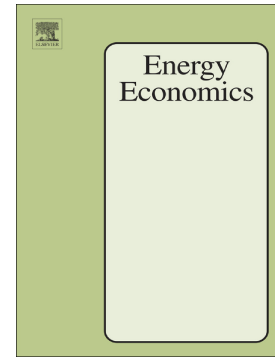


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# Energy Crisis, Economic Growth and Public Finance in Italy

Rosa Canelli<sup>\*</sup>, Giuseppe Fontana<sup>†\*</sup>, Riccardo Realfonzo<sup>\*</sup>, and Marco Veronese Passarella<sup>‡†</sup>

## Abstract:

Italy is the third-largest economy in the European Union after Germany and France. Italy has also the second-highest government debt-to-GDP ratio in the EU after Greece. The 2007-2008 Global Financial Crisis first, and the Covid-19 crisis after, have severely weakened its economy, and further deteriorated its government finance. The recent surge of inflation, due to the rising energy costs in 2022, has had an immediate negative impact on the Italian economy. Could the energy crisis also have profound, long-run effects on the Italian economy, threatening the long-run sustainability of both its government debt-to-GDP ratio and economic growth? This paper assesses the impact of the energy crisis on the Italian economy through a medium-scale stock-flow consistent macroeconomic model. Through a rigorous accounting framework, the paper captures the effects of the changes in energy costs and the feedback mechanisms on both real and financial variables, evaluating some of the policy response available to policy authorities in the EU and Italy. The main conclusion of the paper is that the Italian economy is on the edge of a precipice. The soft landing scenario will bring a low inflation environment, but modest growth and dire public finance, which may trigger punitive EU policy measures. The hard landing scenarios may succeed in containing inflation or bringing the government deficit to GDP ratio in line to EU rules, but at the price of a severe recession and a ballooning government debt to GDP ratio.

**Keywords:** Energy crisis, Inflation, Government debt, Italy, Stock Flow Consistent Models

## Highlights:

- The impact of the energy crisis on the Italian economy
- Medium-scale, stock-flow consistent, structural macroeconomic model

<sup>\*</sup> University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy

- Simulation scenarios: energy price, policy rate, and austerity policy shocks
- Long-run sustainability of the government debt/GDP ratio and economic growth in Italy

Journal Pre-proof

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## 1. INTRODUCTION

Italy is the third-largest economy in the European Union (EU) after Germany and France. Italy has also the second-highest government debt/GDP ratio in the EU after Greece. The 2007-2008 Global Financial Crisis (GFC) first, and the Covid-19 crisis after, have severely weakened its economy. The unexpected surge of inflation, due to the rising energy costs in 2022, has had a negative impact on the Italian economy. This paper explores the possibility that the energy crisis could have profound, long-run effects on the Italian economy, threatening the long-run sustainability of both its government debt/GDP ratio and economic growth.

During the 2008-2019 period and thereafter, Italy has struggled to comply with the budgetary discipline recommended by the European Commission. The debt-to-GDP ratio rose from 106.2% in 2008 to 134.6% in 2019. During the same period, real GDP did not recover its pre-GFC level. The Covid-19 crisis has further weakened the Italian economy. In 2020, GDP dropped 9%, while government deficit and debt/GDP reached 9.6% and 154.9%, respectively (Eurostat, 2023). As many other economies, Italy bounced back in 2021. GDP grew 6.7% and the debt/GDP dropped to 147.1%. This improvement was however short-lived. The energy crisis caused a sharp rise in inflation, which triggered an increase of the policy rate by the ECB. This has produced in Italy an immediate drop in GDP and much uncertainty about the outlook of the debt/GDP ratio.

The current energy crisis poses a particular threat to the Italian economy. Italy has a high energy dependency rate, and hence it is in a highly vulnerable position to energy shocks.<sup>1</sup> For instance, the average annual growth of the Harmonised Consumer Price Indices (HICP) for energy, provided by Eurostat<sup>2</sup>, reached 51.3% (compared to 14.3% in 2021). The monthly change over the previous year reached 71.7% in October 2022, and it declined of 19.9% in October 2023. The annual average index of the HICP for energy rose up to 165.9 in 2022, from 109.6 in 2021 (index 2015 = 100). Monthly data shows that the harmonized index of consumer prices for energy climbed to 209.3 in November 2022, before slowly starting declining during 2023. It is expected to be at 157.5 in November 2023. This vulnerability to energy shocks together with the need to accelerate the transition to non-fossil fuels has led scholars and practitioners to investigate the current dynamics in the Italian energy sector. The literature has focused, among others, on the interaction between energy use, economic development, and energy policies (Zachariadis, 2007; Halicioglu, 2009; Lee and Chien, 2010; Agovino et al., 2019; Magazzino et al., 2021, Prontera and Lizzi, 2023, Prontera, 2024); the energy trade balance (Giordano and Tosti, 2022); the consequences of energy transition policies (Campagnolo and De Cian, 2022; Concettini et al., 2022); the effects of energy-efficiency incentive programs (Alberini and Bigano, 2015); the impact of energy prices on the firms sector (Bardazzi et al., 2015); the impact of the Covid-19 pandemic on the energy sector (Akyildirim et al., 2022; Szczygielski et al., 2022); and the spillover effects of oil price changes on the inflation rate CPI (Elsayed et al., 2021).

This paper contributes to this literature by using an original methodology, namely a medium-scale, stock-flow consistent (SFC), structural macroeconomic model, in order to explore the potential impact of the current energy crisis on the Italian economy. Six macroeconomics sectors are considered: households, non-financial or production firms, banks (and financial intermediaries), the government sector, the central bank (ECB), and the foreign sector. The coefficients of the behavioural equations have been estimated using Eurostat (or ISTAT) data on an annual basis. The considered time span for

<sup>1</sup> See e.g., Eurostat data at:

[https://ec.europa.eu/eurostat/databrowser/view/NRG\\_IND\\_ID\\_custom\\_3844017/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_ID_custom_3844017/default/table?lang=en).

<sup>2</sup> Eurostat Database, Harmonised Index of Consumer Prices (HICP), [https://ec.europa.eu/eurostat/databrowser/explore/all/economy?lang=en&subtheme=prc.prc\\_hicp&display=list&sort=category&extractionId=prc\\_hicp\\_aind](https://ec.europa.eu/eurostat/databrowser/explore/all/economy?lang=en&subtheme=prc.prc_hicp&display=list&sort=category&extractionId=prc_hicp_aind)

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy

both estimations and in-sample simulations is the 1995 to 2022 period, whereas (out-of-sample) predictions have been extended up to 2028.<sup>3</sup>

The remainder of the paper is organised as follows. Section 2 describes the main features of stock-flow consistent (SFC) models. Section 3 sets up the modelling framework. Section 4 discusses the main findings. Section 5 provides concluding remarks.

## 2. METHODOLOGICAL FOUNDATIONS: THE SFC APPROACH

Stock-flow consistent (SFC) models have attracted the attention of an increasing number of scholars (Nikiforos and Zezza, 2017) and world-leading institutions (e.g., Burgess et al. 2016, Barbieri Hermitte et al., 2022). In recent years, there has been a growing awareness in recognising the advantages of the SFC modelling approach in proving a detailed representation of accounting relationships, achieving a notable degree of predictive success in identifying early signs of fragility and unsustainable processes (Godley, 1999; Godley and Lavoie, 2007; Bezemer, 2010). The global financial crisis of 2007-2008 has uncovered the weakness and the poorly predictive performance of the standard dynamic stochastic general equilibrium (DSGE) models. DSGE models have been criticised on several accounts, including adopting rational expectations, overlooking the role of banks, money, and financial markets dynamics, and assuming that the evolution of the economic system is driven by exogenous shocks (Mankiw, 2006; Solow, 2008; Caiani et al., 2016; Romer, 2016; Krugman, 2018; Fontana and Passarella, 2018; Wren-Lewis, 2018;). Differently from DSGEs, which dominated macroeconomics until the late 2000s, the SFC models are able to capture the interconnectedness, endogeneity, and path dependency of macroeconomic variables. They explicitly analyse the monetary and financial dimensions of the economic system, tying together real decisions with monetary and financial consequences (Godley and Lavoie 2007, p. 47). This paper maintains that these features make SFC macroeconomic models well suited for the analysis of energy issues, including the evaluation of an energy price shock, and the policy response to it. Changes in the energy price have a variety of effects on real and financial variables, which, in turn, trigger complex feedback effects, including monetary and fiscal policy responses. SFC macroeconomic models, through their rigorous accounting framework, are able to capture the direct and feedback effects caused by changes in the energy price.

SFC models became increasingly popular after the publication of the seminal book of Godley and Lavoie (2007), which provided a systematic accounting formalisation for complex theoretical models. However, the origins of the approach go back to the independent works of Godley (see Godley and Cripps, 1974, 1983; Cripps et al., 1976; Cripps and Lavoie, 2017) and Nobel prize Tobin (see Brainard and Tobin, 1968; Tobin, 1969, 1982; Backus et al., 1969), in an attempt to combine economic theory and policy, and to build rigorous models that bring together the interdependencies between the real and the financial sides of modern economies. SFC models are built on the following accounting principles (Nikiforos and Zezza, 2017):

1. *flow consistency*: every transaction-monetary flow must come from somewhere and go somewhere (Godley and Lavoie, 2007, p.6).
2. *stock consistency*: financial liabilities issued by a sector are held as financial assets by another sector. The overall net financial wealth of the system sums up to zero.

