Introduction to SFC Dynamic Models

for Economic Research

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List of topics

1. The state of macroeconomics
2. Main features of SFC models
3. A simple SFCM with *fiat* money
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1 The state of macroeconomics

Issues with standard models

Increasing dissatisfaction with standard (DSGE) macroeconomic models (Blanchard, Krugman, Mankiw, Romer, Solow, Wren-Lewis, etc.)

Three main weaknesses:

a) Unrealistic assumptions ► full rationality, optimising behaviour, etc.

b) Limited range ► no financial markets, no banks, no social classes, no ecosystem

c) Poor data fit ► outclassed by other models in the S/R; crises are ruled out

In addition, logical inconsistencies and empirical *non sequitur* (aggregate production function).

Countermand!

(c) Poor data fit

(a) Unrealistic assumptions

model and an explicit role for forward-looking expectations. A weakness of DSGE models is that they often do not fit the data as well as other models, and the causal mechanisms do not always correspond to how economists and policymakers think the economy really works. In order to more easily manage these models, they typically focus on only a few key variables, which can limit the range of situations where they are useful.

(b) Limited range

The key strength of full-system econometric models like MARTIN is that they are flexible enough to incorporate the causal mechanisms that policymakers believe are important and fit the observable relationships in the data reasonably well. They can also be applied very broadly to model a wide range of variables. This flexibility reflects that the model is not derived from a single theoretical framework, which can make causal mechanisms less clear than in DSGE models. The model might capture an empirical relationship that exists in the data, but the cause of this might not be well understood. This means that developments may be more difficult to interpret and assumptions may need to be made about the mechanisms that are at work. If the true causal mechanisms are

Excerpt from *Reserve Bank of Australia*, March 2018 Bulletin

Recent developments

- Alternative models:
  - Heterogeneous agent-based models, network analysis and other complexity models
  - Rediscovery of traditional macroeconometric models
  - Theoretical and empirical SFC models (Zezza and Zezza 2019, Carnevali et al. 2019)
- The Bank of England (2016) and the Italian Ministry of Economy and Finance (2022) have developed their own empirical SFC models.
- Other intitutions (e.g. OECD) and world-leading economists (e.g. Simon Wray-Lewis vs Martin Wolf) have shown interest in SFC models.
- Researchers of the Bank of Italy have released a new *R* package, named *Bimets*, for the analysis of time series and macroeconometric modelling.
- *Bimets* allows defining, estimating and simulating simultaneous equation models. It can be used to create empirical SFC models too (see Canelli et al. 2021, 2022).

2 Main features of SFC models

The inception of SFC models

SFC models gained popularity after Wynne Godley used them to predict the US crises in both 2001 and 2007:

> *There could be a further year or more of robust expansion … [but] current growth is associated with seven unsustainable processes* (Godley 1999)

Godley and the *Cambridge Economic Policy Group* built upon the works of:

- Morris Copeland (1949): integrated national income identities with flow of funds through the quadruple accounting principle
- James Tobin (1981,1982) and the *Yale Group*: Keynesian theory of portfolio equations (as functions of expected return rates and liquidity preference)

Since the the late 2000s, SFC models have emerged as a prevalent method or language among non-neoclassical macroeconomic modellers.

Integrating finance and production

In 2007, Godley and Lavoie published what is still today the reference manual for SFC modelling: Monetary Economics: An Integrated Approach to Credit, Money, Income, Production and Wealth.

Nine SFC models are presented and simulated, in which money is endogenous and behavioural equations respond to post-Keynesian precepts.

Dos Santos (2006) named this method the stock-flow consistent (SFC) approach to macroeconomics (but accounting consistency should be a requirement for all models).

SFC models are well-known outside economics. Ecological economists and environmental scientists use them to assess the impact of anthropic activities on the ecosystem.

Economic SFC models integrate the financial and the real side of the economy, thus tracking stock-flow ratios and identifying un-sustainable processes (e.g. a growing debt/income ratio).

Basic principles

SFC models are based on national accounts and flow of funds. They are explicitly designed to meet **four accounting principles**:

a) Flow consistency ▶ every transaction comes from somewhere and goes to somewhere

b) Stock consistency ▶ a liability issued by agent or sector A is held as a financial asset by agent or sector B

c) Stock-flow consistency ▶ flows affect stocks, capital gains (losses) must be recorded

d) Quadruple book-keeping ▶ every transaction entails four different entries:

- An outflow (e.g. a household purchases an item)
- An inflow (e.g. a firm sales the item)
- A reduction in assets or an increase in liabilities (e.g. household's cash and/or deposits reduce)
- An increase in assets or a reduction in liabilities (e.g. firm's cash and or deposits increase)

Accounting matrices

The economy is divided into several sectors (e.g. households, non-financial firms, commercial banks, central bank, government, and the foreign sector).

SFC models are made up of two components: accounting matrices and dynamic equations.

Accounting matrices match the System of National Accounts:

- The balance sheet (BS) displays tangible stocks (fixed capital, housing), financial assets and financial liabilities of each macro-sector.
- The transactions-flow matrix (TFM) shows financial flows associated with stocks and sectoral budget constraints. It combines the national income equations (identities) with sectoral flow-of-funds accounting.

The TFM is usually extended to include the stock revaluation matrix (SRM), which shows the changes in the stocks resulting from the transactions.

The balance sheet

Assets and liabilities (stocks)

Economic sectors or agents

	Households	Firms	Banks	Central Bank	Government	…	Σ
Cash	$+H_h$			$-H_s$		…	0
Deposits	$+M_h$		$-M_s$			…	0
Loans		$-L_f$	$+L_s$			…	0
Bills	$+B_h$			$+B_{cb}$	$-B_s$	…	0
Capital		$+K$				…	$+K$
…	…	…			…	…	0
Balance (net worth)	$-V_h$	$\pm V_f$	0	0	$+V_g$	…	$-\Sigma V$
Σ	0	0	0	0	0	0	0

Consistency across sectors

Accumulation of fixed capital

Notes: A '+' before a magnitude denotes an asset; a '–' denotes a liability.

Consistency within sectors

The transactions-flow matrix

Transactions and Δ in stocks

Capital account

TFM

SRM

	Households	Firms		Banks	Central Bank	Government	…	Σ
		Current	Capital					
Consumption	$-C$	$+C$					…	0
Investment		$+I$	$-I$				…	0
Wages	$+WB$	$-WB$						0
Interests on loans		$-r_{l,-1} \cdot L_{f,-1}$		$+r_{l,-1} \cdot L_{s,-1}$			…	0
…	…	…	…	…	…	…	…	0
Δ in cash	$-\Delta H_h$				$+\Delta H_s$		…	0
Δ in loans			$+\Delta L_f$	$-\Delta L_s$			…	0
…	…	…	…	…				0
Σ	0	0	0	0	0	0	0	0

Column = budget constraint

Reverse sign

Notes: A '+' before a magnitude denotes a receipt or a source of funds; a '–' denotes a payment or a use of funds.

