros (4 percent of income taxes paid by households) in 2021. Dashed line = solid line + 5.8 billion increase in household consumption in 2021 and −4.5 billion reduction in 2022 + 0.25 percent increase in growth rate of household investment in 2021 and −0.1 percent in 2022. Solid line + circles = dashed line + increase of 8.5 billion in social benefits.

Figure 5.6 Increase in rich household taxes and social transfers

0.32 percent in the growth rate of the volume of households' investment (0.4 percent increase in level). The result of this combined shock is clear (dashed line). Since wealthy households preserve their expenditures by saving less, the impact on economic activity is almost nil. The only impact concerns public finances which improve with a reduction of public debt. The counterpart is a reduction of households' wealth. Third, this fiscal surplus can be used to finance a new policy, for example, a transfer in favor of the low-level incomes with an increase of 8.5 billion in social benefits (solid line + circles). The global result is positive. The economic activity is more sustained with more households' consumption and investment, a slight improvement of the public finance and a reduction of income inequality.

Imported Inflationary Shock and Possible Policy Responses

In this section we study an inflationary shock coming from the rest of the world and its impact on the French economy. This takes place via an increase in import prices but also world export prices by 5 percent. We compare this to the same shock with a few policy responses added: interest rate hike of 3 percent (to fight inflation in a traditional way), increased social transfers by 0.7 percent of GDP (to support households' income) or a 1.8 percent increase in the growth rate of wage per worker (to try to preserve the purchasing power of wages). Figure 5.7 shows the effects.

In this hypothetical scenario, in 2021 a 5 percent increase in world import prices induces imported inflation which lowers workers' purchasing power. Economic activity slows down. Imports in volume are reduced but imports in current prices increase with the increase in import prices, leading to an initial 0.8 percent of GDP trade deficit. With the economic slowdown the public balance initially worsens (−0.4 percent of GDP). After the initial inflationary shock, a reversal appears. Inflation falls. The trade balance reverses its course and remains slightly in surplus. The public balance as a share of GDP also improves. Government debt mirrors this evolution, rising by 0.5 percent in 2021 and then falling by 0.7 percent the next year. All in all, after the initial drain linked to the rise in import prices, economic activity rebounds and GDP joins the baseline scenario.

Facing this external shock, the authorities could decide to increase social transfers by 0.7 percent of GDP (column 1, dashed) in order to support households. This has indeed the desired lessening effect on the output drop, although at the cost of (slightly) raising demand-pull inflation, worsening public finances and the trade balance. But this degradation remains limited. Fighting an imported inflationary shock through social transfers appears as a good option as long as the shock does not continue.