<sup>3</sup> A detailed step-by-step description of the model (including the model R code to replicate and assess the model), the scenarios, and the related dataset has now been updated and is available on the following website: <https://github.com/marcoverpas/Italy-SFC-Model>.

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy

3. *stock-flow consistency*: flows contribute coherently to the formation of stocks. The end-of-period stocks are given by cumulating flows, including possible capital gains and losses.
4. *quadruple book-keeping*: every transaction requires filling in a quadruple entry (Copeland, 1949); namely every inflow in favour of a unit is matched by the outflow faced by another unit, and a reduction (increase) in assets (liabilities) held by a unit is matched by the increase (reduction) in assets (liabilities) held by the other unit.

These principles ensure the internal logical consistency of the models and are integrated in the balance sheet and the transactions-flow matrix, which provide the accounting framework of SFC models.

The balance sheet includes the allocation of real capital and financial assets among institutional sectors; assets are usually noted down using a positive sign, whereas liabilities and net worth are given negative sign. The stock consistency principle entails that each row of the balance sheet sums up to zero. The transaction-flow matrix includes the monetary flows associated with stocks and sectoral budget constraints, for the entire economic system. The matrix registers sources of funds using a positive sign, while uses of funds have a negative sign. The difference between sources and uses of funds gives rise to the net lending of the sector, namely the end-of-period financial position. The horizontal consistency requires that flow and uses of funds for each transaction sum up to zero, whereas vertical consistency entails that each column of the matrix sums up to zero. Balance sheet and transaction flow matrix allow identifying the first set of model equations, namely accounting identities (e.g., national income, net wealth). Identities are then combined with equilibrium conditions (i.e., adjustment mechanisms that equal demand and supply) and behavioural (or stochastic) equations to close the model.

After the GFC, SFC contributions had mainly a theoretical nature (Godley and Lavoie 2007; Nikiforos and Zezza, 2017), though the early work of Godley's New Cambridge group in the 1960-70s contained the general principles of modern SFC empirical models (e.g., Cripps and Godley, 1976; Cripps, Godley, and Fetherston, 1976; Godley and Cripps, 1983). Recently, there has been a growing interest towards fully developed empirical models. Canelli et al. (2021) maintain that empirical SFC models can be classified into two main groups, namely theory-to-data (TTD) and data-to-theory (DTT) models. TTD models are built starting from a theoretical model, defining equilibrium conditions and behavioural equations, and then collecting data to estimate in a pragmatic way the coefficients of the model.<sup>4</sup> DTT models are primarily grounded on sectoral balance sheets and flow of funds statistics of the economy under investigation, within a theoretical framework.

Empirical SFC models have been developed for studying national economies, including Argentina (Michelena et al., 2017, Guaita and Michelena, 2019; Valdecantos, 2020), Austria (Miess and Schmelzer, 2016a, 2016b), Denmark (Godley and Zezza, 1992), Greece (Papadimitriou et al., 2013a, 2013b; Pierros, 2020), Ireland (Kinsella and Aliti, 2012), United States (Godley, 1999; Godley et al., 2007; Zezza, 2009), the United Kingdom economy (Cripps and Godley, 1976; Burgess et al., 2016), and Italy (Zezza, 2018; Veronese Passarella, 2019; Zezza and Zezza, 2020; Canelli et al., 2021, 2022). A measure of the growing interest in the SFC methodology is its application to address some of the foremost issues of the current time, e.g. providing innovative contributions to the policy debate on inequality and financialization (Cardaci and Saraceno, 2016; Botta et al., 2021), fiscal policies and debt sustainability (Canelli et al., 2022), climate-related financial issues and environmental policies

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<sup>4</sup> Accordingly, in the model of this paper regressions are not employed to 'query' data about the existence of correlations, but rather, building from the theoretical structure, used to 'calibrate' the model based on the observed data.



(Berg et al., 2015; Jackson and Victor 2015; Naqvi 2015; Dafermos et al., 2017, 2018; Bovari et al., 2018; Monasterolo and Raberto 2018; Ponta et al., 2018; Yajima, 2021). The model presented in this paper contributes to this literature by developing an empirically calibrated SFC macroeconomic model in order to explore the potential impact of the current energy crisis on the Italian economy under alternative scenarios.

### 3. THE MODEL

#### 3.1. Model setup and data

The model is made up of 101 equations, of which 36 behavioural equations, 49 fundamental identities, and 16 auxiliary equations. Variables are expressed at current prices (euro), unless otherwise stated. Six macro sectors are considered: households, non-financial or production firms, banks (and financial intermediaries), the government sector, the central bank (ECB), and the foreign sector. Coefficients of behavioural equations have been estimated by using Eurostat (or ISTAT) data on an annual basis. Time series have been reclassified in such a way to reduce the density of cross-sector transactions, thus limiting the size of the model. This is shown by Table 1 and Table 2, which display the balance-sheet matrix and the transactions-flow matrix for Italy in 2021.<sup>5</sup> The most apparent amendment compared with the official national accounting is that output is assumed to be produced by non-financial firms only. The same goes for investment (gross fixed capital formation), which is entirely attributed to private firms. Similarly, consumption is entirely attributed to the household sector (which is the final recipient of all incomes distributed by private firms and commercial banks), while wages are entirely paid by the non-financial firms sector. By contrast, there are no major changes concerning balance-sheet entries, except for a higher level of data aggregation. The considered time span for both estimations and in-sample simulations is the 1995 to 2022 period, whereas out-of-sample simulations have been extended up to 2028. All variables have been expressed in real terms and log levels. Equation coefficients have been estimated using ordinary least squares. Lastly, the system of difference equations is solved using an iterative algorithm provided by *Bimets*, an *R* package recently developed by the Bank of Italy.<sup>6</sup>

At this stage, it is worthy to highlight some of the main limitations of the SFC model of this paper. First, the model does not consider cross-industry interdependencies. One potential avenue for the future is the integration of an input-output structure within the production sector. Another limitation lies in the oversight of the role of the functional income distribution, an aspect that warrants more thorough modelling in an advanced version of the model. Additionally, the use of quarterly data, as opposed to annual data, could be recommended for an accurate definition of time lags, albeit this may introduce potential seasonality issues. Furthermore, the use of observed annual time series and the existence of potentially several structural breaks in the period considered (e.g. the launch of the euro, the COVID-19 crisis) make the use of more sophisticated estimation techniques challenging. In principle, the paper could have addressed the stationarity issue by using the first difference of log variables. However, abandoning (log) levels would have implied a further loss of information. Finally, the balance-sheet entry ‘Other net financial assets’ is currently excessively large. Mitigating this it involves a higher level of disaggregation of model stocks to reduce this residual component. Coupled with a more refined estimation of model coefficients (e.g., via cointegration methods), these future adjustments could enhance the empirical robustness of model predictions.

<sup>5</sup> Entries are expressed at current prices, million euro.

<sup>6</sup> The *R* code reproducing both the baseline scenario and the simulations of alternative scenarios is available at: <https://github.com/marcoverpas/Italy-SFC-Model>.

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L’Aquila, Italy



### 3.2. Non-financial firms

The national income identity opens the model and identifies Italy's GDP ( $Y$  hereafter) as the sum of nominal consumption  $C$ , nominal investment (gross capital formation,  $I$ ), government net expenditure ( $G$ ), gross export ( $X$ ), net of import ( $M$ ):

$$Y = C + I + G + X - M \quad (1)$$

Real investment decisions are driven by the capital to output ratio (which is a proxy for the capacity utilisation of plants), and the average interest rate on Italian securities (which is a proxy for both the country risk and the cost of funding of housing investment). Using  $\log(\cdot)$  to denote the logarithmic function, the real net investment function is therefore:

$$\log\left(\frac{I_n}{p}\right) = \gamma_0 + \gamma_1 \cdot \log\left(\frac{Y_{-1}}{K_{-1}}\right) \quad (2)$$

where  $\gamma_0$  is an autonomous or shock component,  $p$  is the average price level (Italy's GDP deflator), and  $K$  is the total stock of capital expressed in nominal terms (current prices).

Investment expenditures must cover capital depreciation too. Thus, the gross nominal investment is:

$$I = I_n + \delta \cdot K_{-1} \quad (3)$$

where  $\delta$  is the annual average depreciation rate of capital.<sup>7</sup>

As a result, the current value of the stock of fixed capital is:

$$K = K_{-1} \cdot (1 - \delta) + I \quad (4)$$

The profit of non-financial firms is calculated as a residual distributive variable:

$$FT_f = Y - INT_f - WB + OP_f \quad (5)$$

where  $INT_f$  represents interests on bank loans paid by non-financial firms,  $WB$  is the total wage bill, and  $OP_f$  is a catch-all entry capturing all other net incomes that firms have received from (paid to) other sectors.

Firms pay interests to commercial banks:

$$INT_f = r_l \cdot L_f \quad (6)$$

where  $L_f$  is the stock of loans obtained by non-financial firms and  $r_l$  is the related interest rate.