Identities and behavioural equations

BS and TFM allow deriving the first set of model equations, namely accounting identities.

Identities are then coupled with equilibrium conditions and behavioural equations to close the model:

- Identity: accounting definition, which is always true. Example: $Y \equiv C + I + G + X - M$
- Equilibrium condition: adjustment mechanism that matches demand with supply
  Example: $M_s = M_d$
- Behavioural (or stochastic) equation: defines the behaviour of a certain variable
  Example: $C = \alpha_1 \cdot YD + \alpha_2 \cdot V_{-1}$

Behavioural equations are usually based on the assumption that economic agents set stock-flow targets, e.g. wealth-to-income ratio ($V/YD = (1 - \alpha_1)/\alpha_2$).

Theory and policy implications

The long-run dynamics of SFC models is usually not predetermined by a supply-side exogenous attractor (e.g. NAIRU). It is only constrained by the accounting structure.

While Godley was quite confident about the constraining power of an accurate accounting, the long-run dynamics of SFC models is defined also by behavioural assumptions.

SFC modellers usually assume that production, income and employment are demand-led both in the short- and long-run.

Some heterodox policy corollaries follow (e.g. fiscal policies can imply long-lasting effects, monetary policies can bring about paradoxical and counter-intuitive effects, etc.).

However, there is flexibility. SFC models are consistent with a variety of theoretical views.

Supply-side and/or ecological constraints are increasingly incorporated into the models.

Solution and identification

Standard SFC models are medium-scale macro-econometric dynamic models (≈ 30 to 250 eq.s). But they can be meso- (Input-Output SFC) or micro-founded (Agent-Based SFC).

Usually formulated in discrete time (difference equations), but they can also be developed in continuous time (differential equations).

The simplest models can be solved analytically (by finding steady-state solutions). More advanced models must be solved through computer simulations.

Coefficients can be:

a) fine-tuned to obtain a specific baseline scenario (previous studies, selected from a reasonable range of values)

b) calibrated to match the data

c) estimated from observed data (using econometric methods: OLS, cointegration, etc.)

3 A simple SFCM with *fiat* money

Box 1 How to install *R* and run the model

a) Download and install *R* (free software)

b) Download and install *R-Studio Desktop* (free version)

c) Get familiar with *R* using the Cheat Sheet

d) Download toy models from my GitHub repository

e) Copy and paste the code in the main *R* field (top-left)

f) Run the code by clicking Source

g) Check model variables (Data) and coefficients (Values) in the top-right field, named Global Environment

h) Charts are displayed in the Plots field (bottom-right)

Model PC: assumptions

This is a model developed in chapter 4 of Godley and Lavoie (2007). PC stands for portfolio choice, because households can hold their wealth in terms of cash and/or government bills.

Key assumptions are as follows:

- Closed economy
- Four agents: households, “firms”, government, central bank
- Two financial assets: government bills and outside money (cash)
- No investment (accumulation) and no inventories
- Fixed prices and zero net profits
- No banks, no inside money (bank deposits)
- No ecosystem

Box 2 Steps for developing a SFC model

1. Identify sectors to be modelled (households, firms, etc.)
2. Create balance-sheet (BS) of the economy
3. Create transactions-flow matrix (TFM)
4. Write down identities from the TFM
    i. Use columns to derive budget constraints
    ii. Use also rows with multiple entries
    iii. Identify buffer variables
5. Define behavioural equations and equilibrium conditions

Model PC: balance-sheet

	Households	Firms (production)	Central Bank	Government	Σ
Money (cash)	$+H_h$		$-H_s$		0
Bills	$+B_h$		$+B_{cb}$	$-B_s$	0
Balance (net worth)	$-V_h$			$+V_g$	0
Σ	0	0	0	0	0

Equation (6)

Equation (10)

Notes: A '+' before a magnitude denotes an asset; a '–' denotes a liability.

Model PC: transactions-flow matrix

	Households	Firms (production)		Banks	Central Bank	Government	Σ
Consumption	$-C$	$+C$					0
Gov. spending		$+G$				$-G$	0
Income=GDP	$+Y$	$-Y$	Equation (1)				0
Interest payments	$+r_{-1} \cdot B_{h,-1}$				$+r_{-1} \cdot B_{cb,-1}$	$-r_{-1} \cdot B_{s,-1}$	0
CB profits					$-r_{-1} \cdot B_{cb,-1}$	$+r_{-1} \cdot B_{cb,-1}$	0
Taxes	$-T$					$+T$	0
Δ in cash	$-\Delta H_h$				$+\Delta H_s$		0
Δ in bills	$-\Delta B_h$				$-\Delta B_{cb}$	$+\Delta B_s$	0
Σ	0	0		0	0	0	0

Notes: A '+' before a magnitude denotes a receipt or a source of funds; a '–' denotes a payment or a use of funds