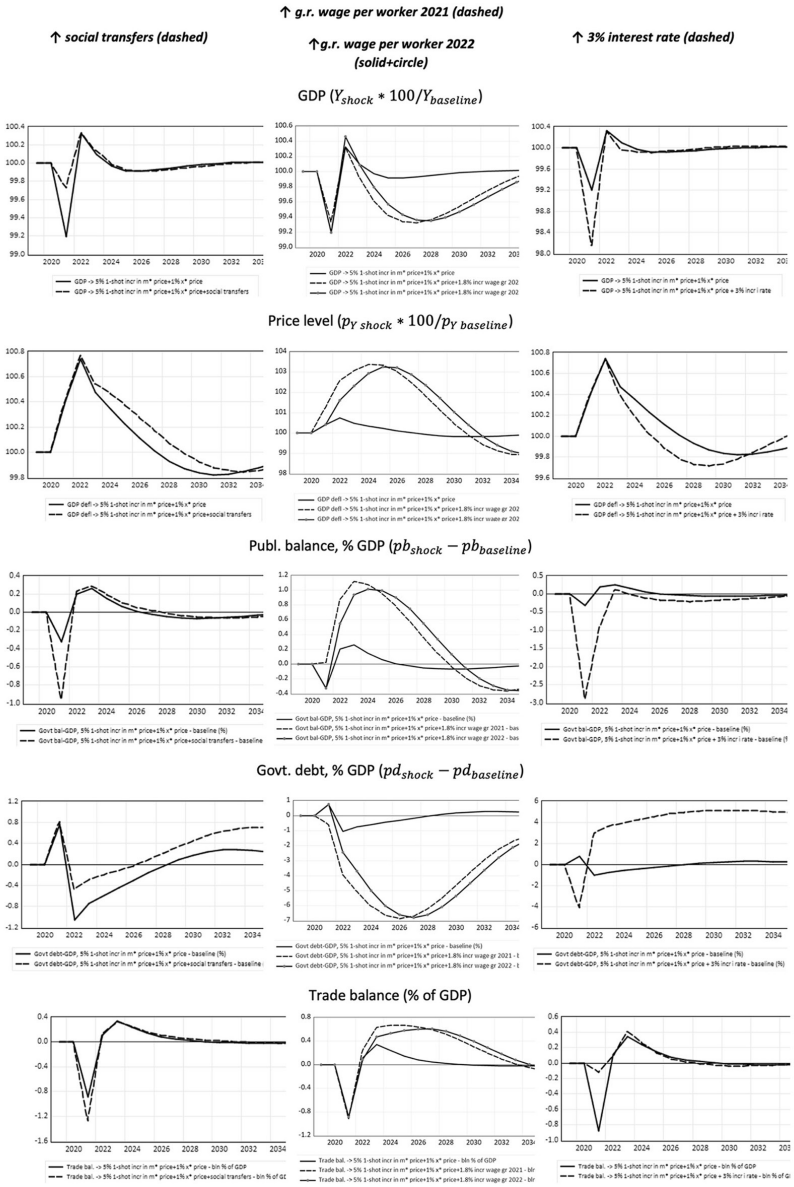


Figure 5.7 *Inflationary shock (solid line) and scenarios starting in 2021 unless otherwise stated*

A second option would be to increase wages in the hope of preserving purchasing power (column 2, dashed and solid + circle). We analyze the consequences of doing so in 2021 (when the inflationary shock takes place) or the year after. The results are not fundamentally different in either case, except for the lag in the response of the series. Prices rise considerably and a wage-price spiral starts. GDP worsens due to the declining purchasing power induced by increasing inflation. In spite of the inflation drift the trade balance improves thanks to the declining demand. The only positive point of this scenario is the improvement of the public finance induced by the inflation drift. The public balance increases by more than 1 percent of GDP and the stock of government debt falls by 8 percent of GDP in 2028. Fighting an imported inflationary shock by increasing wages does not seem a good option for the workers, but the acceptance of an inflationary drift can be useful for public finances.

A third option is that the inflationary shock questions the credibility of the central bank and has to be fought by traditional monetary policy tools. A 3 percent increase in the interest rate is introduced as an illustration (column 3, dashed). The cost of this restrictive policy is high for a rather modest and delayed effect on prices. The rise in domestic prices is progressively contained, via the sharp contraction in aggregate demand (−2 percent of GDP in 2021). The public balance worsens significantly (−3.2 percent of GDP in 2021) due to the slowdown, the decrease of public resources and the rising cost of debt services. Furthermore, public debt is much higher starting in 2022 (4 percent of GDP and higher afterwards), due to the reduced activity and the more moderate prices which limit nominal GDP. This traditional contractionary monetary policy with the increase in the interest rate is not adapted to fight imported inflation that is not caused by excessive demand pressure. Its cost is high for a limited and delayed result.

