



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

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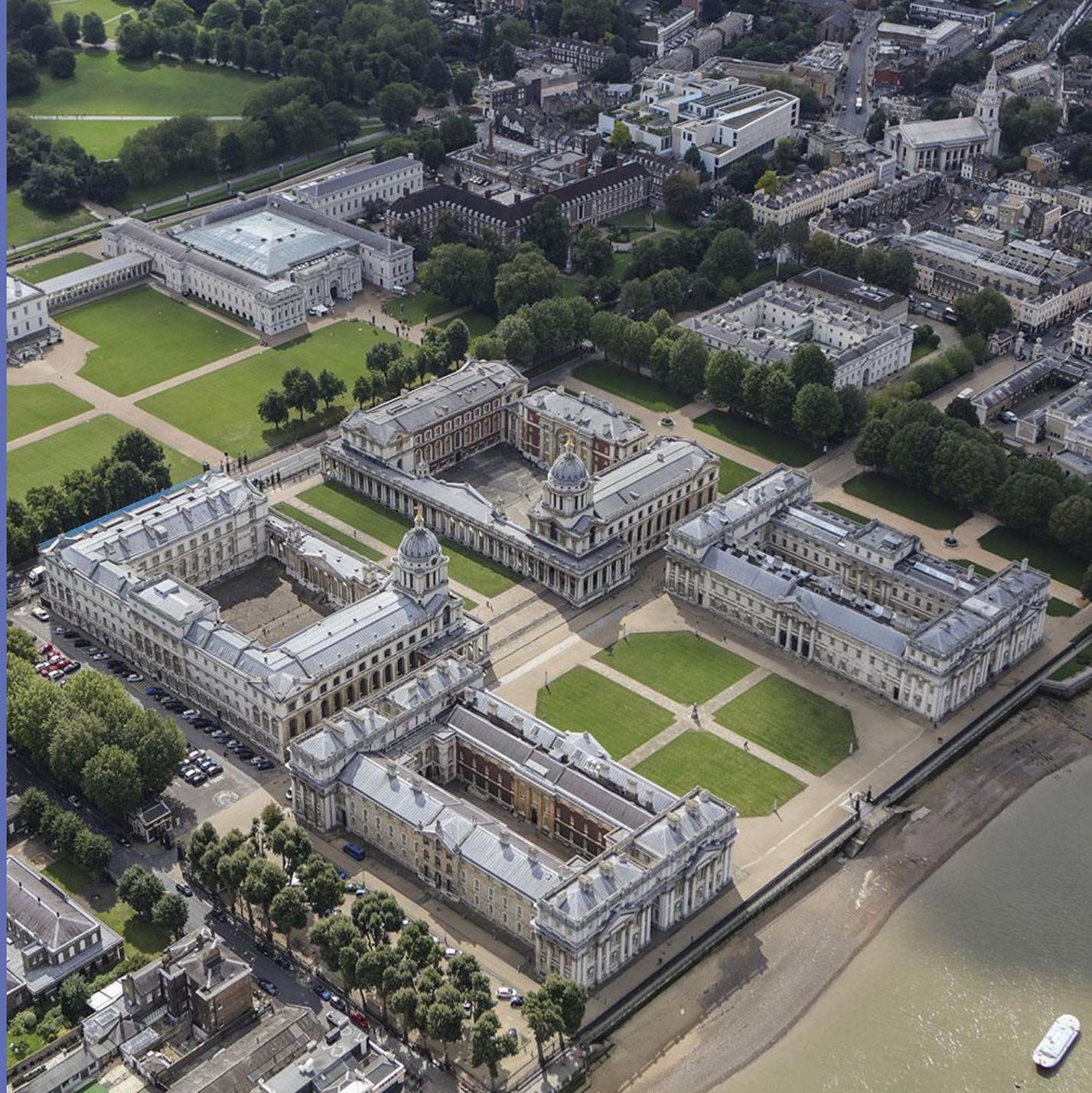
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# Outline

- 1 Introduction
- 2 Features
- 3 Steps in developing an SFC model
- 4 Steps in simulating an SFC model
- 5 Topics in SFC modelling
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- Over the past decade, **stock-flow consistent** (SFC) modelling has become a dominant approach in heterodox macro modelling.
- This approach has proved quite successful in formulating the complex interactions between the **financial** and the **real** spheres of the economy.
- The SFC approach has its origins to the work of the **Yale group** of James Tobin and the **Cambridge Economic Policy Group** of Wynne Godley that used SFC structures to analyse the US and the UK economy in the 1970s and the 1980s.