The latter is defined as:

$$r_l = r^* + m_l \quad (7)$$

where  $r^*$  is the main refinancing operation rate set by the ECB, and  $m_l$  is the mark-up set by commercial banks on loans to firms. The latter is a function of the mark-up of Italian government securities:

$$m_l = \mu_{l0} + \mu_{l1} \cdot m_{b,-1} \quad (8)$$

Undistributed or retained profits of non-financial firms are calculated as a share of total profit:

<sup>7</sup> Over the 1996-2019 period, the average value of  $\delta$  is 4.6 percent.

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy

$$FU_f = \theta \cdot FT_f \quad (9)$$

where  $\theta$  is the average retention rate on corporate profits.

Dividends payments and other distributed profits of non-financial firms are:

$$FD_f = FT_f - FU_f \quad (10)$$

The change in bank loans at the end of each period matches the part of investment that is not covered by internal funds:

$$L_f = L_{f,-1} + I - FU_f - \Delta E_s - \Delta OA_f \quad (11)$$

where  $E_s$  is the nominal stock of shares issued by non-financial firms, and  $OA_f$  are other net financial assets held (or liabilities issued) by the corporate sector.

For the sake of simplicity, the total supply of shares is assumed to adjust to the household demand:

$$E_s = E_{s,-1} + \Delta E_h \quad (12)$$

The total net wealth accumulated by the firms is:

$$V_f = OA_f - L_f - E_s \quad (13)$$

Its amount contributes to determine the net value of other payments received (or made) by firms to the other sectors (see Appendix 1).

### 3.3. Households

The model defines the disposable income of Italian households as the summation of all private and public incomes, net of taxes:

$$YD = WB + INT_h + FD_f + F_b + OP_h + TR - T \quad (14)$$

where  $INT_h$  is net received interest payments,  $F_b$  are (distributed) bank profits,  $OP_h$  is a composite entry including other net payments to/from households,  $TR$  is government transfers (including unemployment benefits), and  $T$  is total taxes.

Real consumption depends on both disposable income and the net stock of wealth of households:

$$\log\left(\frac{C}{p}\right) = \alpha_1 \cdot \log(yd^e) + \alpha_2 \cdot \log\left(\frac{V_{h,-1}}{p_{c,-1}}\right) \quad (15)$$

where  $yd^e$  is the expected real disposable income,  $p_c$  is the consumer price index (see section 3.10). Notice that equation (15) implies that Italian consumers follow an implicit stock-flow norm, that is, to set a target wealth to disposable income ratio.<sup>8</sup>

Household net wealth increases as households save:

$$V_h = V_{h,-1} + YD - C \quad (16)$$

Mortgages and other loans obtained by Italian households are identified as a percentage of their disposable income:

<sup>8</sup> Over time, households try to keep their real consumption more stable than their current disposable income. As a result,  $yd^e = \psi \cdot Y_{-1}/p_{c,-1}$ , where  $\psi = E(YD/Y)$  is the average disposable income to GDP ratio over the considered period.

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy

$$\log(L_h) = \log(L_{h,-1}) + \phi \cdot \frac{c_{-1}}{YD_{-1}} \quad (17)$$

Households pay interests to banks and financial intermediaries. Total interests are:

$$INT_{lh} = r_{lh} \cdot L_{h,-1} \quad (18)$$

where  $r_{lh}$  is the interest rate on personal loans:

$$r_{lh} = r^* + m_{lh} \quad (19)$$

And  $m_{lh}$  is the related mark-up:

$$m_{lh} = \mu_{h0} + \mu_{h1} \cdot m_{b,-1} \quad (20)$$

Interest payments received by the households on their holdings of government debt are:

$$INT_{gh} = B_{h,-1} \cdot r_b^h \quad (21)$$

where  $B_h$  is the stock of government securities and  $r_b^h$  is the average interest rate they yield.

Therefore, the total net interest payments received by households are:

$$INT_h = INT_{gh} + INT_{mh} - INT_{lh} \quad (22)$$

where  $INT_{mh}$  is net interest payments from banks to households (including interests on deposits). Notice that the value of  $INT_h$  is always positive for the Italian household sector considered as a whole.

### 3.4. Commercial banks and financial intermediaries

Loans are provided on demand by commercial banks to both non-financial firms and households:

$$L_s = L_f + L_h \quad (23)$$

Correspondingly, deposit accounts are opened on demand by creditworthy households:

$$M_s = M_h \quad (24)$$

For the purpose of simplification, all bank production costs are assumed away. If interest payments on advances and reserves are also negligible, bank profits equal net received interest payments:

$$F_b = INT_b \quad (25)$$

Net interest payments received by the banks are calculated as:

$$INT_b = INT_{gb} + INT_f + INT_{lh} - INT_{mh} \quad (26)$$

where  $INT_{gb}$  is interest payments received on government securities holdings,  $INT_f$  is interest payments from firms,  $INT_{lh}$  is interest payments from households.

Interest payments made by the government sector to the banks are:

$$INT_{gb} = r_b^b \cdot B_{b,-1} \quad (27)$$

The stock of government securities held by the banking sector is modelled as a share of their core assets (that is, loans, reserves, and government securities):

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy

$$\log(B_b) = \lambda_b^b \cdot \log(L_{s,-1} + H_{b,-1} + B_{b,-1}) \quad (28)$$

The total wealth accumulated by the banks is:

$$V_b = H_b + B_b + L_s + OA_b - M_s \quad (29)$$

where  $H_b$  is the stock of reserves and  $OA_b$  is the stock of other net financial assets held by the banking sector.

Its amount contributes to determine the value of other payments received (or made) by banks to the other sectors (see Appendix 1).

### 3.5. The government sector

Equation (30) shows that the dynamic of the Italian government net expenditure:

$$G = \sigma_1 \cdot \left( \frac{G_{t-1}}{p_{t-1}} \right) \cdot p \quad (30)$$

where the component  $\sigma_1$  is the auto-regressive coefficient of real government spending.

The total tax revenue is:

$$T = \tau_1^T \cdot WB_{-1} + \tau_2^T \cdot (YD_{-1} - WB_{-1}) + \tau_3^T \cdot V_{h,-1} \quad (31)$$

where  $\tau_1^T$  is the estimated average tax rate on labour incomes,  $\tau_2^T$  is the average tax rate on other incomes, and  $\tau_3^T$  is the average tax rate on wealth.

The total amount of transfers and benefits is identified as a function of the value taken in the previous period and (the change in) the unemployment rate:

$$TR = \tau_1^{TR} \cdot TR_{-1} + \tau_2^{TR} \cdot \Delta un \quad (32)$$

Therefore, the government deficit in each period is:

$$DEF = G + TR + INT_g - T - F_{cb} \quad (33)$$

where  $F_{cb}$  is the seigniorage income that the ECB returns to the Italian government, through the Bank of Italy.

The net interest payments paid by the government on the national debt are:

$$INT_g = r_b \cdot B_{s,-1} \quad (34)$$

Total issues of government debt are:

$$B_s = B_{s,-1} + DEF \quad (35)$$

which consist of bills, bonds, and all other government securities.

Finally, the net wealth of the government sector is:

$$V_g = -B_s + OA_g \quad (36)$$

where  $OA_g$  is the amount of other net financial assets held by the government.

The value of  $V_g$  contributes to determine the value of other payments made (or received) by the government to the other sectors (see Appendix 1).

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy

### 3.6. Portfolio decisions

The composition of households' financial holdings is usually determined using Tobinesque portfolio equations (e.g., Godley and Lavoie, 2007). Accordingly, the percentage of corporate shares held by Italian households should be defined as a positive function of the return rate on shares, and a negative function of both households' liquidity preference (proxied by the disposable income to wealth ratio), and interest rates accruing on other financial assets. Similarly, the percentage of wealth held in the form of government debt would be defined as a positive function of the interest rate on government securities, a negative function of households' liquidity preference, and so on. However, Tobinesque portfolio equations can make the model rather unstable. Besides, they do not quite fit the available data for the Italian economy. As a result, Equation (37) shows that households' holdings of corporate shares are a simple function of their total stock of wealth at the beginning of the period:

$$\log(E_h) = \lambda_E \cdot \log(V_{h,-1}) \quad (37)$$

Similarly, the nominal stock of government securities demanded by households has been defined as:

$$\log(B_h) = \lambda_B \cdot \log(V_{h,-1}) \quad (38)$$

The demand for banknotes (cash) depends on households' real consumption plans:

$$\Delta \log(H_h) = \lambda_c \cdot \log\left(\frac{C}{p_c}\right) \quad (39)$$

Notice that the gross wealth of households includes cash, bank deposits, government securities, shares, and other net financial assets. Bank deposits act as the buffer stock:

$$M_h = V_h + L_h - H_h - B_h - E_h - OA_h \quad (40)$$

When households save more (less) than initially planned, the stock of bank deposits held at the end of the period reduces (increases) compared with its expected value.