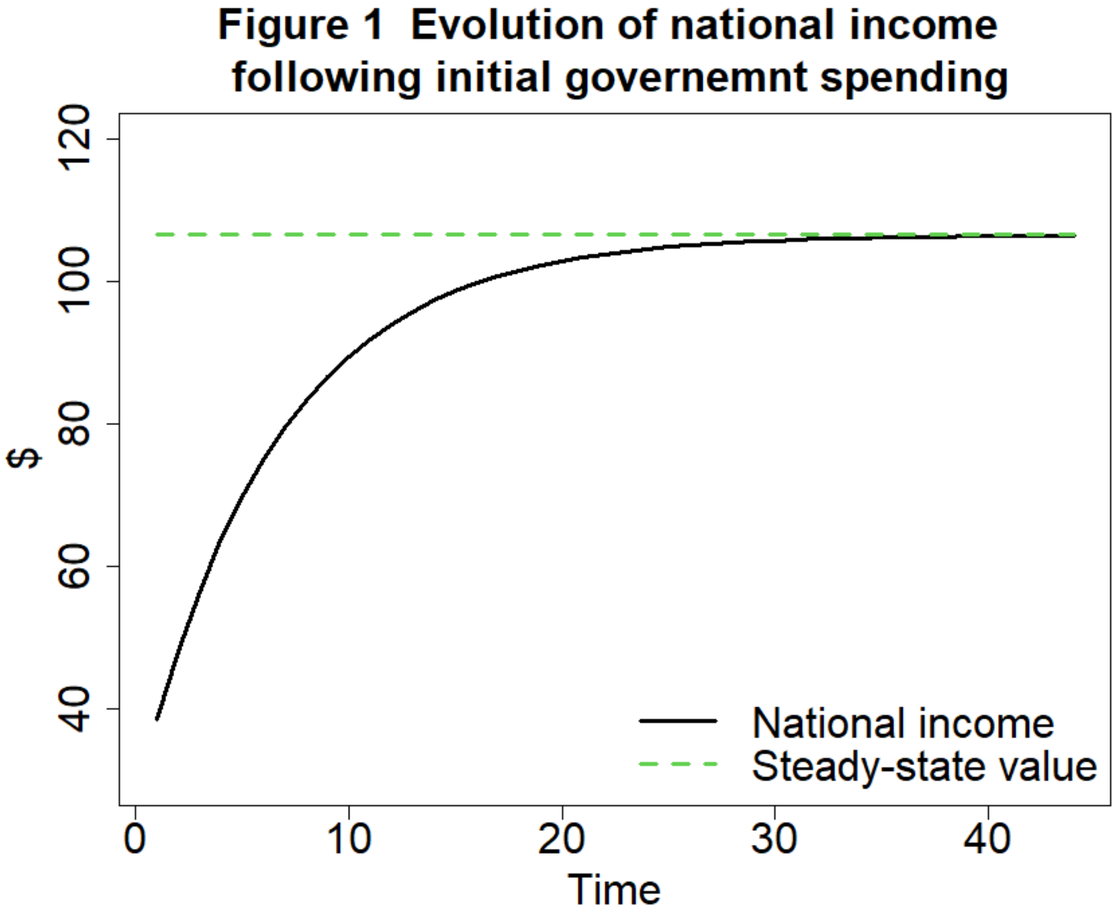
Model PC: equations

National income:	$Y = C + G$	(1)
Disposable income:	$YD = Y - T + r_{-1} \cdot B_{h,-1}$	(2)
Tax revenue:	$T = \theta \cdot (Y + r_{-1} \cdot B_{h,-1})$	(3)
Household wealth:	$V_h = V_{h,-1} + YD - C$	(4)
Consumption:	$C = \alpha_1 \cdot YD + \alpha_2 \cdot V_{-1}$	(5)
Cash held by households:	$H_h = V_h - B_h$	(6)
Bills held by households:	$B_h = \lambda_0 \cdot V_h + \lambda_1 \cdot V_h \cdot r - \lambda_2 \cdot YD$	(7)
Supply of bills:	$B_s = B_{s,-1} + G - T + r_{-1} \cdot (B_{s,-1} - B_{cb,-1})$	(8)
Supply of cash:	$H_s = H_{s,-1} + \Delta B_{cb}$	(9)
Bills held by the central bank:	$B_{cb} = B_s - B_h$	(10)
Interest rate:	$r = \bar{r}$	(11)
Redundant equation:	$H_h = H_s$	

- Identity
- Equilibrium condition
- Behavioural equation

Model PC: dynamics

Stationary (quasi steady-state) solution: $Y^* = \dfrac{G + r \cdot B_h^* \cdot (1-\theta)}{\theta}$



$G = 20$

$r = 0.025$

$\theta = 0.2$

$B_h^* \sim 64.87$

$Y^* \sim 106.49$

Tip: how to find the quasi steady-state

Notice that $C = YD$ and $B_{h,-1} = B_h$ in steady state. Use $C = YD$ in equation (1), from which: $Y^* = YD + G$. Next, use equations (2) and (3) in Y, from which: $Y^* = (Y^* + r \cdot B_h^*) \cdot (1-\theta) + G$. Next, solve for Y^*.

Model PC: BS steady-state values

	Households	Firms (production)	Central Bank	Government	Σ
Money (cash)	$+21.62$		-21.62		0
Bills	$+64.87$		$+21.62$	-86.49	0
Balance (net worth)	-86.49			$+86.49$	0
Σ	0	0	0	0	0

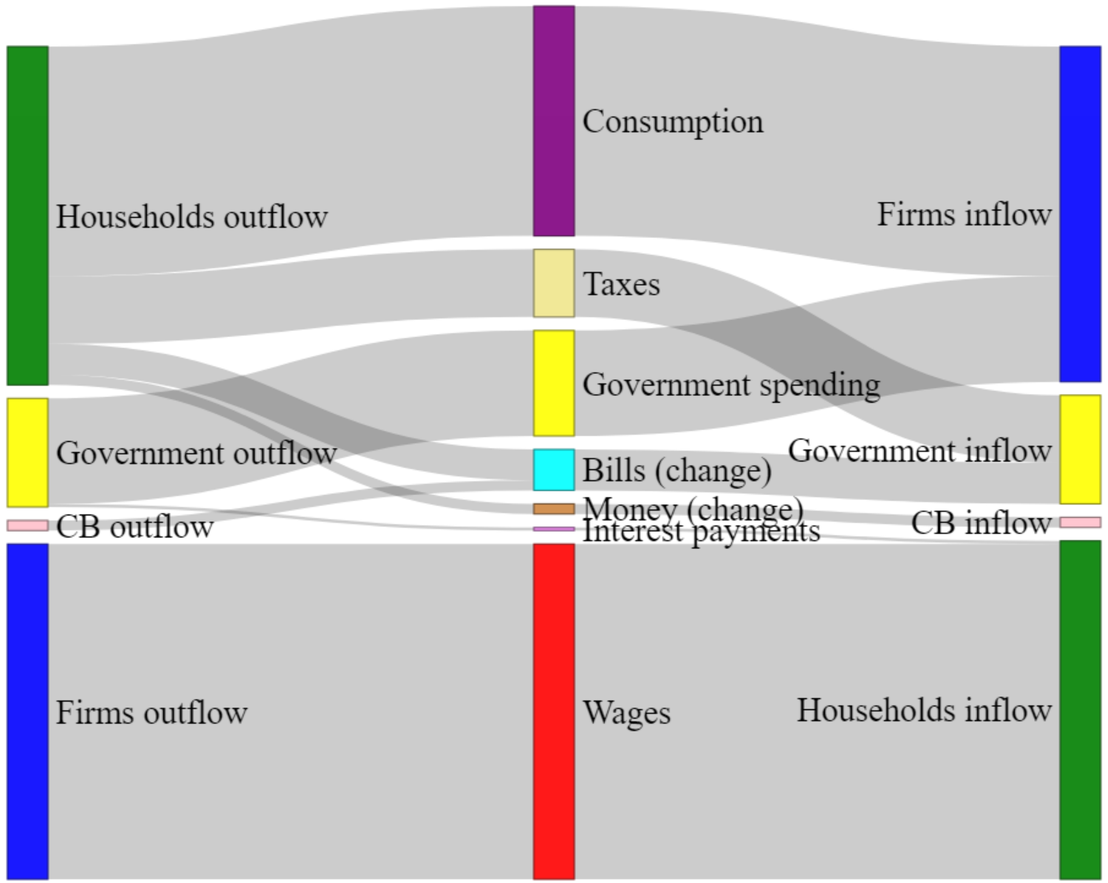
Notes: A '+' before a magnitude denotes an asset; a '–' denotes a liability.

