Post-Keynesian stock-flow consistent modelling: theory and methodology

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Introduction

- Over the past decade, post-Keynesian **stock-flow consistent** (SFC) modelling has become a dominant approach in heterodox macro modelling, largely due to the works of Wynne Godley and Marc Lavoie (see, e.g., Godley and Lavoie, 2007).
- This approach has proved quite successful in formulating the complex interactions between the **financial** and the **real** spheres of the economy.
- It has also proved quite useful in capturing empirical developments. For example, at the Levy Economics Institute **Wynne Godley** and his macro modelling team used the stock-flow consistent approach in order to model the US economy. This allowed them to predict many problems related to the global financial crisis.

Introduction

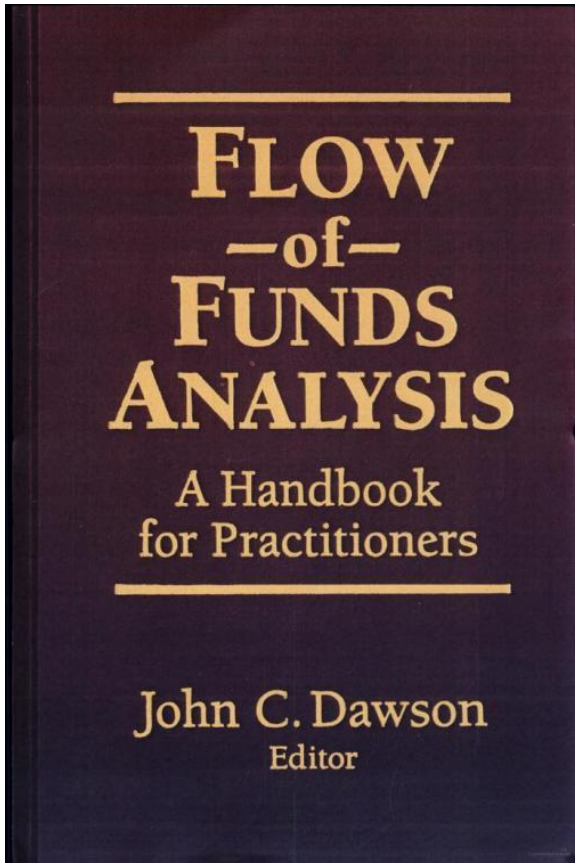
- There is currently a lot of research that takes place on **theoretical SFC modelling**. One of the reasons that explains that is that SFC models are characterised by a high *flexibility* that allows them to be deployed for the analysis of a wide range of topics (e.g. financialisation, income distribution, fiscal and monetary policies).
- There is also research on **empirical SFC modelling**. However, it is clear that the empirical SFC literature is much less developed than the theoretical one. Interestingly, there are some indirect links between the empirical SFC literature and some projects on *flow-of-funds* that take place in central banks (see, for example, Barwell and Barrows, 2011).

Contents

1. Background of SFC models

Morris Copeland

- The SFC approach is very much related to the **flow-of-funds analysis** which goes back to **Morris Copeland (1949)** who was the main originator of the US flow-of-funds data.
- Copeland wanted to construct a framework in order to answer the following questions:
- '*When total purchases of our national product increase, where does the money come from to finance them? When purchases of our national product decline, what becomes of the money that is not spent?*' (Copeland 1949 (1996:7)).



1. Background of SFC models

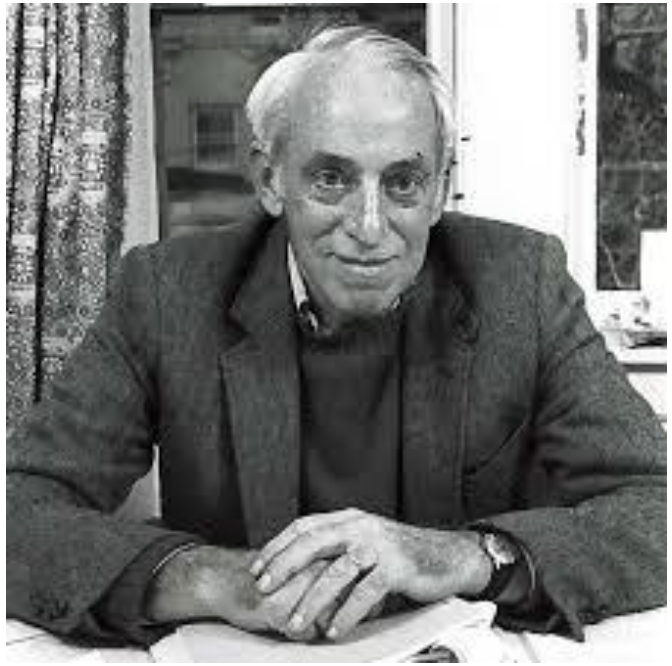
Morris Copeland

- The new 1968 **System of National Accounts (SNA)** (confirmed with the revised 1993 SNA) provided a theoretical scheme that emphasised the integration of the national income accounts with financial transactions, capital stocks and balance sheet. In so doing, it answered the concerns of Copeland.
- However, it is remarkable that **most mainstream macroeconomists** were unwilling to explicitly incorporate financial stocks and flows in their models.
- Moreover, the **quadruple-entry principle** (which is fundamental for the SFC approach) is also attributed to Copeland (1949). Copeland (1949 (1996: 8)) points out that: *'because money flows transactions involve two transactors, the social accounting approach to money flows rests not on a double-entry system but on a quadruple-entry system'*.

