



Stock-Flow-Consistent Macro Models: An Overview

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Outline

1. **Reasons to be interested**
2. SFC & current debate on macroeconomics
3. Historical background
4. Main principles of SFC modeling
5. Model closures
6. Open economy models
7. Applications

Why is it of interest?

- ▶ The SFC approach provides a tight framework for modeling the interactions between real and financial markets
- ▶ It has a rigorous, yet flexible structure to accommodate alternative theoretical – and empirical – closures
- ▶ In its post-Keynesian version, it has been found to be effective to understand/predict financial or economic crisis (Bezemer 2010)

Examples

Godley (1999) “Seven unsustainable processes”

Predicted the 2001 recessions

Godley – Zezza (2006) “Debt and lending”

Predicted the 2007 recessions

Papadimitriou – Nikiforos – Zezza (2013) “The Greek Economic Crisis and the Experience of Austerity”

Better projections of Greek depression vs IMF, etc.

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The debate on macro

Olivier J. Blanchard (2008) “The state of macro”, NBER WWP

“a largely shared vision both of fluctuations and of methodology has emerged ... the state of macro is good”

Blanchard (2014) “Where Danger Lurks”, Finance and Development, IMF, Sep.

“If macroeconomic policy and financial regulation are set in such a way as to maintain a healthy distance from dark corners, then our models that portray normal times may still be largely appropriate ... Trying to create a model that integrates normal times and systemic risks may be beyond the profession’s conceptual and technical reach at this stage.”

The debate on macro #2

Ray Fair (2012) “Has macro progressed?”, Journal of Macroeconomics

“If the macro 2 message is not sensible or its methodology is not feasible for estimating realistic models, it is perhaps time to move back to macro 1 (the Cowles Commission approach)”

Paul Romer (2016) “The trouble with macroeconomics”, The American Economist

“In the last three decades, the methods and conclusions of macroeconomics have deteriorated to the point that much of the work in this area no longer qualifies as scientific research”

The debate on macro #3

Ricardo Reis (2017) “Is something really wrong with macroeconomics?”, forthcoming

“most critiques of the state of macroeconomics are off target ... (but) perhaps that there is too little discussion of which models to teach”

Simon Wren-Lewis (2017) “Ending the Microfoundations Hegemony”, forthcoming

Compares SEMs to DSGE, suggests coexistence

Where does the SFC approach stand?

Methodology similar to the Cowles Commission approach

The economy is demand-driven, even in the long run

Disequilibria in the short term imply adjustments

Emphasis on the analysis of stock-flow and flow-flow norms
(example: debt/income ratio, debt burden/income)

SFC approach ignored so far, but...

Burgess, Stephen, Oliver Burrows, Antoine Godin, Stephen Kinsella, and Stephen Millard (2016) “A Dynamic Model of Financial Balances for the United Kingdom.” Bank of England Staff Working Paper No. 614, September. London: Bank of England.

Michael G. Miess - Stefan Schmelzer (2016) “Stock-flow Consistent Modelling of Real-Financial Cycles and Balance Sheet Dynamics” (model for Austria)

Citations start to appear in ECB staff papers

Three projects devoted to build a SFC model for Italy...

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Origins

- ▶ Copeland (1947)
- ▶ Godley and Cripps (1983)
- ▶ Tobin (1969)
- ▶ Others include Davidson (1968); Eichner (1987); Taylor (1983); Skott (1989); Foley (1982)
- ▶ Main reference: Godley and Lavoie (2007)
- ▶ Recent survey in [Nikiforos – Zezza \(2017\)](#)

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Main principles: #1

Horizontal consistency

- 1) Everything comes from somewhere and goes somewhere: no black holes (income for somebody is a payment from somebody else)

This principle is relative to monetary flows.

A Social Accounting Matrix (SAM) is a good way to ensure that the first principle is respected.

An alternative is the Transaction Matrix

Main principles: #2

Vertical consistency

- 2) Every transaction involves at least two entries within each unit

Example: consumer expenditure implies, say, a reduction in the consumer's cash balance

(link between real side and financial side of the economy, or between income-expenditure accounts and flow of funds)

Main principles: #3

Flows-to-stocks consistency

- 3) Every flow implies the change in one or more stocks

$$S_t = S_{t-1} + F_t + CG_t$$

Where net capital gains CG are given by

$$CG_t = \Delta p \cdot s_{t-1}$$

Where p is the market price of the stock, and $S = p \cdot s$

Introduces dynamics and possibly path-dependency

Main principles: #4

Stocks consistency

- 4) The financial liabilities of an agent or sector are the financial assets of some other agent or sector

Net financial wealth for all sectors (including the foreign sector) must be zero.