### 3.7. The central bank (ECB)

The ECB purchases government securities from commercial banks and financial intermediaries on the secondary market. At the end of each period, the amount of Italian debt held by the ECB is therefore:

$$B_{cb} = B_s - (B_h + B_b + B_{row}) \quad (41)$$

The supply of cash  $H_s$  arises out from the balance-sheet identity, namely *assets*  $\equiv$  *liabilities*:

$$H_s = B_{cb} + OA_{cb} - V_{cb} \quad (42)$$

where  $OA_{cb}$  are other net financial assets held by the ECB (e.g., advances to commercial banks).

If interest payments on advances and reserves are assumed away, ECB net revenues equal interest payments received on its holdings of Italian government securities:

$$F_{cb} = INT_{cb} = INT_g - INT_{gh} - INT_{gb} - INT_{grow} \quad (43)$$

The reserve requirement for commercial banks is calculated on collected deposits:

$$H_b = \rho \cdot M_s \quad (44)$$

where  $\rho$  is the average reserve ratio of Italian banks.

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy

### 3.8. The foreign sector

Real import increases as domestic income increases and the relative price of import (with respect to the domestic price level) reduces:

$$\log\left(\frac{M}{p}\right) = \mu_0 + \mu_1 \cdot \log(Y_{-1}) - \mu_2 \cdot \frac{p_{m,-1}}{p_{-1}} \quad (45)$$

Real export grows as foreign income and foreign prices grow, and decreases as the nominal exchange rate and domestic prices increase:

$$\log\left(\frac{X}{p}\right) = \varepsilon_0 + \varepsilon_1 \cdot \log(Y_{-1}^{row}) + \varepsilon_2 \cdot exr_{-1} \cdot \frac{p_{-1}}{p_{row,-1}} \quad (46)$$

where  $exr$  is the euro-US dollar exchange rate (defined as the quantity of US dollars per 1 euro) and  $p_{row}$  is the foreign price index.

In turn, foreign income increases following an exogenous rate:

$$Y^{row} = Y_{-1}^{row} \cdot (1 + g_y^{row}) \quad (47)$$

Net export is:

$$NX = X - IM \quad (48)$$

Foreign investors hold an amount of Italian government securities:

$$B_{row} = \lambda_{row} \cdot B_s \quad (49)$$

where  $\lambda_{row}$  is the estimated share of Italian debt subscribed by the rest of the world.

Therefore, net interests paid by the Italian Treasury to foreign investors amount to:

$$INT_{row} = r_b^{row} \cdot B_{row,-1} \quad (50)$$

At the end of the period, the amount of wealth accumulated by the foreign sector is:

$$V_{row} = B_{row} + OA_{row} \quad (51)$$

where  $OA_{row}$  is the value of other Italian net financial assets owned by the rest of the world.

The value of  $V_{row}$  contributes to determine the value of other payments received (or made) by foreign agents to Italy's domestic sectors (see section 3.10).

### 3.9. Interest rates

The model includes eight interest or return rates. Notably, the return rate on equity and shares is endogenously determined as the ratio of corporate distributed profits to the total stock of shares subscribed by the households:

$$r_e = \frac{F_{fd}}{E_{h,-1}} \quad (52)$$

The ECB buys government securities on the secondary market, using a “best bid” rule.<sup>9</sup> The average mark-up on the policy rate is positively associated to the government debt to GDP ratio at the beginning of the period, and negatively linked with the share of securities held by the central bank and

<sup>9</sup> This implies the purchasing of new government securities by the private sector at the beginning of each period, which are then partly sold to the ECB within the same period.

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy

the policy rate, since changes in the latter are never fully converted into changes to government bond yields:

$$m_b = \mu_{b1} \cdot \frac{B_{S,-1}}{Y_{-1}} - \mu_{b2} \cdot \frac{B_{cb}}{B_S} - \mu_{b3} \cdot r^* \quad (53)$$

The average interest rate on government securities is therefore:

$$r_b = r^* + m_b \quad (54)$$

However, net received interest rates can vary across sectors, because of the different composition (in terms of maturities) of sector-related holdings of government securities.<sup>10</sup> More precisely, the interest rate on households' holdings of government securities is:

$$r_b^h = r^* + m_b^h \quad (55)$$

The interest rate on banks' holdings of government securities is:

$$r_b^b = r^* + m_b^b \quad (56)$$

Similarly, the interest rate on foreign sector's holdings of government securities is:

$$r_b^{row} = r^* + m_b^{row} \quad (57)$$

In turn, sector-related mark-ups over the policy rate are defined and estimated as positive linear functions of the average premium paid by the Italian Treasury:

$$m_b^h = \mu_{b1}^h \cdot m_{b,-1}^h + \mu_{b2}^h \cdot m_b \quad (58)$$

$$m_b^b = \mu_{b1}^b \cdot m_{b,-1}^b + \mu_{b2}^b \cdot m_b \quad (59)$$

$$m_b^{row} = \mu_{b1}^{row} \cdot m_{b,-1}^{row} + \mu_{b2}^{row} \cdot m_b \quad (60)$$

### 3.10. Energy imports and the price level

There are two price indexes in the model: the GDP deflator ( $p$ ) and the consumer price index ( $p_c$ ). Both are modelled as a linear function of the foreign price index, the energy price index, and the real GDP of Italy<sup>11</sup>:

$$\log(p) = \pi_y^1 \cdot \log(p_{row,-1}) + \pi_y^2 \cdot \log(p_{en,-1}) + \pi_y^3 \cdot \log\left(\frac{Y_{-1}}{p_{-1}}\right) \quad (61)$$

$$\log(p_c) = \pi_c^1 \cdot \log(p_{row,-1}) + \pi_c^2 \cdot \log(p_{en,-1}) + \pi_c^3 \cdot \log\left(\frac{Y_{-1}}{p_{-1}}\right) \quad (62)$$

Notice that the consumer price index is expected to be more sensitive to energy market conditions, because of the impact of imported consumer goods (Asafu-Adjaye, 2000).

<sup>10</sup> Zezza (2018) offers an alternative accounting for interest rates.

<sup>11</sup> There are four theoretical reasons for including real GDP as an explanatory variable in price equations (Stock and Watson, 1999, 2007), namely as a proxy for: (1) the overall volume of activity or income in an economy (changes in income can affect the demand for goods and services, thus indirectly affecting the price level); (2) aggregate demand pressures (changes in aggregate demand can put direct upward pressure on prices, particularly when aggregate supply is constrained); (3) labour market conditions (changes in the employment rate can lead to similar changes in nominal wages and prices); (4) the medium-term trend in the economy (changes in the trend can influence the price level). Please note that in the New Consensus Macroeconomics (NCM), the output gap (namely the difference between current real GDP and its 'natural' value) is used as an explanatory variable in price equations. This paper rejects this NCM practice, since it accepts Keynes' principle of effective demand, namely that aggregate demand can affect both current and potential output (Fontana and Palacio Vera, 2007)."

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy



Both the foreign price level and the price of energy are assumed to grow according to an exogenous rate:

$$p_{row} = p_{row,-1} \cdot (1 + \pi_{row}) + p_{row}^0 \quad (63)$$

$$p_{en} = p_{en,-1} \cdot (1 + \pi_{en}) + p_{en}^0 \quad (64)$$

where  $p_{row}^0$  and  $p_{en}^0$  are the respective shock components.

The import of energy products is a share of total import:

$$M_{en} = \mu_{en} \cdot M \quad (65)$$

where:

$$\mu_{en} = \epsilon_1^{en} \cdot \log\left(\frac{Y_{-1}}{p_{-1}}\right) - \epsilon_2^{en} \cdot \pi_{en} \quad (66)$$

The nominal share of energy imports to total import ( $\mu_{en}$ ) grows as Italy's real GDP grows (income effect) and falls as the inflation rate energy products ( $\pi_{en}$ ) increases (price effect).<sup>12</sup>

### 3.11. The labour market

In the labour market, the employment level ( $N_d$ ) and the wage rate ( $w$ ) determine the wage bill paid by the non-financial firms sector:

$$WB = w \cdot N_d \quad (67)$$

The real value added per employee is defined on basis of the so-called Kaldor-Verdoorn's law or Smith effect, which states that labour productivity grows proportionally to output. It also depends on the real wage rate, since firms are more prone to innovate as the relative and absolute cost of labour increases.<sup>13</sup>

$$\Delta \log(pr) = v_0 + v_1 \cdot \Delta \log\left(\frac{w}{p}\right) + v_2 \cdot \Delta_2 \log\left(\frac{Y}{p}\right) \quad (68)$$

Total demand for labour, hence the employment level, are therefore:

$$N_d = \frac{Y/p}{prod} \quad (69)$$

The total available labour force tends to adjust to the demand for labour:

$$\log(N_s) = v_{s1} \cdot \log(N_{s,-1}) + v_{s2} \cdot [\log(N_d) - \log(N_{s,-1})] \quad (70)$$

The percentage change in the nominal wage rate is a function of the change in the unemployment rate and the inflation rate:

$$g_w = \omega_1 \cdot \Delta \log(p) + \omega_2 \cdot \Delta un \quad (71)$$

Therefore, the average nominal wage rate is:

$$w = w_{-1} \cdot (1 + g_w) \quad (72)$$

The rate of unemployment is:

<sup>12</sup> Unsurprisingly, the price effect is not significant, as the Italian demand for energy imports is rigid.