Towards an Endogenization of the Rate of Interest

Interest rates are exogenous in the present version of the model. It seems logical to keep the ECB key interest rate ($r_€$) exogenous as one of the main tools for monetary policy. But the 10-year interest rate on public bonds (i_{10yrs}) could be endogenized as it is playing a leading role. Following the SFC tradition it could be determined implicitly by the balance of the public bonds market between the supply $p^G_{B_L}\Delta^* B^G_L$ coming from the government balance and the demand of public bonds by the different agents, banks $\left(p^{B_G}_{B_A}\Delta^* B^{B_G}_A\right)$, central bank $\left(p^{CB_G}_{B_A}\Delta^* B^{CB_G}_A\right)$, firms $\left(p^{F_G}_{B_A}\Delta^* B^{F_G}_A\right)$ and rest of the world $\left(p^{R_G}_{B_A}\Delta^* B^{R_G}_A\right)$.

$$p^G_{B_L}\Delta^* B^G_L = p^{B_G}_{B_A}\Delta^* B^{B_G}_A + p^{CB_G}_{B_A}\Delta^* B^{CB_G}_A + + p^{F_G}_{B_A}\Delta^* B^{F_G}_A + p^{R_G}_{B_A}\Delta^* B^{R_G}_A$$

By substituting in the previous equation the demand of public bonds by the rest of the world $\left(p^{R_G}_{B_A}\Delta^* B^{R_G}_A\right)$ and by banks $(p^{B_G}_{B_A}\Delta^* B^{B_G}_A)$ and solving for i_{10yr} we obtain:

$$\left(\frac{p^{R_G}_{B_A}\Delta^* B^{R_G}_A}{p_Y Y}\right) = 0.02 + 0.78\left(i_{10yr} - i^{LT*} + \frac{\Delta NEER}{NEER_{-1}}\right)$$

$$\left(\frac{p^{B_G}_{B_A}\Delta^* B^{B_G}_A}{p_Y Y}\right) = 0.35\left(\frac{p^{B_G}_{B_{A-1}}\Delta^* B^{B_G}_{A-1}}{p_{Y-1} Y_{-1}}\right) + 0.5\left(i_{10yr} - i^{LT*} + \frac{\Delta NEER}{NEER_{-1}}\right)$$

where i^{LT*} is the weighted average long-term foreign interest rate and *NEER* is the nominal effective exchange rate.

$$i_{10yr} = \left(i^{LT*} - \frac{\Delta NEER}{NEER_{-1}}\right)$$

$$+\left(\frac{1}{1.28}\right)\left(\left(\frac{p^{G}_{B_L}\Delta^* B^{G}_L - p^{CB_G}_{B_A}\Delta^* B^{CB_G}_A - p^{F_G}_{B_A}\Delta^* B^{F_G}_A}{p_Y Y}\right) - 0.02 - 0.35\left(\frac{p^{B_G}_{B_{A-1}}\Delta^* B^{B_G}_{A-1}}{p_{Y-1} Y_{-1}}\right)\right)$$

Where the public bonds held by the central bank $p^{CB_G}_{B_A}\Delta^* B^{CB_G}_A$ are driven by quantitative easing, the public bonds held by firms $(p^{F_G}_{B_A}\ B^{F_G}_A)$ are small and simply determined in percentage of value added and public bonds issued by the government $\left(p^{G}_{B_L}\Delta^* B^{G}_L\right)$ close the government's account. According to this equation the main determinant of the 10-year interest rate on public bonds is the foreign one, after correction of the exchange rate variation $\left(i^{LT*} - \frac{\Delta NEER}{NEER_{-1}}\right)$. A larger issuance of public bonds increases the 10-year interest rate while a more active quantitative easing decreases it. Unfortunately, problems of respect of financial wealth balances appeared in solving the model with this specification.

