Chapter 25

Modeling the Economy as a Whole – Stock-Flow Models

By

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MODELING THE ECONOMY AS A WHOLE – STOCK-FLOW MODELS

The *Stock-Flow-Consistent* modeling approach, pioneered by Wynne Godley in Cambridge in the 1970s and James Tobin in Yale in the 1980s, is being adopted by a growing number of young (and not-so-young) researchers in the Post-Keynesian and other heterodox traditions, especially after the publication of Godley – Lavoie (2007), which provided a general framework for the analysis of whole economic systems, and after the recognition that macroeconomic models integrating "real" markets with flow-of-fund analysis had been particularly successful in predicting the *Great Recession* of 2007 (Bezemer, 2010).

In this chapter we first introduce the general features of the Stock-Flow-Consistent (SFC) approach, discussing its standard Post-Keynesian closures, and discuss next the most promising new lines of research adopting this approach from an heterodox perspective.

Stock-flow-consistent models: general features

The current post-Keynesian Stock-Flow-Consistent (SFC) literature has been developing quickly in recent years, adopting the methodology described in Godley – Lavoie (2007). Its main features, however, were already present in Godley – Cripps (1983), a book which tried – without great success at the time – to convey the insights of the *New Cambridge* approach[1] developed in the previous decade, and successfully adopted for policy analysis of the U.K. economy.

The consistency requirement of the SFC approach should be respected by any coherent macroeconomic model for the economy as a whole[2]. It is useful to analyze separately the accounting principles – which are not specific to a given theoretical approach – and model closures, which are derived instead from a given theory of macroeconomic behavior.

Accounting consistency

Looking at any economy where sectors are consolidated[3], stock-flow accounting consistency requires that:

[1] On the "New Cambridge" approach see Godley and Cripps (1974), (1983) and Mc Callum and Vines (1981).
[2] Some mainstream models achieve stock-flow consistency by assuming forward-looking behavior of rational optimizing agents in perfect markets, so that both stocks and flows in any instant are at their optimal level. We will not analyze this literature further here.
[3] Sectors are consolidated when payments within each sector are netted out. For instance, when a household purchases an existing house from another household, the distribution of real assets and liquidity among households changes, but the real value of aggregate household wealth is unaffected. In some cases, national accounts are published without consolidating, say, the government sector, so that – for instance – payments from the central government to local governments appear on both sides of the general government account.

1) Every payment from one sector is a receipt for another sector (there are no "black holes" where monetary payments disappear, and there is no monetary payment coming from nowhere);

2) Every transaction implies a quadruple entry in the accounting: when a U.S. firm imports goods from Japan, say, the accounting registers an increase in income in Japan, an increase in expenditure in the U.S., as well as an increase in Japanese bank deposits and a corresponding decrease in U.S. bank deposits. Current account payments and receipts imply a change in at least one stock of real of financial assets/liabilities.

3) From (2) – and from logic! – it follows that every financial asset for a sector is a liability for a different sector: net financial wealth for the system as a whole is zero;

4) End-of-period stocks are obtained by cumulating the relevant flows, eventually taking capital gains into account. In general, $S_t = S_{t-1} + F_t + CG_t$, where S is the end-period monetary value of a stock, F the corresponding flow during the period, and CG net capital gains given by the change in the market value of S over the period[4];

These simple rules are the same which guide the construction of National Accounts:

> "quadruple-entry bookkeeping … is the accounting system underlying the recording in the System of National Accounts (SNA)" (SNA 2008, p.50)

where quadruple-entry bookkeeping is an accounting methodology introduced by Copeland (1947; 1949), which merges what the SNA calls the vertical double-entry bookkeeping where "each transaction leads to at least two entries, traditionally referred to as a credit entry and a debit entry, in the books of the transactor. This principle ensures that the total of all credit entries and that of all debit entries for all transactions are equal", with the "horizontal double-entry bookkeeping (which) ensures the consistency of recording for each transaction category by counterparties" (ibid.)