<sup>13</sup> See Kaldor (1961, 1978), Verdoorn (1980), and Sylos-Labini (1983).

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy

$$un = 1 - \frac{N_d}{N_s} \quad (73)$$

Finally, it is worthy to clarify the impact of the energy inflation rate on real wage and on the wage share of income. A higher price of energy sources is *ceteris paribus* associated with a higher GDP deflator and a higher CPI, which reduce real wages. A higher price of energy sources also depresses *ceteris paribus* real consumption, real net investment, real aggregate demand, and output, which in turn negatively affects labour productivity. This means that the fall in real wages coexists with an increase in the wage share to total income. This paradoxical effect is due to labour productivity falling faster than real wages.

#### 4. FINDINGS

Table 3 presents the economic forecasts for Italy made by the Italian government (September 2023), the IMF (October 2023), the European Commission (November 2023), the Bank of Italy (October 2023), the OECD (November 2023), and the Italian National Institute of Statistics (ISTAT, December 2023) during the 2023-2026 period. The forecasts are for the GDP (and some of its main components), the inflation rate (as measured by the Harmonised Index of Consumer Prices (HICP) and the GDP deflator), and two public finance indicators (namely the government deficit to GDP and government debt to GDP ratios). Table 3 also presents similar economic simulations (the baseline scenario) for the Italian economy made by the SFC model of this paper covering the 2023-2028 period. Under the baseline scenario, the energy import price shock picks in 2023, and then gradually fades away. In line with the policy recommendation of the dominant New Consensus Macroeconomics theory (see e.g. Fontana and Palacio Vera, 2007, Figure 1, p. 275) as the energy price shocks spread to the inflation rate, the ECB first increases the policy rate and then - as inflation slows down - it progressively decreases it. As a result, after reaching 8.8% in 2023, and in line with the economic forecast of national and international institutions, the inflation rate fluctuates around the 2% target in 2024 and 2025.

Table 4 presents three additional scenarios in addition to the baseline scenario. Scenario 1 is the baseline with the assumption that the energy-led price shock has a more persistent effect on inflation, with the inflation rate (CPI) still standing around 5% for the foreseeable years. Scenario 2 builds on the previous scenario. In this case, the baseline is hit by two shocks, namely a persistent inflation rate and a robust policy response by the ECB, which keep the policy rate at 4.5% over the 2024-2026 period. Finally, Scenario 3 simulates policy austerity measures implemented by the fiscal authorities in Italy. According to the official economic forecasts of national and international institutions and the baseline scenario, in 2023 the government deficit and government debt to GDP ratios will be around 5% and 140%, respectively. Concerned by these high public finance ratios, Scenario 3 shows the effects of policy austerity measures which, in accordance with the Maastricht Treaty, bring the government deficit to GDP ratio to 3% in 2024 (and following years). A table of coefficients and a table of shocks, namely Table A1 and Table A2 in the Appendix 2, indicate the parameter values and the assumptions made for the projections presented in Table 4.

At this stage, it is worthy to note that Scenarios 1 and 2 are consistent with the main thesis of Goodhart and Pradhan's book *The Great Demographic Reversal* (2020). Goodhart and Pradhan have been arguing well before the start of the Ukraine-Russia war that inflation is going to be a serious problem in future. They reach this conclusion because of recent major demographic changes. In previous decades, globalisation has allowed millions of low-paid workers from urbanizing China and smaller emerging countries in Eastern Europe and Asia to: (a) enter the global labour force, and (b) increase the production of goods and services for the global markets. This explains the stagnant

\* University of Sannio, Italy; † University of Leeds, UK; ‡ University of L'Aquila, Italy

wages, disinflationary pressures, and low nominal interest rates of the 1990s and 2000s. However, ageing working-age population in China and advanced countries is going to run in reverse the previous trends. Global shortage of low-paid workers will increase the bargaining power of unions just as the production of goods and services for the global markets decreases, and the demand for workers in the care industry increases. According to Goodhart and Pradhan, these new trends will bring a return of inflation and higher nominal interest rates for the next few decades.

Figures 1(a-d) and 2(a-b) below show the evolution of some of the main macroeconomics variables in Italy during the 1995-2028 period. The purple plain line presents the times series values of those variables during the 1995-2022 period, while the dotted line indicates the SFC model simulations of the variables during the 2023-2028 period, i.e. the baseline scenario. The green, brown, and pink lines represent Scenario 1 (baseline *with* persistent inflation), Scenario 2 (baseline *with* persistent inflation *and with* higher policy rate), and Scenario 3 (baseline *with* austerity policy), respectively.

Figure 1 indicates the dynamics of real GDP (Figure 1a), the unemployment rate (1b), the energy inflation rate (1c), and the inflation rate (1d). Figure 1(a) shows that GDP was hit hard by the Covid-19 pandemic. According to the baseline scenario, GDP will recover through positive though modest annual increases. The main drivers of this trend are the government sector, and in part the foreign sector. Scenarios 1-3 indicate that over the next five years Italy will not be able to escape a significant recession, with an especially significant cumulative decline of over 10% of GDP in Scenario 3. For all four scenarios, by 2025 real GDP is not expected to have recovered the level reached before the 2007-2008 global financial crisis (GFC).

Figure 1(b) indicates that the unemployment rate increased dramatically after the GFC but has been rapidly declining in the last few years. According to the baseline scenario, the rate will continue to decline, though it will remain well above 6% for the entire simulation period. By contrast, Scenarios 1-3 show that the unemployment rate will rise substantially in future, reaching over 10% by 2025 in the case of Scenario 3. Figure 1(c) shows that after a period of fluctuations around low levels, in 2022 the energy inflation rate jumped to over 50%, before declining to more moderate historical levels of around 5%, with the exception of Scenarios 2 and 3, due to the imposed persistent energy-led inflation shock. Finally, Figure 1(d) presents the dynamics of the inflation rate. Figure 1(d) confirms that from the mid-1990s till the GFC the inflation rate is around the 2% target set by the ECB. From the GFC till the 2022 the inflation rate is mostly below the 2% target. Given the relevance and impact of the energy crisis on the Italian economy, the inflation rate closely follows the energy inflation rate: it reaches 8.8% in 2023 before rapidly declining toward the 2% target. Again, the exceptions are Scenarios 2 and 3 where the imposed persistent energy-led inflation shock keeps the inflation rate above 5%.

Figure 2 indicates the dynamics of government debt to GDP ratio (Figure 2a) and the government deficit to GDP ratio (2b). Figure 2(a) shows that from the mid-1990s the government debt to GDP ratio had been on a moderate downward trajectory, before a large increase due to the GFC first, and the Covid-19 pandemic, later. There was a small reduction in 2021, as a result of the post-Covid-19 rebound of GDP. However, after that, by 2025 all scenarios record a rise in the government debt to GDP ratio, keeping the ratio to over 140% for the foreseeable years, which is more than twice the 60% level prescribed by the Maastricht treaty. There are possibly different reasons for this outcome.

Following Domar (1944) and Pasinetti (1998), the government debt to GDP ratio rises when, *ceteris paribus*, the average interest rate on government debt is higher than the nominal GDP growth rate (Canelli et al., 2021, 2022). In the SFC model of Italy presented in the paper, the energy crisis and associated high levels of the inflation rate have several and possibly conflicting effects. High levels of

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy

inflation are usually associated with restrictive monetary measures, including a high policy rate, in order to curb, among other things, inflation expectations. Then, *ceteris paribus*, a high policy rate raises the average interest rate on government debt, hence increasing the government debt to GDP ratio. Similarly, a high policy rate negatively affects the interest rate sensitive components of aggregate demand. This, *ceteris paribus*, leads to a lower nominal GDP, and hence a higher government debt to GDP ratio. Finally, high levels of the inflation rate lift the price of goods and services available in the economy. This boosts the nominal value of GDP, hence lowering the government debt to GDP ratio. Under the assumption that the high policy rate effects dominate the latter nominal GDP effect, it should come as a surprise that the SFC model of this paper predicts a more dramatic rise in the government debt to GDP ratio for Scenario 2 (higher policy rate) and Scenario 3 (austerity measures depressing GDP) reaching by 2028 173% and 167%, respectively.

Figure 2(b) reinforces the conclusion about the dynamics of the government debt to GDP ratio. Figure 2(b) shows that the government deficit to GDP ratio first soared as a result of the Covid-19 pandemic, and then dropped significantly due to the post-Covid-19 rebound of GDP. However, by the end of the period the government deficit to GDP ratio will be twice the 3% level prescribed by the Maastricht treaty, and it will keep rising in future in all of the considered scenarios. The only exception is scenario 3 (austerity measures), which by construction was built such that Italy will be able to reach and maintain the 3% Maastricht criteria from 2024.

## 5. CONCLUSIONS

This paper has explored the potential long-run effects of the change in energy prices on the Italian economy. The paper has used a medium-scale, stock-flow consistent (SFC) macroeconomic model. The model has been empirically calibrated using available annual series. Four different alternative scenarios for the period 2023-2028 have been considered and compared. The main conclusion of the paper is that the surge of the inflation rate due to the energy crisis in 2022 is a serious threat for both the long-run sustainability of the government debt to GDP ratio and economic growth.