- There is currently a lot of research that takes place on **theoretical SFC modelling**. This is partly explained by the fact that SFC models are characterised by a high flexibility that allows them to be deployed for the analysis of a wide range of topics.
- 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.
- SFC models are currently viewed as **alternative models to the DSGE models** (especially when they are combined with agent-based structures).

The aims of this lecture are:

- 1 To provide an introduction to the features and the methodology of SFC models. Particular emphasis will be placed on the **steps** that need to be followed in practice in order to construct and simulate SFC models.
- 2 To present some research topics in which SFC models have been used, paying particular emphasis to **recent research developments**.

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### (1) There are no black holes

'Everything comes from somewhere and goes somewhere'. This is ensured by using two matrices: (i) the balance sheet matrix and (ii) the transactions flow matrix.

### (2) 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.

### (3) Behavioural equations are based on post-Keynesian assumptions

The behavioural equations are constructed following post-Keynesian theories.

# (1) There are no black holes

## Balance sheet matrix

	Households	Firms	Commercial banks	Central bank	Total
Deposits	+M		-M		0
Loans		-L	+L		0
Equities	+p <sub>e</sub> e	-p <sub>e</sub> e			0
Capital		+K			+K
High-powered money			+HPM	-HPM	0
Advances			-A	+A	0
Total (net worth)	+V <sub>h</sub>	+V <sub>f</sub>	0	+V <sub>cb</sub>	+K

# (1) There are no black holes

## 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				- $r_{cb} A_{-1}$		+ $r_{cb} A_{-1}$		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) 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:
  - 1 Finance of the investment of firms (via loans and equities).
  - 2 Asset prices effects on consumption and investment.

## (2) The financial and the real spheres are integrated

- Consider for example 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) The financial and the real spheres are integrated

### First step: Firms ask for finance

	Households	Firms		Commercial banks	Total
		Current	Capital		
Consumption					0
Investment in working capital					0
Wages					0
Change in deposits			$-\Delta M_f$	$+\Delta M$	0
Change in loans			$+\Delta L$	$-\Delta L$	0
Total	0	0	0	0	0

## (2) The financial and the real spheres are integrated

### Second step: Firms pay the wages to households

	Households	Firms		Commercial banks	Total
		Current	Capital		
Consumption					0
Investment in working capital		+I	-I		0
Wages	+W	-W			0
Change in deposits	$-\Delta M_h$			$+\Delta M$	0
Change in loans			$+\Delta L$	$-\Delta L$	0
Total	0	0	0	0	0

## (2) 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).

### (3) 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 possible to introduce **supply-side** effects (e.g. by including a Phillips curve or loan defaults).

### (3) Behavioural equations are based on post-Keynesian assumptions

- 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).
- 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**.

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## Steps in developing an SFC model

- **Step 1:** Construct the balance sheet matrix.
- **Step 2:** Construct the transactions flow matrix.
- **Step 3:** Write down the identities from the transactions flow matrix. Use the columns (which reflect the budget constraints) and the rows with more than two entries. Identify the buffer variables in the identities.
- **Step 4:** Identify the variables that need to be determined based on behavioural equations. Select your behavioural equations.
- **Step 5:** Put together the identities and the behavioural equations.

Suppose that we have an economy with the following features:

- There are four sectors: firms, households, banks and a central bank.
- **Firms** make investment by using retained profits, loans and equity. A part of firms' profits is distributed to households.
- **Households** accumulate savings in the form of deposits and equity.
- **Banks** provide firm loans by creating deposits. Banks' profits are distributed to households.
- **Central bank** holds advances on the asset side of its balance sheet and high-powered money on the liability side.