1. Background of SFC models

James Tobin

- The **Yale group** of James Tobin developed various features of the contemporary SFC models (see, e.g., Backus et al., 1980; Tobin, 1982).
- In Tobin's models there are **balance sheets** that track stocks, there is a **portfolio allocation** of assets based on the rate of return on assets and not only on one rate of return (see IS-LM models), there are **budget and adding up constraints** in the allocation of assets and the **financial and monetary policy operations** are explicitly formulated.



1. Background of SFC models

James Tobin

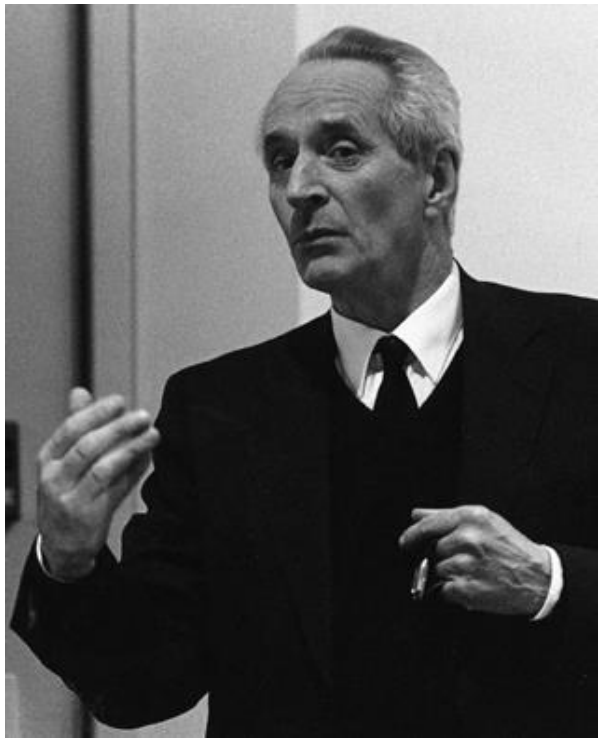
- In his **Nobel Prize acceptance speech**, Tobin (1982) argues that a proper macroeconomic framework should:

1. *integrate stocks and flows into the analysis, and their accounting must be done in a fully coherent manner;*
2. *include a multitude of sectors and of assets, each with its own rate of return;*
3. *incorporate all monetary and financial operations, and thus integrate the central bank and commercial banks;*
4. *have no 'black holes': all flows must inevitably have an origin and a destination; all budget and portfolio adding-up constraints must be respected, both for behavioural relations and for the actual values of the variables.*

1. Background of SFC models

Wynne Godley

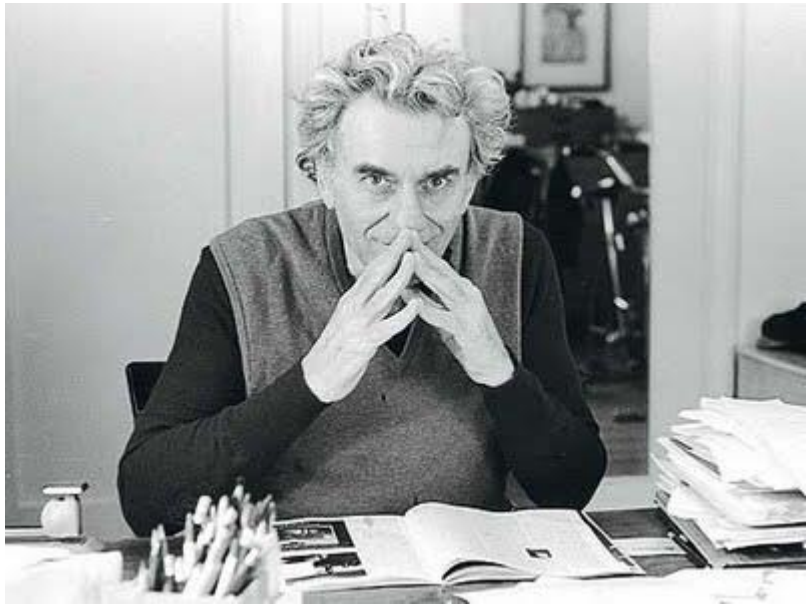
- In the 1970s and 1980s the **Cambridge Economic Policy Group** of Wynne Godley used the stock-flow consistent framework primarily for forecasting purposes. The main idea was to identify unsustainable processes in the UK economy.
- In a very influential macroeconomic book, Godley and Cripps (1983: 18) argue that: *'The fact that money stocks and flows must satisfy accounting identities in individual budgets and in an economy as a whole provide a fundamental law of macroeconomics, analogous to the principle of conservation of energy in physics'*.
- The work of Wynne Godley in the **1990s** shaped the features of the contemporary SFC models.



1. Background of SFC models

Hyman Minsky

- *'One way every economic unit can be characterized is by its portfolio: the set of tangible and **financial assets** it owns and the **financial liabilities** on which it owes'* (Minsky 1975: 70; emphasis added).
- *'To analyze how financial commitments affect the economy it is necessary to look at economic units in terms of their **cash flows**. The cash-flow approach looks at all units – be they households, corporations, state, and municipal governments, or even national governments – as if they were banks'* (Minsky 1986 (2008: 221); emphasis added).



1. Background of SFC models

Paul Davidson

- *'It will be the objective of the historical model developed below to provide a simple analysis of capital accumulation by blending the **stock** and **flow elements** in the demand and supply of (i) real capital, (ii) money, and (iii) securities…with the more familiar concepts…of effective demand developed in the General Theory. Within such a framework it is possible to provide more perspective on the interplay among organised security exchanges, corporate financing policy, investment underwriters and the banking system in **channelling the funds** that are necessary for capital accumulation. Regrettably, this is an analysis which is virtually ignored in most 'analytical' Post-Keynesian models'* (Davidson 1972: 31; emphasis added).