The SFC simulations show that Italy is on the verge of falling in two different economic paths. The first path is the soft landing represented by the baseline scenario. According to it, everything being equal, in the next five years Italy will experience a return to an average inflation rate of circa 2%, together with an average ECB policy rate of circa 2.5%. This low inflation and moderate ECB policy rate environment will however be characterised by an anaemic growth rate of around 1%, and dire public finance. The government debt to GDP ratio and government deficit to GDP ratio will stabilise just above the current levels at around 145% and 6%, respectively. This is twice or more the public finance levels imposed by EU rules. The EU rules were suspended in 2020 at the beginning of the Covid-19 pandemic and are now in the process of being renegotiated as part of much-debated reforms of the EU fiscal framework. Would Italy be able to secure with EU authorities a long time framework for bringing its public finance to the likely required downward path? Furthermore, what will happen if the much-feared inflation rate remain stubbornly higher than the ECB target of 2%? These two questions lead to the second likely economic path for the Italian economy.

The second path is the hard landing represented, in different ways, by Scenarios 1, 2, and 3. Scenario 1 examines the effects of a persistent inflation rate, as measured by the CPI of around 5%. This is not a particularly high level of inflation. Yet, as a result of it, Italy will face a recession and an increasing level of unemployment, together with a deterioration of the current public finance. In 2028, the economic growth rate will drop to -2.5% and the unemployment rate will be above 10%, whereas the government debt to GDP and government deficit to GDP ratios will reach levels of 159% and 8.4%, respectively. Scenario 2 explores the effects of a persistent inflation rate (like in Scenario 1), together with a robust response by ECB that keeps the policy rate at 4.5% in order to keep inflation

\* University of Sannio, Italy; † University of Leeds, UK; ‡ University of L'Aquila, Italy

expectations at bay. The tight monetary policy will cause an immediate and prolonged economic recession, together with a considerable deterioration of public finance. In 2028, the government debt to GDP and government deficit to GDP ratios will be 173% and 10.1%, respectively. Finally, Scenario 3 shows the effects of a tightening of the EU fiscal rules. The austerity measures introduced in order to bring the government deficit to GDP ratio to the 3% Maastricht rule will cause a severe recession. Over the next foreseeable five-year period, the economic growth rate will drop annually by circa 3% and unemployment will explode, being more than 15% by 2028. It is also worthy to recall that the hard landing path is driven by exogenous shocks, namely a persistent inflation rate (Scenario 1), a persistent inflation rate and a robust ECB policy response (Scenario 2), and austerity measures caused by a tightening of the EU fiscal rules (Scenario 3). Italian authorities will have very little policy space to respond, at least immediately, to the effects of those shocks, and yet those exogenous shocks will have very dramatic impacts on economic growth, the unemployment rate, and public finance in Italy.

In conclusion, because of its structural features and of the 2022 energy crisis, the Italian economy is on the edge of a precipice. The soft landing path will bring a low inflation environment, but at the cost of anaemic growth and dire public finance, which may trigger punitive measures by the EU authorities. The hard landing path may succeed in containing inflation from spiralling out of control (Scenarios 1 and 2) or in bringing the government deficit to GDP ratio to the 3% EU rule (Scenario 3), but at the cost of a severe recession and ballooning government debt to GDP ratio to levels never recorded before.

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy

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\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy



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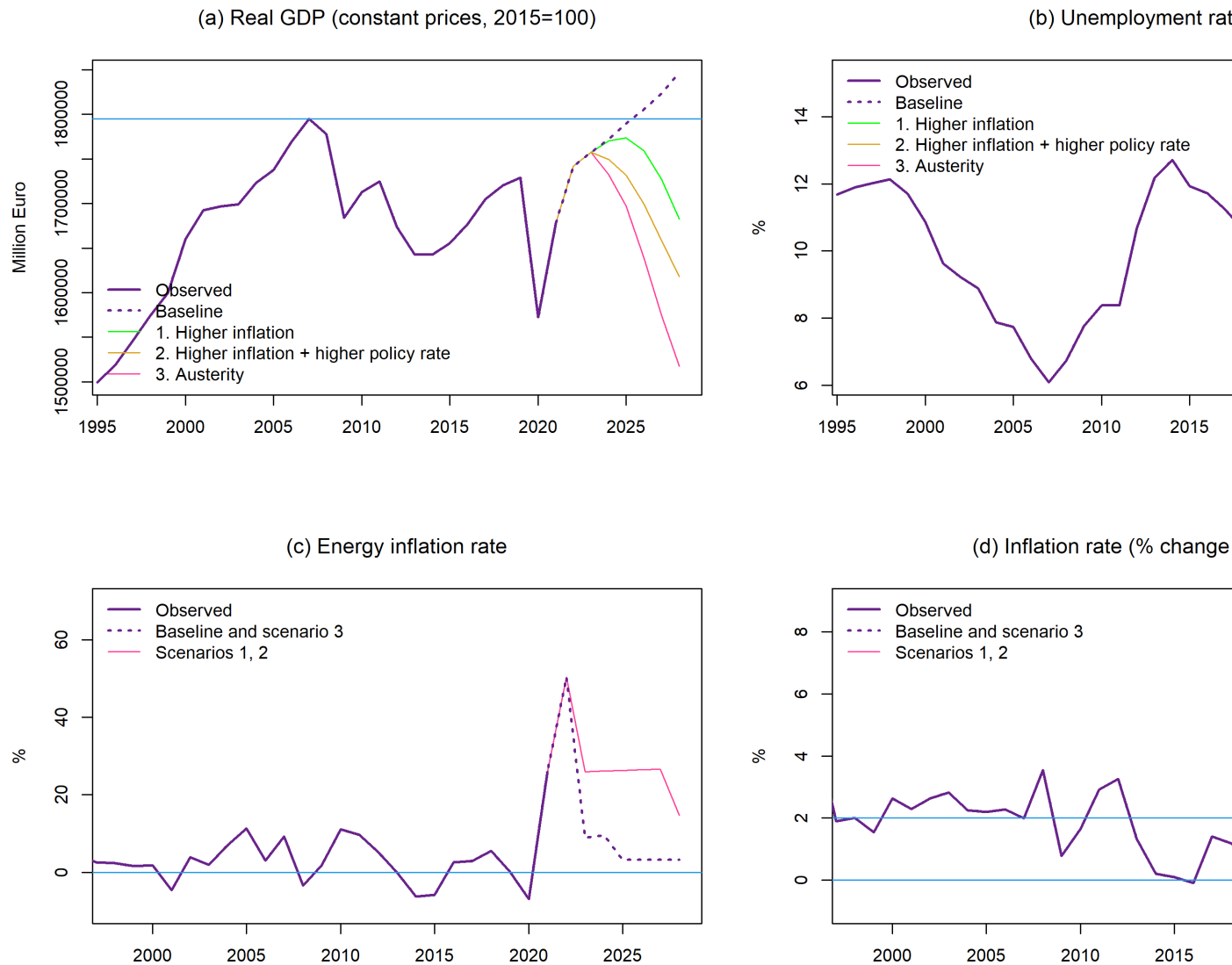
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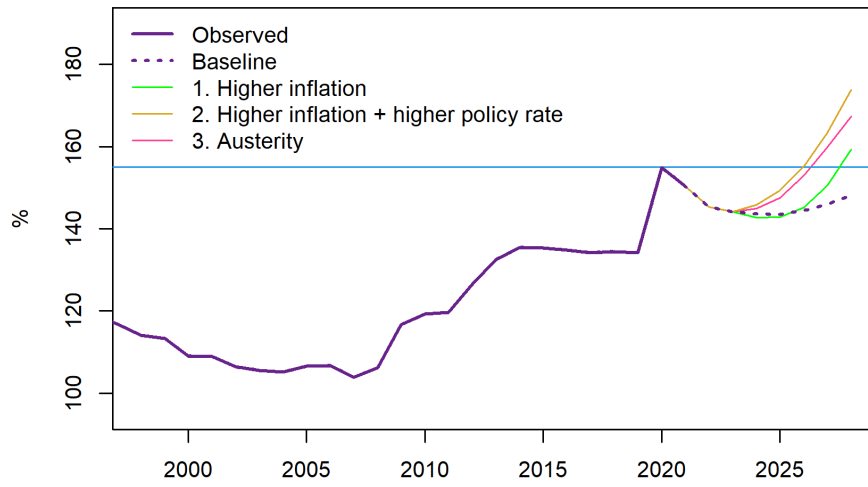
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**Figure 1. The dynamics of real GDP, unemployment, and inflation rates in Italy: out-of-sample simulations, alternative scenarios**