This is a model with both private bank money and central bank money.

## Step 1: Construct the balance sheet matrix.

	Households	Firms	Commercial banks	Central bank	Total
Deposits	+M		-M		0
Loans		-L	+L		0
Equities	+p <sub>e</sub> e	-p <sub>e</sub> e			0
Capital		+K			+K
High-powered money			+HPM	-HPM	0
Advances			-A	+A	0
<b>Total (net worth)</b>	<b>+V<sub>h</sub></b>	<b>+V<sub>f</sub></b>	<b>0</b>	<b>+V<sub>cb</sub></b>	<b>+K</b>

## Step 2: Construct the 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		$-\eta L_{-1}$		$+\eta L_{-1}$				0
Interest on advances				$-r_{cb} A_{-1}$		$+r_{cb} A_{-1}$		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

**Step 3:** Write down the identities from the transactions flow matrix. Use the columns (which reflect the budget constraints) and the rows with more than two entries. Identify the buffer variables in the identities.

	Households	Firms		Commercial banks		Central bank		Total
		Current	Capital	Current	Capital	Current	Capital	
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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	$+r_m M_{t-1}$			$-r_m M_{t-1}$				0
Interest on loans		$-r_l L_{t-1}$		$+r_l L_{t-1}$				0
Interest on advances				$-r_{cb} A_{t-1}$		$+r_{cb} A_{t-1}$		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

- $M = M_{-1} + YD - C - p_e \Delta e$
- $TP = Y - W - r_l L_{-1}$
- $L = L_{-1} + I - RP - p_e \Delta e$
- $BP = r_l L_{-1} - r_m M_{-1} - r_{cb} A_{-1}$
- $A = A_{-1} + \Delta HPM + \Delta L - \Delta M$
- $CBP = r_{cb} A_{-1}$
- $A_{red} = A_{-1} + \Delta HPM + CBP$
- $DP = TP - RP$

	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
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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				- $r_{cb} A_{-1}$		+ $r_{cb} A_{-1}$		0
Change in deposits	- $\Delta M$				+ $\Delta M$			0
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Change in advances					+ $\Delta A$		- $\Delta A$	0
Total	0	0	0	0	0	0	0	0

**Step 4:** Identify the variables that need to be determined based on behavioural equations. Select your behavioural equations.

- Wage income of households: **W**
- Disposable income of households: YD
- Consumption expenditures: **C**
- Wealth (identity):  $V_h$
- Deposits (identity): M
- Income: Y
- Total profits of firms (identity): TP
- Retained profits: **RP**
- Distributed profits (identity): DP
- Investment: **I**
- Capital stock: **K**
- Loans (identity): L
- Number of equities: **e**
- Price of equities: **p<sub>e</sub>**
- Profits of banks (identity): BP
- High-powered money: **HPM**
- Advances (identity): A
- Profits of central bank (identity): CBP

- Wage income of households:  $W=s_w Y$
- Consumption expenditures:  $C=c_1 YD_{-1}+c_2 V_{h-1}$
- Retained profits:  $RP=s_f TP$
- Investment:  $I=g_k K_{-1}$
- Capital stock:  $K=K_{-1}+I$
- High-powered money:  $HPM=hM$
- Value of equity held by households:  

$$E=(\lambda_0+\lambda_1 r_{e-1}+\lambda_2 r_m+\lambda_3 (YD_{-1}/V_{h-1}))V_{h-1}$$
- Number of equities:  $e=e_{-1}+\frac{xI_{-1}}{p_e}$
- Price of equities:  $p_e=\frac{E}{e}$

## Step 5: Put together the identities and the behavioural equations. Households

- Wage income of households:  $W = s_w Y$
- Disposable income of households:  $YD = W + DP + BP + r_m M_{-1}$
- Consumption expenditures:  $C = c_1 YD_{-1} + c_2 V_{h-1}$
- Wealth (identity):  $V_h = M + p_e e$
- Value of equity held by households:  
$$E = (\lambda_0 + \lambda_1 r_{e-1} + \lambda_2 r_m + \lambda_3 (YD_{-1}/V_{h-1})) V_{h-1}$$
- Deposits (identity):  $M = M_{-1} + YD - C - p_e \Delta e$