2. Features of the post-Keynesian SFC models

a. **There are no black holes**: 'Everything comes from somewhere and goes somewhere'. This is ensured by using three matrices: (i) the balance sheet matrix, (ii) the transactions flows matrix and (iii) the full-integration matrix.

b. **The financial and the real spheres are integrated:** Following the post-Keynesian tradition on the non-neutrality of money and finance, the SFC models explicitly formulate the various links between financial and real variables.

c. **Behavioural equations are based on post-Keynesian assumptions:** The behavioural equations are constructed following post-Keynesian theories.

2. Features of the post-Keynesian SFC models

a. There are no black holes

- The **balance sheet matrix** shows the assets and the liabilities of the institutional sectors of the economy.
- This matrix ensures that **'someone's financial assets are someone else's financial liabilities'**.
- The **assets** are shown with a plus sign while the **liabilities** are denoted by a minus sign.
- The last line of the matrix shows the net wealth of each sector. The net wealth is defined by the difference between the assets and the liabilities.
- All columns and all rows that contain financial assets or liabilities must sum to zero. However, the row that contains the capital stock of firms (a real asset) does not sum to zero.

2. Features of the post-Keynesian SFC models

Balance sheet matrix

	Households	Firms	Commercial banks	Central bank	Total
Deposits	+M		-M		0
Loans		-L	+L		0
Equities	$+p_e e$	$-p_e e$			0
Capital		+K			+K
High-powered money			+HPM	-HPM	0
Advances			-A	+A	0
Total (net worth)	$+V_h$	$+V_f$	0	$+V_{cb}$	+K

2. Features of the post-Keynesian SFC models

a. There are no black holes

- The **transactions flow matrix** depicts the transactions that occur between the institutional sectors of the economy (each row represents a transaction).
- This matrix ensures that **'someone's inflows are someone else's outflows'** .
- For each sector **inflows** are denoted by a plus sign and **outflows** are denoted by a minus sign.
- The upper part of the matrix shows transactions that are related with the revenues and expenditures of the various sectors. The bottom part of the matrix indicates changes in financial assets and liabilities that arise from transactions.
- The columns represent the **budget constraints** of the sectors.

2. Features of the post-Keynesian SFC models

Transactions flow matrix

	Households	Firms		Commercial banks		Central bank		Total
		Current	Capital	Current	Capital	Current	Capital	
Consumption	-C	+C						0
Investment		+I	-I					0
Wages	+W	-W						0
Firms' profits	+DP	-TP	+RP					0
Banks' profits	+BP			-BP				0
Central bank's profits						-CBP	+CBP	0
Interest on deposits	$+r_M M_{-1}$			$-r_M M_{-1}$				0
Interest on loans		$-r_L L_{-1}$		$+r_L L_{-1}$				0
Interest on advances				$-r_A A_{-1}$		$+r_A A_{-1}$		0
Change in deposits	$-\Delta M$				$+\Delta M$			0
Change in loans			$+\Delta L$		$-\Delta L$			0
Change in equities	$-p_e \Delta e$		$+p_e \Delta e$					0
Change in high-powered money					$-\Delta HPM$		$+\Delta HPM$	0
Change in advances					$+\Delta A$		$-\Delta A$	0
Total	0	0	0	0	0	0	0	0

2. Features of the post-Keynesian SFC models

a. There are no black holes

- In order to integrate the balance sheet matrix with the transactions flow matrix we use the **full-integration matrix**.
- The **first row** of the full-integration matrix is related to the last row of the balance sheet matrix representing the initial net wealth of each sector.
- The **last row** shows the new net wealth, which is estimated by using: (i) the initial net wealth of each sector from the balance sheet matrix, (ii) the change in net assets arising from transactions from the transactions flow matrix and (iii) the change in the prices of assets/liabilities.
- The **acquisition of a financial asset** is denoted by a plus sign because it adds something to the wealth. However, in the transactions flow matrix it has a minus sign since it is part of the use of funds.

2. Features of the post-Keynesian SFC models

Full-integration matrix

		Households	Firms	Commercial banks	Central bank	Total
	Net wealth, end of previous period	V_{h-1}	V_{f-1}	0	V_{cb-1}	K_{-1}
Change in net assets arising from transactions	Change in deposits	$+\Delta M$		$-\Delta M$		0
	Change in loans		$-\Delta L$	$+\Delta L$		0
	Change in equities	$+p_e\Delta e$	$-p_e\Delta e$			0
	Change in capital		$+p_k\Delta k$			$+p_k\Delta k$
	Change in high-powered money			$+\Delta HPM$	$-\Delta HPM$	0
	Change in advances			$-\Delta A$	$+\Delta A$	0
Change in net assets arising from revaluations	Capital gains in equities	$+e_{-1}\Delta p_e$				0
	Capital gains in capital		$+k_{-1}\Delta p_k$			$+k_{-1}\Delta p_k$
	Net wealth, end of current period	V_h	V_f	0	V_{cb}	K

2. Features of the post-Keynesian SFC models

a. There are no black holes

- The full-integration matrix ensures that the balance sheets always balance across sectors and the impact of flows on balance sheets is always recorded.
- In **most published SFC papers** the full-integration matrix is not presented. However, it is implicitly used in the accounting identities.
- In some cases the revaluation matrix is reported (this matrix is part of the full-integration matrix).

2. Features of the post-Keynesian SFC models

b. The financial and the real spheres are integrated

- The post-Keynesian SFC models integrate the real with the financial side of the economy.
- All SFC models have **at least one financial asset/liability**.
- Money is introduced both as a **stock** and as a **flow** variable.
- Two **examples** of the real sector-financial sector interlinkages are the following:

1. Finance of the investment of firms (via loans and equities).
2. Portfolio choice effects on consumption and investment.

