Working Paper No. 1063

Fiscal and Monetary Policy in an SFC Model of the Italian Economy

by

Francesco Zezza
Sapienza University of Rome (IT)
Levy Economics Institute of Bard College

December 2024

Levy Economics Institute
P.O. Box 5000
Annandale-on-Hudson, NY 12504-5000
http://www.levyinstitute.org

ISSN 1547-366X

ABSTRACT

Following the Great Financial Crisis of 2008–9, there has been a shift in mainstream economic policy modeling toward "realism," with dynamic stochastic general equilibrium (DSGE) models partly diverging from the representative agent framework, and large-scale, New-Keynesian structural models addressing real-financial interactions in greater detail. Still, the need for tractability of the former, and the lack of theoretical structure of the latter prevented the complete introduction of a modern—and complex—multi-sector/multi-asset financial system in policy models in use at central banks and treasuries. However, empirical models adopting the Stock-Flow Consistent (SFC) approach resolved most of these complications with a surge in the number of country models over the last few years.

The present work lays out the main out-of-sample features of a quarterly SFC model of the Italian economy (MITA). Section 2 reviews the existing SEM models of the Italian economy, and places SFC models along the suite of policy models in use around the world, discussing the main pros and cons of adopting the SFC approach over others. Section 3 briefly presents the model structure and main behavioral equations, and discusses the main differences between and similarities with the other large scale SFC model of the Italian economy. Section 4 shows the out-of-sample properties of the model, implementing different monetary and fiscal policy shocks, and assessing their effects in terms of growth, distributional dynamics, and sectoral debt sustainability. Section 5 concludes.

KEYWORDS: Empirical Stock-Flow Consistent Models; Monetary Policy; Fiscal Policy; Italy

JEL CODES: C54; E12; E17; E44; E58

INTRODUCTION

Governments and policy institutions need rigorous—and realistic—quantitative models to reliably forecast the future paths and dynamics of some variables of interest, which must be suitable for policy evaluations and scenario analysis.

After the formalization of Keynes' work in a general-equilibrium framework—first by James Meade (1937), then into the IS-LM framework by John Hicks (1937) and later spread in its neoclassical synthesis version made by Paul Samuelson (1955)—this new paradigm was used to analyze and implement macroeconomic policies. To the *Years of High Theory* (Shackle 1967) in macroeconomics corresponded the *Years of High Econometrics* (Louça 2007). Under the influence of Ragnar Frisch and the Econometric Society, and by the implementation of the National Accounts by Morris A. Copeland (1947) and Richard Stone (1941; 1962), empirical works in macroeconomics flourished.[1]

This led to the first economy-wide models being constructed, and later becoming, with the works of the Cowles Commission and others, what Ray Fair (2012) refers to as Macro 1. However, with the stagflation of the 1970s, "structural" models developed following the Cowles Commission approach, were abandoned by most central banks in favor of either dynamic stochastic general equilibrium (DSGE) types or micro-founded versions of investment-savings and liquidity preference–money supply (IS-LM) New-Keynesian models (Hendry and Muellbauer 2018). By 2007, mainstream economists claimed that "the state of Macro is good" (Blanchard 2008), since New-Keynesian and RBC economists were converging toward a simple, unique model thought to provide a clear description of a closed economy, with only three equations (i.e., the New Macroeconomic Consensus Model, NMC)[2], with an established empirical counterpart—DSGE models. A few years later, the extent and the depth of the Great Recession had shown that these approaches had failed.

---

[1] For an account on the history and developments of National Accounts, see De Bonis and Gigliobianco (2012) and Vanoli (2005).

[2] See Arestis (2011).

In a more recent piece, the same Blanchard (2018) claimed that there should be a distinction between *theory* and *policy models*, i.e., the Structural Econometric Models (SEM) in use at central banks and policy institutions. The latter are defined as models "aimed at analysing actual macroeconomic policy issues. Models in this class should fit the main characteristics of the data, including dynamics, and allow for policy analysis and counterfactuals" (Blanchard 2018, 50). Most important, Blanchard argues that theorists and policy modelers should go their own ways. While the former will need to adapt their theories to face the pressing questions stemming from the GFC (i.e., an active role for money, credit, and financial institutions, as well as hysteresis effects), "policy modelers should accept the fact that equations that truly fit the data can have only a loose theoretical justification" (51).

The crisis led indeed to a shift in mainstream economic policy modelling toward "realism," with DSGEs partly diverging from the representative agent framework, and institutional SEM addressing real-financial interactions in greater detail. Still, the tractability requirements of the former, and the lack of a clear theoretical structure of the latter, prevented the complete introduction of modern—and complex—multi-sector/multi-asset financial systems in policy models. However, empirical models adopting the Stock-Flow Consistent (SFC) approach already resolved most of these complications, leading to a surge in the number of country models over the last few years. This follows from the systematic integration of the saving/investment decisions of institutional sectors to the accumulation of financial assets and liabilities and their feedback effects on real variables, with a central role given to money and the financial system, usually absent in most state-of-the-art NMC models.

Italy, which has a rich historical tradition in building SEM, presents a perfect example of this trend, with the Italian Ministry of Economics and Finance (MEF) recently producing the first "institutiona"' SFC model (called the ITFIN) among Eurozone countries (Hermitte et al. 2023). Though the model adopts SFC principles, the macro-econometric core is still New-Keynesian in spirit, and the different financial closures make it diverge in out-of-sample simulations with respect to the other SFC models of the Italian economy that follow instead a Post-Keynesian tradition (Canelli et al. 2021; Zezza and Zezza 2020, 2022).

The present work presents the main out-of-sample features of a quarterly SFC model of the Italian economy (MITA). Section 2 reviews the existing SEM models of the Italian economy, and places SFC models along the suite of policy models in use around the world, discussing the main pros and cons of adopting the SFC approach over others. Section 3 briefly presents the model structure and main behavioral equations. Section 4 shows the in- and out-of-sample properties of the model, implementing different monetary and fiscal policy shocks, and assess their effects in terms of growth, distributional dynamics and sectoral debt sustainability. Section 5 concludes.

2. LITERATURE REVIEW

2.1 Main SEM in Use at Italian Institutions

Given its prominent role in developing National Accounts, Italy has a long tradition in building "institutional" SEMs, particularly at the Bank of Italy.

Originally developed in the mid-1980s by a team from the Bank of Italy's (BoI) research department led by Albert Ando (Visco and Bodo 1986), the Bank of Italy Quarterly Model (BIQM) is continuously updated and evolves to capture the new features (i.e., changed institutional frameworks, policy rules, expectation formation mechanisms, etc.) of the system and data sources, and is still the BoI's main tool for the preparation of medium-term macroeconomic forecasts for the Italian economy, to assess the effects of monetary and fiscal policies and implement "counterfactual" scenarios. Being one of the world's largest SEMs in use at a central bank, it consists of 750 equations, with 95 behavioral equations estimated with limited information techniques, primarily OLS.[3] It aggregates the balance sheets of households and firms, but models separately the financial sector.

[3] The Bank also uses several DSGEs and micro simulation models to forecast both short-run and long-run dynamics and perform Scenario Analysis. A detailed reference list can be found on the Bank institutional website (https://www.bancaditalia.it/compiti/ricerca-economica/modelli-macroeconomici/index.html?com.dotmarketing.htmlpage.language=1&dotcache=refresh).

As with most central banks' macro-econometric models, the BIQM[4] exhibits the theoretical properties of a neoclassical growth model in the long run, with output growth determined by factor endowments and technical progress. In contrast, in the short run it behaves in accordance with Keynesian principles, with output mainly driven by aggregate demand fluctuations. In equilibrium, when no shocks occur, all adjustment processes are complete, expectations are fulfilled, the model converges to the NAIRU, and all real variables grow according to a combination of the exogenous rate of increase of population and technical progress. The rate of inflation is maintained at a constant level consistent with the equilibrium level of employment.

The production side of the economy is characterized by oligopolistic markets, in which firms assume a given production cost structure and select the optimal level of labor and capital inputs, which are then converted into output according to a constant return-to-scale technology, and prices are set as a mark-up over marginal cost. In formulating their spending plans, consumers are guided by the life-cycle hypothesis, taking into account their income and net wealth, as well as real interest rates. The accumulation of savings serves to finance capital expansion, thereby enhancing the production capacity. The relative prices of labor and capital ensure that the amount of savings is precisely equal to the capital requirements, and that the labor market is in equilibrium. In the short run, a number of rigidities and adjustment processes affect equilibrium outcomes. These include delivery lags and other costs of changing the capital stock, sticky prices and wages, and expectation errors.

Several other models have been developed by research departments and public institutions, which share more or less the same structure with different levels of detail depending on their use.

Among the most important is the Italian Treasury Econometric Model (ITEM), developed by the Treasury Department of the Ministry of Economics and Finance (Cicinelli et al. 2008). It is a medium-sized structural model consisting of 371 variables, with 211 accounting identities, and 36 behavioral equations. It is estimated using quarterly national accounts data and is used for official government projections and evaluations of domestic economic policies. As for the

[4] The latest model update is in Bulligan et al. (2017). A detailed description of the main features of the original model can be found in Galli, Terlizzese, and Visco (1989).

BIQM, it belongs to the class of macroeconomic models that assign a prominent role to the supply side of the economy, with frictions in wages and price settings only (relatively) affecting demand in the short run.

We then find the MeMo-It model developed by Istituto Nazionale di Statistica (ISTAT) (Bacchini et al. 2013a, b). This model, which is one of the three main tools used by ISTAT for its economic projections, makes use of global economic indicators and microsimulation models, together with current domestic economic indicators, to forecast short-run scenarios for the main aggregates of the national accounts. While it is relatively simple in terms of its real-financial connections, it is worth noting the recent efforts to include an "environment" block in the model structure to capture links between economic and environmental variables, such as the use of natural resources and pollution.

Finally, there are a number of models run by other private or public institutions, such as the CSC model by the Italian employers' federation Confindustria (Pappalardo et al. 2007), or the PROMETEIA model (Welfe 2013).

The next section into SFC models, placing them along the suite of policy models in use around the world, and discussing the main pros and cons of adopting the SFC approach over others.

2.2. Placing Empirical Stock-Flow Consistent Models in the Literature

As discussed in Zezza and Zezza (2019), the main principles of stock–flow consistency require[5]:

1. ***Horizontal and vertical consistency***. To each payment from a sector corresponds a receipt for another sector (i.e., outflows equal inflows). Every change in a sector current account implies at least one change in the stock of asset/liability (i.e., quadruple-entry bookkeeping).

[5] See Nikiforos and Zezza (2017), Carnevali, Deleidi, and Passarella (2019) and Pierros (2024) for a survey of the literature.

2. ***Balance-sheet consistency***. The financial assets of one sector must match financial liabilities of one or more sectors, possibly pairing creditors to debtors.

3. ***Dynamic consistency***. Any stock of real and financial assets at current prices, at the end of an accounting period (A_t), is given by the relevant flow during the period (F_t), plus net capital gains (NKG_t) due to fluctuation of the market price of the asset ($A_t = A_{t-1} + F_t + NKG_t$). Net capital gains play a leading role in driving demand and supply of financial assets and should thus be carefully modelled.

4. ***Stocks-to-flows feedback***. Financial liabilities imply future payments from one sector to another. Moreover, every stock included must have implications for sectoral behavior (i.e., real and financial wealth for consumption and investment of households and firms, liability structure for banks' lending, stock of public debt for government fiscal stance, etc.)

To this list, we may add a fifth, which applies specifically to empirical SFC Policy models: ***data consistency.*** That is, whenever appropriate statistics are available—i.e., sectoral financial and non-financial accounts—model data should align as much as possible with published statistics.

In recent years, there have been numerous attempts at developing SFC models for whole countries by both academic researchers and policy institutions. These can be split between theory-driven models—which start from a theoretical model and then calibrate it to data—and Godley-Levy (GL) type models, which are purely data-driven.[6]

Even though the complexity of SFC empirical models has been on the rise, most researchers still adopt a theory-driven approach to modelling, possibly due to the lack of a comprehensive

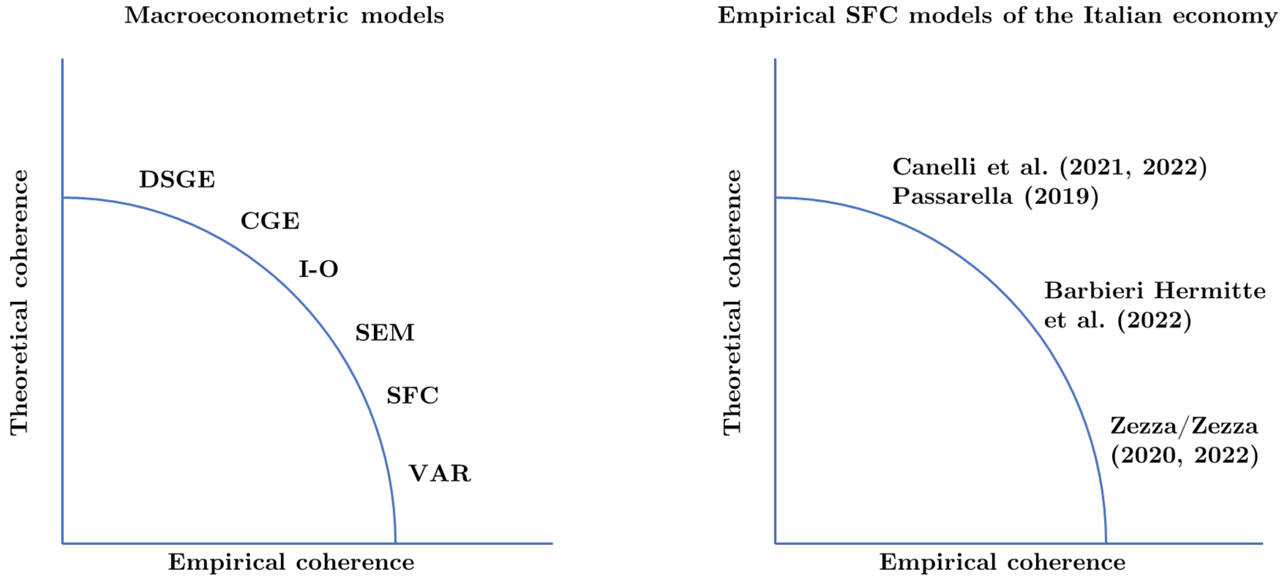
[6] See Zezza (2009) and Zezza and Zezza (2019) for a discussion on how to build Godley-Levy empirical models. Pierros (2024) uses a somewhat different taxonomy, distinguishing models by type—between New Cambridge, Godley-Lavoie, and High-Complexity models—and by scope—i.e., "external or sector imbalances," "medium-term projections," "fiscal, monetary or financial operations," "functional income distribution," "financialization," and "green transition." As we are interested in the comparison between the SFC approach and other standard macro approaches, we refrain here from further discussing differences within the SFC camp and stick to a simple taxonomy.

description of the methodology followed by Godley and associates, and available software codes to replicate existing models. In the GL group, moreover, only the model for Italy discussed here explicitly disentangles the central bank, and splits the private sector between households, firms, and banks, while most others either adopt the New Cambridge three-sector structure (with the economy divided between private, public, and foreign sectors, as in the Levy model for Greece), or consolidate some of the sectors.

The adoption of a particular approach has implications for the model's ability to track historical data, and to produce accurate and reliable out-of-sample projections. But how do these empirical SFC models differ from other structural macro-econometric models used for policy analysis?[7] Building on Passarella (2019), Figure 1 depicts Pagan's (2003) frontier of model—which shows the tradeoff between theoretical and empirical coherence macro modellers usually face—while Table 1 summarizes the main feature of each model class. The left panel places SFC models with respect to other classes of macro-models. It is worth noting that, within each group, there is ample heterogeneity, so that an RBC-DSGE would be deemed to be more "theory-oriented" than an NK-DSGE, or the BIQM would be more "data-oriented" than the FRB-US, and so forth. Indeed, the right panel zooms in, placing the three different SFC models of the Italian economy along the same curve, with the theory-driven model of Canelli et al. (2024) in the upper part—the one presented here as the more data-driven—and the recently developed ITFIN model of Barbieri Hermitte et al. (2023) lying somewhere in the middle.

[7] This quote from Haavelmo (2015) perfectly states what we intend for structural: "The totality of properties of the experimental conditions under which a particular economic relation is valid, is often called the structure of the economy considered, and the relation itself is called a structural relation. Thus, a structural economic relation is not actually a particular kind of economic relation, but rather any economic relation associated with and valid for a specified real economic structure" (2). Thus, empirical SFC models, as well as "old"-Keynesian macro models à la Cowles Commission are *structural* because they incorporate a good deal of theory while remaining close to the "environment" under analysis, even though the underlying microeconomic mechanisms are not explicitly modeled—as modern Neoclassical and New-Keynesian models—as the (policy-invariant) outcome of the forward-looking behavior of rational agents.

Figure 1. Empirical SFC models positioning along Pagan's (2003) 'best practice' curve



Source: Author's elaboration on Passarella (2019)

On the two extremes we have DSGE and VAR models, which are supposedly the more theoretically and empirically coherent, respectively.[8] Both classes of models, however, can hardly be used for certain policy exercises, such as medium-term projections of the effects of public policies, as the ones published by governments in budgetary laws – since they lack the necessary level of detail. If for a document we need accurate medium-run forecasts for dozens of variables, these all need to be explicitly addressed in the model. This is usually not possible in DSGEs, as models need to be analytically solvable, while the number of variables in VARs needs to be limited to avoid incurring in the so-called "Curse of Dimensionality," (Altman and Krzywinski, 2018) since the number of parameters to be estimated increases quadratically with the number of variables. A similar argument applies to CGE and IO models, which have a richer sectoral and industrial structure—and can thus answer to a larger set of questions, but do not employ time-series data, limiting their use to static exercises. Indeed, even though large-scale DSGE models have found their way to policy institutions,[9] their main tool of analysis is still

[8] A comparison between SFC and DSGE models is given by Burgess et al. (2016) and Carnevali et al. (2019). All models are placed on the frontier, but we are aware that different researchers could have different opinions regarding the relative merits of their own approach.

[9] See for instance the SIGMA model developed by the US Federal Reserve (Erceg et al. 2005), the QUEST III from the European Commission (e.g., Pfeiffer et al., 2023), and the IGEM model from the Italian Ministry of Finance (e.g., Acocella et al. 2020).

represented by SEMs still mostly grounded in what Fair (2012) refers to as the Macro 1 approach.[10]

Leaving theoretical considerations aside and focusing on estimation methods, nowadays mostly through Bayesian techniques, the parameters of maximization problems faced by rational agents (households, firms, the monetary authority, etc.) are estimated in state-of-the-art DSGEs.[11] In contrast, SEMs—as well as SFC models—employ time-series techniques to estimate parameters of aggregate equations which, following the Cowles Commission method, feature adaptive expectations, using lagged values of endogenous variables, error-correction mechanisms, and cointegration analysis.