## Firms

- Income:  $Y=C+I$
- Total profits of firms (identity):  $TP=Y-W-r_lL_{-1}$
- Retained profits:  $RP=s_f TP$
- Distributed profits (identity):  $DP=TP-RP$
- Investment:  $I=g_k K_{-1}$
- Capital stock:  $K=K_{-1}+I$
- Loans (identity):  $L=L_{-1}+I-RP-p_e \Delta e$
- Number of equities:  $e=e_{-1} + \frac{XI_{-1}}{p_e}$
- Price of equities:  $p_e = \frac{E}{e}$
- Rate of return of firms:  $r_e = \frac{DP}{p_{e-1}e_{-1}} + \frac{\Delta p_e}{p_{e-1}}$

## Commercial banks

- Profits of banks (identity):  $BP=r_lL_{-1}-r_mM_{-1}-r_{cb}A_{-1}$
- High-powered money:  $HPM=hM$
- Advances (identity):  $A=HPM+L-M$

## Central bank

- Profits of central bank (identity):  $CBP=r_{cb}A_{-1}$
- Advances (identity):  $A_{red}=A_{-1}+\Delta HPM+CBP$

## Useful tips - Consistency

- In order for your model to be consistent you need to ensure that:
  - 1 In the initial period all the stocks in the model satisfy the restrictions of the balance sheet matrix.
  - 2 The identities from the transactions flow matrix and balance sheet matrix are correctly written.
  - 3 The adding-up constraints are satisfied, if your model includes portfolio allocation.
- If the model is consistent, the redundant equation is satisfied.

## Useful tips - Wealth and capital gains

- **Deposits** are determined by the following identity:  
$$M=M_{-1}+YD-C-p_e\Delta e \quad (1)$$
- Equation (1) can be rewritten as follows:  
$$\Delta M+p_e\Delta e=YD-C \quad (2)$$
- We know from the balance sheet matrix that the **wealth of households** is:  
$$V_h=M+p_e e \quad (3)$$
- Therefore, the change in the wealth of households is:  
$$\Delta V_h=\Delta M+p_e\Delta e+e_{-1}\Delta p_e \quad (4)$$
- By combining equations (2) and (4) we get:  
$$V_h=V_{h-1}+YD-C+e_{-1}\Delta p_e \quad (\text{identity})$$

## Useful tips - Equity market

Equations of the **portfolio choice**:

$$E = (\lambda_{10} + \lambda_{11}r_{e-1} + \lambda_{12}r_b + \lambda_{13}r_m + \lambda_{14}(YD_{-1}/V_{-1}))V_{-1}$$

$$B = (\lambda_{20} + \lambda_{21}r_{e-1} + \lambda_{22}r_b + \lambda_{23}r_m + \lambda_{24}(YD_{-1}/V_{-1}))V_{-1}$$

$$M = (\lambda_{30} + \lambda_{31}r_{e-1} + \lambda_{32}r_b + \lambda_{33}r_m + \lambda_{34}(YD_{-1}/V_{-1}))V_{-1}$$

where E is the value of equity, B are Treasury bills, M are deposits, V is wealth, YD is disposable income,  $r_e$  is the rate of return on equities,  $r_m$  is the interest rate on deposits and  $r_b$  is the interest on Treasury bills.

## Useful tips - Equity market

- In the equity market we assume equilibrium:

$$e = \frac{E}{p_e}$$

- By using the equation for the number of equities in the previous equation we get:

$$e_{-1} + \frac{xI_{-1}}{p_e} = \frac{E}{p_e}$$

- By rearranging we have the following equation for the price of equities:

$$p_e = \frac{E - xI_{-1}}{e_{-1}}$$

## Useful tips - Steady state of the model

At the steady state all flow-stock, stock-flow, flow-flow and stock-stock ratios (e.g.  $Y/K$ ,  $L/K$ ,  $M/Y$ ) are constant.