Model PC: TFM steady-state values

	Households	Firms (production)	Banks	Central Bank	Government	Σ
Consumption	-86.49	$+86.49$				0
Gov. spending		$+20$			-20	0
Income=GDP	$+106.49$	-106.49				0
Interest payments	$+1.62$			$+0.54$	-2.16	0
CB profits				-0.54	$+0.54$	0
Taxes	-21.62				$+21.62$	0
Δ in cash	0			0		0
Δ in bills	0			0	0	0
Σ	0	0	0	0	0	0

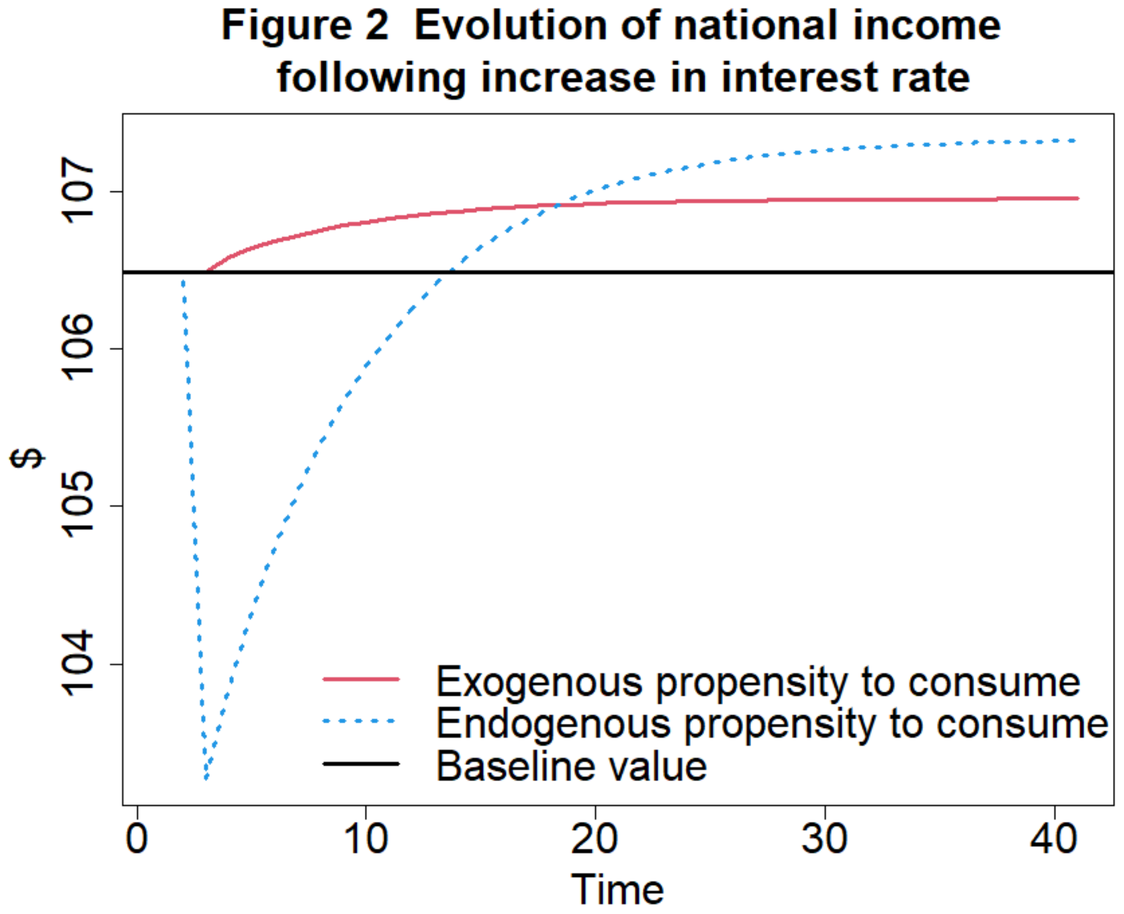
Notes: A '+' before a magnitude denotes a receipt or a source of funds; a '–' denotes a payment or a use of funds

Model PC: Sankey diagram (t=5)



Model PC: experiment

Higher interest rate on government bonds: $r = 0.025 \rightarrow 0.035$



Scenario «blue»

Additional equation:

$\alpha_1 = \alpha_{11} - \alpha_{12} \cdot r$

Coefficient values:

$\alpha_{11} = 0.65$

$\alpha_{12} = 2$

4 A simple SFCM with bank money

Model BMW: assumptions

This is a model developed in chapter 7 of Godley and Lavoie (2007). BMW stands for bank-money world, because there is only one kind of *financial* assets: bank deposits held by households. Firms' investment in fixed capital is (partially) funded by bank loans.

Key assumptions are as follows:

- Closed economy and no ecosystem
- Three agents: households, firms, banks
- A/L: loans, deposits, tangible (or fixed) capital
- Investment funded by loans and internal funds
- Target capital to output ratio
- Fixed prices and zero net profits
- No State, no outside money (cash)

Model BMW: balance-sheet

	Households	Production firms	Banks	Σ
Deposits	$+M_h$		$-M_s$	0
Loans		$-L_f$	$+L_s$	0
Fixed capital		$+K$		$+K$
Balance (net worth)	$-V_h$	0	0	$-V_h$
Σ	0	0	0	0

Notes: A '+' before a magnitude denotes an asset; a '–' denotes a liability.

Tip: unlike a financial asset, a real or tangible asset (K) is not matched by a liability, because it is not a claim of someone against someone else!

Model BMW: transactions-flow matrix

	Households	Production firms		Banks		Σ
		Current	Capital	Current	Capital	
Consumption	$-C_d$	$+C_s$				0
Investment		$+I_d$	$-I_d$			0
[Production]		$[Y]$				
Wages	$+WB$	$-WB$				0
Depreciation		$-AF$	$+AF$			0
Int. on loans		$-r_{l,-1} \cdot L_{f,-1}$		$+r_{l,-1} \cdot L_{s,-1}$		0
Int. on deposits	$+r_{m,-1} \cdot M_{h,-1}$			$-r_{m,-1} \cdot M_{s,-1}$		0
Δ in loans			$+\Delta L_f$		$-\Delta L_s$	0
Δ in deposits	$-\Delta M_h$				$+\Delta M_s$	0
Σ	0	0	0	0	0	0

Equation (8)

Notes: A '+' before a magnitude denotes a receipt or a source of funds; a '–' denotes a payment or a use of funds