2. Features of the post-Keynesian SFC models

b. The financial and the real spheres are integrated

- Let us concentrate on the **finance of firms' investment via loans**.
- We can use Copeland's **quadruple-entry principle** and the **transactions flow matrix** in order to show how this takes place.
- We consider **two steps**. In the *first step* firms ask for finance and, as a result, loans and deposits are created by banks. In the *second step* deposits of firms are transferred by cheques to the workers that provide their labour to firms.

2. Features of the post-Keynesian SFC models

First step: Firms ask for finance

	Households	Firms		Commercial banks	Total
		Current	Capital		
Consumption					0
Investment					0
Wages					0
Change in deposits			-ΔM	+ΔM	0
Change in loans			+ΔL	-ΔL	0
Total	0	0	0	0	0

2. Features of the post-Keynesian SFC models

Second step: Firms pay the wages to households

	Households	Firms		Commercial banks	Total
		Current	Capital		
Consumption					0
Investment		+I	-I		0
Wages	+W	-W			0
Change in deposits	-ΔM			+ΔM	0
Change in loans			+ΔL	-ΔL	0
Total	0	0	0	0	0

2. Features of the post-Keynesian SFC models

b. The financial and the real spheres are integrated

- The **portfolio choice** (i.e. the allocation of wealth of households among financial assets) is determined by the (expected) relative rates of return and liquidity preference.
- The portfolio choice can affect the **price of financial assets** (e.g. government bonds or equities) having feedback effects on consumption (since wealth is incorporated in the consumption function) and investment (if, for example, Tobin's q is included in the investment function).
- Therefore, the SFC models can easily formulate the interactions between the real economy and the financial market which, for example, were considered very important in the analyses of **Davidson** and **Minsky**.

2. Features of the post-Keynesian SFC models

c. Behavioural equations are based on post-Keynesian assumptions

- Labour and product markets do not clear through changes in wages and prices (as in neoclassical models). On the contrary, they clear via the **adjustment of supply to demand**.
- The **pricing mechanism** only plays a clearing role in the **financial markets**.
- Although the post-Keynesian SFC models are primarily demand-led, it is possibly to introduce **supply-side** effects (e.g. by including a Phillips curve or loan defaults).
- The **decisions of households** are formulated using **Davidson**'s two-step decision process: The **1st step** refers to the decision about the proportion of income that will be saved. The **2nd step** refers to the way that savings will be allocated between the various assets (portfolio choice).

2. Features of the post-Keynesian SFC models

c. Behavioural equations are based on post-Keynesian assumptions

- In many behavioural equations economic agents have **stock-flow targets** (e.g. wealth-to-income ratios, debt-to-income ratios, inventories-to-sales ratios) and **react to disequilibria** in order to achieve these targets.
- There is **no utility maximisation**.

3. How can we construct an SFC model?

- This section presents the steps through which an SFC model can be constructed.
- The steps are presented by using **three** different **models**.
- The **codes** for the solution of these models in **EViews** are provided in the accompanied pdf file.

3. How can we construct an SFC model? Model 1

Model 1

Suppose that we have an economy with the following features:

- There are three sectors: households, production sector and government.
- **Households** accumulate savings in the form of money (government debt).
- The **production sector** produces output.
- The **government** issues debt in order to cover government expenditures and interest payments.

This is a model with **outside (or government) money**. Generally speaking, outside money is the money that is issued by public institutions.

3. How can we construct an SFC model? Model 1

- **Step 1**: We construct the balance sheet matrix.

	Households	Production sector	Government	Total

3. How can we construct an SFC model? Model 1

- **Step 1**: We construct the balance sheet matrix.

	Households	Production sector	Government	Total
Money (government debt)	+M		-M	0
Total (net worth)	+M	0	-M	0

3. How can we construct an SFC model? Model 1

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Total
Total	0	0	0	0

3. How can we construct an SFC model? Model 1

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Total
Gov. expenditures		+G	-G	0
Total	0	0	0	0

3. How can we construct an SFC model? Model 1

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Total
Gov. expenditures		+G	-G	0
Consumption	-C	+C		0
Total	0	0	0	0

3. How can we construct an SFC model? Model 1

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Total
Gov. expenditures		+G	-G	0
Consumption	-C	+C		0
Income (or GDP)	+Y	-Y		0
Total	0	0	0	0

3. How can we construct an SFC model? Model 1

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Total
Gov. expenditures		+G	-G	0
Consumption	-C	+C		0
Income (or GDP)	+Y	-Y		0
Interest payments on money (government debt)	$+rM_{-1}$		$-rM_{-1}$	0
Total	0	0	0	0

3. How can we construct an SFC model? Model 1

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Total
Gov. expenditures		+G	-G	0
Consumption	-C	+C		0
Income (or GDP)	+Y	-Y		0
Interest payments on money (government debt)	$+rM_{-1}$		$-rM_{-1}$	0
Change in money (government debt)	$-\Delta M$		$+\Delta M$	0
Total	0	0	0	0

3. How can we construct an SFC model? Model 1

- **Step 3**: We identify the endogenous variables of the model using the transactions flow matrix and the balance sheet matrix.

	Households	Production sector	Government	Total	
Gov. expenditures		+G	-G	0	G
Consumption	-C	+C		0	C
Income (or GDP)	+Y	-Y		0	Y
Interest payments on money (government debt)	$+rM_{-1}$		$-rM_{-1}$	0	
Change in money (government debt)	$-\Delta M$		$+\Delta M$	0	M
Total	0	0	0	0	

3. How can we construct an SFC model? Model 1

- **Step 3**: We identify the endogenous variables of the model using the transactions flow matrix and the balance sheet matrix.