For example:

$$\Delta\left(\frac{Y}{K}\right) = \frac{Y}{K} - \frac{Y_{-1}}{K_{-1}} = \frac{Y}{K} - \frac{Y_{-1}(1+g_k)}{K} = \frac{\Delta Y - g_k Y_{-1}}{K} = \frac{\Delta Y}{K} - \frac{Y}{K} \frac{g_k}{(1+g_k)}$$

Since  $Y/K$  should be constant at the steady state, we need

$$\Delta\left(\frac{Y}{K}\right) = 0.$$

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- SFC models can be simulated using various **software programmes** (e.g. EViews, R, Excel or MATLAB).
- SFC models can be either **discrete-time** or **continuous-time** models.
- When SFC models are **small** we can solve them analytically (e.g. by finding the steady-states and conducting stability analysis).
- When SFC models are **large** in most cases we use numerical simulations.

## Steps in simulating an SFC model

- **Step 1:** Identify the endogenous variables of the model (as well as some auxiliary variables).
- **Step 2:** Identify the baseline scenario and select the parameter values (see the table below).

<b>Category</b>	<b>Description</b>
<b>(A)</b>	<b>Econometrically estimated parameters</b>
<b>(B)</b>	<b>Directly calibrated parameters</b>
(Bi)	Based on data
(Bii)	Based on previous studies
(Biii)	Selected from a reasonable range of values
<b>(C)</b>	<b>Indirectly calibrated parameters</b>
(Ci)	Calibrated such that the model matches the data
(Cii)	Calibrated such that the model generates the baseline scenario

## Steps in simulating an SFC model

- **Step 3:** Select the initial values using the data for your economy or the equations of the model.
- **Step 4:** Write down the equations and run the model.
- **Step 5:** Report your results by using tables and graphs.
- **Step 6:** Validate the model by using your baseline scenario. Validation can be conducted, for example, by estimating the volatility, the auto-correlation and the cross-correlation for some key variables.
- **Step 7:** Re-run the simulations by changing key parameters (sensitivity analysis).
- **Step 8:** Re-run the simulations by changing parameters that correspond to policies/institutional structures.

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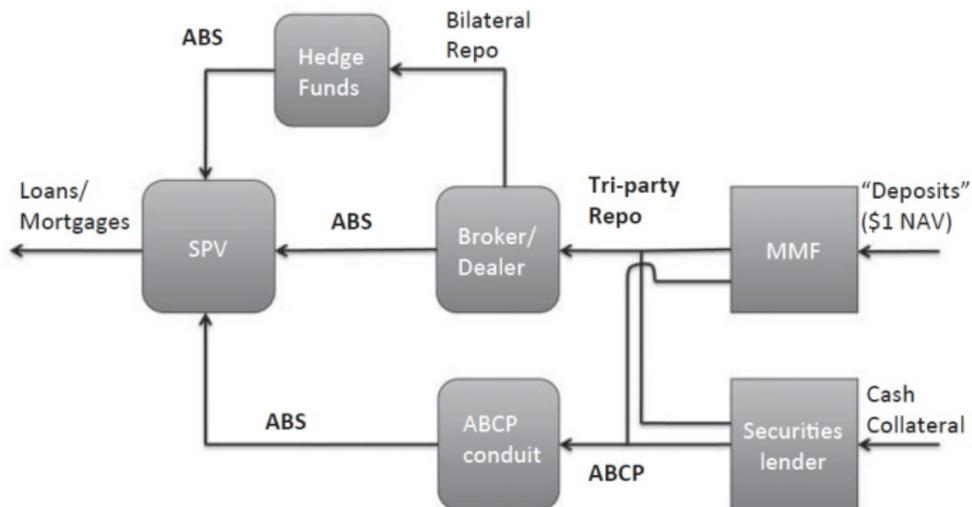
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## Shadow banking

- Most SFC models assume a simple banking sector.
- However, a realistic formulation of the modern banking system needs to include **shadow banking activities**.
- There have been some recent attempts to analyse shadow banking by using an SFC framework (see Eatwell et al., 2008; Pilkington, 2008; Lavoie, 2014; Bhaduri et al., 2015; Nikolaidi, 2015; Botta et al., 2016).