A simpler modeling has been tested. The closure for domestic public bonds held by banks is kept as in the version where interest rates are exogenous. This allows to keep explicitly the accounting equation.

$$p^{B_G}_{B_A}\Delta^* B^{B_G}_A = p^{G}_{B_L}\Delta^* B^{G}_L - p^{CB_G}_{B_A}\Delta^* B^{CB_G}_A - p^{F_G}_{B_A}\Delta^* B^{F_G}_A - p^{R_G}_{B_A}\Delta^* B^{R_G}_A$$

The interest rate is now the solution for i_{10yr} in the (unwritten) estimated equation

$$\left(\frac{p^{B_G}_{B_A}\Delta^* B^{B_G}_A}{p_Y Y}\right) = 0.7\left(i_{10yr} - i^{LT*} + \frac{\Delta NEER}{NEER_{-1}}\right)$$

Solving the previous expression for domestic interest rate yields

$$i_{10yr} = \left(i^{LT*} - \frac{\Delta NEER}{NEER_{-1}}\right) + 1.4\left(\frac{p_{B_A^{B_G}} \Delta^* B_A^{B_G}}{p_Y Y}\right)$$

This version of the model[3] with endogenous interest rate works correctly and yields acceptable results for the simulations on the past. We can compare the multiplier effects of a permanent hypothetical increase in public investment by 1 percent of GDP starting in 2021 under three possible model specifications: *model 1* includes an exogenous interest rate and no output gap in firms' accumulation rate, *model 2* also has an exogenous interest rate and there is an output gap in firms' accumulation rate, while *model 3* includes an endogenous interest rate and the output gap in the accumulation rate (Figure 5.8).

In Figure 5.8 we observe that model 3 with endogenous interest rate displays results close to those of the models with exogenous interest rate, except for public finances which worsen more when the interest rate is endogenous (because of its slight tendency to increase following an activist fiscal policy). The evolution of the price level is very similar in the three models, which increases by about 2.5 percent after 10 years.

CONCLUSION

A new version of an econometric SFC model of the French economy has been presented, including an impact of demand pressure on firms' investment described via an output gap. The dynamic simulations on the past over the period 1996–2019 provide acceptable results. A comparison with a previous version of the model, without output gap effect on investment, has been made. The results of both models seem close.

The model has been used to study the effects of different forms of unconventional economic policies. A distribution of HM in favor of the government to finance additional public investments or social transfers has a stimulating impact without increasing public debt. However, as a counterpart, the wealth and own funds of the central bank deteriorate by an amount equivalent to the initial shock. If the intervention is not punctual and limited, this evolution could be problematic. Although the central bank can create its own currency, recapitalization of the central bank raises problems. The combination of public indebtedness and repurchase by the central bank has been described. The results seem close to the case where there is no repurchase by the central bank but the effects of the repurchase may be underestimated in a version of the model with exogenous interest rates. Partial cancellation of the public debt held by the central bank has been examined. It has, as a counterpart, a degra-