Model BMW: equations

Supply of consumption goods:	$C_s = C_d$	(1)
Supply of investment goods:	$I_s = I_d$	(2)
Labour supply:	$N_s = N_d$	(3)
Supply of loans:	$L_s = L_{s,-1} + \Delta L_d$	(4)
Total gross production:	$Y = C_s + I_s$	(5)
Wage bill (as residual income):	$WB_d = Y - r_{l,-1} \cdot L_{d,-1} - AF$	(6)
Amortisation funds:	$AF = \delta \cdot K_{-1}$	(7)
Demand for loans:	$L_d = L_{d,-1} + I_d - AF$	(8)
Disposable income:	$YD = WB_s + r_{m,-1} \cdot M_{d,-1}$	(9)
Deposits held by households:	$M_h = M_{h,-1} + YD - C$	(10)
Supply of deposits:	$M_s = M_{s,-1} + \Delta L_s$	(11)

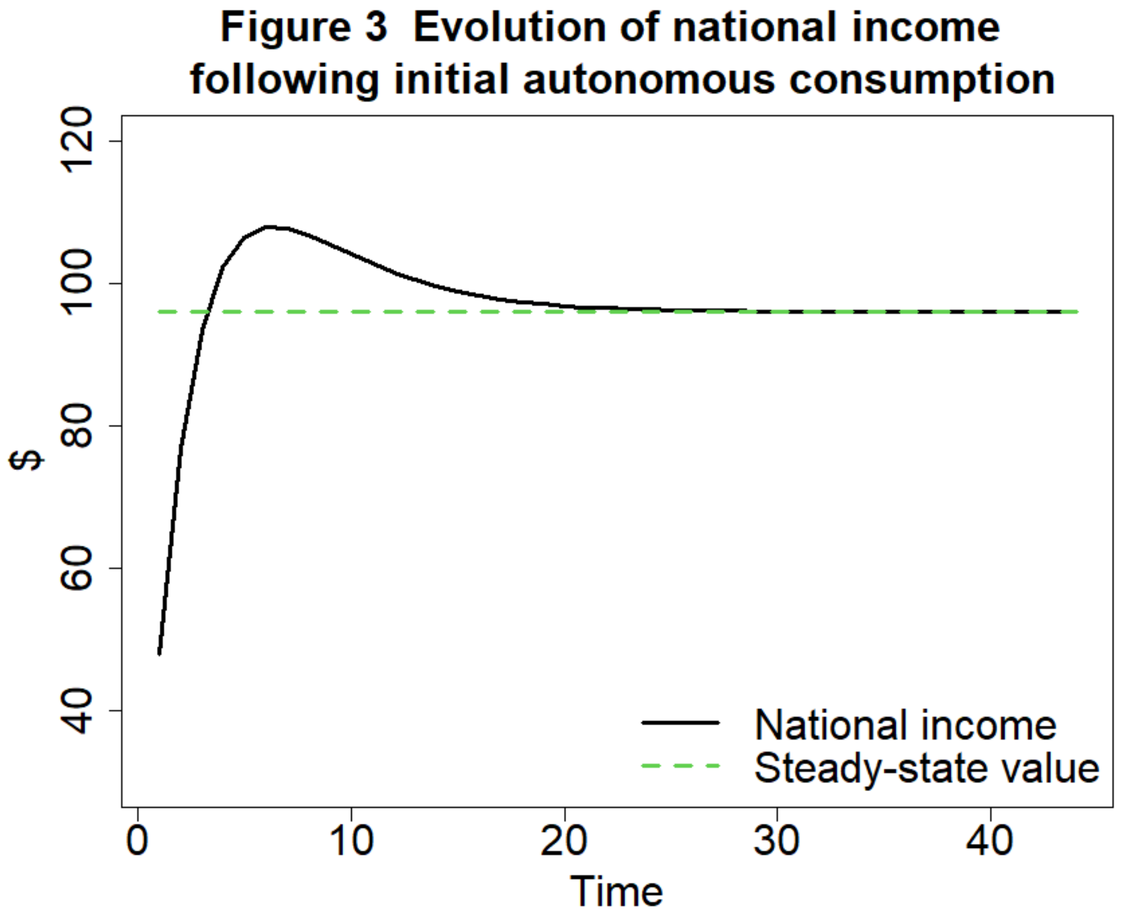
- Identity
- Equilibrium condition
- Behavioural equation

Model BMW: equations (cont'd)

Return rate on deposits:	$r_m = r_l$	(12)
Wage bill:	$WB_s = w \cdot N_s$	(13)
Demand for labour:	$N_d = Y/pr$	(14)
Wage rate:	$w = WB_d/N_d$	(15)
Consumption:	$C_d = \alpha_0 + \alpha_1 \cdot YD + \alpha_2 \cdot M_{h,-1}$	(16)
Capital stock:	$K = K_{-1} + I_d - DA$	(17)
Depreciation allowances:	$DA = \delta \cdot K_{-1}$	(18)
Target capital stock:	$K^T = \kappa \cdot Y_{-1}$	(19)
Gross investment:	$I_d = \gamma \cdot (K^T - K_{-1}) + DA$	(20)
Interest rate on loans:	$r_l = \bar{r}_l$	(21)
Redundant equation:	$M_h = M_s$	

Model BMW: dynamics

Stationary (steady-state) solution: $Y^* = \dfrac{\alpha_0}{(1-\alpha_1)\cdot(1-\delta\cdot\kappa)-\alpha_2\cdot\kappa}$



$\alpha_0 = 12$

$\alpha_1 = 0.75$

$\alpha_2 = 0.40$

$\delta = 0.15$

$\kappa = 1$

$Y^* = 96$

Tip: how to find the steady-state

Use equations (1), (2), (16) and (20) in Y identity, that is, equation (5). Next, use equation (9) in Y and equation (6) in equation (9). Notice that $K = K^T = \kappa \cdot Y$ and $M = L = K$, under steady state. Replace variables with respective equations and solve for Y^*.