# Shadow banking

## Short-term funding flows in the shadow banking system (Krishnamurthy et al., 2014, p. 2383)



# Shadow banking

Based on Nikolaidi (2015)

	Worker households	Firms	Commercial banks	SPVs	Hedge funds	ABCP conduits	MMMFs	Investor households	Government	Central bank	Total
Houses	$+p_H H_{DW}$	$+p_H H_{HU}$						$+p_H H_{DI}$			$+p_H H$
Productive capital		$+K_F$									$+K_F$
High-powered money			$+HPM_B$					$+HPM_I$		$-HPM$	0
Consumer loans	$-LC$		$+LC$								0
Housing loans	$-LH$		$+LH_{NS}$	$+LH_S$							0
Firms' loans		$-LF$	$+LF$								0
Treasury bills			$+B_B$		$+B_{HF}$		$+B_M$	$+B_I$	$-B$	$+B_{CB}$	0
MBSs				$-p_M MBS$	$+p_M MBS_{HF}$	$+p_M MBS_{ABCP}$					0
Repo			$+repo$		$-repo$						0
ABCPs			$+p_{CF} CF_B$				$+p_{CF} CF_{MMMF}$				0
Deposits			$-D$					$+D$			0
Money markets' shares							$-SH$	$+SH$			0
Firms' equities		$-p_E \#$						$+p_E \#$			0
Advances			$-A$							$+A$	0
Total (net worth)	$+V_W$	$+V_F$	$+V_B$	$+V_{SPV}$	$+V_{HF}$	$+V_{ABCP}$	$+V_{MMMF}$	$+V_I$	$-B$	0	$+K_F + p_H H$

## Household heterogeneity and distribution

Some SFC papers that incorporate household heterogeneity are:

- van Treeck (2009) and Caverzasi and Godin (2015) who pay attention to financialisation issues.
- Zezza (2008) and Kapeller et al. (2016, 2017) who focus on household debt.
- Dafermos and Papatheodorou (2015) who analyse the links between functional and personal income distribution.

## Ecological macroeconomics

- In SFC models economic growth can continue for ever. **Environmental constraints play no role.**
- However, in reality the energy and matter are not infinite and climate change causes non-trivial economic damages.
- In a recent paper (Dafermos, Nikolaidi and Galanis, 2017) we have developed an SFC model that incorporates environmental aspects, using insights from the flow-fund model of Georgescu-Roegen and the climate change literature.
- For other SFC models with ecological considerations see Berg et al. (2015), Jackson and Victor (2015), Naqvi (2015), Richters and Siemoneit (2017) and Bovari et al. (2018).



Nicholas  
Georgescu-Roegen  
(1906-1994)

## Ecological macroeconomics

- In Dafermos, Nikolaidi and Galanis (2018) we develop an **ecological macroeconomic model** that sheds light on these financial stability effects of climate change.
- The model builds on the stock-flow-fund model of Dafermos, Nikolaidi and Galanis (2017). We call our model **DEFINE** (Dynamic Ecosystem FINance Economy); for more information, see: [www.define-model.org](http://www.define-model.org)

The model consists of two big blocks and various sub-blocks.