Table 1. Main features of model classes

	Model class				
Features	DSGE	CGE	IO	SEM	SFC
Vertical & horizontal consistency	Y	Y	N	Y	Y
Flow consistency	Y	Y	Y	Y	Y
Stock consistency	Y	Y	N	Y	Y
Dynamic consistency	Y	N	N	Mixed	Y
Stock-to-flow feedback	Y	N	N	Mixed	Y
Data consistency	Mixed	Y	Y	Mixed	Y
Output determined by …	Mixed	Supply	Supply	Mixed	Demand
Microfoundations	Y	Y	N	Mixed	N
Expectations	Rational	Rational	n.a.	Mixed	Adaptive
Detailed data for industries	N	Y	Y	N	N
Detailed data for institutional sectors	Mixed	Y	Y	Mixed	Y
Time series data	Y	N	N	Y	Y
Estimation methods	Bayesian	Calibration	Calibration	S.E.	S.E.

Source: own elaboration
Legend: DSGE = Dynamic Stochastic General Equilibrium; CGE = Computable General Equilibrium; IO = Input-Output; SEM = Structural Macroeconometric; SFC = Stock-Flow Consistent
Notes: S.E. = single equation (e.g., OLS, ECM, 2SLS)

[10] As the FRB–US model developed by the US Federal Reserve (Brayton et al., 2014), or the discussed BIQM from the Bank of Italy (Bulligan et al., 2017). Each institution follows its different 'degree of purity', with some microfounding some of the behavioral blocks, output being supply determined in the long run, and so on. In most cases, though, the 'theoretical background' of institutional models lies in the same neoclassical tradition.

[11] We do not think that theoretical considerations are not worth debating. On the contrary, we believe there is not enough space in the present article to discuss them thoroughly. A critical take on the effects of the rational expectations revolution on models at policy institutions, is given by Wren-Lewis (2018) and Hendry and Muellbauer (2018), while Fair (2012) and Romer (2015) focus on DSGE's estimation methods.

There are two main advantages of the SFC approach over standard models. The first stems from the presence of a complex financial system interacting with real economy, constrained by an accounting edifice that mimics the actual structure of the data.[12] This gives SFC models the ability to capture the interrelations between expenditure-saving decisions and their implications for financial markets—in terms of debt accumulation and growth path sustainability—and to lay down explicitly the interconnections between balance sheets and flows of payments, in the presence of multiple financial assets, each with its own price/return. Thus, for example, fiscal and monetary policies may have unintended effects on the private sector through balance sheet transmission channels and shocks coming from financial markets feedback in the real economy and through credit provisioning and asset accumulation (which imply future flows of capital incomes affecting the net-lending position, and so on). The second is their strong path dependency and disequilibrium nature. In contrast to NMC models where dynamics are led by the presence of long-run attractors (such as a production function, the NAIRU/NAWRU, etc.), in SFC models the long run is determined as a sequence of (demand-led) short runs, within which agents are not on target[13]—reflected in the error correction mechanisms leading behavior—and the convergence to the steady state is driven by the so-called "stock-flow norms."

There are of course some drawbacks in adopting the SFC approach for policy models, too. First, empirical SFC models tend to be very large and complex—and thus difficult to build in the first place, and to update and manage thereafter—making their results harder to interpret. Second, notwithstanding their data-driven nature, behavioral equations are still grounded in post-Keynesian theory. Third, the Lucas Critique applies since, as in standard SEMs, decisions are not the result of optimization exercises within a system of rational agents (which may not be deemed a drawback by many). This, however, prevents the use of this class of models to assess the impact of policies that imply changes in structural relations.

---

[12] Even though some SEM do link the flows of net lending from NFA to FoF tables (as in the BIQM), it does not separate households and firms, and does not have the same level of detail for financial assets and real financial interactions as all empirical SFC models presented in this issue.

[13] "[Agents] set themselves norms and targets, and act in line with these and the expectations that they may hold about the future. These norms, held by agents, produce a kind of autopilot. Mistakes, or mistaken expectations, bring about piled-up (or depleted) stocks – real inventories, money balances, or wealth – that signal a required change in behavior" (Godley and Lavoie 2007, 16).

The next section presents the structure of the quarterly model of Zezza and Zezza (2022), discussing the points of contact with other existing models and underlining their main differences. For a complete description of all model equations, the interested reader is referred to Zezza and Zezza (2020; 2022).

3. MODEL STRUCTURE AND MAIN FEATURES

In theoretical SFC models, the researcher has far more liberty on the decisions about the number of sectors and assets to include on the closures and the behavioral specifications; all are choices that may lead to a wide arrange of different models, suited for the question at hand. In contrast, in empirical SFC models, the first constraint is related to the availability and structure of the appropriate data, from which all other decisions should follow.

When building an empirical model which satisfies the SFC principles listed above,

> "the idea is that we want to start from a complete description of the balance sheet of all institutional sectors, for all financial assets for which we have data, and then proceed to reduce the degree of complexity according to the specific features of the economy we are studying. Once the desired level of detail has been obtained, the complexity of the transaction matrix will also be specified." (Zezza and Zezza 2019, 136)

Of course, different strategies and modelling choices will lead to different models, depending on the desired level of detail, the main research questions one wants to answer, and the ultimate use of the model. If the model is to be used for policy, following the late Blanchard (2018), then it should track historical data well and allow for scenario analysis.

To design a model which respects the theoretical requirements of the SFC approach, the core of the statistics must be:

- the National Income and Product Accounts (NIPA) and the Non-Financial Accounts of Institutional Sectors (NFA)—published in Italy by Istat at quarterly frequency from 1999 to present;
- the Flow of Funds (FoF) and Financial Accounts of Institutional Sectors (FAIS)—published by the Bank of Italy at quarterly frequency from 1995 to present.

NIPA provides data on GDP and components—from both the production and income sides—on sectoral output and value added. From the NFA one can exploit the income side to get information related to wages, interest, dividends, profits, transfer payments, and taxes. Finally, there is data on investment, split between gross fixed-capital formation, changes in inventories and net acquisition of non-produced, non-financial assets. The last entry represents the net-lending/borrowing values of the various sectors or—as Godley called it—the *Net Acquisition of Financial Assets* (*NAFA*), which has the property that the overall net-lending position of the country matches the net-borrowing position of the foreign sector. This is the so-called Fundamental Identity, usually portrayed as: $NAFA - GD - CAB = 0$ (Lavoie 2022, ch. 4).

Balance sheet data provided by FoF and FAIS—detailing the stocks and flows of (non-consolidated) financial asset and liabilities—offer a larger sectoral disaggregation than that provided in NFA data published by Istat. Financial corporations are here divided into seven sub-sectors. Most important, the central bank is separated from domestic banks, which allows it to model monetary policy in a more systematic way. The last entry represents the net wealth of the various sectors.

When using these two sets of data, some problems arise (discussed in Appendix A1). Yet again, the desired level of detail for such a model largely depends upon *for what the model is designed*. The different solutions adopted will lead to different model structures, and this will have an impact on its ability to accurately replicate the data.[14]

[14] Appendix A2 further elaborates on this point, using MITA and ITFIN as examples.

In our case, MITA "is an attempt to merge the SFC methodology for jointly tracking the real and financial sides of the economy to the methodology that was adopted for structural models by central banks around the world before the counter-revolution of rational expectations" (Zezza and Zezza 2022, 138). Our aim was to design a model that satisfied all five SFC principles discussed above, making the most out of available data, and that could "speak" with people at policy institutions.

Table 2 describes the main features of the model, while Figures 2 and 3 depict the balance-sheet relations and transactions among sectors, respectively.[15] In Figure 2, colors indicate the different real-financial channels at work: in blue, we have monetary policy; in orange, the banking channel, which operates through money creation; in yellow the firm's channel; green and grey depict, respectively, the government bond and foreign channels. In Figure 3, in turn, we see the sequence of sectoral transactions—i.e., from the functional distribution of income among sectors (wages, profits, and indirect taxes) to their net-lending position, passing through transactions in capital incomes, taxation, and final demand.

Table 2. MITA: main features

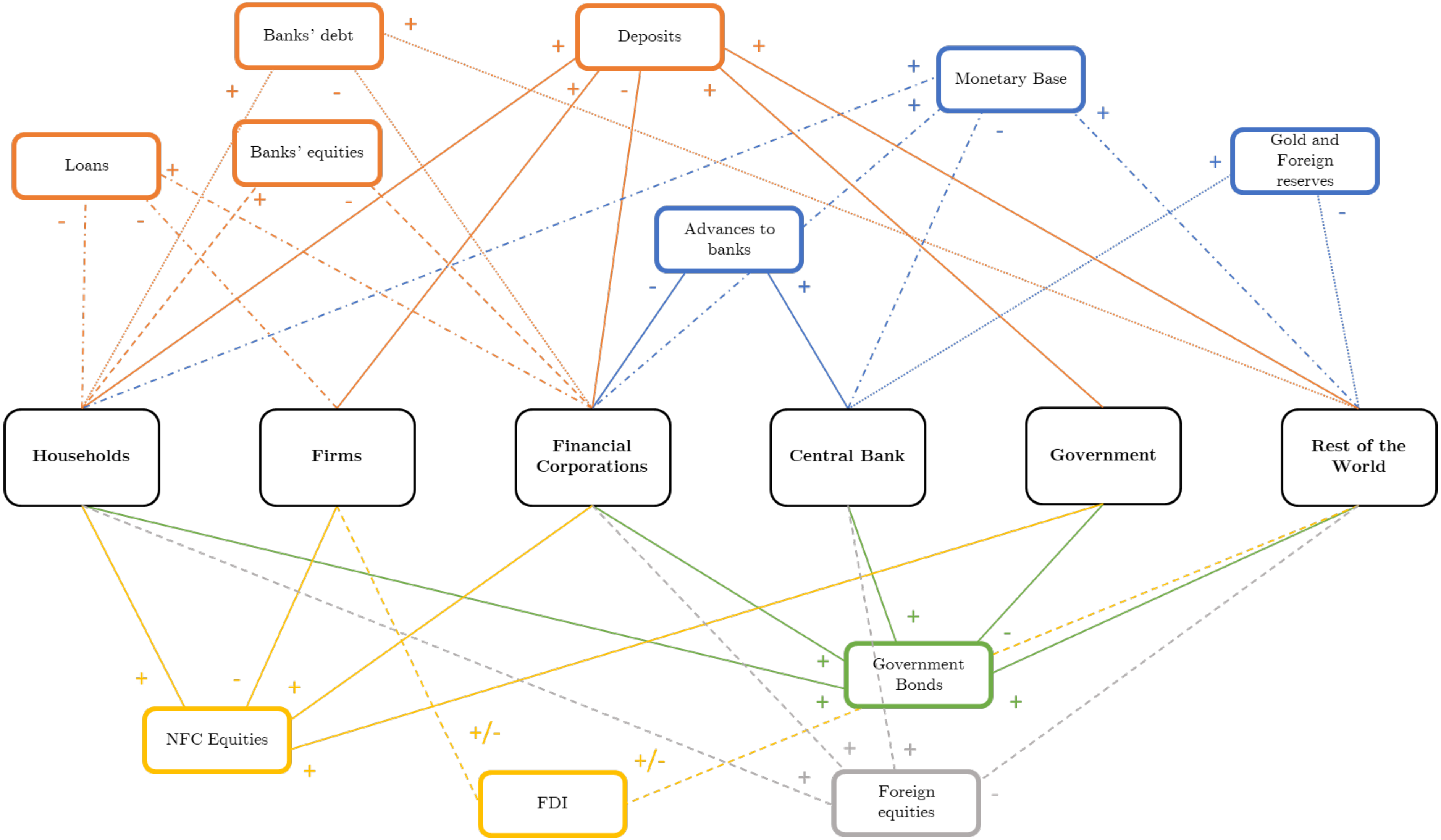
Features	Description
Institutional sectors	Households* Non-Financial Corporations Banks Central Bank Government Rest of the World
Real capital stocks/sectors holding	- Households: housing - Non-fin. Corp.: machineries, non-residential - Government: infrastructures
Financial asset/liabilities	15
Demand/supply of assets	Tobin Portfolio for households' illiquid financial assets; single (estimated) equations for other assets/sectors
Prices	Phillips-curve-type link between the unemployment rate and the wage level. Wages in turn impact on prices
Labour market	Employment and unemployment depend on aggregate demand, with productivity growth linked to economic activity
Endogenous	272
Exogenous	167

Source: own elaboration

[15] Canonical Balance Sheet and Transaction Matrices are reported in Tables A3.1 and A3.2.

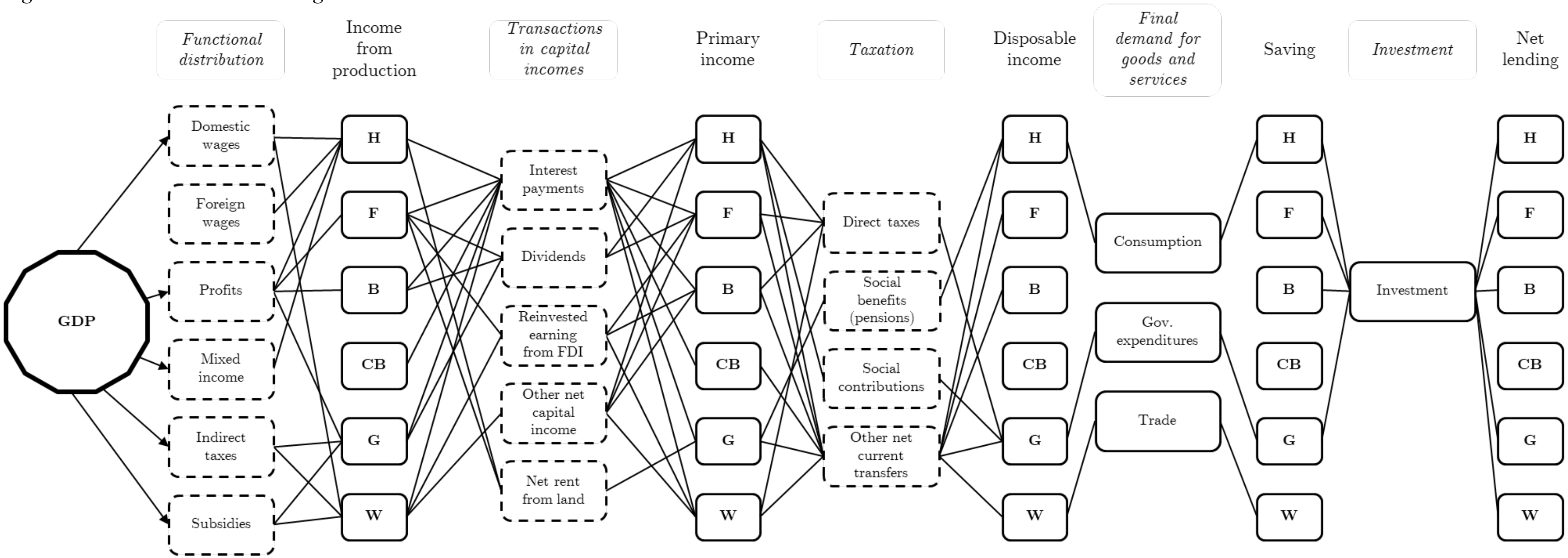
MITA is a large-scale model with 272 equations, of which 37 stochastic equations estimated with single equation techniques. It features six sectors—households, non-financial corporations, banks, the central bank, government, and rest of the world. Importantly, we chose to only include in the banks sector monetary–financial institutions other than the central bank (i.e., commercial banks and mutual funds), and to merge the remaining financial corporations into the household sector. In this way, we separate institutions with the power to create money from those only serving households as intermediaries. We model separately fifteen classes of financial assets (given the structure of sectors' balance sheets discussed in Appendix 2), and four different capital stocks: housing, firms—including machineries and non-residential buildings—and public capital. Importantly, we introduce a residual "other net financial asset" variable, which ensures that model variables track historical data as closely as possible. Demand for assets is mostly estimated econometrically, while labor market and price developments are linked to fluctuations in aggregate demand.

Figure 2. MITA. Balance sheet relations



Source: own elaboration
Notes: (+) and (-) signs stand for asset and liabilities, respectively

Figure 3. MITA. Transactions among sectors



Source: own elaboration

Regarding estimation of behavioral relations, for this class of models—which include hundreds of variables and several stochastic equations—the methodological approach must be pragmatic. We try to use, whenever possible, error correction models, following a general-to-specific approach to reach the final form of our estimated equations, taking care of cointegration and parameter stability concerns. However, since the model should be structural in Haveelmo's sense, theoretical considerations are also important. This means, in practice, that at times we prefer to include a variable in the estimation, even if not statistically significant (but with the "right" sign), if it is needed to preserve important real-financial interactions—as real wealth in the consumption function, or foreign prices in the export equation. Moreover, we use dummy variables, when needed, to eliminate outliers or to take structural breaks into account. To some extent, this was also the methodology used to estimate structural models in early stages of macro econometrics (Fair 2012).

3.2 Model Closures

While accounting consistency is important by itself for building a sound macroeconomic model, as it reduces the degrees of freedom and provides some important insights about the constraints faced by any economic system, it is not enough. As shown long ago by Lance Taylor (Taylor 2004; Taylor and Lysy 1979), indeed, the conclusions that can be drawn from a model are primarily led by the direction of causality the author imposes over the variables—in other words, its *closures*.

Given the *k* counting identities that come out of the transactions and balance sheets matrices,[16] if we want to determine *n* endogenous variables, we need *n–k* additional equations. These are given by specifying how the agents and the different sectors behave. Broadly speaking, one needs to specify how: (i) *agents make their expenditures* (i.e., the determination of consumption, investment, government expenditures, trade, etc.); (ii) *agents finance their expenditures* (i.e., how the government finances its deficit, how many more loans that households and firms will take on, etc.); (iii) *agents allocate their wealth* (i.e., the determination of the demand and supply of financial assets)[17]; (iv) *the financial sector acts/reacts* (i.e., how the central bank reacts to inflation or

---

[16] Recalling that, for each column and row of both the TM and the BSM, the last identity is implied by all others, and thus needs to be dropped to avoid over-determination. This is the so-called "redundant equality".