Main principles

Quadruple entry

These principles, taken together, imply that every transaction involves a quadruple entry in accounting (Copeland)

For example, when a household purchases a product from a firm, the accounting registers an increase in the revenues of the firm and the expenditure of the household, and at the same time a decrease in at least one asset (or increase in a liability) of the household and correspondingly an increase in at a least one asset of the firm.

Table 1: Balance-Sheet Matrix

	(1)	(2)	(3)	(4)	(5)	(6)
	Households	Production Firms	Government	Central Bank	Banks	Total
(A) Fixed capital		$+PK$				$+PK$
(B) HPM	$+H_h$			$-H_{cb}$		0
(C) Deposits	$+D_h$				$-D_b$	0
(D) Loans	$-L_h$	$-L_c$			$+L_b$	0
(E) Bills	$+B_h$		$-B_g$	$+B_{cb}$	$+B_b$	0
(F) Bonds	$+p_{bl}BL_h$		$-p_{bl}BL_g$	$+p_{bl}BL_{cb}$	$+p_{bl}BL_b$	0
(G) Equities	$+p_eE_h$	$-p_eE_c$			$+p_eE_b$	0
(H) Balance (net worth)	$-V_h$	$-V_c$	$-V_g$	$-V_{cb}$	$-V_b$	$-PK$
(I) Sum	0	0	0	0	0	0

Table 2: Transactions-Flows Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Households	NFC		Government	Central Bank	Banks	Total
		Current	Capital				
Transactions							
(A) Consumption	$-PC$	$+PC$					0
(B) Investment		$+PI$	$-PI$				0
(C) Gov. Expenditure		$+PG$		$-PG$			0
(D) <i>[memo: Output]</i>		$[PY]$					
(E) Wages	$+W$	$-W$					0
(F) NFC Profits	$+\Pi_{c,d}$	$-\Pi_c$	$+\Pi_{c,r}$				0
(G) Taxes	$-T_h$		$-T_c$	$+T$		$-T_b$	0
(H) C.B. Profits				$+\Pi_{cb}$	$-\Pi_{cb}$		0
(I) Interest on Deposits	$+r_{d-1}D_{h-1}$					$-r_{d-1}D_{h-1}$	0
(J) Interest on Loans	$-r_{l-1}L_{h-1}$		$-r_{l-1}L_{c-1}$			$+r_{l-1}L_{b-1}$	0
(K) Interest on Bills	$+r_{b-1}B_{h-1}$			$-r_{b-1}B_g$	$+r_{b-1}B_{cb-1}$	$+r_{b-1}B_{b-1}$	0
(L) Interest on Bonds	$+r_{bl-1}BL_{h-1}$			$-r_{bl-1}BL_g$	$+r_{bl-1}BL_{cb-1}$	$+r_{bl-1}BL_{b-1}$	0
Flow of Funds							
(M) <i>[memo: Net Lending]</i>	$[NL_h]$		$[NL_c]$	$[NL_g]$	$[NL_{cb}]$	$[NL_b]$	0
(N) Δ in HPM	$-\Delta H_h$				$+\Delta H$		0
(O) Δ in Deposits	$-\Delta D_h$					$+\Delta D_b$	0
(P) Δ in Loans	$+\Delta L_h$		$+\Delta L_c$			$-\Delta L_b$	0
(Q) Δ in Bills	$-\Delta B_h$			$+\Delta B_g$	$-\Delta B_{cb}$	$-\Delta B_b$	0
(R) Δ in Bonds	$-p_{bl}\Delta BL_h$			$+p_{bl}\Delta BL_g$	$-p_{bl}\Delta BL_{cb}$	$-p_{bl}\Delta BL_b$	0
(S) Δ in Equities	$-p_e\Delta E_h$		$+p_e\Delta E_c$			$-p_e\Delta E_b$	0
(T) Sum	0	0		0	0	0	0

Main principles #5

Stocks-to-flows feedbacks

In the accounting (i.e. interest payments depend on the opening stock of debt)

In “behavioral” assumptions:

Real wealth affects consumption

The stock of capital affects investment, etc.