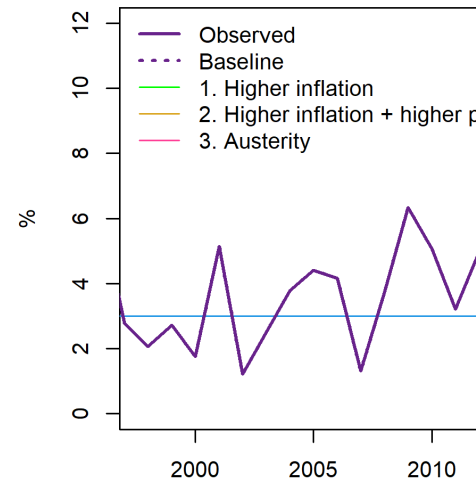


**Figure 2. The dynamics of public finance in Italy: out-of-sample simulations, alternative scenarios**

(a) Government debt to GDP ratio



(b) Government



**Table 1. Balance-sheet matrix of Italian economy, 2021 (million-euro, current prices)**

	Household s	Firms	Governmen t	Banks	ECB	Foreig n	Row total
Cash and reserves	200683			10817	- 211500		0
Deposits	1428434			- 1428434			0
Securities	233263		-2678397	1366294	868289	21055 1	0
Loans	-763488	-871902		1635390			0
Shares	1372850	- 1372850					0
Other net FA	1583746	284629	323282	- 1563895	- 783662	15590 0	0
Net financial wealth	4055488	- 1960123	-2355115	20172	- 126873	36645 1	0
Column total	0	0	0	0	0	0	0



**Table 2. Transactions-flow matrix of Italian economy, 2021 (million-euro, current prices)**

	Households	Firms		Government	Banks	ECB	Foreign	Row total
		Current	Capital					
Consumption	- 1030124	1030124						0
Total investment		357215	- 357215					0
Government spending		352718		-352718				0
Export		582192					- 582192	0
Energy import		-64859					64859	0
Other import		- 475339					475339	0
[GDP]		1782051						
Taxes	-483366			483366				0
Transfers	188601			-188601				0
Wages	692915	- 692915						0
Interest payments	10905	-2326		-60678	29134	13200	9765	0
Corporate profit	738858	- 1141970	403112					0
Bank profit	29134				- 29134			0
ECB seigniorage				13199.6451		- 13200		0
Other payments	-60675	55160		275576.588	- 151307	-5171	- 113584	0
Change in cash and reserves	15250				-657	- 14593		0
Change in deposits	57376				- 57376			0
Change in securities	-30072			-105432	- 77658	103317	109845	0
Change in loans	-27196		169601		- 142405			0
Change in shares	138716		- 13871					0

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				6			
Change in other net FA	-67825	15012	275577	12678 9	- 9389 5	- 25565 8	0
Change in net wealth	86249	45897	170145	- 15130 7	- -5171	- 14581 3	0
Column total	0	0	0	0	0	0	0

**Table 3. Economic Forecasts of GDP components, inflation, and government balances in Italy**

	Italian Government September 2023 <sup>14</sup>				IMF October 2023 <sup>15</sup>		European Commission November 2023 <sup>16</sup>			Bank of Italy October 2023 <sup>17</sup>			OECD November 2023 <sup>18</sup>			ISTAT December 2023 <sup>19</sup>		Our Model (Baseline scenario)					
Variable/ period	2023	2024	2025	2026	2023	2024	2023	2024	2025	2023	2024	2025	2023	2024	2025	2023	2024	2023	2024	2025	2026	2027	2028
<i>Annual growth rates (%)</i>																							
GDP	0.8	1.2	1.4	1.0	0.7	0.7	0.7	0.9	1.2	0.7	0.8	1.0	0.7	0.7	1.2	0.7	0.7	0.8	0.8	0.9	0.8	1.0	1.2
Consumption	1.3	1.3	1.1	1.0	1.4	1.1	1.3	0.9	1.0	1.3	0.9	1.0	1.2	0.7	1.0	1.4	1.0	1.0	0.7	1.3	0.9	1.0	1.5
Investment	1.0	3.0	2.4	1.9	1.1	2.8	0.5	0.3	1.3	0.5	0.3	1.3	0.8	0.5	1.6	0.6	0.6	0.5	0.8	0.0	1.1	0.0	1.1
Import	0.1	3.3	4.1	3.6	1.7	3.2	1.1	2.3	3.1	1.1	2.3	3.1	1.0	0.9	1.2	0.3	0.0	0.9	2.2	2.6	2.4	2.1	2.0
Export	0.7	2.4	4.3	3.5	2.2	2.8	0.4	2.4	3.1	0.4	2.4	3.1	0.4	1.3	2.0	0.0	1.1	0.7	2.3	2.0	1.9	1.1	1.9
GDP deflator	4.5	2.9	2.1	2.1	6.2	3.6	4.5	2.8	3.7	4.5	2.8	3.7	4.2	2.9	2.6	4.9	2.8	4.3	3.0	2.6	2.2	2.0	1.4
HICP/Consumer price	5.6	2.3	2.0	2.1	6.0	2.6	6.1	2.7	2.3	6.1	2.4	1.9	6.1	2.6	2.3	5.4	2.5	8.8	2.3	2.3	1.2	1.1	1.2
<i>Government balance ratios (%)</i>																							
Deficit to GDP	5.3	4.3	3.6	2.9	5.0	4.0	5.3	4.4	4.3	-	-	-	5.4	4.2	3.6	-	-	6.2	4.9	4.8	5.3	5.7	6.2
Debt to GDP	140.2	140.0	139.9	139.6	143.7	143.2	139.8	140.0	140.9	-	-	-	141.4	141.0	140.5	-	-	144.0	143.3	143.4	144.4	145.8	148.1

<sup>14</sup> NADEF (2023).<sup>15</sup> IMF (2023b). Please note that in the October 2023 report the IMF has not fully updated all previous forecasts. Therefore, the data in violet indicate the forecasts made in the July 2023 Report (IMF 2023a).<sup>16</sup> European Commission (2023).<sup>17</sup> Bank of Italy (2023).<sup>18</sup> OEDC (2023).<sup>19</sup> ISTAT (2023).

**Table 4. Simulations results under alternative scenarios (Source: this paper model elaborations on Eurostat data)****BASELINE SCENARIO  
PERSISTENT INFLATION**

	2023	2024	2025	2026	2027	2028
GDP	0.8	0.8	0.9	0.8	1.0	1.2
Import	0.9	2.2	2.6	2.4	2.1	2.0
Export	0.7	2.3	2.0	1.9	1.9	1.9
GDP deflator	4.3	3.0	2.6	2.2	2.0	1.4
CPI	8.8	2.3	2.3	1.2	1.2	1.2
Deficit to GDP	6.1	4.9	4.8	5.2	5.7	6.2
Debt to GDP	144.0	143.6	143.4	144.3	145.8	148.1
Policy rate	3.8	3.0	2.5	2.5	2.5	2.5
Av. yield on gov. debt	2.7	2.8	3.0	3.2	3.3	3.4

**SCENARIO 1:**

	2023	2024	2025	2026
GDP	0.8	0.7	0.1	-0.1
Import	0.9	2.2	3.2	2.1
Export	0.7	2.3	2.1	2.0
GDP deflator	4.3	3.9	3.4	3.0
CPI	8.8	5.0	5.0	4.0
Deficit to GDP	6.1	5.0	5.0	5.0
Debt to GDP	144.0	142.7	142.7	145.0
Policy rate	3.8	3.0	2.5	2.0
Av. yield on gov. debt	2.7	2.8	2.9	3.0

**SCENARIO 2: PERSISTENT INFLATION + HIGHER POLICY RATE  
AUSTERITY (FROM BASELINE)**

	2023	2024	2025	2026	2027	2028
GDP	0.8	-0.4	-1.0	-1.8	-2.4	-2.4
Import	0.9	2.2	2.4	1.7	1.0	0.4
Export	0.7	2.3	2.1	2.0	2.0	2.0
GDP deflator	4.3	3.9	3.3	3.2	2.9	2.3
CPI	8.8	5.0	4.9	4.8	4.7	4.7
Deficit to GDP	6.1	6.4	6.8	7.7	8.8	10.1
Debt to GDP	144.0	145.7	149.3	155.1	163.3	173.8
Policy rate	3.8	4.5	4.5	4.5	4.5	4.5
Av. yield on gov. debt	2.7	3.7	4.1	4.4	4.6	4.7

**SCENARIO 3:**

	2023	2024	2025	2026
GDP	0.8	-1.4	-2.0	-3.0
Import	0.9	2.2	1.2	0.0
Export	0.7	2.3	2.0	1.0
GDP deflator	4.3	3.0	2.3	1.0
CPI	8.8	2.3	2.1	0.0
Deficit to GDP	6.1	3.0	3.0	3.0
Debt to GDP	144.0	144.9	147.5	150.0
Policy rate	3.8	3.0	2.5	2.0
Av. yield on gov. debt	2.7	2.9	3.2	3.0

\* University of Sannio, Italy; <sup>†</sup> University of Leeds, UK; <sup>‡</sup> University of L'Aquila, Italy

## Appendices

Journal Pre-proof

## APPENDIX 1: Vertical constraints and consistency check

One of the most important challenges when developing an empirical stock-flow consistent model is that seldom net flows recorded by non-financial transaction series match changes in stocks as recorded by financial balance sheets (Veronese Passarella, 2019; Zezza and Zezza, 2019). This issue is usually solved by using a variable named ‘other payments’, which allows each sector (but one) to meet its vertical constraints, that is, to bridge the gap between observed flows and observed changes in stocks:

$$OP_f = \Delta V_f - (Y - I - WB - INT_f - FD_f) \quad (73)$$

$$OP_b = \Delta V_b - (INT_b - F_b) \quad (74)$$

$$OP_g = \Delta V_g - (T + F_{cb} - G - TR - INT_g) \quad (75)$$

$$OP_{cb} = \Delta V_{cb} \quad (76)$$

$$OP_{row} = -(OP_f + OP_b + OP_{cb} + OP_h + OP_g) \quad (77)$$

where:

$$OP_h = OP_h^0 \quad (78)$$

is estimated from observed data.