[17] In theoretical models, this is usually done with a 'tobinesque' approach. If there are *m* assets, one needs to specify *m-1* demand function (the last one being implied by the rest), thus assuring that any increase in a stock implies a corresponding decrease in some other. This approach is very difficult to implement in practice, possibly because of ongoing processes of financialization, structural breaks in time series (due to either changes in monetary policy or in agents' behavior) and co-movements in rates of return.

unemployment pressures, what drives banks credit provisioning, etc.); and (v) *productivity growth, wages, and inflation are determined*.

3.2.1 Demand Components

Starting from demand determination, the SFC literature has always grounded itself within the boundaries of post-Keynesian economics (Godley and Lavoie 2007; Lavoie 2022), with effective demand driving economic growth *both in the short and in the long run*.

In empirical SFC models, demand components—i.e., aggregate consumption, investment, government expenditure, imports, and exports—are estimated, usually employing error correction models, and cointegration techniques to preserve both short- and long-run relations. Table 3 reports how each component is determined in the model.[18]

Table 3. MITA: determination of demand components, in real terms

Demand component	Long-run	Short-run
Consumption	Real disposable income per capita (+); real wealth per capita (+); interest rate on consumer credit (-)	Real disposable income per capita (+); share prices (+); interest rate on consumer credit (-)
Investment (housing)	Disposable income in terms of price of investment in new houses (+); real stock of houses (-); interest rate on mortgages (-)	
Investment (firms)	Real GDP (+); flows of profits net of dividends (+); interest rate on loans to firms (-)	
Government consumption and investment	Exogenous	Exogenous
Imports	Real GDP (+); relative prices (-)	Real GDP growth (+)
Exports	World demand (+); REER (+)	Growth in world demand (+); growth in domestic prices (-); growth in foreign prices (+); REER (+)

Source: own elaboration

As common practice in the SFC literature, the determinants of consumption are coherent with a dynamic process of adjustment toward a stable stock-flow norm between household disposable income and accumulated wealth, with an additional effect coming from the interest rate on consumer credit, as in equation (1).[19]

$$C = \alpha_1 YD + \alpha_2 NW_{t-1} \qquad (1)$$

[18] Note that demand components are estimated in real terms, with separate (estimated) deflators for each component.

[19] For the dynamic specification, we also find that share prices play a role. It is important once again to notice our "pragmatic approach": real wealth is not significant (and coefficient is rather small, equal to 0.001) but has the right sign; thus, we kept it to respect the principle of convergence to a stable norm between wealth and income.

Equation (1) can also be expressed as a wealth accumulation function[20]:

$$\Delta NW = \alpha_2(\alpha_3 * YD - NW_{t-1}) \quad (2)$$

Where $\alpha_3 = (1 - \alpha_1)/\alpha_2$. Equation (2) is a *partial adjustment function*. Wealth accumulates at a certain rate, determined by the partial adjustment parameter (α_2), toward a desired proportion (α_3) of disposable income. Thus, households save to end the period with some well-defined quantity of accumulated wealth. Put another way, any period opens with a stock of existing wealth (NW_{t-1}), and, given the disposable income of the period, households now have a *target level* of wealth, given by $NW = \alpha_3 YD$. The α_3 coefficient is the stock-flow norm of households, i.e., the assumed wealth-to-income target ratio which is implicitly embedded into the consumption function. Thus, if the target level of wealth is not reached, households will save more in following periods, attempting to reach their target.

In a similar way, investment in housing and productive capital are modelled as a process of adjustment to a stable stock–flow ratio of housing wealth-to-income in the former case, and of capital-to-income (i.e., profits) in the latter, with also a long-run effect of the interest rate on firms' loans. The determination of the trade block is quite standard, with imports responding to changes in domestic activity and relative prices, and exports dependent on world demand and exchange rates.

3.2.2 From Net Lending to Demand for Assets

For all sectors, we compute net lending (NL^i) in equation (3) as the difference between saving, transfers and taxes on capital account, expenditures in non-produced non-financial assets, gross fixed capital formation, and changes in inventories – linking it to net lending from financial accounts in equation (4).

$$NL^i = S^i - TRK^i - OTHDNA^i - I^i - \Delta Inv^i \quad (3$$

$$NLFA_i = NL^i + disc^{NL^i} \quad (4$$

$$NFA_i = NFA_{i,t-1} + NLFA_i + NKG_i \quad (5$$

[20] See Godley and Lavoie (2007, 74–75).

Net-financial assets are determined in equation (5) by cumulating the opening period stock (NFA_{t-1}^{i}), net lending ($NLFA_i$), and net capital gains (NKG_i). The latter should be due to changes in the market price of assets, but also to write-offs due to bankruptcy. In principle, and abstracting from write-offs of debt, if e is one equity with a market value p^E, the market value of the stock of equities evolves as follows:

$$E_t \cdot p_t = E_{t-1} \cdot p_t^E + f_t \cdot p_t^E \qquad (6$$

where f_t is the number of new equities issued during the period. Notice that the number of equities at the beginning of the period (i.e. E_{t-1}) must be valued at the current market price. Adding and subtracting $e_{t-1} \cdot pe_{t-1}$, we get:

$$E_t \cdot p_t = E_{t-1} \cdot p_{t-1}^E + f_t \cdot p_t^E + (E_{t-1} \cdot p_t^E - E_{t-1} \cdot p_{t-1}^E) \qquad (7$$

Multiplying and dividing by p_{t-1}^E in the last bracket, and using $E_t = E_t \cdot p_t^E$, we get:

$$E_t = E_{t-1} + F_t + \dot{p}_t^E \cdot E_t \qquad (8$$

where $\dot{p}_t^E$ is the rate of change in p^E. Net capital gains, abstracting from write-offs, are equal to the rate of change in the market price of the asset, multiplied by the opening stock of assets. We have used equation (8) to compute the rate of change in each asset, given the values of the stocks available from the balance sheets and the value of flows.

A problem emerges, in practice, when more than one sector is holding the stock, E, as an asset. In principle, we could use equation (8) for each sector and, assuming that each sector holds the same basket composing E, the rate of change in the market price should be the same, or at least similar, when computed from different sectors' data. If, however, each sector holds a different component of the total basket defining E, the market price of each respective basket will vary. The problem is even more severe when we allow for write-offs.

One way to address the issue and obtain consistent identities would be to split equation (8) for the different baskets for each sector and use different prices for each basket, with p^E the weighted average for all equities. However, since this procedure implies the proliferation of price variables for financial assets, which sometimes have unpredictable dynamics, we preferred to use a shortcut, which is to: (a) compute the market price of the aggregate stock, (b) compute net capital gains for each sector on the basis of the overall market price, and (c) compute a residual component. For each sector, thus, we have:

$$E_{i,t} = E_{i,t-1} + F_{i,t} + \dot{p}_t^E \cdot E_{i,t} + NKGD_{i,t} \quad (9$$

where $NKGD$ is the discrepancy for the i-th sector arising from the different composition of the basket of the i-th sector against the total basket.

Next, we compute net capital gains for each asset of the model, following the classification of financial assets in the balance sheet presented in Table A3.1., with net capital gains on other net-financial assets (NKG_{ONFA}) for each sector obtained residually so that:

$$ONFA_{i,t} = ONFA_{i,t-1} + VONFA_{i,t} + NKG\_ONFA_{i,t} \quad (10$$

We are now able to specify the component of net capital gains (including write-offs) for each sector:

$$NKG_{H,t} = \dot{p_{H,t}^{BB}} \cdot BB_{H,t-1} + \dot{p_{H,t}^{EB}} \cdot EB_{H,t-1} + \dot{p_{H,t}^{B}} \cdot B_{H,t-1} + \dot{p_{H,t}^{EN}} \cdot EN_{H,t-1} + \dot{p_{H,t}^{F}} \cdot F_{H,t-1} + BLCCWO_t + BLMOWO_t + DISC\_VB_{H,t} + DISC\_VEN_{H,t} + DISC\_VF_{H,t} + NKG\_ONFA_{H,t} \quad (11$$

$$NKG_{F,t} = \dot{p_{F,t}^{B}} \cdot B_{F,t-1} + \dot{p_{F,t}^{EN}} \cdot EN_{t-1} + \dot{p_t^{FDIO}} \cdot FDIO_{t-1} - \dot{p_t^{FDII}} \cdot FDII_{t-1} + BLFIRMS_t + DISC\_VB_{F,t} + NKG\_ONFA_{F,t} \quad (12$$

$$NKG_{CB,t} = \dot{p_t^{GOLD}} \cdot GOLD_{t-1} + \dot{p_{CB,t}^{B}} \cdot B_{CB,t-1} + \dot{p_{CB,t}^{F}} \cdot F_{CB,t-1} + DISC\_VB_{CB,t} + NKG\_ONFA_{CB,t} + NKG\_GOLD_t \quad (13$$

$$NKG_{G,t} = \dot{p_{G,t}^{EN}} \cdot EN_{G,t-1} - \dot{p_t^{B}} \cdot B_{t-1} + NKG\_ONFA_{G,t} \quad (14$$

$$NKG_{W,t} = \dot{p_t^{GOLD}} \cdot GOLD_{t-1} + \dot{p_{W,t}^{BB}} \cdot BB_{W,t-1} - \dot{p_t^{FDIO}} \cdot FDIO_{t-1} + \dot{p_t^{FDII}} \cdot FDII_{t-1} - \dot{p_t^{F}} \cdot F_{t-1} + DISC\_VB_{W,t} + NKG\_ONFA_{W,t} \quad (15$$

And it must be the case that $\sum NKG_i = 0$, so that one variable can be obtained as a residual (*redundant*) from the accounting identity (the equation for banks, in our case).

3.2.3 Financial Closures

We then turn to portfolio behavior, i.e., how the changes in the net-lending position translate into specular changes in the asset/liability structure of each sector's balance sheet. Closure and main mechanisms are summarized in Table 4.

Table 4. MITA: sectoral Closures for balance sheet

Sector	**Asset** / mechanism
H	***Other net financial assets (stock)*** Households' portfolio behaviour work as follows: (i) they decide how much money they want to hold in liquid form (either banknotes or deposits at banks) in the future; (ii) they decide how much new debt to take on; (iii) decide how to allocate funds between illiquid financial assets (i.e., stocks of banks' equities and shares, government bonds, NFC shares, and foreign assets); (iv) remaining funds increase the stock of other net financial assets, which close the HH sector balance sheet
F	***Banks' Loans (flow)*** Non-Fin. Corp. finance investment mainly out of retained profits, the rest out of loans
B	***Excess Reserves (stock)*** When QE is active, banks accumulate excess reserves. If QE is not active, banks clear the market for government bonds
CB	***Monetary Base (stock)*** The CB accommodates the demand for money
G	***Gov. Bond (Flow)*** Government finances its deficit emitting Bonds
W	***Target2 balances (stock)*** Redundant equation

Source: own elaboration
Legend: H=household; F=firms; B=banks; CB=Central Bank; G=government; W=Rest of the World

Households. Starting from the household sector, as in Keynes (1936), it is money—and thus liquidity—that links the past, the present, and the future. Thus, the household first decides how much money she wants to hold in liquid form (either banknotes or deposits at banks) in the future and how to split the cash between the two. Then, she must decide how much debt to take on. In the model, households demand bank loans either to finance their housing investment through mortgages—the flow of which (relative to disposable income) is driven by household residential investment, the interest rate on mortgages, the existing stock of mortgage debt, and mortgages write-offs—or for consumption purposes, which depends on consumption relative to income and the interest rate on consumer credit.

The decision on how to allocate funds between illiquid financial assets follows Tobin's principles.

In theory, households want to hold a certain share of their wealth in the form of asset i, but this proportion is modified by the expected rate of return on this asset and by the level of expected (regular) disposable income. Thus, when making their portfolio allocations, households are concerned about the interest rate on the different assets (r^j), which is determined at the end of the period and will generate the future interest payments, and by the expected return on that asset (ERr_j).

The coefficients in each portfolio equation follow from the assumption that people make consistent decisions on wealth allocation. Thus, the sum of the constants must be unity, as the decision to hold one asset implies the decision to hold the remaining wealth in the other two. In the same way, the sum of the coefficients with respect to each argument of the portfolio equations must be zero: if a change in interest (or income) makes people wish to hold a higher proportion of cash, it implies that they want to hold a lower proportion of bills and bonds (and vice versa). This is the *adding-up constraint* (Tobin 1969): if there are m assets, one needs to specify $m - 1$ demand functions (the last being implied by the rest), thus assuring that any increase in a stock implies a corresponding decrease in some other, and the same applies to the relative rate of returns (i.e., an increase in one rate implies that, at least, there is a specular change in another).

With real world statistics, however, it is difficult to estimate from the data (given their structure, the available time span, the presence of structural breaks, etc.) the appropriate relations—if they exist—between the relative rate of returns and the demand and supply for different assets and liabilities. Nevertheless, the principles behind Tobin's theory shall hold.

We thus followed once again a pragmatic approach: we defined the growth rates of prices of financial assets as the rate of change in their price over the last quarter; computed the return on assets as the sum of the change in their price and the relative interest rate; defined the stock of each asset using the (estimated) portfolio ratios in total illiquid assets; assumed households have adaptive expectations with respect to the rate of return. We then estimated the resulting system of equation, with results highlighting a negative relation between domestic and foreign bonds, and between banks' bonds and equities.

Residual assets are then allocated to other net-financial assets, which closes the balance sheet.

Non-Financial Corporations. On the asset side of the non-financial business sector, the stock of bank deposits is modeled as a ratio to the wage bill, while the demand for government bonds is interpreted as an additional demand for liquid assets, and it is therefore modeled with respect to the stock of deposits. This means that firms demand liquid assets with respect to their current wage bill, and split their liquid assets between deposits and government bonds. The flows of outgoing and incoming foreign direct investment, as well as new issues of equities, are projected exogenously as the result of domestic and foreign firms' strategies ruled by animal spirits. Finally, portfolio adjustments for the nonfinancial business sector are meant to determine the additional demand for credit from banks, meaning that firms will first use their own funds to finance investments and take on new debt to finance the gap.

Central Bank. In the last decade, because of interest rates reaching the zero lower bound, the central bank largely resorted to asset purchases and other balance sheet operations for monetary policy purposes. But how does one model the Central Bank in a monetary union, merging available statistics available with data from FAIS? How does one disentangle Quantitative Easing (QE), and model this important monetary transmission channel appropriately?

In the model, the central bank only collects interest on the stocks of advances lent to banks and on the stocks of government bonds and the foreign liabilities it holds. We assumed that all these interest streams are passed to the government sector—as per the Statute of the Bank—so that the net-lending position of the central bank is zero.

In national accounts, some operations made by the central bank as part of the European System of Central Banks (ESCB) are treated as operations with the rest of the world (RoW), but the monetary liabilities in Target2 appear as part of the liabilities of the national central bank in FAIS. It is reasonable to assume that, in normal times, the demand for the monetary base—coming from households, banks, and foreign institutions—is accommodated by the central bank, as in equation (17). Changes in the monetary base would in turn be related to changes on the asset side: households' demand for liquidity, the reserve requirements needed by banks, and the part of external imbalances not covered by changes in other net assets vis-à-vis the RoW (i.e., the Target2 balance). Indeed, this is in line with the theoretical discussions of central bank monetary policy made by Godley and Lavoie (2007), Lavoie (2014), the Bank of England (McLeay et al. 2014), and the ECB itself (2017).

$$MB = MB_{hh} + MB_{fc} + MB_{T2} \qquad (17$$

Things became more complex following the Great Recession, when the ECB started adopting "unconventional" monetary policies. Through its QE operations, the ESCB supplied central bank reserves well above the demand for liquidity stemming from the banking sector, inducing a sizable increase in base money (and excess reserves). This mechanism started with the bank refinancing operations and was further enhanced with the launch of the asset purchase programs (APPs), worth over €3.4 trillion by the end of the program in 2022.[21] When purchasing assets, the ECB supplies reserves to the banking system and, "since banks are typically the only entities, apart from central government, that hold deposit accounts with the central bank, purchases are always settled through them, regardless of who the ultimate seller is. Thus, purchases conducted under the APP resulted in a mechanic, direct increase in base money" (European Central Bank, 2017). Importantly, this increase in excess reserves translates mechanically into a worsening of the overall Target2 balance, since most of QE operations involve cross-border transactions. This is shown in the right panel of Figure 4: Target2 balances move in tandem first with LTROs, during the first phase of QE operations from 2011 to 2014, and then with the acquisition of domestic government bonds by the BoI, from 2015 onwards.

When running unconventional policies it is thus the central bank, through its operations, that determines the amount of reserves in the system, instead of them being demand-driven through the net demand for credit. Most importantly, banks can do nothing to reduce the number of reserves. Only if banks' demand for compulsory reserves increases (because of increases in deposits) should the stock of excess reserves diminish. Therefore, in times of QE, the total monetary base is entirely determined by the central banks' decisions to purchase assets.

Thus, we split the monetary base on the asset side of banks' balance sheets between the reserve requirement—which varies with the reserve ratio to deposits and the share of sight deposits in total

[21] The main programs adopted by the ECB consisted of two rounds of long-term refinancing operations (LTRO and TLTRO) and the APP, which substantially increased with the launch of the Public Sector Purchase Program (PSPP).

deposits, and "excess" liquidity—determined by the demand for liquidity due to financial instability and unconventional monetary policy. We therefore model the "excess" stock of monetary base as the residual in the banks' portfolio adjustment.

Given that the ESCB purchased assets from the financial system in exchange for monetary base—making some components the mirror of QE operations rather than arising from the demand for liquidity—we assumed that the end-of-period stock of monetary base is determined by the asset side in the central bank's balance sheet. This includes net central bank financial assets determined exogenously, but takes into account net capital gains.