Steady-growth requires **stable stock-flow norms**

Main principles

Emphasis on consistency

$$NL_h + NL_c + NL_b + NL_g = 0$$

For example, a government surplus ($NL_h > 0$) implies that at least another sector is a net borrower

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Closing the model

By “model closure” we mean how we set the direction of causality among the macroeconomic variables

- ▶ Components of expenditure
- ▶ How is expenditure financed
- ▶ How sectors manage their financial portfolio
- ▶ Behavioral rules for the financial sector
- ▶ How are wages/prices determined

General rule: stocks feed back on flows

Consumption

A simple approach

$$C_t = \alpha_1 \cdot YD_t^e + \alpha_2 \cdot \frac{Vh_{t-1}}{p_t}$$

When

$$YD_t^e = YD_t$$

Implies simultaneity between C and YD, while

$$YD_t^e = YD_{t-1}$$

Makes the system possibly recursive

Note the dynamics between YD-C=Saving $\gg \Delta Vh$

(C=real consumption, YD=real disposable income, Vh=nominal stock of wealth)

Investment

$$g_t = \frac{I_t}{K_{t-1}} = \beta_0 + \beta_1 \cdot \frac{RP_t}{p_t \cdot K_{t-1}} - \beta_2 \cdot \frac{L_{t-1}}{p_t \cdot K_{t-1}} + \beta_3 \cdot u_{t-1}$$

(possibly plus additional effects)

(I=real investment, K=real stock of capital, RP=retained profits; L=stock of debt outstanding; u=utilization rate)

Where

$$u_t = \frac{Y_t}{K_t}$$

(Y=real output)

Portfolio choice

Example

$$\begin{bmatrix} M \\ B \\ E \end{bmatrix} = \begin{bmatrix} \lambda_{10} \\ \lambda_{20} \\ \lambda_{30} \end{bmatrix} \cdot V + \begin{bmatrix} \lambda_{11} & \lambda_{12} & \lambda_{13} \\ \lambda_{21} & \lambda_{22} & \lambda_{23} \\ \lambda_{31} & \lambda_{32} & \lambda_{33} \end{bmatrix} \cdot \begin{bmatrix} 0 \\ r \\ re \end{bmatrix} \cdot V + \begin{bmatrix} \lambda_{14} \\ \lambda_{24} \\ \lambda_{34} \end{bmatrix} \cdot Y$$

λ_{i0} represent normal shares

$$\lambda_{11}; \lambda_{22}; \lambda_{33} > 0$$

$$\lambda_{12} = \lambda_{21}; \lambda_{13} = \lambda_{31}; \lambda_{23} = \lambda_{32} < 0$$

$$\lambda_{14} > 0; \lambda_{24} < 0; \lambda_{34} < 0$$

Banks and monetary policy

In a simple setting, money is endogenous at the given target interest rate

The Central Bank sets the target rate for refinancing

Banks are willing to lend at a premium over the target rate

But other closures are possible

Supply side

- ▶ Productivity usually exogenous, or dependent on production
- ▶ Prices given by a mark-up over direct unit costs
- ▶ Employment level given by the level of output
- ▶ Unemployment rate determined by employment level and demographics
- ▶ Wages influenced by unemployment

Parameters

Different approaches: estimation, calibration

The identification problem of structural models

- ▶ ECMs
- ▶ A pragmatic approach

Short-run equilibrium

When adopting the Tobinesque closure for portfolio management, financial markets are cleared by price movements. But demand is based on expected relative returns on the asset, so one stock acts as a buffer when expectations are not fulfilled

Output movement ensures that aggregate saving equals investment

Long-run equilibrium

Long-run equilibrium is the result of the sequence of short-term adjustments

Not necessarily at a NAIRU

Different closures based on the assumptions about the rate of capacity. Do firms have a fixed target rate of capacity? Or is the target rate adjusting?

In any case, long-run model behavior is examined through stock-flow norms and how they react to shocks

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Open economy SFC models

Full S-F consistency requires that the open economy is modeled taking into account the willingness of other countries to accommodate imbalances in the domestic economy.

In some cases, through a fully specified model for each country

A CA surplus for X implies a CA deficit for someone else

Export-led strategy for all is not feasible

Open economy: the role of CBs

Godley and Lavoie (2007) present a three-country model that discusses the eurozone economy. In a somewhat prophetic manner, they stress that the situation in the eurozone in the presence of imbalances would be sustainable as long as the ECB was willing to accumulate an ever-rising quantity of bills from the “weak” country (the country with external deficits). If not, interest rates in the weak country would keep on rising. The only alternative would be for the government of the weak country to endogenize fiscal policy: essentially to create a recession that would decrease imports and rebalance the current account.