These payments are due to the fact that each sector holds other net financial assets, in addition to cash, deposits, government securities, and corporate shares.

In addition to sector-related vertical constraints, cross-sector or economy-wide horizontal constraints must be fulfilled. For this purpose, the stock of other net financial assets held by the foreign sector and total net wealth attributed to the ECB are calculated residually:

$$OA_{row} = -(V_f + V_b + V_{cb} + V_g + NV_h) \quad (79)$$

$$V_{cb} = -(V_f + V_b + V_{row} + V_g + V_h) \quad (80)$$

Notice that the stocks of other net financial assets held by each domestic sector (and the ECB) are simply defined as AR(1) processes, and they have all been exogenised in out-of-sample simulations:

$$OA_h = \lambda_{h0}^{oa} + \lambda_{h1}^{oa} \cdot OA_{h-1} \quad (81)$$

$$OA_f = \lambda_{f0}^{oa} + \lambda_{f1}^{oa} \cdot OA_{f-1} \quad (82)$$

$$OA_g = \lambda_{g0}^{oa} + \lambda_{g1}^{oa} \cdot OA_{g-1} \quad (83)$$

$$OA_b = \lambda_{b0}^{oa} + \lambda_{b1}^{oa} \cdot OA_{b-1} \quad (84)$$

$$OA_{cb} = \lambda_{cb0}^{oa} + \lambda_{cb1}^{oa} \cdot OA_{cb-1} \quad (85)$$

The model is now complete. Because of the Walras’s law, there is a redundant equation, which is the equality between demand and supply of money (including cash and bank reserves):

$$H_s = H_h + H_b \quad (42B)$$

The left-hand side of equation (42B) is determined by equation (42), whereas the right-hand side is independently defined by equations (39) and (44). This condition is not included in the simulations, as

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it would over-determine the model. However, it can be used (along with the balance-sheet matrix and the transactions-flow matrix) to double-check the accounting consistency of model simulations over time. Figure 1 displays the Sankey diagram of transactions and changes in stocks for Italy in 2021. It shows that each payment made by a sector is a receipt for another sector (or sectors). Similarly, each change in the stock of assets owned by a sector implies a change in the liabilities issued by another sector (or sectors). Because of the assumption that domestic output is only produced by non-financial firms, the latter represent the largest sector of the Italian economy, followed by domestic households, the government sector, and the foreign sector.

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## APPENDIX 2: Tables A1 and A2

Table A1: List of coefficients

Name	Description	Value
$\delta$	Depreciation rate (average 1996-2019)	0.046
$\theta$	Share of undistributed profits	0.265
$\phi$	Elasticity of personal loans to consumption	0.058
$\mu_{b1}^h$	Premium on gov. bills held by households: coefficient 1	0.793
$\mu_{b2}^h$	Premium on gov. bills held by households: coefficient 2	0.804
$\mu_{l0}$	Markup on loans to firms: coefficient 1	-0.014
$\mu_{l1}$	Markup on loans to firms: coefficient 2	0.49
$\mu_{h0}$	Markup on personal loans: coefficient 1	0.029
$\mu_{h1}$	Markup on personal loans: coefficient 2	0.23
$\lambda_{h0}^{oa}$	Other financial assets of households: coefficient 1	134828.967
$\lambda_{h1}^{oa}$	Other financial assets of households: coefficient 2	0.908
$\lambda_b^b$	Stock of bills held by banks: coefficient 1	0.918
$\tau_1^T$	Average tax rate on labour incomes	0.514
$\tau_2^T$	Average tax rate on non-labour incomes	0.061
$\tau_3^T$	Average tax rate on wealth	0.042
$\tau_1^{TR}$	Transfers and benefits: auto-regressive component	1.043
$\tau_2^{TR}$	Transfers and benefits: elasticity to unemployment rate	374169.858
$\lambda_B$	Holdings of government bills: coefficient 1	0.903
$\lambda_E$	Holdings of shares as a ratio to total wealth	0.925
$\lambda_c$	Elasticity of cash holdings to real consumption	0.006
$\rho$	Reserve ratio	1.004
$g_y^{row}$	Foreign growth rate	0.037
$exr$	Exchange rate coefficient	1
$r^*$	Policy rate	0.019
$\mu_{b1}^b$	Premium on government bills held by banks: coefficient 1	0.924
$\mu_{b2}^b$	Premium on government bills held by banks: coefficient 2	0.248
$\mu_{b1}^{row}$	Premium on government bills held by RoW: coefficient 1	0.554
$\mu_{b2}^{row}$	Premium on government bills held by RoW: coefficient 2	0.916
$v_0$	Labour productivity: autonomous component	-0.004
$v_1$	Labour productivity: elasticity to real wage rate	0.397

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Name	Description	Value
$\nu_2$	Labour productivity: elasticity to real output	0.183
$\nu_{s1}$	Labour force: auto-regressive component	1.001
$\nu_{s2}$	Labour force: elasticity to labour demand gap	0.031
$\omega_1$	Wage growth rate: elasticity to inflation	0.009
$\omega_2$	Wage growth rate: elasticity to unemployment rate	-0.786
$p_{row}^0$	Foreign price level: coefficient 1	0.207
$p_{row}$	Foreign price level: coefficient 2	0.959
$\epsilon_2^{en}$	Share of energy prod. to tot. import: elasticity to energy inflation	-0.002
$\epsilon_1^{en}$	Share of energy prod. to tot. import: elasticity to real output	0.013
$p_{en}$	Energy price coefficient	1.006
$\lambda_{f0}^{oa}$	Other financial assets/liabilities of firms: coefficient 1	16702.341
$\lambda_{f1}^{oa}$	Other financial assets/liabilities of firms: coefficient 2	0.897
$\lambda_{g0}^{oa}$	Other financial assets/liabilities of government: coefficient 1	86022.616
$\lambda_{g1}^{oa}$	Other financial assets/liabilities of government: coefficient 2	0.583
$\lambda_{b0}^{oa}$	Other financial assets held by banks: coefficient 1	-431517.076
$\lambda_{b1}^{oa}$	Other financial assets held by banks: coefficient 2	0.745
$\lambda_{cb0}^{oa}$	Other financial assets held by ECB: coefficient 1	-4533.844
$\lambda_{cb1}^{oa}$	Other financial assets held by ECB: coefficient 2	1.141
$\alpha_1$	Marginal propensity to consume out of real income	0.906
$\alpha_2$	Marginal propensity to consume out of real wealth	0.055
$\sigma_1$	Real government spending: auto-regressive coefficient	1.01
$\gamma_0$	Real net investment: autonomous component	-117.512
$\gamma_1$	Real net investment: elasticity to output to capital ratio	138.616
$\varepsilon_0$	Real export: autonomous component	7.879
$\varepsilon_1$	Real export: elasticity to foreign income	0.512
$\varepsilon_2$	Real export: elasticity to relative price of export	0.08
$\mu_0$	Real import: autonomous component	4.092
$\mu_1$	Real import: elasticity to domestic income	0.633
$\mu_2$	Real import: elasticity to relative price of import	-0.106
$\pi_y^2$	GDP deflator: elasticity to energy price level	0.058
$\pi_y^1$	GDP deflator: elasticity to foreign price level	0.619
$\pi_y^3$	GDP deflator: elasticity to real output	0.104
$\pi_c^2$	Consumer price index: elasticity to energy price level	0.182
$\pi_c^1$	Consumer price index: elasticity to foreign price level	0.505
$\pi_c^3$	Consumer price index: elasticity to real output	0.101
$\mu_{b1}$	Av. premium on gov. bills: elasticity to debt to GDP ratio	0.032
$\mu_{b2}$	Av. premium on gov. bills: elasticity to ECB's holdings	-0.079

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Name	Description	Value
$\mu_{b3}$	Av. premium on gov. bills: elasticity to policy rate	-0.422

**Table A2: List of assumptions (i.e., shocks) for Scenarios 1-3**

**Table.** List of assumptions (i.e., shocks) for Scenarios 1-3

	2023	2024	2025	2026	2027	2028
<i>Scenario 1</i>						
Energy price level (log)	+0.14	+0.14	+0.20	+0.20	+0.20	+0.10
<i>Scenario 2</i>						
Adjust. of average policy rate <sup>a</sup>	0	+100	+200	+200	+200	+200
Energy price level (log)	+0.14	+0.14	+0.20	+0.20	+0.20	+0.10
<i>Scenario 3</i>						
Government spending <sup>b</sup>	0	-47	-15	-33	-39	-40

Notes: <sup>a</sup> basis points; <sup>b</sup> billion euros. GDP and main component are calibrated such that the model generates the baseline scenario of Table 4 (based on Economic Commission predictions).