Model BMW: BS steady-state values

	Households	Production firms	Banks	Σ
Deposits	+96		−96	0
Loans		−96	+96	0
Fixed capital		+96		+96
Balance (net worth)	−96	0	0	−96
Σ	0	0	0	0

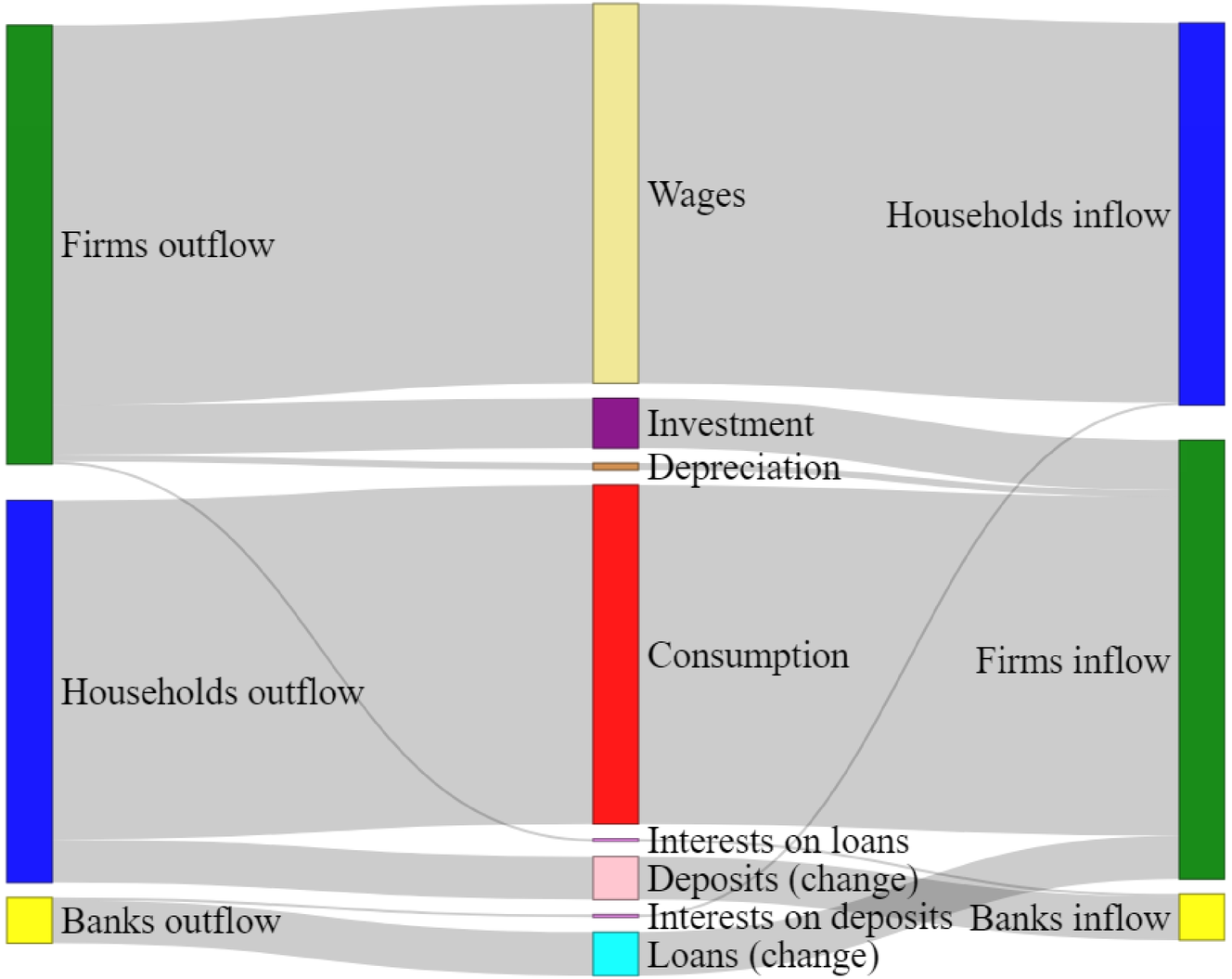
Notes: A '+' before a magnitude denotes an asset; a '–' denotes a liability.

Model BMW: TFM steady-state values

	Households	Production firms		Banks		Σ
		Current	Capital	Current	Capital	
Consumption	−86.4	+86.4				0
Investment		+9.6	−9.6			0
[Production]		[+96]				
Wages	+82.56	−82.56				0
Depreciation		−9.6	+9.6			0
Int. on loans		−3.84		+3.84		0
Int. on deposits	+3.84			−3.84		0
Δ in loans			0		0	0
Δ in deposits	0				0	0
Σ	0	0	0	0	0	0

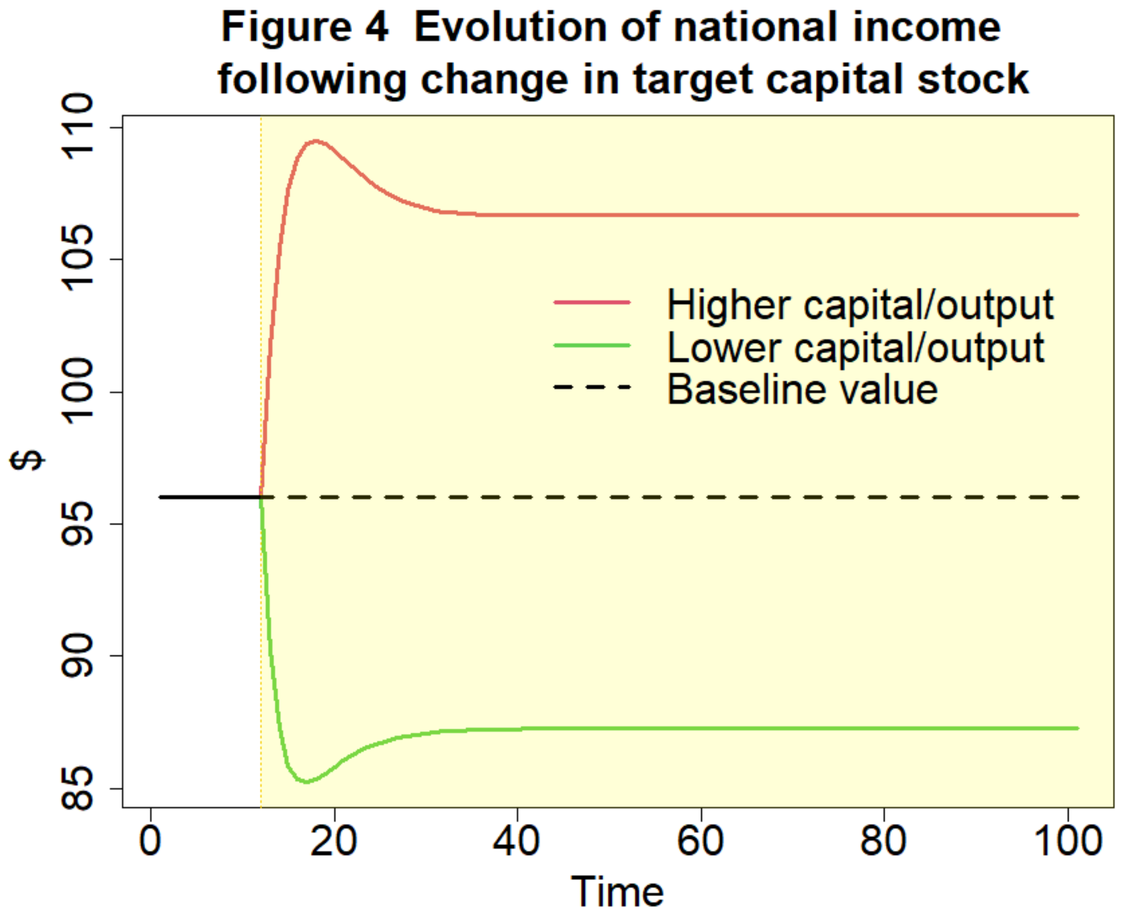
Notes: A '+' before a magnitude denotes a receipt or a source of funds; a '–' denotes a payment or a use of funds