National accounts are the results of a method for measuring economic activity using internationally agreed standards, and provide a sequence of accounts for each aggregate sector in the economy, going from flow accounting (production; distribution of income; use of income) to flow of funds - which give details of changes in real and financial assets for each sector, to the revaluation account – which measures changes in the value of stocks due to fluctuation in market prices, to balance sheets, which measure end-of-period net real and financial wealth for each sector. National accounts can therefore be viewed as a

[4] In national accounting, capital gains are presented in the "revaluation account", which also includes the write-off of debt, when the debtor defaults. See SNA (2008, p.218)

simplified set of measures of economic stocks and flows, where the assumptions on how to go from reality to accounting have been agreed upon among international institutions.

The accounting part of SFC models rely on the same sequence of matrices for describing an economy, although their level of detail – in empirical models - is usually extremely simplified relative to national accounts, and where the choice of how to simplify the economy, while keeping consistency, is based on a specific research question.

To provide a simple illustration, assume we are interested in modeling alternative sources of funding for investment, in a closed economy without a public sector. A simple transactions-flow matrix could be presented as in Table 25.1[5].

The first two rows in Table 25.1 record the value of production of consumption goods and investment goods, with a distinction between values recorded in the current account and in the capital account. Payments which imply a change in the end-of-period stock of real or financial wealth are recorded in the capital account: other payments are recorded in the current account. A negative sign implies that the sector in the column is making a payment, while a positive sign implies that the sector is receiving the payment. In such a way, the sum of each element in any row must be zero.

The economy described by Table 25.1 is not relying on specific theoretical assumptions, but uses a number of simplifying hypothesis, namely that there is no government, no Central bank and no foreign sector, so that financial assets are given only by bank deposits and bank loans. It is additionally assumed that banks do not issue either equities or bonds. Such assumptions can easily be dropped, at the cost of an increase in model complexity which however should not be relevant for the problem at hand.

It must also be noted that the degree of realism of the model can be increased by further splitting each sector into its components, using a top-down approach. For instance, we could study separately commercial banks and other financial institutions, or split production firms by sector, or separate workers and rentiers (or capitalists) within the household sector, provided that we keep the same logic in recording each monetary payment/receipt[6].

[5] An alternative way to present flow accounting is given in Appendix 1.
[6] In empirical models the ability to increase the level of detail is constrained by the availability of data.

Table 25.1 Transactions-flows matrix for a simple SFC model							
	Households		**Production firms**		**Banks**		**Total**
	Current	Capital	Current	Capital	Current	Capital	
Consumption	-C		+C				0
Investment			+I	-I			0
Wages	+W		-W				0
Dividends	+DIVh		-DIV		+DIVb		0
Banks distributed profits	+FB				-FB		0
Int.on bonds	+IB		-IB				0
Int.on loans			-IL		+IL		0
Int.on deposits	+ID				-ID		0
Net lending	-NLh	+NLh	-NLf	+NLf	-NLb	+NLb	0
[Total]	0		0		0		0
Δ in loans				+ΔL		-ΔL	0
Δ in deposits		-ΔD				+ΔD	0
Δ in bonds		-ΔB		+ΔB			0
Δ in equities		-pe*ΔEh		+pe*ΔE		-pe*ΔEb	0
Total		0		0		0	

The next set of rows in Table 5.1 record transfers among sectors. This is where many textbook models become inconsistent, omitting a formal representation of interest payments from one sector to the other which is implied by the existence of a stock of debt.

The "Net lending" row in the first part of Table 25.1 is given by the difference between current receipts and current payments for each sector, and implies an increase in net financial assets when receipts are larger than payments – and the sector is a net lender – or a decrease in net financial assets in the opposite case. For the household sector, for instance, the identity implied by the accounting is

$$NLh = (W + DIV + FB + IB + ID) - C \qquad (25.1$$

where the sum in parenthesis defines household disposable income, and *NLh* in this simplified model is synonymous with saving.

The second, bottom part of Table 25.1 is the *Flow of funds* matrix, which shows, by column, the possible destination of saving for a sector which is a net lender, or the possible sources of credit for a sector which is a net borrower. For households, saving must take the form of an increase in the end-of-period stock of bank deposits, newly issued bonds or equities, where the latter are assumed to be purchased at the current market price.