	Households	Production sector	Government	Total
Money (government debt)	+M		-M	0
Total (net worth)	+M	0	-M	0

3. How can we construct an SFC model? Model 1

- **Step 4**: We identify the identities and the buffer variables for each of these identities.

	Households	Production sector	Government	Total
Gov. expenditures		+G	-G	0
Consumption	-C	+C		0
Income (or GDP)	+Y	-Y		0
Interest payments on money (government debt)	$+rM_{-1}$		$-rM_{-1}$	0
Change in money (government debt)	-ΔM		+ΔM	0
Total	0	0	0	0

G

C

~~Y~~

~~M~~

$$M = M_{-1} + Y + rM_{-1} - C \qquad Y = C + G \qquad M_{red} = M_{-1} + G + rM_{-1}$$

3. How can we construct an SFC model? Model 1

- **Step 5**: For the rest variables we identify behavioural and supplementary equations.
- Households consume (***C***) a part of their income:

$$C = c_1 Y_{-1} + c_2 rM_{-1}$$

c_1 is the propensity to consume out of income (Y) and c_2 is the propensity to consume out of interest payments (rM_{-1}).

- The government expenditures (***G***) grow at an exogenously given rate (gg):

$$G = G_{-1}(1 + gg)$$

3. How can we construct an SFC model? Model 1

- **Step 6**: We put together the equations of the model.

Households and production sector:

- Consumption expenditures (***C***): $C = c_1 Y_{-1} + c_2 r M_{-1}$
- Money or government debt (***M***) (identity): $M = M_{-1} + Y + r M_{-1} - C$
- Income (***Y***) (identity): $Y = C + G$

Government:

- Government expenditures (***G***): $G = G_{-1}(1 + gg)$
- Money or government debt (redundant identity): $M_{red} = M_{-1} + G + r M_{-1}$

3. How can we construct an SFC model? Model 2

Model 2

Suppose that we have an economy with the following features:

- There are three sectors: firms, households and banks.
- **Firms** make investment by using retained profits and loans. A part of firms' profits is distributed to households.
- **Households** accumulate savings in the form of deposits.
- **Banks** provide firm loans by creating deposits. Banks' profits are distributed to households.

This is a model with **inside (or private) money**. Generally speaking, private money is the money that is issued by private institutions.

3. How can we construct an SFC model? Model 2

- **Step 1**: We construct the balance sheet matrix.

	Households	Firms	Commercial banks	Total

3. How can we construct an SFC model? Model 2

- **Step 1**: We construct the balance sheet matrix.

	Households	Firms	Commercial banks	Total
Deposits	+M		-M	0

3. How can we construct an SFC model? Model 2

- **Step 1**: We construct the balance sheet matrix.

	Households	Firms	Commercial banks	Total
Deposits	+M		-M	0
Loans		-L	+L	0

3. How can we construct an SFC model? Model 2

- **Step 1**: We construct the balance sheet matrix.

	Households	Firms	Commercial banks	Total
Deposits	+M		-M	0
Loans		-L	+L	0
Capital		+K		+K

3. How can we construct an SFC model? Model 2

- **Step 1**: We construct the balance sheet matrix.

	Households	Firms	Commercial banks	Total
Deposits	+M		-M	0
Loans		-L	+L	0
Capital		+K		+K
Total (net worth)	+M	$+V_f$	0	+K

3. How can we construct an SFC model? Model 2

- **Step 2**: We construct the transactions flow matrix.

	Households	Firms		Commercial banks		Total
		Current	Capital	Current	Capital	
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 2

- **Step 2**: We construct the transactions flow matrix.

	Households	Firms		Commercial banks		Total
		Current	Capital	Current	Capital	
Consumption	-C	+C				0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 2

- **Step 2**: We construct the transactions flow matrix.

	Households	Firms		Commercial banks		Total
		Current	Capital	Current	Capital	
Consumption	-C	+C				0
Investment		+I	-I			0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 2

- **Step 2**: We construct the transactions flow matrix.

	Households	Firms		Commercial banks		Total
		Current	Capital	Current	Capital	
Consumption	-C	+C				0
Investment		+I	-I			0
Wages	+W	-W				0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 2

- **Step 2**: We construct the transactions flow matrix.

	Households	Firms		Commercial banks		Total
		Current	Capital	Current	Capital	
Consumption	-C	+C				0
Investment		+I	-I			0
Wages	+W	-W				0
Firms' profits	+DP	-TP	+RP			0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 2

- **Step 2**: We construct the transactions flow matrix.

	Households	Firms		Commercial banks		Total
		Current	Capital	Current	Capital	
Consumption	-C	+C				0
Investment		+I	-I			0
Wages	+W	-W				0
Firms' profits	+DP	-TP	+RP			0
Banks' profits	+BP			-BP		0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 2

- **Step 2**: We construct the transactions flow matrix.

	Households	Firms		Commercial banks		Total
		Current	Capital	Current	Capital	
Consumption	-C	+C				0
Investment		+I	-I			0
Wages	+W	-W				0
Firms' profits	+DP	-TP	+RP			0
Banks' profits	+BP			-BP		0
Interest on deposits	$+r_M M_{-1}$			$-r_M M_{-1}$		0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 2

- **Step 2**: We construct the transactions flow matrix.