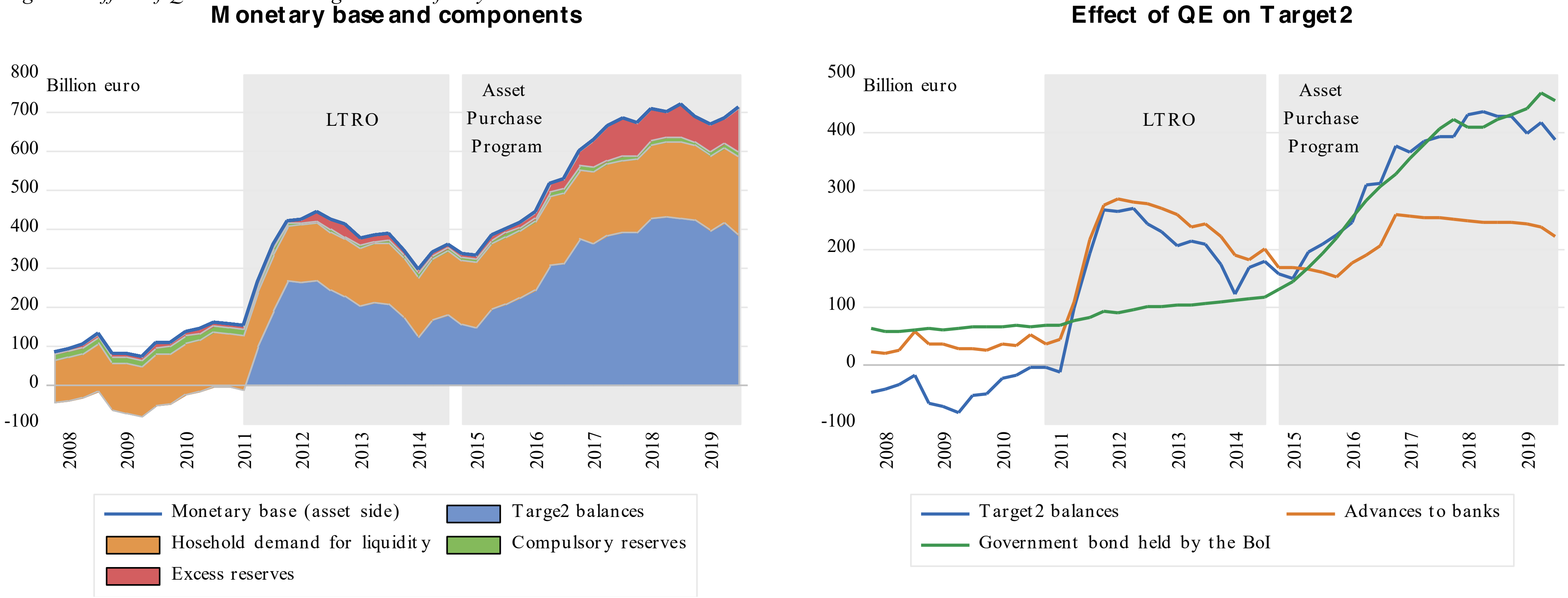
Changes in central bank advances to banks have been split into two components to better differentiate monetary operations and to disentangle the ECB's role from that of the Bank of Italy. We subtract QE-related operations (mainly LTRO) from total advances to get the BoI's ordinary operations. Both will be exogenously determined in the model. The central bank's acquisition of government bonds is given partly by the PSPP and, for the rest, by the central bank's standard operations, with both components determined exogenously. Notice that this assumption does not imply that the central bank is purchasing Treasuries on the primary market, nor that it is controlling the interest rate on Treasuries, which are governed by another equation in the model—one that links the interest rate on Italian bonds to the German rate, plus a spread that depends on financial conditions.

Banks. As in Godley and Lavoie (2007), we assume that banks fulfil the demand for loans from household and nonfinancial firms and adjust their level of reserves accordingly, with the central bank accommodating. However, the model becomes more complex when QE starts, since banks will adapt their portfolio whenever cheap credit is available from central banks' QE operations.

As discussed, we modeled the "excess" stock of monetary base as the residual in banks' portfolio adjustment. Consumer credit, mortgages, and loans to firms are all supplied by banks on demand. For firms' equities, we assume the financial sector is the residual buyer for the new emissions, while the evolution of the stock is linked to our spread measure. However, this has no implication on how the market price of equities is determined in the model. The issues of new bank equities are projected exogenously as independent decisions of banks, assuming that supply of equities matches households' demand.

Banks clear the market for government bonds. However, most new bonds in the last decade have been purchased by the ECB through its QE operations until June 2022, implying that, for a very long period, there was not any market to clear. We model the flow of foreign assets as a function of the interest rate on government bonds and the spread between Italian and German Treasuries, the (changes in) exchange rate against the, and the flow of interest income paid by the foreign sector relative to the stock of assets.

Figure 4. Effect of Quantitative Easing on Bank of Italy balance sheet



Source: own elaboration

Government. The government sector's financial operations are quite straightforward when compared to those discussed above. The sector holds deposits, mainly to pay out wages to public employees, and the flows are estimated as a function of government expenditures over deposits; it buys all the residual shares of domestic firms; and issues new bonds to cover the deficit. Demand for other net financial assets are, as usual, left exogenous.

Rest of the World. We decided to treat the foreign sector as the residual buyer for some of our assets. The RoW holds domestic banks' deposits as liquidity for trade, and buys the residual supply of domestic banks' securities, while the acquisition of new government bonds is currently left exogenous. Moreover, we assumed that the demands for foreign assets coming from the domestic sectors are completely matched. To assure balance sheet consistency, other net financial assets of the foreign sector are determined as the sum of all other sectors, while the buffer stock is represented here by the Target2 balance, which is the redundant equation of the model.

Labor Market and prices. The treatment of the labor market is rather simple at this stage. Population is projected exogenously, and the share of the working-age population is obtained through exogenous parameters, identifying those below working age and retired people. The size of the labor force is given by an exogenous participation rate. Employment is determined from a simple relation to real GDP through average labor productivity, which we model as a function of the business cycle and of part-time workers' share in the labor force. For both the long- and short-run specifications, we found the presence of a structural break related to the GFC. We model the ratio of part-time workers in the labor force as a function of the business cycle and the unemployment rate. Notice this implies that increases in labor market fragmentation will translate into lower employment via a productivity channel.

The average wage—estimated as a function of domestic and foreign prices (through the imports deflator) and the past unemployment rate—together with the level of employment determines the wage bill. The long-run elasticity of nominal wages to prices is one,[22] while import prices do not seem to have a long-run impact. An increase in the unemployment rate is

[22] The elasticity of wages to prices was larger than one, but since a test did not reject the hypothesis of a unit elasticity, we imposed this restriction.

found to have an impact on the level of wages (rather than on wage inflation, as in the Phillips curve). The short-run specification needs to be investigated further, since we find a negative short-run impact of price inflation on wage inflation.

Prices of goods and financial assets in the model—as well as interest rates—are estimated with simple mechanisms. Of course, most of these specifications may well be improved, but it is not the purpose of that initial version to come out with the "best" econometric outcomes, but rather to capture the major interrelations among our sectors and overall financial dynamics. A complete description of all model equations is available in Zezza and Zezza (2020; 2022).

4. IN- AND OUT-OF-SAMPLE PROPERTIES

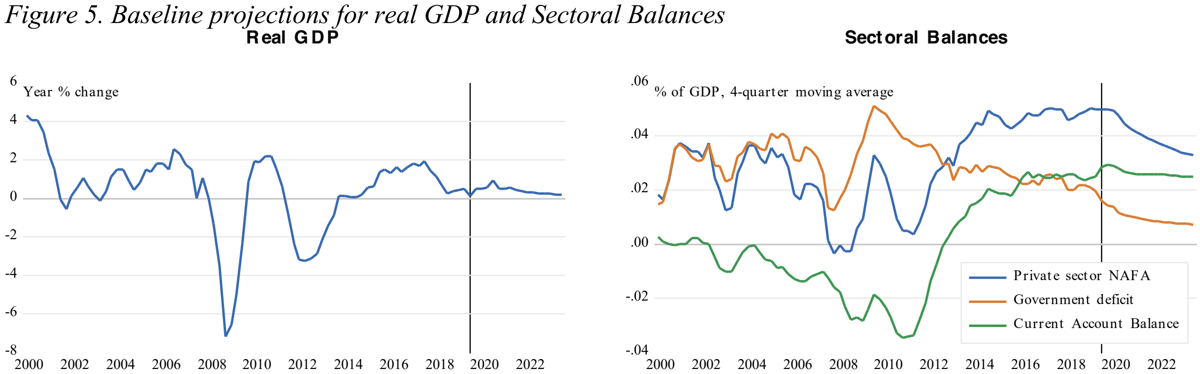
In this section, we first show the in-sample properties of the model, i.e., their ability to track the dynamics of historical data. We then discuss how we constructed the baseline scenario and, finally, we show the results of out-of-sample exercises. In particular, we perform four different shocks: a monetary policy shock, increasing the base interest rate (in Scenario 1), and three fiscal policy shocks, reducing government expenditures, increasing direct taxes on households and firms, and increasing the indirect tax rate (in Scenario 2, Scenario 3 and Scenario 4, respectively).

Figures A4.1 to A4.5 show how the model performs in replicating historical data over the period 2001q1 to 2019q4. Starting with GDP, Figure A4.1 displays the evolution of real GDP, in volumes and annual growth rates, showing that our estimate satisfactorily replicates historical data. The single components of GDP, in real values, are displayed in Figure A4.2. We overestimate consumption and investment for the period 2013–16—thus leading to a higher GDP growth rate in the simulation for the relative period—and accurately track the dynamics of the other components of demand. The same applies to net lending (Figure A4.3) and, to a lesser extent, net financial assets positions (Figure A4.4). Finally, sectoral net capital gains are also tracked satisfactorily (Figure A4.5). Overall, the model performs rather well, and shows the ability to capture major trends in important variables.

In the last published version (Zezza and Zezza 2022), the model was updated up to 2020q2 (the start of the COVID crisis), so we chose not to produce a scenario analysis at the time. Updating the entire model proved difficult during the pandemic, so the baseline presented here is meant to only show the *properties* of the model.

The strategy adopted to construct the fictitious baseline for the period 2020q1 to 2023q4 was to produce stable projections (GDP growth converging to 0.1 percent, as in the period 2018q1–2019q4, and government and foreign financial balances stabilizing with respect to GDP), by putting all small flows to zero, deactivating QE-related bond acquisitions, and setting exogenous variables to grow at a stable (slow) pace (i.e., government spending, exchange rate, world demand, etc.). The baseline scenario is shown in Figure 5, along with the simulated sectoral balances for the private, public, and foreign sectors.

Figure 5. Baseline projections for real GDP and Sectoral Balances



Source: own elaboration
Notes: the vertical line indicates the start of projections

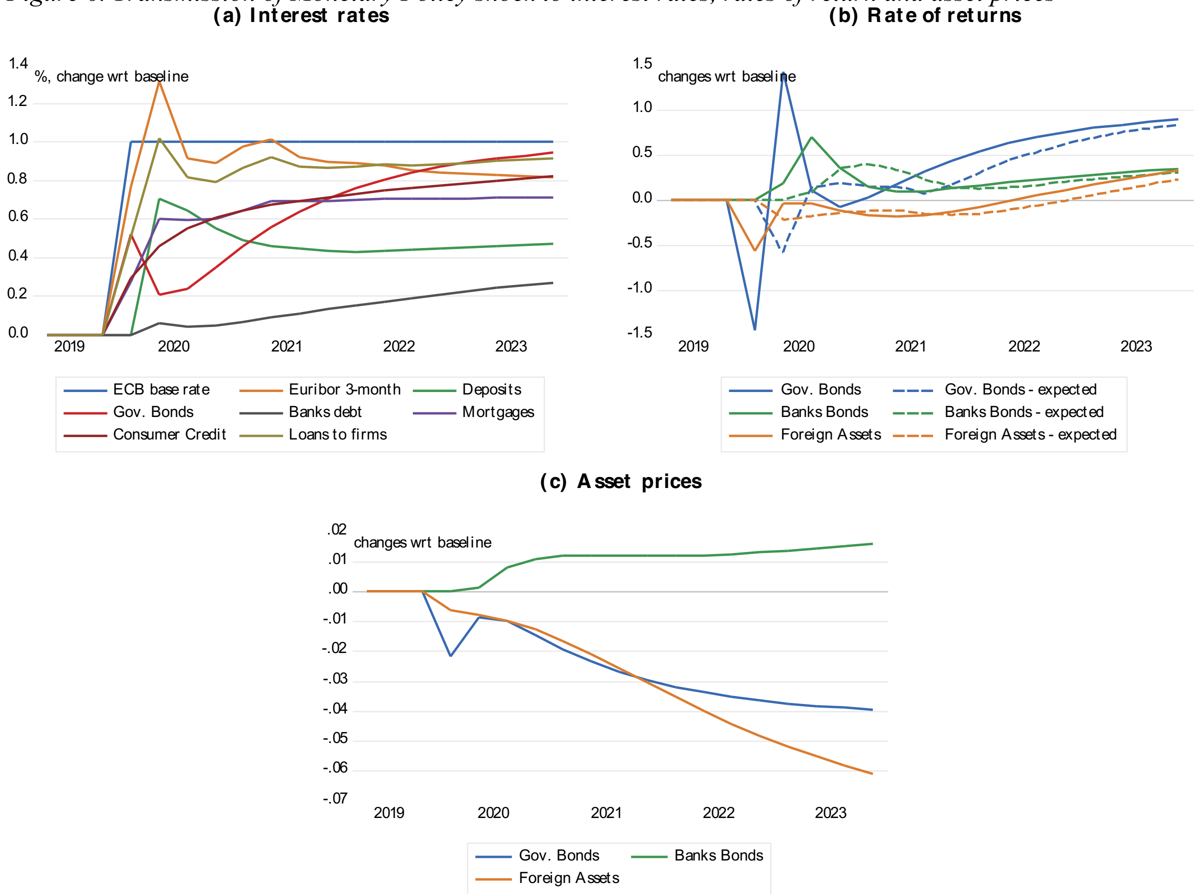
Monetary Policy Shock

We start by analyzing model responses to a (contractionary) monetary policy shock, i.e., an increase in the ECB base rate of 100 basis points, to explore the transmission mechanisms, the effects, and the real-financial dynamics at work in our stylized financial sector.

As shown in Figure 6, an increase in the base rate immediately impacts all other interest rates, including deposit, lending, mortgage, and bond rates, within the first quarter. This rise in interest rates drives changes in the relative rate of return on assets and leads to significant asset price adjustments. For instance, bond prices (both domestic and foreign) decrease, as investors demand higher yields.

An important aspect is the behavior of the interbank market. According to our estimates, the Euribor initially overshoots relative to the base rate, leading to a positive interest rate differential in the same quarter of the shock, before turning negative in subsequent quarters. This behavior in the interbank market affects banks' funding costs, which rise significantly as they are forced to pay more to borrow. Consequently, banks pass these higher costs onto firms and households by raising loan rates, which dampen investment and consumption. In contrast, deposit rates rise more slowly, meaning the additional income households and firms receive on their deposits does not fully offset the increased interest payments on loans.

Figure 6. Transmission of Monetary Policy shock to interest rates, rates of return and asset prices

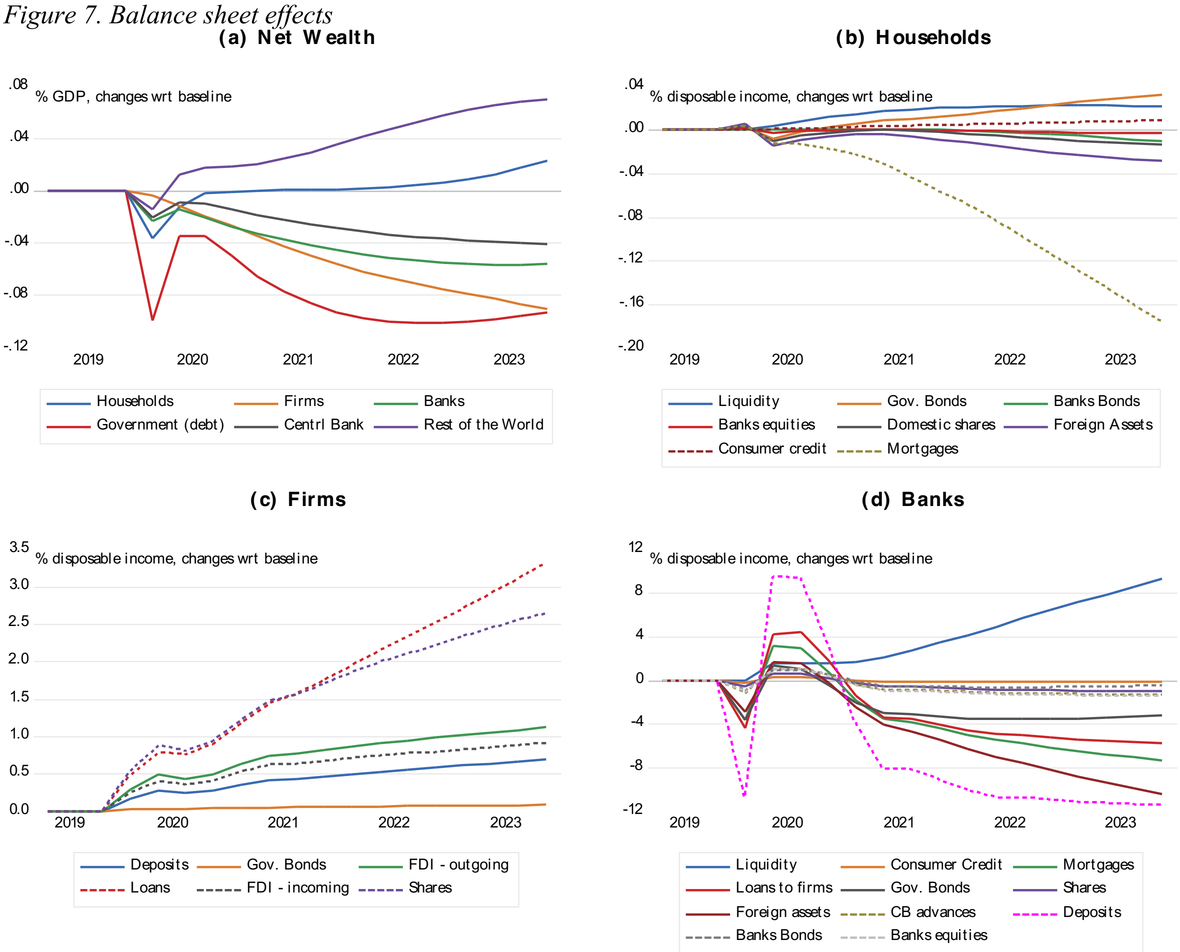


Source: own elaboration

In terms of wealth dynamics, the shock has a more pronounced effect on private sector wealth (Figure 7). As financial conditions tighten, households begin repaying their mortgages, which subsequently decrease as a share of disposable income due to reduced housing investment in the following quarters. This results in an increase in overall net wealth as liabilities decrease. On the other hand, firms respond to the reduction in incomes by getting into debt, on one side, and increasing their foreign-denominated assets and issuing share, on the other.

Government debts decrease sharply as a share of GDP, and stabilize at lower levels than in the baseline.