Model BMW: Sankey diagram (t=5)



Model BMW: experiment

Higher/lower target capital to output ratio: $\kappa_0 = 1$, $\kappa_1 = 1.1$, $\kappa_2 = 0.9$



5 Empirical SFC Models

Basic classification

Two types:

1. Theoretical models
2. Empirical models
   A. Data to theory (or bottom up) models (Godley's original approach)
   B. Theory to data (or top down) models (e.g. BoE)

Note:

- Even when B is used, data must be reclassified to reduce the density of BS and TFM
- Expect inconsistencies and missing data in national accounts and balance-sheets
- Assumptions must be made about "who" is paying "whom"

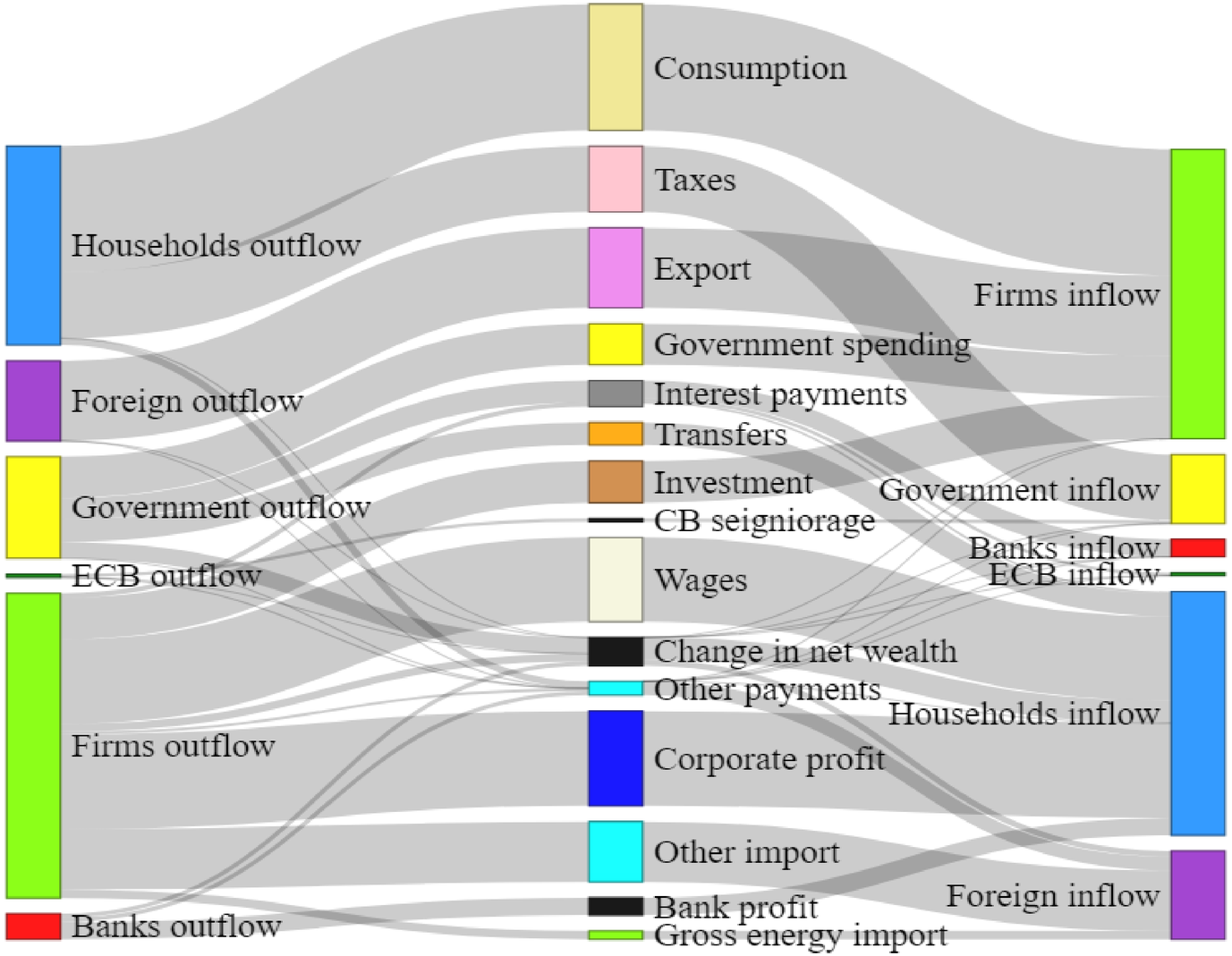
Example - BS of Italy, 2022 (mln EUR, current prices)

	Households	Firms	Government	Banks	ECB	Foreign	Row total
Cash and reserves	200683			10817	-211500		0
Deposits	1428434			-1428434			0
Securities	233263		-2678397	1366294	868289	210551	0
Loans	-763488	-871902		1635390			0
Shares	1372850	-1372850					0
Other net FA	1583746	284629	323282	-1563895	-783662	155900	0
Net financial wealth	4055488	-1960123	-2355115	20172	-126873	366451	0
Column total	0	0	0	0	0	0	0

Example - TFM of Italy, 2022 (mln EUR, current prices)

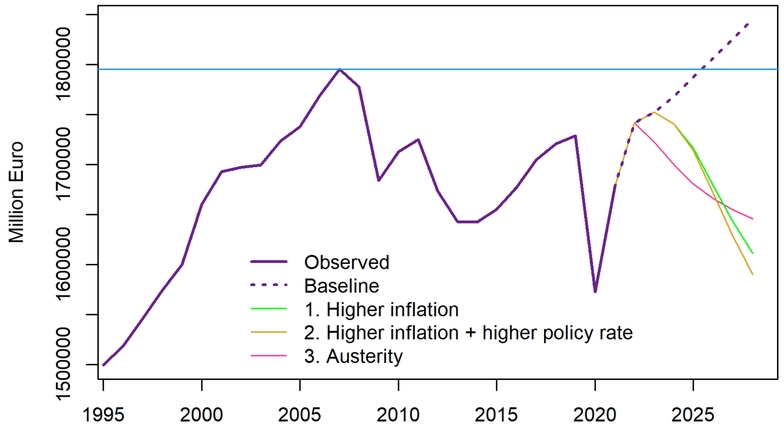
	Households	Firms		Government	Banks	ECB	Foreign	Row total
		Current	Capital					
Consumption	-1030124	1030124						0
Total investment		357215	-357215					0
Government spending		352718		-352718				0
Export		582192					-582192	0
Energy import		-64859					64859	0
Other import		-475339					475339	0
[GDP]		1782051						
Taxes	-483366			483366				0
Transfers	188601			-188601				0
Wages	692915	-692915						0
Interest payments	10905	-2326		-60678	29134	13200	9765	0
Corporate profit	738858	-1141970	403112					0
Bank profit	29134				-29134			0
ECB seigniorage				13199.6451		-13200		0
Other payments	-60675	55160		275576.588	-151307	-5171	-113584	0
Change in cash and reserves	15250				-657	-14593		0
Change in deposits	57376				-57376			0
Change in securities	-30072			-105432	-77658	103317	109845	0
Change in loans	-27196		169601		-142405			0
Change in shares	138716		-138716					0
Change in other net FA	-67825		15012	275577	126789	-93895	-255658	0
Change in net wealth	86249		45897	170145	-151307	-5171	-145813	0
Column total	0		0	0	0	0	0	0