	Households	Firms		Commercial banks		Total
		Current	Capital	Current	Capital	
Consumption	-C	+C				0
Investment		+I	-I			0
Wages	+W	-W				0
Firms' profits	+DP	-TP	+RP			0
Banks' profits	+BP			-BP		0
Interest on deposits	$+r_M M_{-1}$			$-r_M M_{-1}$		0
Interest on loans		$-r_L L_{-1}$		$+r_L L_{-1}$		0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 2

- **Step 2**: We construct the transactions flow matrix.

	Households	Firms		Commercial banks		Total
		Current	Capital	Current	Capital	
Consumption	-C	+C				0
Investment		+I	-I			0
Wages	+W	-W				0
Firms' profits	+DP	-TP	+RP			0
Banks' profits	+BP			-BP		0
Interest on deposits	$+r_M M_{-1}$			$-r_M M_{-1}$		0
Interest on loans		$-r_L L_{-1}$		$+r_L L_{-1}$		0
Change in deposits	-ΔM				+ΔM	0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 2

- **Step 2**: We construct the transactions flow matrix.

	Households	Firms		Commercial banks		Total
		Current	Capital	Current	Capital	
Consumption	-C	+C				0
Investment		+I	-I			0
Wages	+W	-W				0
Firms' profits	+DP	-TP	+RP			0
Banks' profits	+BP			-BP		0
Interest on deposits	$+r_M M_{-1}$			$-r_M M_{-1}$		0
Interest on loans		$-r_L L_{-1}$		$+r_L L_{-1}$		0
Change in deposits	-ΔM				+ΔM	0
Change in loans			+ΔL		-ΔL	0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 2

- **Step 3**: We identify the endogenous variables of the model using the transactions flow matrix and the balance sheet matrix.

	Households	Firms		Commercial banks		Total
		Current	Capital	Current	Capital	
Consumption	-C	+C				0
Investment		+I	-I			0
Wages	+W	-W				0
Firms' profits	+DP	-TP	+RP			0
Banks' profits	+BP			-BP		0
Interest on deposits	$+r_M M_{-1}$			$-r_M M_{-1}$		0
Interest on loans		$-r_L L_{-1}$		$+r_L L_{-1}$		0
Change in deposits	-ΔM				+ΔM	0
Change in loans			+ΔL		-ΔL	0
Total	0	0	0	0	0	0

C

I

W

DP

TP

RP

BP

M

L

3. How can we construct an SFC model? Model 2

- **Step 3**: We identify the endogenous variables of the model using the transactions flow matrix and the balance sheet matrix.

	Households	Firms	Commercial banks	Total
Deposits	+M		-M	0
Loans		-L	+L	0
Capital		+K		+K
Total (net worth)	+M	$+V_f$	0	+K

C
I
W
DP
TP
RP
BP
M
L

K

3. How can we construct an SFC model? Model 2

- **Step 4**: We identify the identities and the buffer variables for each of these identities.

	Households	Firms		Commercial banks		Total
		Current	Capital	Current	Capital	
Consumption	-C	+C				0
Investment		+I	-I			0
Wages	+W	-W				0
Firms' profits	+DP	-TP	+RP			0
Banks' profits	+BP			-BP		0
Interest on deposits	$+r_M M_{-1}$			$-r_M M_{-1}$		0
Interest on loans		$-r_L L_{-1}$		$+r_L L_{-1}$		0
Change in deposits	-ΔM				+ΔM	0
Change in loans			+ΔL		-ΔL	0
Total	0	0	0	0	0	0

C
I
W
~~DP~~ K
~~TP~~
RP
~~BP~~
~~M~~
~~L~~

$M = M_{-1} + W + Y_c - C$

$M_{red} = L$

$DP = TP - RP$

$TP = Y - W - r_L L_{-1}$

$L = L_{-1} + I - RP$

$BP = r_L L_{-1} - r_M M_{-1}$

3. How can we construct an SFC model? Model 2

- **Step 5**: For the rest variables we identify behavioural and supplementary equations.

Households:

- Wage income of households (***W***) is a proportion (s_w) of income (Y):

$$W = s_w Y$$

- Capital income of households ($\boldsymbol{Y_c}$) :

$$Y_c = DP + BP + r_M M_{-1}$$

- Consumption expenditures (***C***):

$$C = c_1 W_{-1} + c_2 Y_{c-1} + c_3 M_{-1}$$

c_1 is the propensity to consume out of wage income (W), c_2 is the propensity to consume out of capital income and c_3 is the propensity to consume out of deposits (M).

3. How can we construct an SFC model? Model 2

- **Step 5**: For the rest variables we identify behavioural and supplementary equations.

Firms:

- Investment (***I***) grows at a constant growth rate (g_k):

$$I = g_k K_{-1}$$

- Capital stock (***K***) is:

$$K = K_{-1} + I$$

- Income (***Y***) is:

$$Y = C + I$$

- Retained profits (***RP***) is a proportion (s_f) of total profits (TP):

$$RP = s_f TP$$

3. How can we construct an SFC model? Model 2

- **Step 6**: We put together the equations of the model.

Households:

- Wage income of households (***W***): $W = s_w Y$
- Capital income of households ($\boldsymbol{Y_c}$): $Y_c = DP + BP + r_M M_{-1}$
- Consumption expenditures (***C***): $C = c_1 W_{-1} + c_2 Y_{c-1} + c_3 M_{-1}$
- Change in deposits (identity) (***M***): $M = M_{-1} + W + Y_h - C$

Firms:

- Income (***Y***): $Y = C + I$
- Total profits of firms (identity) (***TP***): $TP = Y - W - r_L L_{-1}$

3. How can we construct an SFC model? Model 2

- **Step 6**: We put together the equations of the model.
- Retained profits (***RP***): $RP = s_f TP$
- Distributed profits (identity) (***DP***): $DP = TP - RP$
- Investment (***I***): $I = g_k K_{-1}$
- Capital stock (***K***): $K = K_{-1} + I$
- Loans (identity) (***L***): $L = L_{-1} + I - RP$

Banks:

- Profits of banks (identity) (***BP***): $BP = r_L L_{-1} - r_M M_{-1}$
- Deposits (redundant identity) (***M***): $M_{red} = L$

3. How can we construct an SFC model? Model 3

Model 3

Suppose that we have an economy with the following features:

- There are four sectors: Households, production sector, government and central bank.
- **Households** accumulate savings in the form of money (government debt).
- The **production sector** produces output.
- The **government** issues debt in order to cover government expenditures and interest payments. It also collects taxes.
- The **central bank** prints high-powered money to finance the debt that is not held by households.