Figure 7. Balance sheet effects

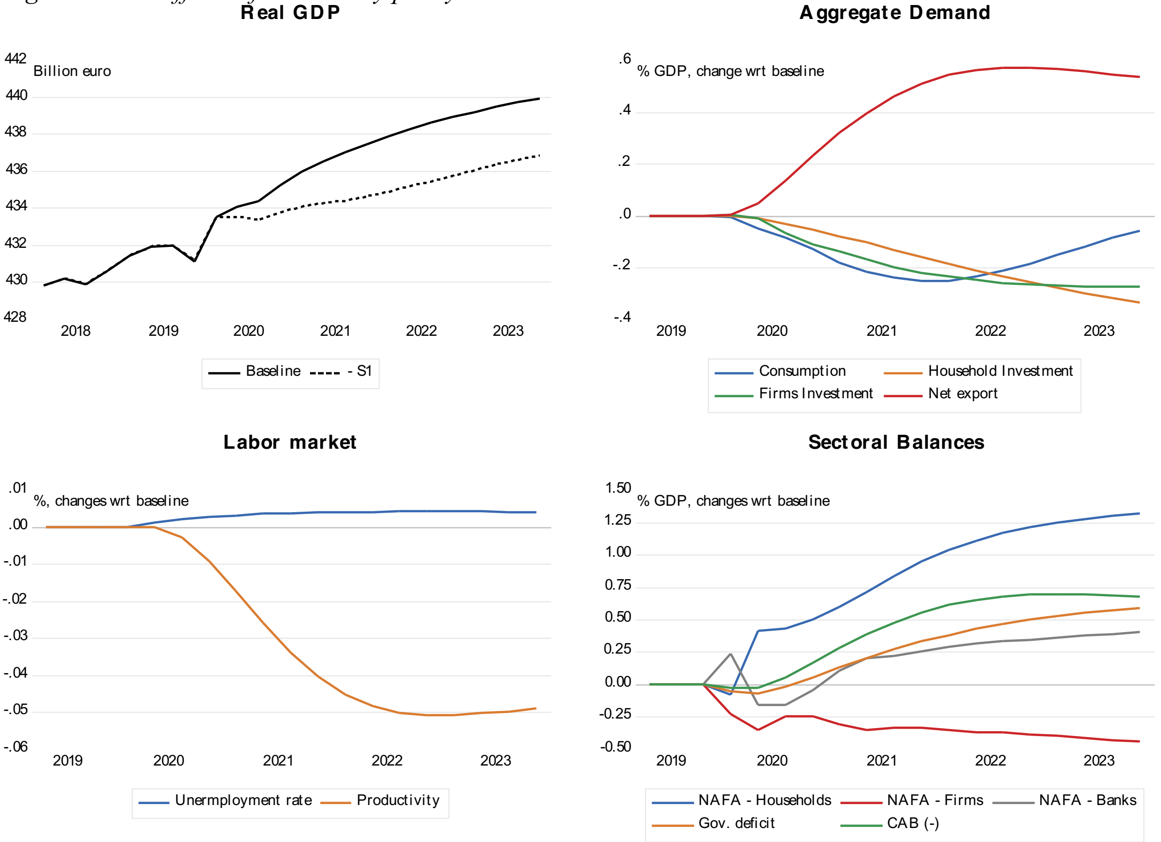


Source: own elaboration
Notes: Sectoral balance sheet data are expressed as percent of the sector disposable income. Solid lines denote assets, dashed lines liabilities

Shifting focus to the broader macroeconomic impacts, Figure 8 offers insights of the real economy. Consumption and household investment fall sharply in response to higher borrowing costs and tighter credit availability. At the same time, firms cut back on capital expenditures as the cost of financing increases. Net exports improve following the shock, as domestic demand contracts, leading to a permanent boost in the trade balance, driven by a fall in imports. Consequently, real GDP declines as reductions in private demand outweigh the positive contribution from net exports. This contractionary environment also affects the labor market, with a notable rise in the unemployment rate and a corresponding decline in productivity. Higher unemployment emerges as businesses scale down production in response to the weakened demand.

After an initial improvement, the government deficit widens relative to the baseline, driven by lower tax revenues and higher expenditures on unemployment benefits and other automatic stabilizers. This fiscal deterioration reflects the weakening macroeconomic environment and the increased burden on public finances. On the other hand, the current account surplus increases, reflecting the aforementioned improvement in net exports. The private sector, particularly households, responds to the shock by increasing savings, as indicated by a rise in net lending as they reduce consumption and investment, opting for caution in the face of higher interest rates.

Figure 8. Real effects of a monetary policy shock



Source: own elaboration

All in all, the model illustrates the complex transmission channels of a contractionary monetary policy shock. The interaction between financial markets, private sector behavior, and sectoral balances creates an intricate dynamic where private savings rise and external imbalances improve, but at the cost of a significant economic slowdown and worsening public finances (though government debt is somewhat lower).

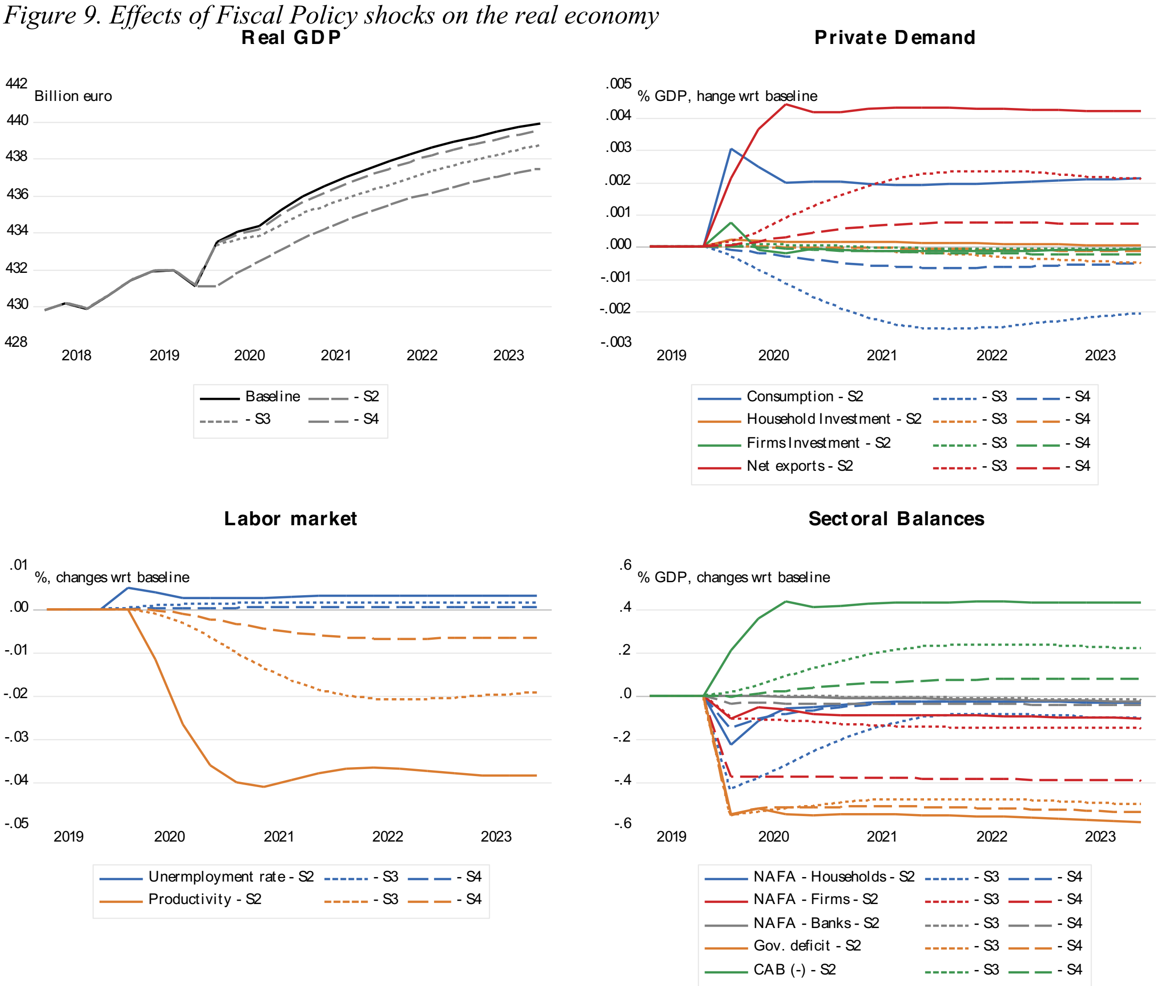
Fiscal Policy

This section explores model responses to fiscal (contractionary) policy shocks. In Scenario 2, we permanently reduce government expenditures at time *t* (2020q1, in our factionary baseline), and then let it grow from *t+1* at same rate as in the baseline (i.e., at 0.1 percent). This shock changes the composition of GDP, leading to adjustments in other demand components. In Scenario 3, in contrast, we increase direct taxes on households and firms by 0.5 percent. This shock in turn reduces their after-tax incomes, inducing adjustments in spending and saving patterns. Finally, in Scenario 4 we increase instead the indirect tax rate, which affects the distribution of incomes from production. Notice that shocks are calibrated in such a way that the extra government deficit at impact is similar, around €2.5 billion at current prices.

Figure 9 looks at the real effects of the shock. In all scenarios, as the government reduces its spending, or increases tax rates, real GDP drops substantially. The impact multiplier of government spending is 1.02, rising to 1.08 in following quarters. In contrast, the multiplier of direct taxes is below 0.01 at impact, and reaches 0.54 three years after the shock. For indirect tax rate, the multiplier is even smaller: 0.02 at impact, and 0.18 three years from the shock.

In all scenarios, consumption drops substantially. In Scenario 1, however, the share of consumption in GDP increases, due to the very large drop in production, giving rise to greater demand for liquidity by households. The fall in domestic incomes reduces imports, improving the trade balance, with the stronger effects recorded for Scenario 1. Again, this is not enough to offset the fall in domestic demand. Weak growth translates into higher unemployment rates and lower productivity.

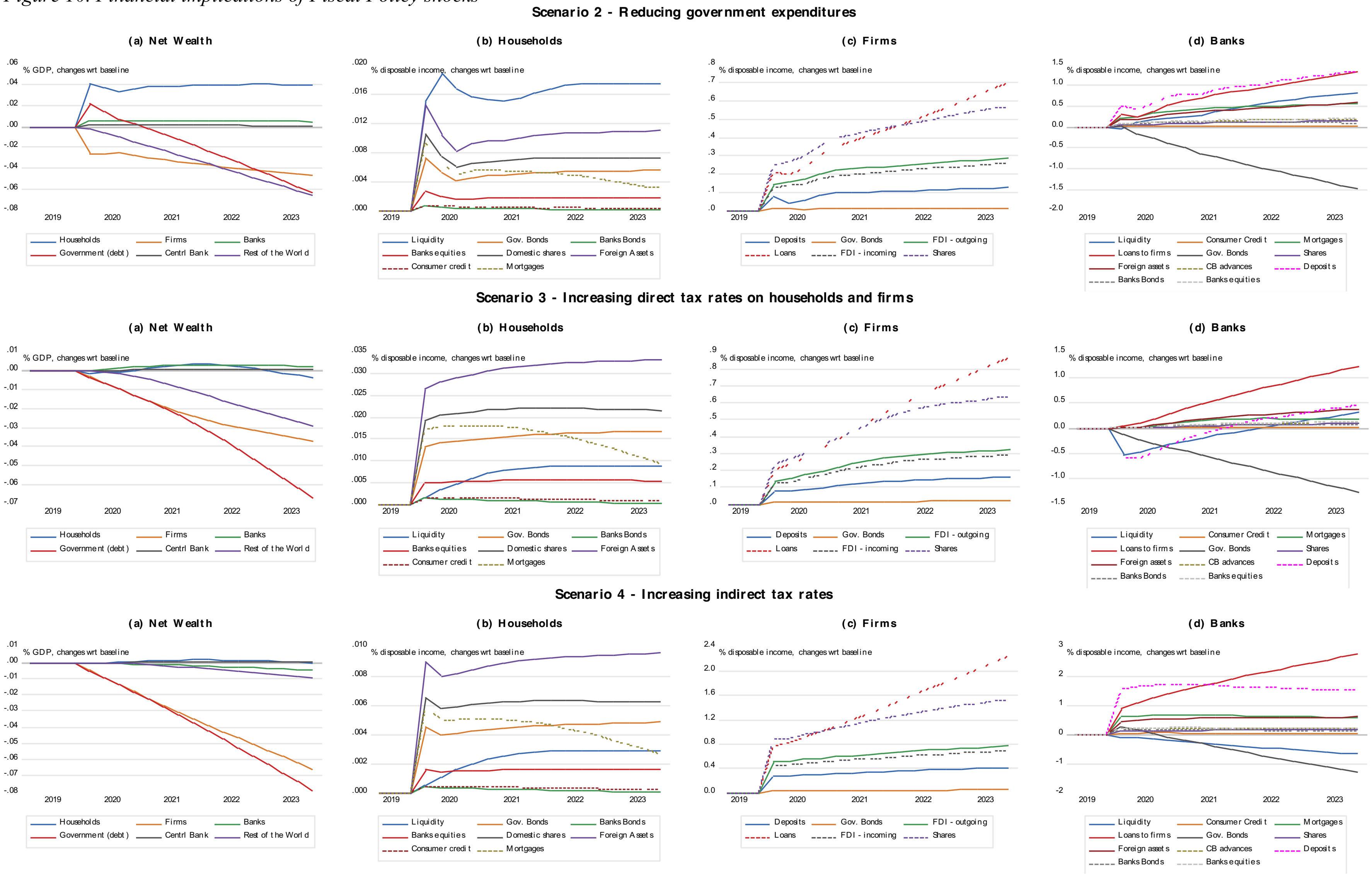
Figure 9. Effects of Fiscal Policy shocks on the real economy



Source: own elaboration

Facing lower demand, firms respond by resorting to debt, while households increase their demand for asset, in a "search for safety". In all three scenarios, both government and external debt drop substantially relative to the baseline (Figure 10). However, this comes at the cost of a recession and, in the case of tax hikes, permanently lower growth rates.

Figure 10. Financial implications of Fiscal Policy shocks



Source: own elaboration

Notes: Sectoral balance sheet data are expressed as percent of the sector disposable income. Solid lines denote assets, dashed lines liabilities

5. CONCLUSION

This paper has presented the main out-of-sample features of MITA—a large-scale, six-sector, quarterly SFC model of the Italian economy. Developed in response to the ongoing debate surrounding policy models, particularly in light of Blanchard's (2018) critique of mainstream approaches post–Great Recession, MITA provides a framework that accounts for the intricate real-financial interactions often absent in standard models. As such, it offers an alternative to the neoclassical models used in many policy institutions, especially regarding financial stability and sectoral balance-sheet dynamics.

The analysis of monetary and fiscal policy shocks reveals important insights about transmission mechanisms in the Italian economy. In the monetary policy scenario, for instance, we observe the complex interplay between interest rates, asset prices, and sectoral balance sheets. The Euribor, overshooting in response to the base rate shock, highlights the sensitivity of the interbank market to monetary policy changes. This has profound implications for banks' funding costs and overall credit supply, which ultimately impacts household and firm behavior. On the fiscal side, the contrasting results of government expenditure reductions versus tax increases demonstrate the nuanced effects that different fiscal tools can have on macroeconomic aggregates, especially in terms of growth multipliers and sectoral debt dynamics.

However, the development of models like MITA is not without its challenges. The first major limitation is the inherent complexity of large, empirical SFC models. Building, updating, and managing such models require significant resources and effort, and their size can limit their usability for quick policy evaluations. Secondly, as with standard SEMs, the Lucas Critique applies to these models. Since agents' decisions are not based on optimization behavior within a rational expectations framework, MITA cannot fully account for structural changes in the economy induced by policy interventions. This limits the model's applicability in certain contexts, such as analyzing policy shifts that alter long-term expectations or structural relationships.

Despite these challenges, the SFC framework offers several key advantages that warrant further exploration. First, it allows for a more detailed examination of financial stability by explicitly modeling the feedback effects between financial flows and real variables. Second, the model's ability to incorporate sectoral balances provides a richer understanding of distributional dynamics, which is increasingly important for policy evaluations. Lastly, its flexibility in handling a wide array of financial instruments and behaviors makes it an ideal tool for assessing the impact of unconventional monetary and fiscal policies, especially in an environment characterized by high uncertainty.

Future research should focus on overcoming some of the limitations highlighted in this paper. One avenue could involve the integration of behavioral or adaptive expectations to better account for changes in agent behavior in response to policy shifts. Additionally, exploring ways to simplify the computational complexity of SFC models while retaining their rich sectoral detail could make them more accessible for real-time policy applications. Finally, there is room for further collaboration between modelers and policymakers to ensure that models like MITA can be tailored to address the specific challenges faced by economies in times of crisis, such as the ongoing debates around post-pandemic recovery strategies.

In conclusion, MITA offers a promising platform for exploring real financial interactions in the Italian economy, providing valuable insights that complement and enhance traditional policy models. By incorporating sectoral balance sheets and focusing on financial stability, it addresses key gaps in existing approaches, although further refinements are needed to improve its usability and scope for policy analysis. As macroeconomic challenges continue to evolve, models like MITA will play a crucial role in helping policymakers navigate complex economic environments.

REFERENCES

Acocella, N., Beqiraj, E., Di Bartolomeo, G., Di Pietro, M., and Felici, F. 2020. "An evaluation of alternative fiscal adjustment plans: The case of Italy." *Journal of Policy Modeling*, vol. 42, no. 3

Altman, N., and Martin Krzywinski. 2018. "The Curse(s) of Dimensionality." Nature Methods vol. 15, no. 6

Arestis, P. 2011. "Keynesian economics and the new consensus in macroeconomics," pp. 88–111, in Hein, E. and Stockhammer, E. (eds.), *A Modern Guide to Keynesian Macroeconomics and Economic Policies*, Cheltenham, UK, Edward Elgar.