## Ecosystem

- Matter, waste and recycling
- Energy
- Emissions and climate change
- Ecological efficiency and technology

## Macroeconomy and financial system

- Output determination
- Firms
- Households
- Banks
- Government sector
- Central banks

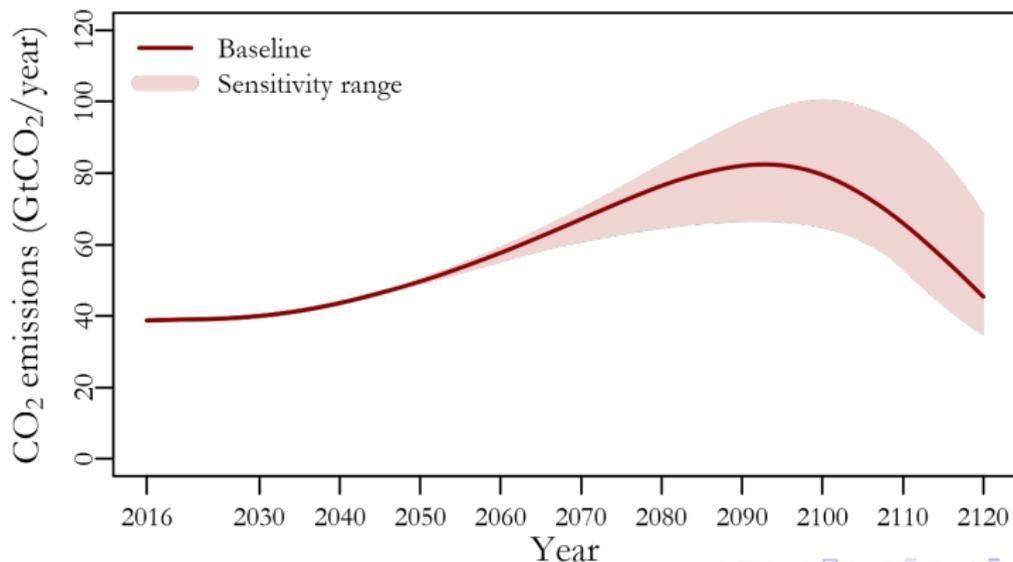
## Ecological macroeconomics

### Calibration/estimation of the model:

- We use a mix of calibration and estimation techniques.
- We estimate some functions (such as investment and consumption) using panel data for the global economy.
- We calibrate some parameter values using data or other studies.
- We develop a baseline scenario and then conduct sensitivity and policy analysis.