This is a model with **outside money**.

3. How can we construct an SFC model? Model 3

- **Step 1**: We construct the balance sheet matrix.

	Households	Production sector	Government	Central bank	Total

3. How can we construct an SFC model? Model 3

- **Step 1**: We construct the balance sheet matrix.

	Households	Production sector	Government	Central bank	Total
High-powered money	+HPM			-HPM	0

3. How can we construct an SFC model? Model 3

- **Step 1**: We construct the balance sheet matrix.

	Households	Production sector	Government	Central bank	Total
High-powered money	+HPM			-HPM	0
Bills	$+B_h$		-B	$+B_{cb}$	0

3. How can we construct an SFC model? Model 3

- **Step 1**: We construct the balance sheet matrix.

	Households	Production sector	Government	Central bank	Total
High-powered money	+HPM			-HPM	0
Bills	$+B_h$		-B	$+B_{cb}$	0
Total (net worth)	+V	0	-B	0	0

3. How can we construct an SFC model? Model 3

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Central bank		Total
				Current	Capital	
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 3

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Central bank		Total
				Current	Capital	
Gov. expenditures		+G	-G			0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 3

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Central bank		Total
				Current	Capital	
Gov. expenditures		+G	-G			0
Consumption	-C	+C				0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 3

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Central bank		Total
				Current	Capital	
Gov. expenditures		+G	-G			0
Consumption	-C	+C				0
Income (or GDP)	+Y	-Y				0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 3

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Central bank		Total
				Current	Capital	
Gov. expenditures		+G	-G			0
Consumption	-C	+C				0
Income (or GDP)	+Y	-Y				0
Interest payments on bills	$+rB_{h-1}$		$-rB_{-1}$	$+rB_{cb-1}$		0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 3

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Central bank		Total
				Current	Capital	
Gov. expenditures		+G	-G			0
Consumption	-C	+C				0
Income (or GDP)	+Y	-Y				0
Interest payments on bills	$+rB_{h-1}$		$-rB_{-1}$	$+rB_{cb-1}$		0
Taxes	-T		+T			0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 3

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Central bank		Total
				Current	Capital	
Gov. expenditures		+G	-G			0
Consumption	-C	+C				0
Income (or GDP)	+Y	-Y				0
Interest payments on bills	$+rB_{h-1}$		$-rB_{-1}$	$+rB_{cb-1}$		0
Taxes	-T		+T			0
Central bank profits			$+rB_{cb-1}$	$-rB_{cb-1}$		0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 3

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Central bank		Total
				Current	Capital	
Gov. expenditures		+G	-G			0
Consumption	-C	+C				0
Income (or GDP)	+Y	-Y				0
Interest payments on bills	$+rB_{h-1}$		$-rB_{-1}$	$+rB_{cb-1}$		0
Taxes	-T		+T			0
Central bank profits			$+rB_{cb-1}$	$-rB_{cb-1}$		0
Change in bills	$-\Delta B_h$		$+\Delta B$		$-\Delta B_{cb}$	0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 3

- **Step 2**: We construct the transactions flow matrix.

	Households	Production sector	Government	Central bank		Total
				Current	Capital	
Gov. expenditures		+G	-G			0
Consumption	-C	+C				0
Income (or GDP)	+Y	-Y				0
Interest payments on bills	$+rB_{h-1}$		$-rB_{-1}$	$+rB_{cb-1}$		0
Taxes	-T		+T			0
Central bank profits			$+rB_{cb-1}$	$-rB_{cb-1}$		0
Change in bills	$-\Delta B_h$		$+\Delta B$		$-\Delta B_{cb}$	0
Change in high-powered money	-ΔHPM				+ΔHPM	0
Total	0	0	0	0	0	0

3. How can we construct an SFC model? Model 3

- **Step 3**: We identify the endogenous variables of the model using the transactions flow matrix and the balance sheet matrix.

	Households	Production sector	Government	Central bank		Total
				Current	Capital	
Gov. expenditures		+G	-G			0
Consumption	-C	+C				0
Income (or GDP)	+Y	-Y				0
Interest payments on bills	$+rB_{h-1}$		$-rB_{-1}$	$+rB_{cb-1}$		0
Taxes	-T		+T			0
Central bank profits			$+rB_{cb-1}$	$-rB_{cb-1}$		0
Change in bills	$-\Delta B_h$		$+\Delta B$		$-\Delta B_{cb}$	0
Change in high-powered money	-ΔHPM				+ΔHPM	0
Total	0	0	0	0	0	0

G
C
Y
B_h
B
B_{cb}
T
HPM

3. How can we construct an SFC model? Model 3

- **Step 3**: We identify the endogenous variables of the model using the transactions flow matrix and the balance sheet matrix.

	Households	Production sector	Government	Central bank	Total
High-powered money	+HPM			-HPM	0
Bills	$+B_h$		-B	$+B_{cb}$	0
Total (net worth)	+V	0	-B	0	0

G
C
Y
B_h V
B
B_{cb}
T
HPM

3. How can we construct an SFC model? Model 3

- **Step 4**: We identify the identities and the buffer variables for each of these identities.