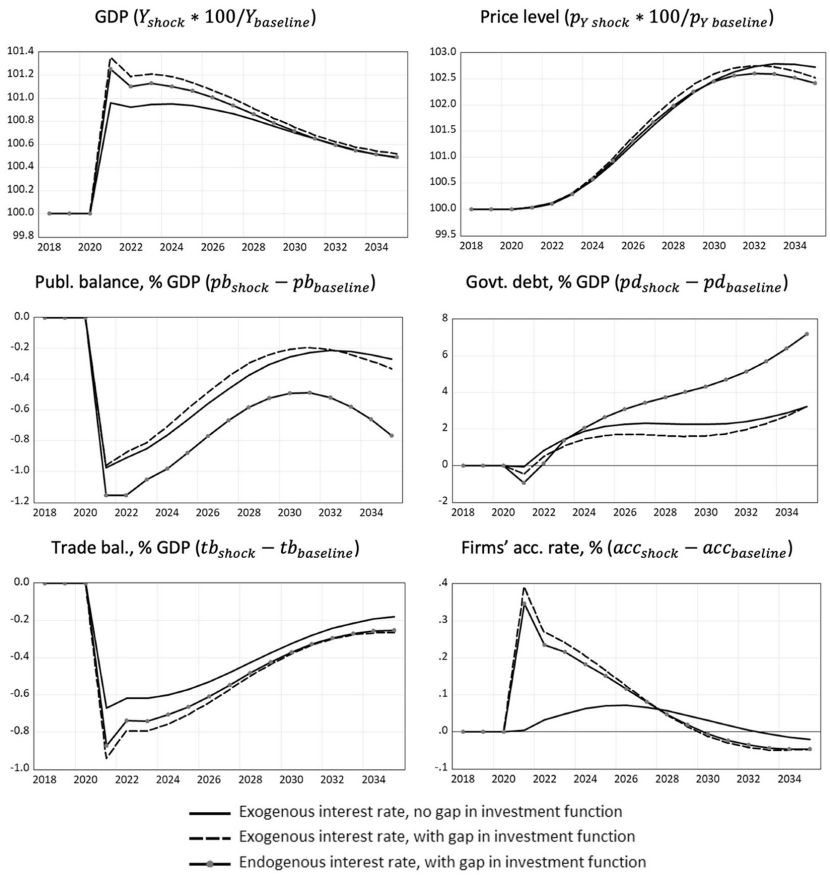


Figure 5.8 *Public investment increases permanently by 1 percent of GDP, three variants of the model*

dation of the wealth and own funds of the central bank which are too important to remain without consequences. Taxation of wealthy households to finance social transfers in favor of the bottom income brackets was simulated and provided positive results.

Imported inflationary shocks have been studied with various policy responses. Increasing social transfers to support households seems like a good option, as long as the shock does not continue. On the contrary, increasing wages in the hope of preserving purchasing power would induce an inflation drift not favorable to workers, but that could prove useful for public finances. A restrictive monetary policy with an increase in interest rates is not adapted

to fight imported inflation. This would have a high cost in terms of growth and public finances for a limited and delayed result in terms of inflation.

Finally, a simple endogenization of the interest rate, based on the balance of the public bonds market, has been tested. Results seem close to the results of the model with exogenous interest rates, except for public finances which worsen more. This version of the model could be checked in more detail and improved. Furthermore, an explicit treatment of the ECB (currently integrated in the rest of the world) and a modeling of the rest of the eurozone remain to be done.

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NOTES

1. The complete working paper of the first version and the technical documentation are available at www.chair-energy-prosperity.org/en/research-area-2/enjeux-macroeconomique-societaux-transition-energetique-en/a-stock-flow-consistent-model-for-the-french-economy/.
2. r_L^F is the apparent (or implicit) interest rate, calculated as the ratio of interests paid by firms and the stock of indebtedness from the previous period.
3. In order to keep this version from being overly sensitive to the evolution of public bonds, the parameter 1.4 was divided by 5. Hence the actual parameter entering the equation is 0.28.

REFERENCES

Godley, W. (1999), Seven unsustainable processes: Medium term prospects and policies for the USA and the world economy, Levy Economics Institute of the Bard College.

Godley, W. and Lavoie, M. (2007), *Monetary economics*, Palgrave Macmillan.

Godley, W., Papadimitriou, D. B., Dos Santos, C. H. and Zezza, G. (2005), The US and the creditors: Can the symbiosis last? Strategic analysis, Levy Economics Institute of the Bard College.

Kelton, S. (2020), *The deficit myth: Modern Monetary Theory and how to build a better economy*, John Murray.

Lavoie, M. and Godley, W. (2001), Kaleckian growth models in a stock and flow monetary approach framework: A Kaldorian view, *Journal of Post-Keynesian Economics*, 24(2), 277–312.

Mazier, J. and Reyes, L. (2022a), A stock flow consistent model for the French economy, in M. Randrup Byrialsen, H. Raza and F. Olesen (eds), *Macro-modelling, economic policy and methodology: Economics at the edge*, Routledge.

Mazier, J. and Reyes, L. (2022b), *Unconventional monetary policy in an econometric SFC model of the French economy: Some lessons for financing the low-carbon transition*, Economie Appliquée.
Scialom, L. and Bridonneau, B. (2020), Crise économique et crise écologique: osons des décisions de rupture, *Terra Nova*, April.