Bacchini, F., Bontempi, M. E., Brandimarte, C., Golinelli, R., Jona-Lasinio, C., and Pappalardo, C. 2013a. "The Macroeconometric models for Italy (MeMo-It): Policy Evaluation and Future challenges, Rivista Italiana di Economia." Demografia e Statistica, vol. LXVII, no. 2, 171–79

Bacchini, F., Brandimarte, C., Crivelli, P., de Santis, R., Fioramanti, M., Girardi, A., Golinelli, R., Jona-Lasinio, C., Mancini, M., Pappalardo, C., Rossi, D., Ventura, M., and Vicarelli, C. 2013b. "Building the core of the Istat system of models for forecasting the Italian economy." MeMo-It, Rivista di Statistica Ufficiale, no. 1, Advance Access published 2013

Barbieri Hermitte, R., Cagnazzo, A., Favero, C. A., Felici, F., Macauda, V., Nucci, F., and Tegami, C. 2023. ITFIN: A stock-flow consistent model for the Italian economy, *Economic Modelling* 119: 106113

Blanchard, O. J. 2008. "The State of Macro." NBER Working Paper No.14259, Advance Access published 2008

Blanchard, O. J. 2018. "On the future of macroeconomic model." *Oxford Review of Economic Policy* 34(1–2): 43–54.

De Bonis, R., and A. Gigliobianco. 2012. "The Origins of Financial Accounts in the United States and Italy: Copeland, Baffi and the Institutions." In *The Financial Systems of Industrial Countries,* edited by R. De Bonis and A. F. Pozzolo, 15–49. Berlin: Springer.

Brayton, F., T. Laubach, and D. L. Reifschneider. 2014. "The FRB/US Model: A Tool for Macroeconomic Policy Analysis." *FEDS Notes.* Advance Access published 2014.

Bulligan, G., F. Busetti, M. Caivano, P. Cova, D. Fantino, A. Locarno, and M. L. Rodano. 2017. "The Bank of Italy Econometric Model: An Update of the Main Equations and Model Elasticities." *Banca d'Italia, Temi di Discussione* no. 1130. Advance Access published 2017.

Burgess, S., O. Burrows, A. Godin, S. Kinsella, and S. Millard. 2016. "A Dynamic Model of Financial Balances for the United Kingdom." *Bank of England Staff Working Paper* no. 614. Advance Access published 2016.

Canelli, R., G. Fontana, R. Realfonzo, and M. V. Passarella. 2021. "Are EU Policies Effective to Tackle the Covid-19 Crisis? The Case of Italy." *Review of Political Economy* 33(3): 432–61.

Canelli, R., G. Fontana, R. Realfonzo, and M. V. Passarella. 2024. "Energy Crisis, Economic Growth and Public Finance in Italy." *Energy Economics* 132: 107430.

Carnevali, E., M. Deleidi, and M. Veronese Passarella. 2019. "Stock-Flow Consistent Dynamic Models: Features, Limitations and Developments." In *Frontiers of Heterodox Macroeconomics*, edited by P. Arestis and M. Sawyer, 223–76. Palgrave Macmillan.

Cicinelli, C., A. Cossio, F. Nucci, O. Ricchi, and C. Tegami. 2008. "The Italian Treasury Econometric Model (ITEM)." Ministry of Economy and Finance - Department of the Treasury. Working Paper Series no. 1. Advance Access published 2008.

Copeland, M. A. 1947. "Tracing Money Flows Through the United States Economy." *The American Economic Review* 37(2): 31–49.

Erceg, C. J., L. Guerrieri, and C. J. Gust. 2005. "SIGMA: A New Open Economy Model for Policy Analysis." *International Finance Discussion Paper* 2005(835r).

European Central Bank. 2017. "Base Money, Broad Money and the APP." *Economic Bulletin* 6.

Fair, R. C. 2012. "Has Macro Progressed?" *Journal of Macroeconomics* 34: 2–12.

Galli, G., D. Terlizzese, and I. Visco. 1989. "Un Modello Trimestrale per la Previsione e la Politica Economica: Le Proprietà di Breve e di Lungo Periodo del Modello della Banca d'Italia." *Politica Economica: Rivista di Studi e Ricerche per la Politica Economica* 5(1): 3–51.

Godley, W., and M. Lavoie. 2007. *Monetary Economics: An Integrated Approach to Credit, Money, Income, Production and Wealth.* Cheltenham, UK: Palgrave Macmillan.

Haavelmo, T. 2015. "Structural Models and Econometrics." *Econometric Theory* 31(1): 85–92.

Hendry, D. F., and J. N. J. Muellbauer. 2018. "The Future of Macroeconomics: Macro Theory and Models at the Bank of England." *Oxford Review of Economic Policy* 34(1–2): 287–328.

Hicks, J. 1937. "Mr. Keynes and the Classics." *Econometrica* 5(2): 147–59.

Keynes, J. M. 1936. *The General Theory of Employment, Interest and Money.* London: Macmillan.

Lavoie, M. 2014. *Post-Keynesian Economics: New Foundations.* Cheltenham, UK: Edward Elgar.

Lavoie, M. 2022. *Post-Keynesian Economics.* Edward Elgar Publishing.

Louça, F. 2007. *The Years of High Econometrics: A Short History of the Generation that Reinvented Economics.* London: Routledge.

McLeay, M., R. Amar, and R. Thomas. 2014. "Money Creation in the Modern Economy." *Bank of England's Monetary Analysis Directorate, Quarterly Bulletin* Q1. Advance Access published 2014.

Meade, J. E. 1937. "A Simplified Model of Mr. Keynes' System." *Review of Economic Studies* 4: 98–107.

Meade, J. E., and R. Stone. 1941. "The Construction of Tables of National Income, Expenditure, Savings and Investment." *The Economic Journal* 51(202/203): 216–33.

Nikiforos, M., and G. Zezza. 2017. "Stock-Flow Consistent Macroeconomic Models: A Survey." *Journal of Economic Surveys* 31(5): 1204–39.

Pagan, A. 2003. "Report on Modelling and Forecasting at the Bank of England." *Bank of England Quarterly Bulletin* Spring: 60–91.

Pappalardo, C., C. Rapacciuolo, and A. Ruocco. 2007. "Il Nuovo Modello Econometrico Trimestrale del CSC per l'Economia Italiana." *Centro Studi Confindustria Working Paper* 58.

Passarella, M. V. 2019. "From Abstract to Concrete: Some Tips for Developing an Empirical Stock–Flow Consistent Model." *European Journal of Economics and Economic Policies: Intervention* 16(1): 55–93.

Pfeiffer, P., J. Varga, and J. in 't Veld. 2023. "Quantifying Spillovers of Coordinated Investment Stimulus in the EU." *Macroeconomic Dynamics* 27(7): 1843–65.

Pierros, C. 2024. "Empirical stock–flow consistent models: evolution, current state and prospects." European Journal of Economics and Economic Policies: Intervention, forthcoming (2024): 1–16.

Romer, P. 2015. "The Trouble with Macroeconomics." *Mimeo*, Advance Access published 2015.

Samuelson, Paul A. *Economics: An Introductory Analysis*. New York: McGraw-Hill, 1955.

Shackle, G. L. S. 1967. *The Years of High Theory: Invention and Tradition in Economic Thought 1926-1939*. Cambridge: Cambridge University Press Archive.

Stone, R., and A. Brown. 1962. *A Computable Model of Economic Growth*. London: Chapman & Hall.

Taylor, L. 2004. *Reconstructing Macroeconomics: Structuralist Proposals and Critiques of the Mainstream*. Cambridge: Harvard University Press.

Taylor, L., and F. J. Lysy. 1979. "Vanishing Income Redistributions: Keynesian Clues about Model Surprises in the Short Run." *Journal of Development Economics* 6, no. 1 (1979): 11–29.

Tobin, J. 1969. "A General Equilibrium Approach to Monetary Analysis." *Journal of Money, Credit and Banking* 1, no. 1 (1969): 15–29.

Vanoli, A. 2005. *A History of National Accounting*. Amsterdam: IOS Press, 2005.

Visco, I., and G. Bodo. 1986. *Modello Trimestrale dell'Economia Italiana*. Banca d'Italia, *Temi di discussione* no. 80, Advance Access published 1986.

Welfe, W. 2013. "Macroeconometric Models: Advanced Studies in Theoretical and Applied Econometrics" (Vol.47), Springer

Wren-Lewis, S. 2018. "Ending the microfoundations hegemony." Oxford Review of Economic Policy, vol. 34, nos. 1–2, 55–69

Zezza, G. 2009. "Fiscal policy and the economics of financial balances." European Journal of Economics and Economic Policies: Intervention vol. 6, no. 2, 289–310

Zezza, G. and F. Zezza. 2019. "On the design of empirical stock-flow consistent models." *European Journal of Economics and Economic Policies: Intervention*, vol. 16, no. 1, 134–58

Zezza, F. and G. Zezza. 2020. "A Stock-Flow Consistent Quarterly Model of the Italian Economy." Levy Economics Institute Working Paper Series No.958, 1–83

Zezza, F. and Zezza, G. 2022. "A Stock-Flow Consistent Quarterly Model of the Italian Economy." pp. 113–42, in Byrialsen, M. R., Raza, H., and Olesen, F. (eds.), Macroeconomic Modelling, Economic Policy and Methodology, London, Routledge.

APPENDIX

Appendix A.1. Reconciling NFA and FAIS

When using Institutional Sector Accounts (financial and non-financial), some problems arise. The different solutions adopted will lead to different model structures, and this will have an impact on its ability to replicate the data.

1. *Net Lending figures from NFA and FAIS are not necessarily consistent with each other*. NFAs detail the sources of income for each sector, and the expenditure on current and capital account, ultimately determining saving and net lending. FAIS provide the detail on how net lending can be broken down as changes in financial assets and liabilities. However, since the two sets of statistics come from different data sources, with the former being based on income and expenditure surveys, and the latter on balance sheet statistics and other sources from the financial sector, the measures of net lending for each sector do not necessarily match. To achieve consistency between the two data sources for model purposes, two strategies may be adopted. One could (a) assume that financial data are measured more accurately than income and expenditure data and add the discrepancy to one of the determinants of saving for each sector (income or expenditure), or (b) treat the discrepancies as unexplained exogenous variables. Option (a) would make model simulations for consumption, income, or saving systematically different from data published in the national accounts, so (b) is to be preferred. This strategy, adopted in both ITFIN and MITA, implies that such exogenously given discrepancies be projected into the future for model simulations, increasing the degree of arbitrariness of model projections.
2. *Sectoral accounts are not seasonally adjusted*, and data exploration shows that, when adjusted with the X12 procedure, they produce series which have some discrepancy with data published in the national accounts. One then can either (a) build the model using non-seasonally adjusted data, which has implications for the estimation of behavioral equations (as in ITFIN); or (b) transform the data and allocate the (exogenous) discrepancies, which increases the number of exogenous variables (as in MITA).[23]

[23] It should be noted that these discrepancy variables are very small, and are set to zero in out-of-sample exercises.

3. *NFA do not provide who-to-whom detail for a number of flows*. Three solutions are at hand: (i) assume, given the trends in the data, how to allocate these payments, at the cost of increasing arbitrariness; (ii) resort to additional data sources which provide more detail (BoP, Financial Institutions Balance sheet, etc.), at the cost of increasing the number of variables/equations, and model complexity. If (i) and (ii) are not possible, one may (iii) add an additional Pool column to the Transactions and Balance sheet matrices. In this case, all sectors will receive/pay from/to the Pool.
4. *The sectoral detail is lower in NFA, which consolidates all financial corporations.* Thus, if the model wants to address monetary policy (as is the case for policy models), the central bank should be explicitly represented (same applies for other financial institutions). Flows of payments/receipts from/to the central bank or other financial institutions have to be imputed (using the flows implied by the balance sheet structure) and subtracted from published figures in NFA, increasing arbitrariness and decreasing the model's ability to pinpoint official statistics.

All simplifying assumptions and modelling choices may create (large) discrepancies between model variables and published data, which must be accounted for if the model is to be used for policy advice.

Appendix A2. Designing an Empirical SFC Model of the Italian Economy: The Case of MITA and ITFIN

As discussed, the desired level of detail for a policy model largely depends upon *what the model is designed for*. The different solutions adopted will lead to different model structures, and this will have an impact on its ability to accurately replicate the data. This appendix elaborates on this point, using MITA and ITFIN as examples.

In our case, MITA "is an attempt to merge the SFC methodology for jointly tracking the real and financial sides of the economy to the methodology that was adopted for structural models by central banks around the world before the counter-revolution of rational expectations" (Zezza and Zezza, 2022, 138). Our aim was to design a model that satisfied all five SFC principles discussed above making the most of available data, and that could "speak" with people at policy institutions.

Instead, given its relevance for policy purposes, and since other models in use at the Treasury do not feature complex financial systems, ITFIN's main focus is "determining the sovereign risk premium in the government debt market, its impact on the financial and banking system, and its transmission to the real economy" (Barbieri Hermitte et al., 2023, 1).

The first step in model construction is to look at the structure of the sector balance sheets (and their dynamics over time), the analysis of which should guide modelling choices. What are the assets/liabilities that must be accounted for? Table A2.1 display Italy's Sectoral Financial Accounts for the year 2019, highlighting the main stocks of net assets/liabilities (i.e., only stocks above €100, €500, or €1000 billion, using darker shades for higher values).

The non-financial corporate sector—the second single largest net debtor—primarily finances itself through the emission of equities (mainly held by households), followed by loans, while it accumulates assets in the form of money and domestic and foreign equities (thus, it is important to model both the NFCs' demand and supply of equities, possibly identifying FDIs). The central bank stands as the largest holder of government debt (followed by insurance companies, the foreign sector, commercial banks, and households), while it has the monetary base as its sole liability. On the liability side of the domestic banking sector, we have the stock of deposit and the equities issued, and loans to the private sector and debt instruments (primarily government debt) on the asset side. The balance sheet of the government sector is quite simple, with bonds on the liability side and equities on the asset side. The household sector accumulates wealth in the form of money, equities, technical reserve (i.e., pension schemes), and debt instruments, while taking out loans to finance consumption and (housing) investments. Finally, the foreign sector accumulates domestic deposits and debt instruments (the foreign sector holds around 30 percent of public debt), while it has €800 billion net liabilities in equities and mutual funds shares, signaling once more the importance of modelling FDI flows.

There are then balance-sheet data for the other five financial sectors, comprising insurance and pension companies and the so-called shadow banks (financial intermediaries, mutual funds, and auxiliaries). While banks and the central bank (i.e., the monetary financial institutions) have the distinctive role of accommodating the demand for money and credit (respectively), these sectors operate on behalf of domestic (and, to a lesser extent, foreign) households in asset and wealth management. Most importantly, these financial institutions do not have the power to create money. Their importance in the Italian economy increased over the last decades (particularly that of insurance companies), but still stands far away from the levels observed in more financialized countries, such as the UK or US. There are different options to deal with this, keeping in mind that every entry in either the balance sheet and transaction matrices implies an additional equation/identity, increasing model complexity.

Table A2.1. Financial Accounts of Institutional Sectors. 2019. Billion euro

		Financial Corporations										
Assets	NFC	CB	BNK	OFI	MF	FAUX	INS	PENS	GVT	HH	RoW	Total
Gold and monetary reserves		113.8									8.1	121.9
Banknotes, coins and deposits	380.7	285.9	742.0	192.8	28.8	140.6	11.7	7.1	91.7	1460.9	778.9	4121.0
Debt	47.2	570.9	875.6	35.8	130.3	62.1	580.0	60.5	42.7	271.1	1068.3	3744.6
Derivatives	20.4	0.0	148.5	1.6	1.3	0.4	0.4			1.1	111.1	284.7
Loans	74.8	2.1	1755.9	337.6			3.8		148.4	12.5	259.5	2594.6
Equities and Mutual funds shares	742.8	13.8	180.2	360.3	113.1	145.5	326.2	42.0	171.2	1447.2	619.9	4162.1
Technical reserves	11.3		10.4				4.7		1.1	1123.0	2.3	1152.7
Other accounts	585.7		16.5	4.5		0.1	5.5		128.9	129.7	107.5	978.5
Total Asset	1862.8	986.5	3729.1	932.7	273.5	348.8	932.2	109.5	584.0	4445.4	2955.6	17160.1
Liabilities												
Gold and monetary reserves		8.1									113.8	121.9
Banknotes, coins and deposits	48.4	786.5	2764.2						234.1		287.9	4121.0
Debt	149.0		468.8	225.6			15.6		2270.8		614.7	3744.6
Derivatives	18.9	0.0	164.9	1.3	0.6	5.0	0.8		27.0	0.0	66.3	284.7
Loans	1074.5		40.4	218.2		96.0	13.2	0.1	216.4	737.0	198.8	2594.6
Equities and Mutual funds shares	1888.9	7.5	196.1	169.0	337.8	14.7	119.4				1428.8	4162.1
Technical reserves	108.9	7.4	4.3				827.3	115.4	10.0	38.2	41.1	1152.7
Other accounts	543.6		2.2	1.5		0.1	6.1		93.6	192.9	138.6	978.5
Total liabilities	3832.2	809.6	3640.8	615.7	338.4	115.7	982.5	115.5	2851.9	968.1	2889.9	17160.1
Net Assets												
Gold and monetary reserves		105.7									-105.7	0.0
Banknotes, coins and deposits	332.3	-500.6	-2022.2	192.8	28.8	140.6	11.7	7.1	-142.3	1460.9	491.0	0.0
Debt	-101.8	570.9	406.9	-189.8	130.3	62.1	564.3	60.5	-2228.1	271.1	453.6	0.0
Derivatives	1.5	0.0	-16.4	0.3	0.7	-4.5	-0.4		-27.0	1.0	44.8	0.0
Loans	-999.7	2.1	1715.5	119.4		-96.0	-9.4	-0.1	-68.0	-724.5	60.7	0.0
Equities and Mutual funds shares	-1146.1	6.3	-15.9	191.3	-224.7	130.8	206.8	42.0	171.2	1447.2	-808.9	0.0
Technical reserves	-97.6	-7.4	6.0				-822.7	-115.4	-8.9	1084.8	-38.8	0.0
Other accounts	42.1		14.3	3.0		0.0	-0.6		35.3	-63.2	-31.1	0.0
Net Wealth	-1969.3	177.0	88.2	317.0	-64.9	233.1	-50.2	-5.9	-2267.9	3477.3	65.6	0.0

Source: Bank of Italy, own elaboration
Legend: NFC = Non-Financial Corporations; CB = Central Bank; BNK = Monetary financial institutions (excl. CB); OFI = Other Financial intermediaries; MF = Mutual Funds; FAUX = Financial Auxiliaries; INS = Insurance companies; PF = Pension Funds; GVT = Government; HH = Households; RoW = Rest of the World
Notes: darker shades indicate stocks of assets (green) and liabilities (red) above €100, €500, and €1000 billion, respectively

There are multiple ways to consolidate the sectoral data displayed above. Table A.2.2 shows four alternatives. In the top panel (Option A), all non-MFI financial corporations are consolidated into Other Financial Corporations (OFC). This new sector would be the largest holder of public debt, and the second largest for domestic equities, having technical reserves on the liability side (matching the asset side of the household sector). However, many different actors are aggregated in this way, each with a different role in the market. The central panels (Options B and C) show the strategy chosen in the two models. In ITFIN, shadow banks are consolidated with banks, and insurance companies and pension funds are kept separately. This is not very different from Option A in terms of balance sheet structure of the banking sector, the main difference being the now higher stock of equities and lower stock of deposits. Option C shows the strategy adopted for the MITA model, where all non-MFI are consolidated in the household sector. In this way, the model now only features six sectors, while the balance sheet structure can now be simplified further, as the stock of technical reserves on households' balance sheet drops from 1tr to a little less than €150 billion. Finally, the lower panel (Option D), show the "classic" New Cambridge structure, with private (i.e., households, firms, and financial corporations net of the central bank), public (government and central bank), and foreign sectors.