	Households	Production sector	Government	Central bank		Total
				Current	Capital	
Gov. expenditures		+G	-G			0
Consumption	-C	+C				0
Income (or GDP)	+Y	-Y				0
Interest payments on bills	$+rB_{h-1}$		$-rB_{-1}$	$+rB_{cb-1}$		0
Taxes	-T		+T			0
Central bank profits			$+rB_{cb-1}$	$-rB_{cb-1}$		0
Change in bills	$-\Delta B_h$		$+\Delta B$		$-\Delta B_{cb}$	0
Change in high-powered money	-ΔHPM				+ΔHPM	0
Total	0	0	0	0	0	0

G
C
~~Y~~
B_h ~~V~~
~~B~~
~~B_{cb}~~
T
~~HPM~~

$B_{cb} = B - B_h$

$V = V_{-1} + YD - C$ $\quad HPM = V - B_h$

$Y = C + G$

$B = B_{-1} + G + rB_{-1} - T - rB_{cb-1}$

$HPM_{red} = B_{cb}$

3. How can we construct an SFC model? Model 3

- **Step 5**: For the rest variables we identify behavioural and supplementary equations.

Households and production sector:

- Disposable income (***YD***) is equal to the output plus interest minus taxes:

$$YD = Y + rB_{h-1} - T$$

- Consumption expenditures (***C***):

$$C = c_1 YD_{-1} + c_2 V_{-1}$$

c_1 is the propensity to consume out of disposable income and c_2 is the propensity to consume out of wealth.

- Treasury bills held by households ($\boldsymbol{B_h}$) are a proportion of (expected) wealth:

$$B_h = (\lambda_0 + \lambda_1 r - \lambda_2 (YD/V_{-1}))V_{-1}$$

3. How can we construct an SFC model? Model 3

- **Step 5**: For the rest variables we identify behavioural and supplementary equations.

Government:

- Government expenditures (***G***) grows at an exogenously given growth rate (*gg*):

$$G = G_{-1}(1 + gg)$$

- Taxes (***T***) are a proportion of disposable income:

$$T = \tau YD$$

3. How can we construct an SFC model? Model 3

- **Step 6**: We put together the equations of the model.

Households and production sector:

- Output (identity) (***Y***): $Y = C + G$
- Disposable income (***YD***): $YD = Y + rB_{h-1} - T$
- Consumption expenditures (***C***): $C = c_1 YD_{-1} + c_2 V_{-1}$
- Wealth (identity) (***V***): $V = V_{-1} + YD - C$
- Treasury bills held by households ($\boldsymbol{B_h}$): $B_h = (\lambda_0 + \lambda_1 r - \lambda_2 (YD/V_{-1}))V_{-1}$
- High-powered money (identity) (***HPM***): $HPM = V - B_h$

3. How can we construct an SFC model? Model 3

- **Step 6**: We put together the equations of the model.

Government:

- Government expenditures (***G***): $G = G_{-1}(1+gg)$
- Treasury bills (identity) (***B***): $B = B_{-1} + G + rB_{-1} - T - rB_{cb-1}$
- Taxes (***T***): $T = \tau YD$

Central bank:

- High-powered money (redundant identity) (***HPM***): $HPM_{red} = B_{cb}$
- Treasury bills held by the central bank (identity) ($\boldsymbol{B_{cb}}$): $B_{cb} = B - B_h$

4. Limitations of SFC models

Some **limitations** of the SFC models are the following:

- The **number of equations can increase very quickly** when we wish to introduce more realistic features. When the number of equations is large it is difficult to understand the underlying economic processes.
- There is **no unified way to solve these models**.
- The **financial sector** in most models is very simple and does not correspond to the way that the financial system works nowadays.
- **Econometric** and **calibration** techniques have not been used sufficiently so far.

5. Research topics in the SFC literature

Indicative theoretical SFC papers by topic:

- **Monetary and fiscal policy**: Godley and Lavoie (2007b), Greenwood-Nimmo (2014), Le Heron (2009, 2012), Le Heron and Mouakil (2008), Ryoo and Skott (2013), Zezza and Dos Santos (2004)
- **Financialisation**: Caversazi and Godin (2015), Lavoie (2008), Ryoo and Skott (2008), van Treeck (2009)
- **Housing market/shadow banking**: Eatwell et al. (2008), Nikolaidi (2014a), Zezza (2008)
- **Credit rationing/liquidity preference**: Chatelain (2010), Dafermos (2012), Le Heron and Mouakil (2008)

5. Research topics in the SFC literature

- **Minskyan analyses**: Nikolaidi (2014b), Keen (2013), Passarella (2012), Ryoo (2010), Taylor (2004, ch. 9), Tymoigne (2009, ch. 5)
- **Income distribution**: Dafermos and Papatheodorou (2015), van Treeck (2009), Zezza (2008)
- **Open economy issues**: Bortz (2014), Greenwood-Nimmo (2014), Lavoie and Daigle (2011), Lavoie and Zhao (2009), Mazier and Tiou-Tagba Aliti (2012)
- **Ecological issues**: Berg et al. (2015), Dafermos et al. (2015), Godin (2012), Naqvi (2015)

5. Research topics in the SFC literature

Empirical SFC models include:

- **Levy model for US:** Godley (1999), Godley et al. (2007), Papadimitriou et al. (2011), Zezza (2009)
- **Levy model for Greece:** Papadimitriou et al. (2013, 2014)
- **Model for Ireland:** Kinsella and Tiou-Tagba Aliti (2013)

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