Example - Sankey diagram of transactions, Italy, 2021

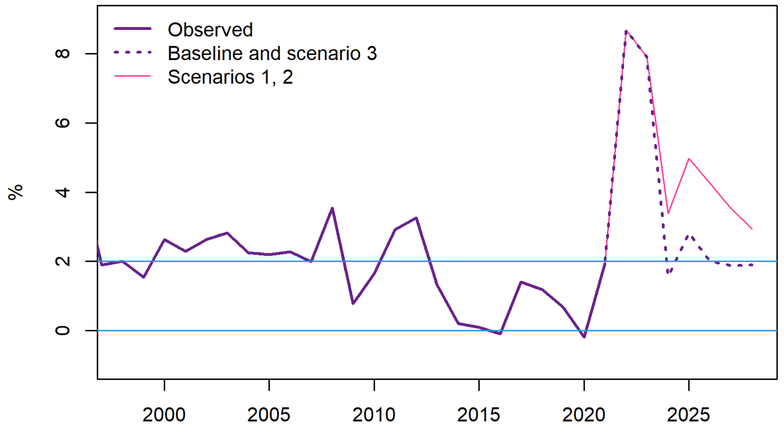


Example - Alternative scenarios, Italy, selected variables

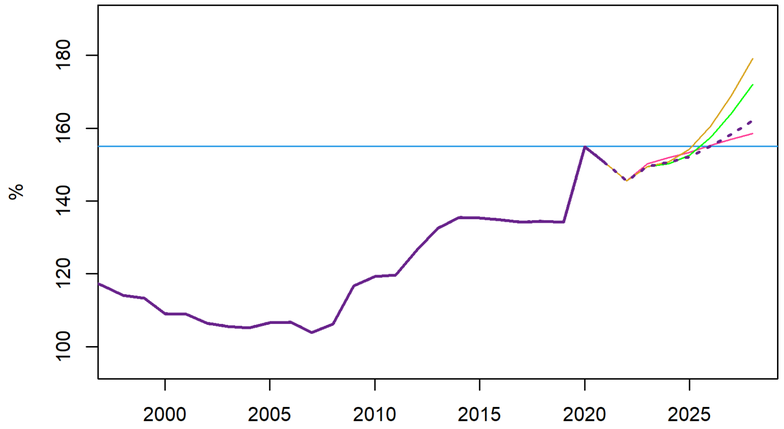
(a) Real GDP (constant prices, 2015=100)



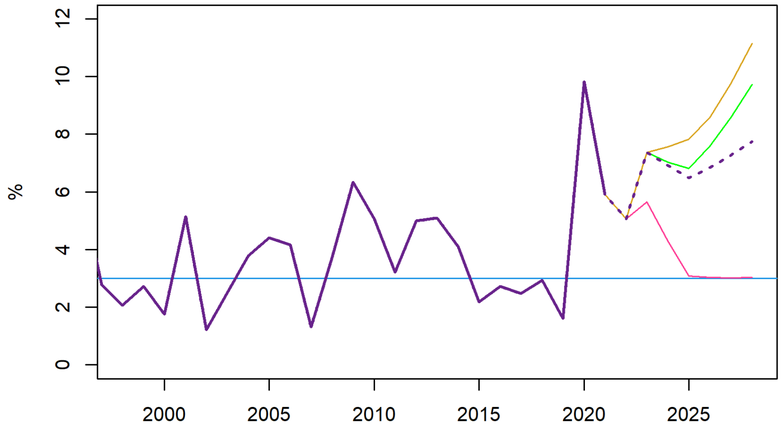
(b) Inflation rate (% change in CPI)



(c) Government debt to GDP ratio



(d) Government deficit to GDP ratio



Box 3 Simulating a SFC model

Steps in simulating a SFC model:

1. Run the model
2. Check model consistency by using the redundant equation
3. Validate results through auto- and cross-correlation analysis of key variables under the baseline
4. Check robustness of findings through sensitivity tests (changing key parameters)
5. Shock key coefficients to obtain alternative scenarios
6. Compare with baseline results (comparative dynamics)

6 Final remarks

Pros and cons of SFC models

Cons:

- Missing data and inconsistencies in national accounts
- Lucas critique (?)

Pros:

- System of national accounts
- High theoretical flexibility
- Wide range of applications

Selected references

KEY READINGS

- W. Godley and M. Lavoie (2007). *Monetary Economics. An Integrated Approach to Credit, Money, Income, Production and Wealth*. Palgrave Macmillan, chapters 1, 2, 3, 4, 7.

ADDITIONAL READINGS

- W. Godley (1999). Seven Unsustainable Processes. *Levy Institute Strategic Analysis*, January 1999.
- C.H. Dos Santos (2006). Keynesian Theorising During Hard Times: Stock-Flow Consistent Models as an Unexplored 'Frontier' of Keynesian Macroeconomics. *Cambridge Journal of Economics*, 30 (4), 541-565.
- M. Nikiforos and G. Zezza (2017). Stock-Flow Consistent macroeconomic Models: A Survey. *Journal of Economic Surveys*, 31 (5), 1204-1239.
- M. Veronese Passarella (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.

Useful web resources for SFC modellers

- Yannis Dafermos and Maria Nikolaidi: https://yannisdafermos.com/sfc-modelling/
- Antoine Godin: http://www.antoinegodin.eu/
- Karsten Kohler: https://karstenkohler.com/
- Joao Macalos: https://joaomacalos.github.io/sfcr/index.html
- Marco Veronese Passarella: https://www.marcopassarella.it/en/teaching-2/
- Gennaro Zezza: https://gennaro.zezza.it/?page_id=10&lang=en

Thanks

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