Focusing on the financial side, the asset decomposition of the two models is broadly similar, but there are a few important differences. First, ITFIN has a richer sectoral structure—as it models insurance companies and pension funds separately, whereas these are consolidated with the household sector in MITA—and greater asset decomposition, with the government issuing both bonds and bills, while in MITA bonds are the sum of both long- and short-term instruments issued by the government. Regarding equities, in ITFIN the foreign sector only issues mutual fund shares (so there are no NFC equities for the ROW) and does not hold shares of domestic non-financial corporations' share (so that FDI's are not considered). Fourth, and crucially, in MITA there is a residual balance sheet variable for each sector (Other Net Financial Assets, ONFA) that assures correspondence with FAIS figures, absent in ITFIN. This has implications, of course, for the models' ability to track financial wealth.

Table A2.2. Consolidating FAIS. 2019. Billion euro

Option A: Consolidate all non-MFI Financial Corporations into OFC

		Financial Corporations						
Net assets/liabilities	NFC	CB	FC	OFC	GVT	HH	RoW	Total
Gold and monetary reserves		105.7					-105.7	0.0
Banknotes, coins and deposits	332.3	-500.6	-2022.2	380.9	-142.3	1460.9	491.0	0.0
Debt	-101.8	570.9	406.9	627.5	-2228.1	271.1	453.6	0.0
Derivatives	1.5	-0.0	-16.4	-4.0	-26.9	1.0	44.8	0.0
Loans	-999.7	2.1	1715.5	13.9	-68.0	-724.5	60.7	0.0
Equities and Mutual funds shares	-1146.1	6.3	-15.9	346.2	171. 2	1447.2	-808.9	0.0
Technical reserves	-97.6	-7.4	6.0	-938.1	-8.9	1084.8	-38.8	0.0
Other accounts	42.1		14.3	2.5	35.3	-63.2	-31.1	0.0
Net Wealth	-1969.3	176.9	88.2	429.1	-2267.9	3477.3	65.6	0.0

Legend: OFC = Other Financial intermediaries, Mutual Funds, Financial Auxiliaries, Insurance companies, Pension Funds

Option B (ITFIN): Consolidate Insurance Companies and Pension Funds, consolidate all remaining non-MFI Financial Corporations into FC

		Financial Corporations						
Net assets/liabilities	NFC	CB	FC+	INSPENS	GVT	HH	RoW	Total
Gold and monetary reserves		105.7					-105.7	0.0
Banknotes, coins and deposits	332.3	-500.6	-1660.0	18.8	-142.3	1460.9	491.0	0.0
Debt	-101.8	570.9	409.6	624.8	-2228.1	271.1	453.6	0.0
Derivatives	1.5	0.0	-20.0	-0.4	-27.0	1.0	44.8	0.0
Loans	-999.7	2.1	1738.9	-9.4	-68.0	-724.5	60.7	0.0
Equities and Mutual funds shares	-1146.1	6.3	81.6	248.7	171.2	1447.2	-808.9	0.0
Technical reserves	-97.6	-7.4	6.0	-938.1	-8.9	1084.8	-38.8	0.0
Other accounts	42.1		17.4	-0.6	35.3	-63.2	-31.1	0.0
Net Wealth	-1969.3	177.0	573.5	-56.2	-2267.9	3477.3	65.6	0.0

Legend: FC+ = Monetary Financial Institutions, Other Financial intermediaries, Mutual Funds, Financial Auxiliaries, Insurance companies, Pension Funds

Option C (MITA): Consolidate all non-MFI Financial Corporations into HH

Net assets/liabilities	NFC	Financial Corporations CB	FC	GVT	HH+	RoW	Total
Gold and monetary reserves		105.7				-105.7	0.0
Banknotes, coins and deposits	332.3	-500.6	-2022.2	-142.3	1841.8	491.0	0.0
Debt	-101.8	570.9	406.9	-2228.1	898.6	453.6	0.0
Derivatives	1.5	0.0	-16.4	-27.0	-3.0	44.8	0.0
Loans	-999.7	2.1	1715.5	-68.0	-710.5	60.7	0.0
Equities and Mutual funds shares	-1146.1	6.3	-15.9	171.2	1793.4	-808.9	0.0
Technical reserves	-97.6	-7.4	6.0	-8.9	146.7	-38.8	0.0
Other accounts	42.1		14.3	35.3	-60.6	-31.1	0.0
Net Wealth	-1969.3	177.0	88.2	-2267.9	3906.4	65.6	0.0

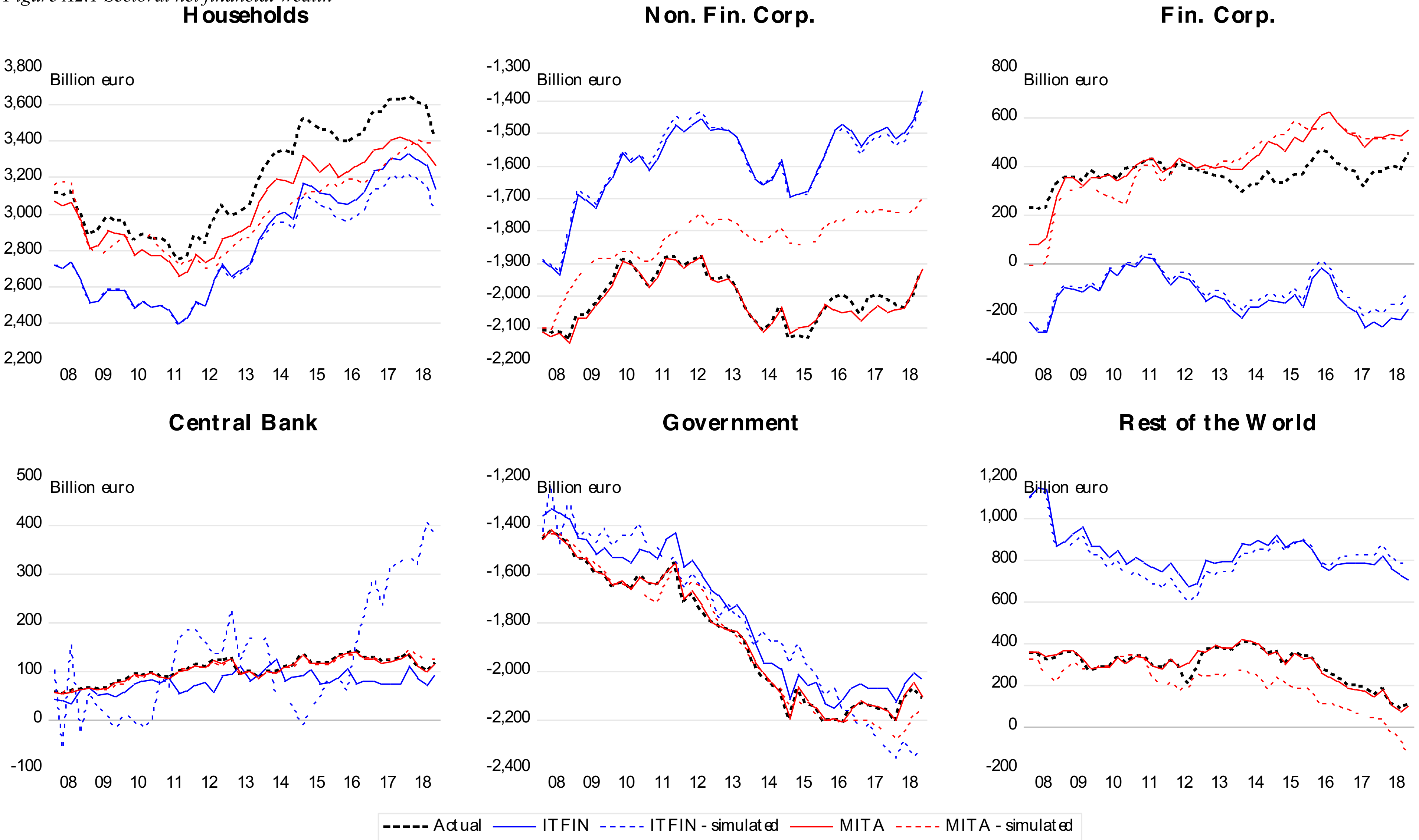
Legend: HH+ = Households, Other Financial intermediaries, Mutual Funds, Financial Auxiliaries, Insurance companies, Pension Funds

Option D: Three-balances model

Assets	Private	Public+	RoW	Total
Gold and monetary reserves		105.7	-105.7	0.0
Banknotes, coins and deposits	152.0	-643.0	491.0	0.0
Debt	1203.6	-1657.3	453.6	0.0
Derivatives	-17.8	-27.0	44.8	0.0
Loans	5.2	-65.9	60.7	0.0
Equities and Mutual funds shares	631.4	177.5	-808.9	0.0
Technical reserves	55.1	-16.3	-38.8	0.0
Other accounts	-4.2	35.3	-31.1	0.0
Net Wealth	2025.3	-2091.0	65.6	-0.1

Legend: Private = households, non-financial corporations, financial corporations (net of Central Bank); Public = Government, Central Bank; RoW = Rest of the World

Figure A2.1 Sectoral net financial wealth



Source: FAIS; own elaboration

This is reflected in Figure A2.1, which shows sectoral net wealth, using figures from the actual data from FAIS (black dotted line), the ones constructed from the models' BSM (colored solid), and the simulated ones (colored dotted).

In MITA, the constructed series (red solid) follows accurately official statistics whenever sectoral data have not been consolidated ex-post (as in the case of households and financial corporations), while the model performs satisfactorily in replicating the underlying data (red dotted), with the exception of the financial and non-financial corporate sector, where the model predicts an increasing trend for wealth against a stable pattern for FCs, and a persistently lower debt position for NFCs, respectively. In ITFIN, in contrast, there are large discrepancies between the model constructed series and official statistics for several sectors, largest for the financial corporate sector (with a debit position instead of a credit one), the non-financial corporate sector (where the debt position is €500 billion lower), and the foreign sector (with a registered credit position more than twice as large as the official figures). This has obvious implications for the model's predictive ability, which will mimic the dynamics of the underlying data (i.e., of the constructed series).[24]

The structure of the transaction matrix, in turn, while in part depends on the chosen level of detail for sectoral transactions detailing real flows (e.g., the wage bill can be decomposed between income from private-, public-, or self-employment, as in ITIFN, or between domestic and foreign wages, as in MITA), on the other it is implied by the assets and liabilities present in the balance sheet matrix.

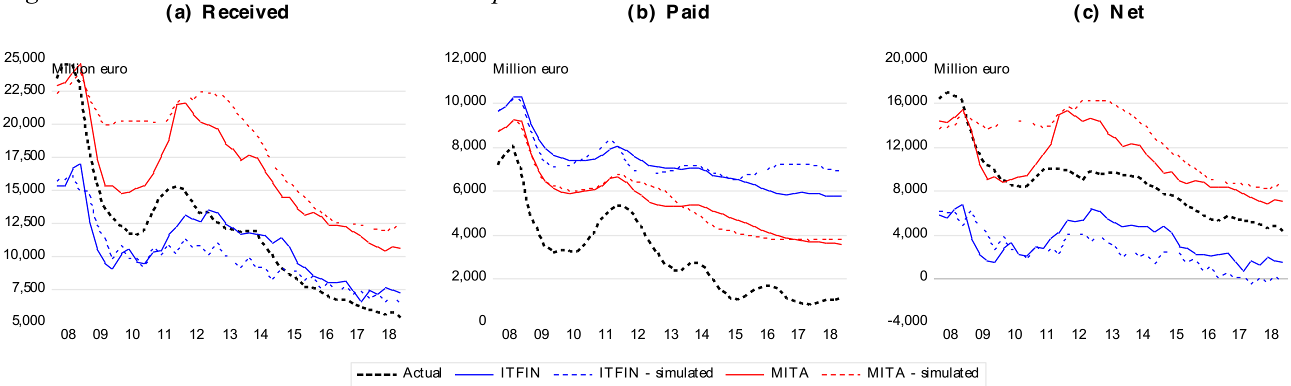
Take the case of household interest incomes (Figure A2.2). In ITFIN, household receive interest income from deposits, banks obligations, government bonds and bills, and domestic and foreign mutual funds, while paying interest on their loans, split between mortgages and other loans. Similarly, net interest income in MITA is given by the sum of household receipts—from deposits, public debt, banks debt instruments and foreign assets—minus the outlays—for mortgages and consumer credit. The inclusion/exclusion of certain assets/liabilities affects the models' ability to track the actual flow from NFA data. Also in this case, the strategy adapted to reach replicability with official statistics when running simulations has implications for the model's predictive power.[25]

---

[24] The dynamics of net wealth are also influenced by net capital gains, which will be discussed later.

[25] In MITA there are discrepancy variables for almost every flow in the TM (in this case, for both interest payments and receipts (not included in Figure 3), while in ITFIN this is done at the "block" level (in the case of households' capital incomes, in the equation for disposable income). In the first case, more exogenous variables

Figure A2.2. Households' interest incomes implied in ITFIN and MITA



Source: own elaboration

are needed (but these are small and set to zero in simulations), increasing arbitrariness but improving the track of official estimates. In the second case, in turn, there will be a large unexplained discrepancy at the block level with actual data, as the errors each row of the TM will cumulate.

Appendix A3. Tables

Table A3.1 MITA Balance Sheet Matrix

	H	F	B	CB	G	W	Total
Real Assets							
Capital (residential)	$+KH$						$+KH$
Capital (non-residential): machineries		$+KM$					$+KM$
Capital (non-residential): wharehouses		$+KNR$					$+KNR$
Capital (public)					$+KG$		$+KG$
Financial Assets							
Gold				$+GOLD$		$-GOLD$	0
Monetary base	$+MB_H$		$+MB_B$	$-MB$		$+MB_{T2}$	0
CB refinancing			$-ADV$	$+ADV$			0
Bank deposits	$+DEPS_H$	$+DEPS_F$	$-DEPS$		$+DEPS_G$	$+DEPS_W$	0
Bank loans: consumer credit	$-BLCC$		$+BLCC$				0
Bank loans: mortgages	$-BLMO$		$+BLMO$				0
Bank loans to firms		$-BLF$	$+BLF$				0
Banks debt	$+BB_H$		$-BB$			$+BB_W$	0
Banks equities	$+EB$		$-EB$				0
Public debt	$+B_H$	$+B_F$	$+B_B$	$+B_{CB}$	$-B$	$+B_W$	0
Firms equities	$+EN_H$	$-EN$	$+EN_B$		$+EN_G$		0
Outgoing FDI		$+FDIO$				$-FDIO$	0
Incoming FDI		$-FDII$				$+FDII$	0
Foreign liabilities	$+F_H$		$+F_B$	$+F_{CB}$		$-F$	0
Other Net Financial Assets	$+ONFA_H$	$+ONFA_F$	$+ONFA_B$	$+ONFA_{CB}$	$+ONFA_G$	$+ONFA_W$	0
Net Financial Assets	$+\boldsymbol{NFA_H}$	$+\boldsymbol{NFA_F}$	$+\boldsymbol{NFA_B}$	$+\boldsymbol{NFA_{CB}}$	$+\boldsymbol{NFA_G}$	$+\boldsymbol{NFA_W}$	0

Source: Zezza and Zezza (2022)

Notes: (+) and (-) signs denote assets and liabilities, respectively. Cells highlighted in grey show the asset/liability 'closing' the column, while the cell in light grey highlights the redundant equation

Table A3.2 Italy: Transaction Matrix

		Sectors						
	Production	H	F	B	CB	G	W	TOT
Gross domestic product	$+\boldsymbol{GDP}$	$-\boldsymbol{C}$ $-\boldsymbol{GFCF^H}$ $-\boldsymbol{DINV^H}$	$-\boldsymbol{GFCF^F}$ $-\boldsymbol{DINV^F}$	$-\boldsymbol{GFCF^B}$ $-\boldsymbol{DINV^B}$		$-\boldsymbol{G}$ $-\boldsymbol{GFCF^G}$ $-\boldsymbol{DINV^G}$	$-\boldsymbol{XGS}$ $+\boldsymbol{MGS}$	0
Wage income: domestic	$-WB$	+WAGES					$-WAGESFROW$	0
Wage income paid abroad	$-WAGES2ROW$						$+WAGES2ROW$	0
Mixed income	$-MIXY$	$+MIXY$						0
Operating surplus	$-OPS$	$+OPS^H$	$+OPS^F$	$+OPS^B$		$+OPS^G$		0
Indirect taxes	$-INDTAX$					$+INDT^G$	$+INDT^W$	0
Subsidies	$+SUBS$					$-SUBS^G$	$-SUBS^W$	0
Memo: Income from production		$+\boldsymbol{INCP^H}$	$+\boldsymbol{OPS^F}$	$+\boldsymbol{OPS^B}$		$+\boldsymbol{INCP^G}$	$+\boldsymbol{INCP^W}$	

Source: Zezza and Zezza (2022)
Legend: HH = households; NFC = nonfinancial corporations; FC = financial corporations; CB = central bank; GVT = public sector; RoW = rest of the world. Notes: (+) signs stand for "sources of income" and (-) for "uses of income." *Continues on next page*