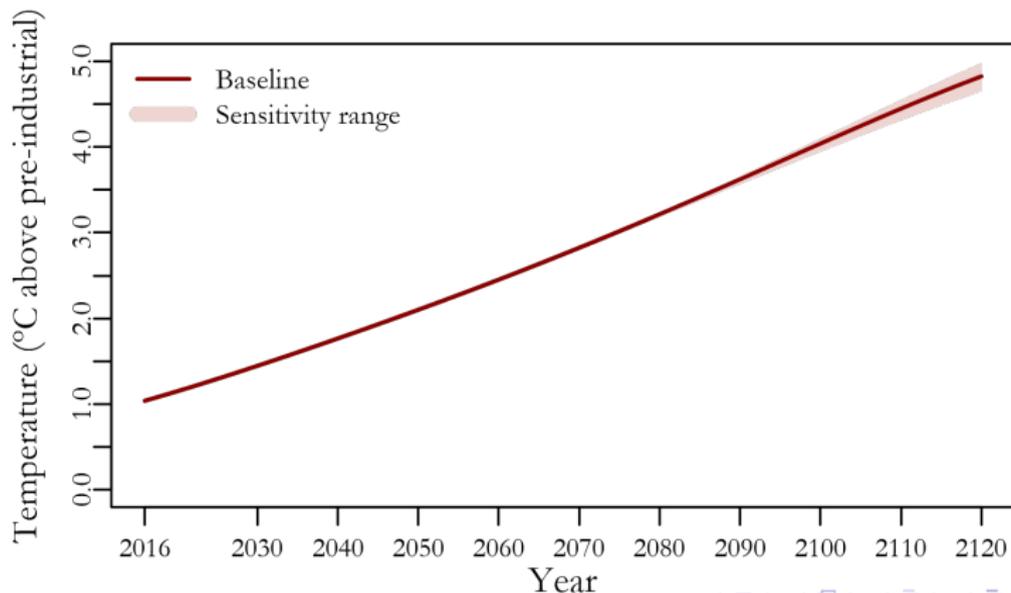
## Ecological macroeconomics

### CO<sub>2</sub> emissions



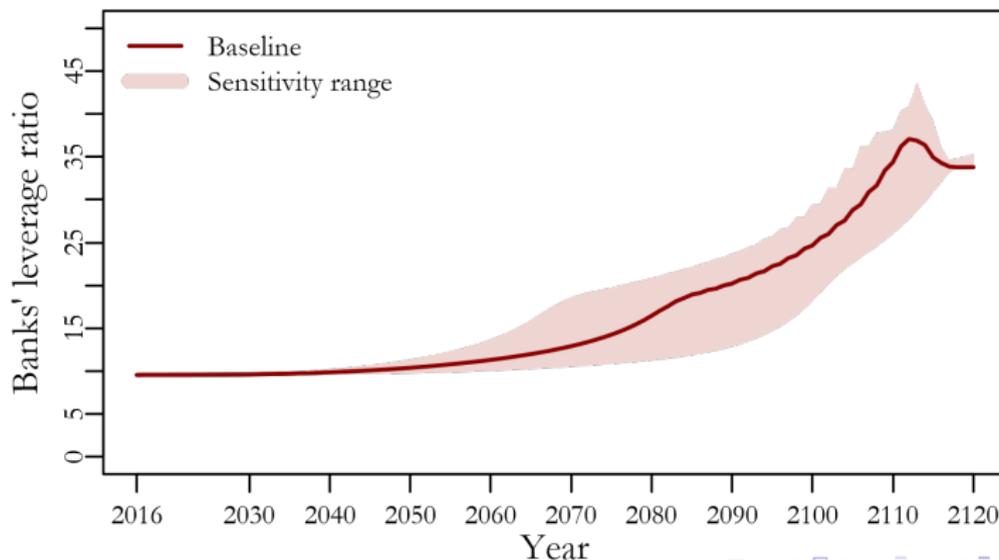
# Ecological macroeconomics

## Atmospheric temperature



# Ecological macroeconomics

## Banks' leverage ratio



## Other topics

### Theoretical SFC models include:

- **Monetary and fiscal policy:** Zezza and Dos Santos (2004), Godley and Lavoie (2007), Le Heron and Mouakil (2008), Le Heron (2009, 2012), Ryoo and Skott (2013), Greenwood-Nimmo (2014), Haas and Young-Taft (2017).
- **Credit rationing/liquidity preference:** Le Heron and Mouakil (2008), Chatelain (2010), Dafermos (2012).
- **Minskyan analyses:** Taylor (2004, ch. 9), Tymoigne (2009, ch. 5), Ryoo (2010), Passarella (2012), Keen (2013), Nikolaidi (2014), Dafermos (2018).
- **Open economy issues:** Duwicquet and Mazier (2010), Lavoie and Zhao (2010), Lavoie and Daigle (2011), Mazier and Tiou-Tagba Aliti (2012), Bortz (2014), Greenwood-Nimmo (2014).

## Other topics

Empirical SFC models include:

- **Levy model for US:** Godley (1999), Godley et al. (2007), Zezza (2009), Papadimitriou et al. (2013, 2016).
- **Levy model for Greece:** Papadimitriou et al. (2013, 2014).
- **Model for Ireland:** Kinsella and Tiou-Tagba Aliti (2012).
- **Model for Austria:** Miess and Schmelzer (2016a, 2016b).
- **Model for Colombia:** Escobar-Espinoza (2016).
- **Models for the UK:** Burgess et al. (2016), Coutts and Gudgin (2016).

# Outline

- 1 Introduction
- 2 Features
- 3 Steps in developing an SFC model
- 4 Steps in simulating an SFC model
- 5 Topics in SFC modelling
- 6 Conclusion**

- SFC models constitute a flexible tool for analysing complex issues that involve an active role of finance.
- They have the capability of forming a solid alternative to the DSGE models.
- More progress needs to be made in the way that these models are calibrated, validated and simulated.

## Promising areas for future research:

- Shadow banking, inequality and ecological macroeconomics
- Empirical applications of SFC models
- Combination of SFC with agent-based modelling