The role of the exchange rate

In open economy models, consistency between the CA balances on one side, and supply and demand for financial assets on the other, allow for sophisticated determination of the exchange rate

An endogenous exchange rate provides additional feedbacks from financial markets to real markets

The three balances

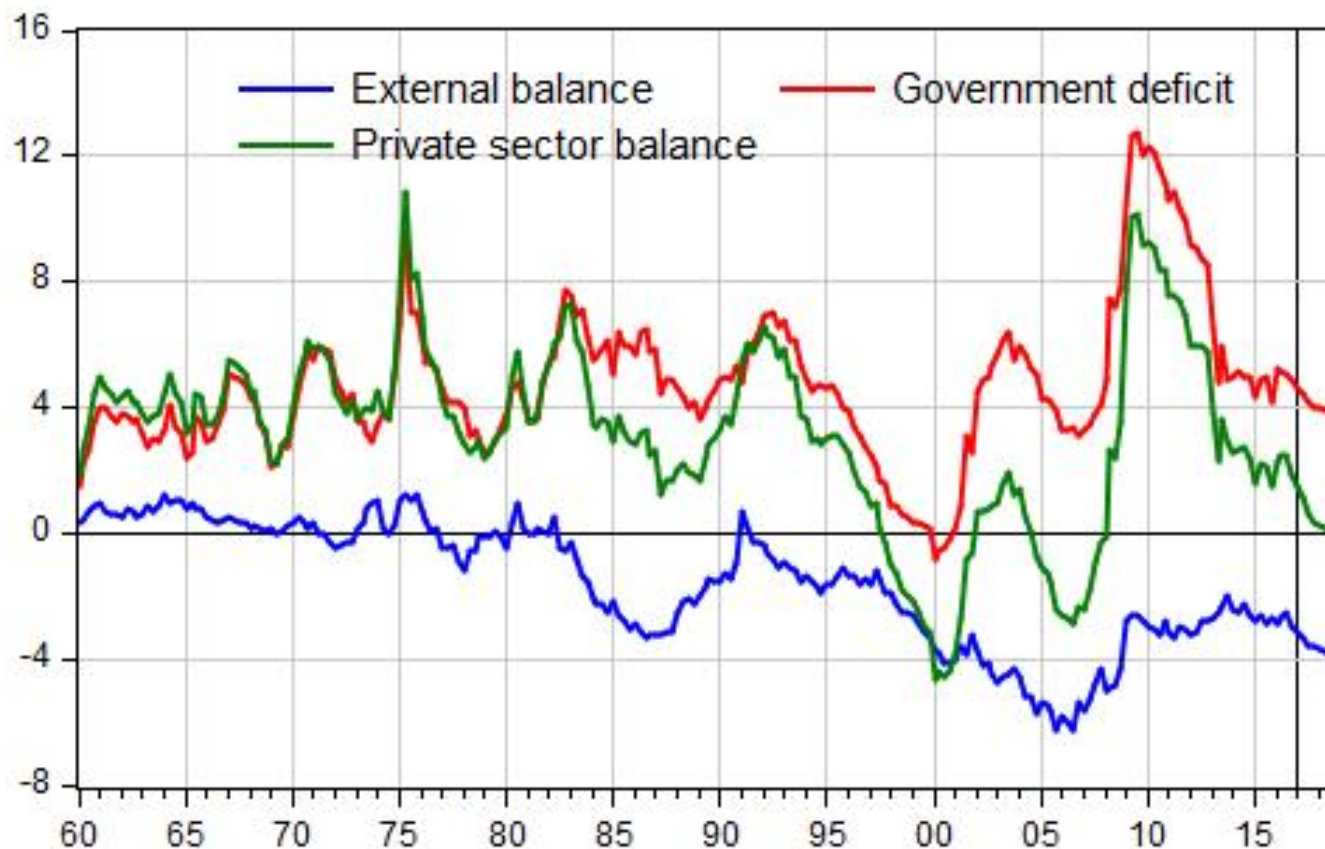
Godley's empirical models introduced the analysis of the three balances, which has become influential

$$\{NL_h + NL_c + NL_b\} + NL_g + NL_f = 0$$

$$+NL_p = DEF + CA$$

Financial balances in the U.S.

U.S. Financial balances



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Financialization

Analysis of the growing role of finance, of the shadow banking system, etc.

Minsky moment

The housing bubble

Role of income distribution

Agent-based models

Does macro need micro-foundations?

ABMs allow for addressing a rich set of research questions with heterogeneous agents

SFC requirements make sure that micro ABMs fulfill appropriate budget constraints at the macro level

Whole-country models

Levy macro group: U.S.; Greece; Ecuador

Limerick-Kingston: Ireland; U.K.

Others: Austria

Environment

Integration of I-O analysis into SFC models

Interaction with the environment (emissions, use of natural resources, etc.)

Links

- ▶ <http://sfc-models.net>
- ▶ FB group: Stock-Flow Consistent (SFC) Modeling