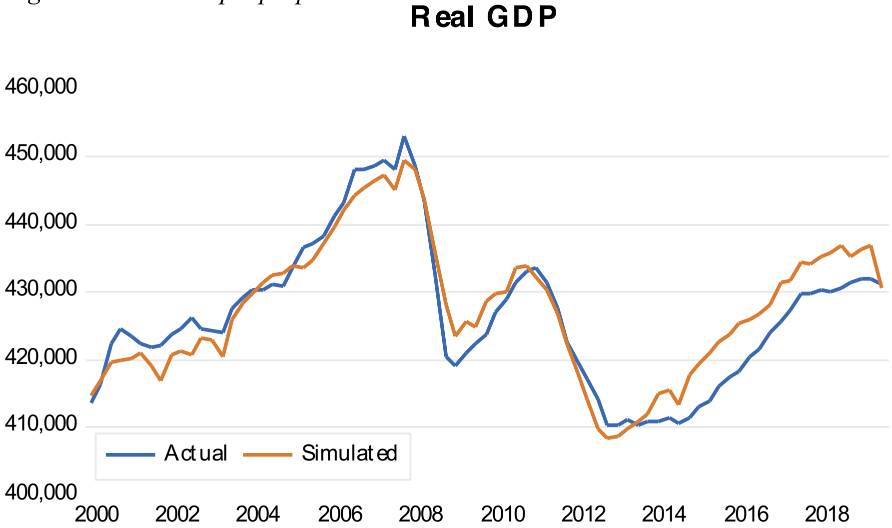
Transaction Matrix: cont'd

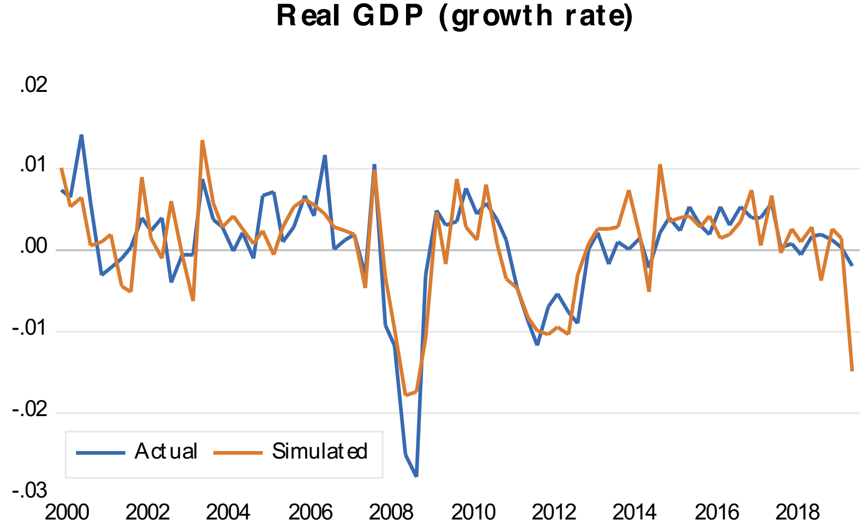
	Sectors						
Transaction	HH	NFC	FC	CB	GVT	ROW	□
Memo: Income from prod.	$\boldsymbol{+INCP^H}$	$\boldsymbol{+OPS^F}$	$\boldsymbol{+OPS^B}$		$\boldsymbol{+INCP^G}$	$\boldsymbol{+INCP^W}$	
Interest payments	+/-	+/-	+/-	+	+/-	+/-	0
Dividends	+	+/-	+/-		+	+/-	0
Reinvested earnings from FDI		+/-	+/-			+/-	0
Other net capital income	+	+/-	+/-			+/-	0
Net rent from land	$-RENTLNP^H$	$-RENTLNP^F$			$+RENTLNR^G$		0
Memo: Primary income	$\boldsymbol{YP^\wedge H}$	$\boldsymbol{YP^F}$	$\boldsymbol{YP^B}$	$\boldsymbol{INTR^{CB}}$	$\boldsymbol{YP^G}$	$\boldsymbol{YP^W}$	
Direct taxes	$-TAXP^H$	$-TAXPD^F$ $-TAXPW$	$-TAXP^F$		$+TAXR^G$	$+TAXPW$ $-TAXP^W$	0
Social benefits	$+PENSPAYM$				$-PENSPAYM$		0
Social contributions	$-SOCCON$				$+SOCCON$		0
Other (net) current transfers	$+OTCN^H$	$+OTCN^F$	$+OTCN^B$	$-OTCP^{CB}$	$+OTCN^G$	$-OTCN^W$	0
Memo: Disposable income	$\boldsymbol{YD^H}$	$\boldsymbol{YD^F}$	$\boldsymbol{YD^B}$		$\boldsymbol{YD^G}$	$\boldsymbol{YD^W}$	
Var. in pension entitlements	$+PENSR^H$	$-PENSP^F$	$-PENSP^B$				0
Memo: final demand	$\boldsymbol{-C}$				$\boldsymbol{-G}$	$\boldsymbol{-XGS+MGS}$	
Memo: Savings	$\boldsymbol{+S^H}$	$\boldsymbol{+SAV^F}$	$\boldsymbol{+SAV^B}$	0	$\boldsymbol{+SAV^G}$	$\boldsymbol{+SAV^W}$	
Taxes on capital account	$-TRKTAXP^H$	$-TRKTAXPD^F$ $-TRKTAXPW^F$	$-TRKTAXP^B$		$+TRKTAXR^G$	$+TRKTAXPW^F$	0
Transfer on capital account	$-NTRK^H$	$-NTRK^F$	$-NTRK^B$		$+NTRK^G$		0
Other non-produced, non-financial assets	$-OTHDNA^H$	$-OTHDNA^F$	$-OTHDNA^B$		$-OTHDNA^G$		0
Memo: final demand	$\boldsymbol{-GFCF^H}$ $\boldsymbol{-DINV^H}$	$\boldsymbol{-GFCF^F}$ $\boldsymbol{-DINV^F}$	$\boldsymbol{-GFCF^B}$ $\boldsymbol{-DINV^B}$		$\boldsymbol{-GFCF^G}$ $\boldsymbol{-DINV^G}$		
Net lending	$\boldsymbol{NL^H}$	$\boldsymbol{NL^F}$	$\boldsymbol{NL^B}$	0	$\boldsymbol{NL^G}$	$\boldsymbol{NL^W}$	0

Legend: H = households; F = nonfinancial corporations; B = financial corporations; CB = central bank; G = public sector; W = rest of the world. Notes: (+) signs stand for "sources of income" and (-) for "uses of income"

Appendix A4. Figures

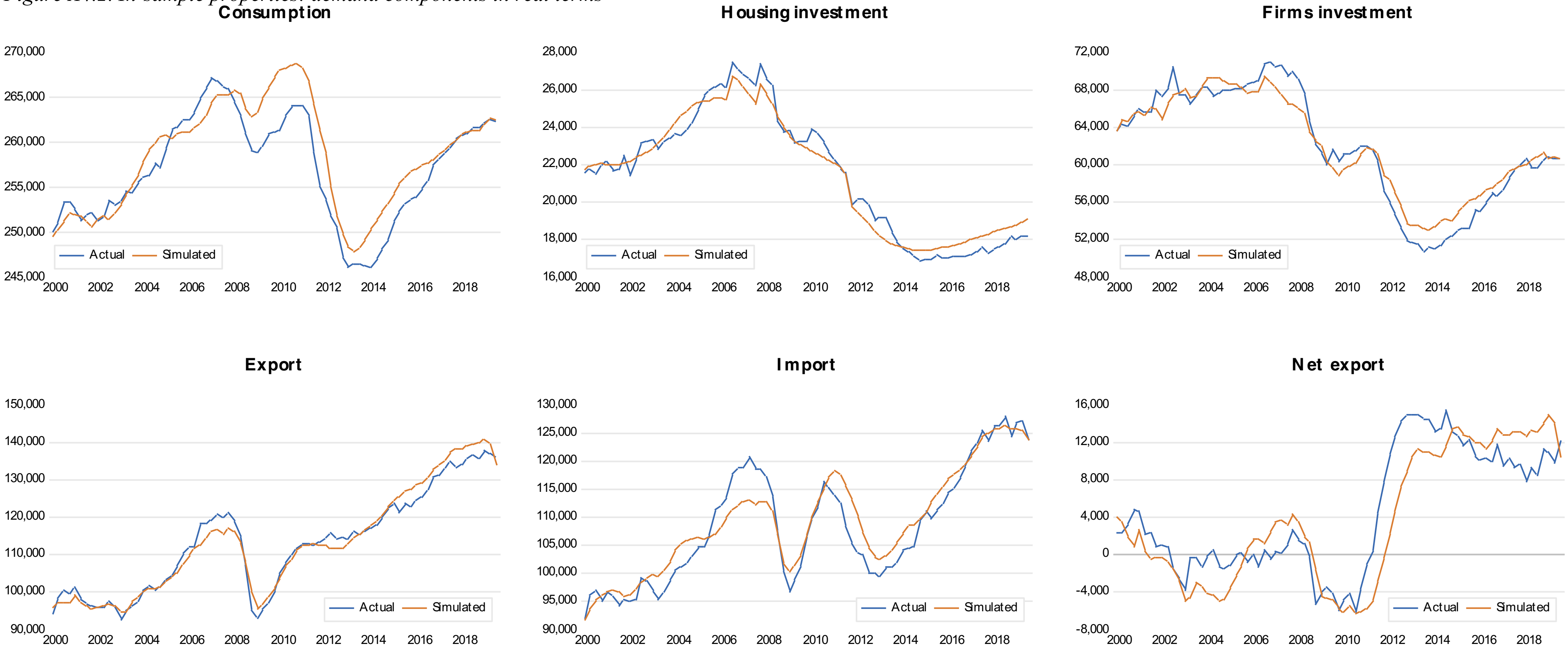
Figure A4.1. In-sample properties: real GDP





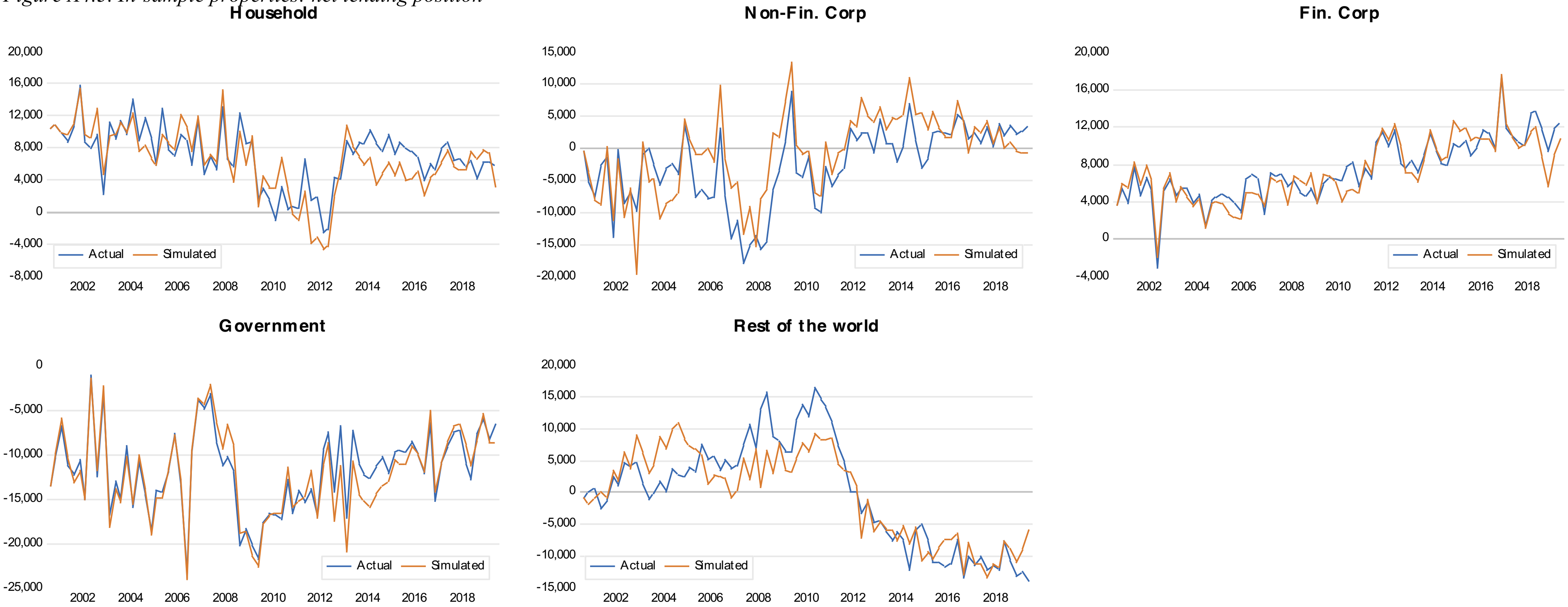
Source: own elaboration

Figure A4.2. In-sample properties: demand components in real terms



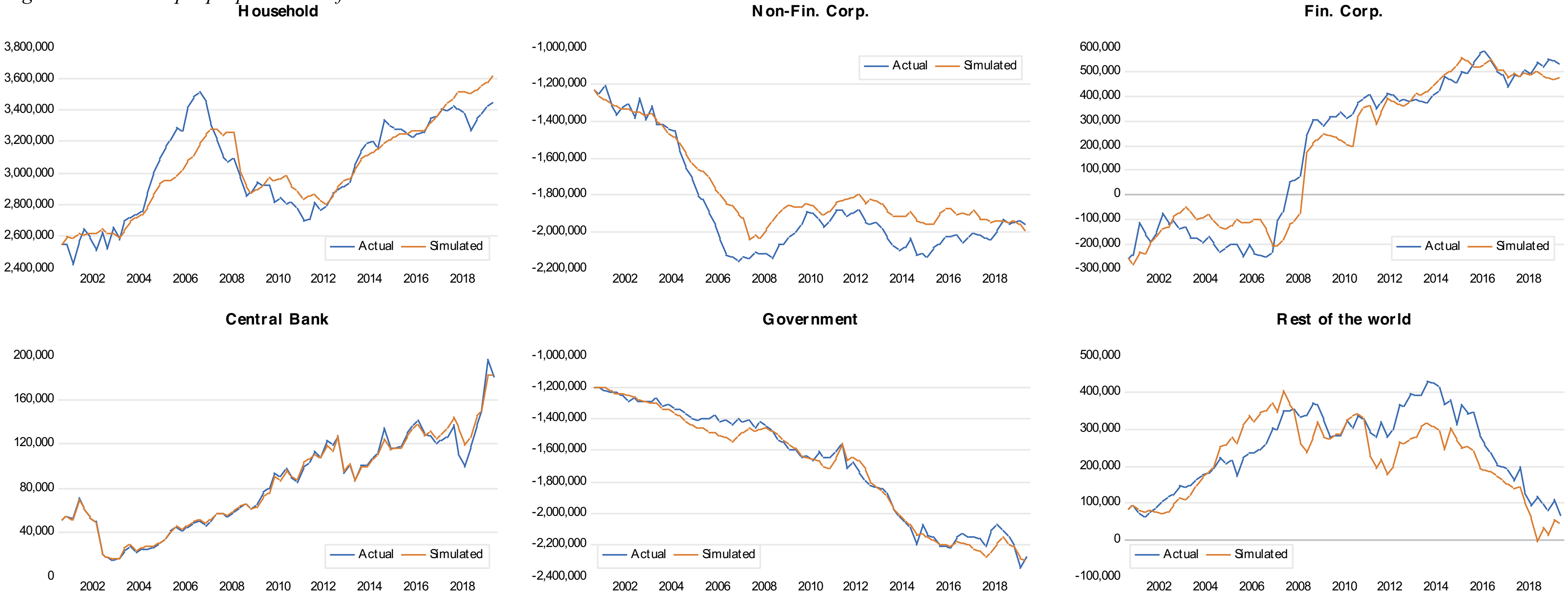
Source: own elaboration

Figure A4.3. In-sample properties: net lending position



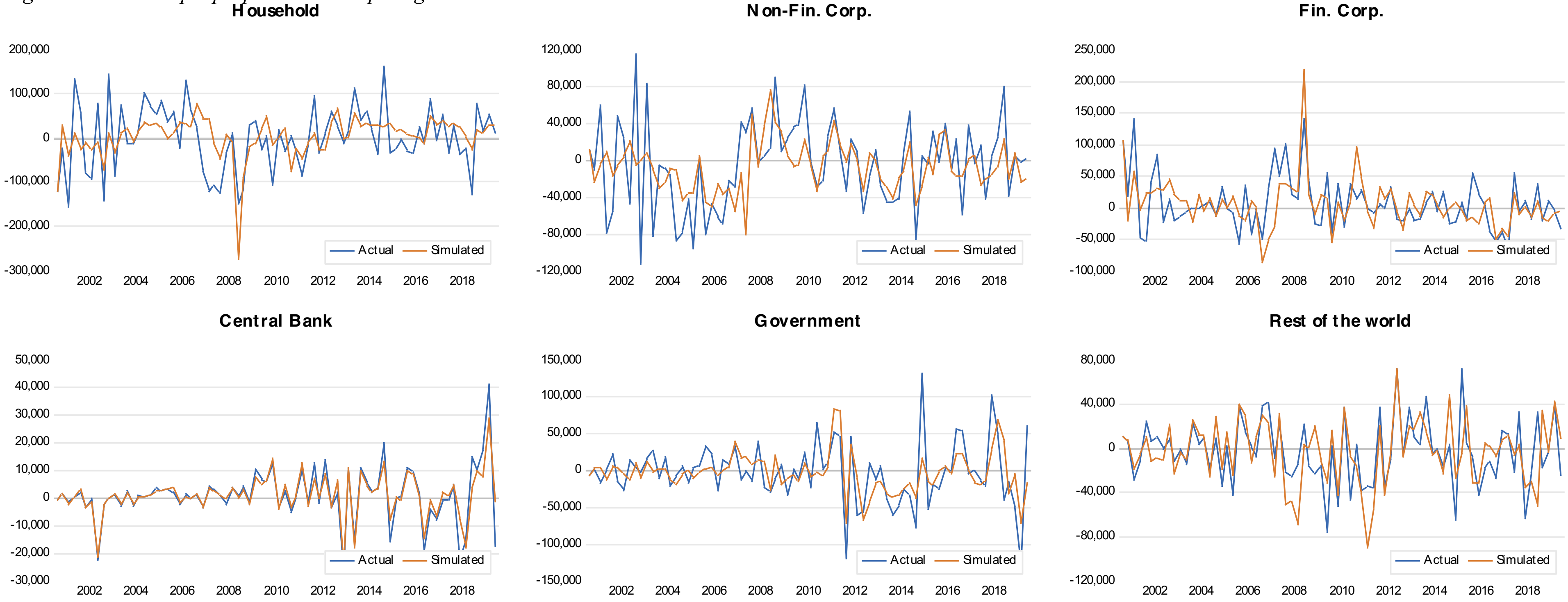
Source: own elaboration

Figure A4.4. In-sample properties: net financial assets



Source: own elaboration

Figure A4.5. In-sample properties: net capital gains



Source: own elaboration