The identity from the capital account of the firms' sector implies the budget constraint for investment:

$$I = NLf + \Delta L + \Delta B + pb^{*}\Delta E \qquad (25.2$$

Investment must be financed either by undistributed profits NLf, an increase in bank loans ΔL, or by issuing additional bonds ΔB or equities ΔE.

A proper integration of flow transactions and flow of funds payments thus lays the ground for models which provide a realistic description of the linkages between the financial sector and the real sector of the economy[7].

The columns for the banking sector in Table 25.1 have been constructed without the simplifying assumptions usually adopted, i.e. that banks distribute all of their profits so that – at the end of each accounting period – their net lender position is zero. On the contrary, undistributed banks' profits given by banks' receipts less payments – including distributed profits

$$NLb = iL + DIVb - iD - FB \qquad (25.3$$

must be equal to the net increase in assets less the net increase in liabilities

$$NLb = \Delta L + pb^{*}\Delta Eb - \Delta D \qquad (25.4$$

so that banks could in principle be having a positive[8], o negative, net financial position[9].

The rows in the Flow of funds matrix show that for each increase in liabilities issued by a sector – say firms' equities – there must be a corresponding increase in assets held by other sectors.

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[7] "The Holy Grail of post-Keynesian economics has always been the full integration of monetary and real macroeconomic analysis…" Lavoie (2011, p.54)

[8] Equation (25.3) implies that banks could have a loss if firms default on their loans, so that iL and DIVb are both zero. In this case, banks would have to sell previously accumulated financial assets to pay interest on banks deposits, or increase their net debt with households (or the model should be made more complex by introducing additional financial instruments).

[9] Instead of simply acting as intermediaries, as in most mainstream models, or providers of credit and liquidity, as in most heterodox models.

The balance sheet matrix corresponding to flow transactions in Table 25.1 is represented in Table 25.2. The links between flows in Table 25.1 and end-of-period stocks in Table 25.2 are given by stock-flow identities, i.e. for the stock of capital[10]

$$K_t = (1 - \delta)*K_{t-1} + I_t \qquad (25.5$$

where δ is the depreciation rate, or

$$D_t = D_{t-1} + \Delta D_t \qquad (25.6$$

For the stock of banks' deposits, and similarly for any financial stock which is not traded at a market price which can fluctuate. For equities, on which capital gains can arise, the identity would be

$$pe_t*E_t = pe_{t-1}*E_{t-1} + pe_t*\Delta E_t + \Delta pe_t*E_{t-1} \qquad (25.7$$

where the last term in (25.7) measures capital gains, given by the change in the market price of existing equities.

Table 25.2. Balance sheet matrix for a simple SFC model

	Households	Prod. Firms	Banks	Total
Fixed capital		+K		+K
Deposits	+D		-D	0
Loans		-L	+L	0
Bonds	+B	-B		0
Equities	+pe*Eh	-pe*E	+pe*Eb	0
Balance (net worth)	-Vh	-Vf	-Vb	-K
Sum	0	0	0	0

Note that the end-of-period value of the stock of wealth for each sector increases/decreases with their net lending/borrowing position, plus net capital gains/losses, i.e. for households

$$Vh_t = Vh_{t-1} + NLh_t + \Delta pe_t*Eh_{t-1} \qquad (25.8$$

Note that for each stock of financial assets/liabilities in Table 25.2 there must be an entry in Table 25.1 identifying the corresponding return on such assets.

[10] Assuming that firms cannot resell installed physical capital, which therefore does not have a market price.

Note that – following accounting practices – all stocks are measured at the end of period. This feature is relevant in some models which distinguish between ex-ante, or target, values for stocks and the ex-post, realized value of stocks at the end of the period. The distinction is particularly relevant in the approaches linked to the Monetary theory of production, which discuss "initial finance" demanded at the beginning of a production period, and debt outstanding at the end of the period[11].

Finally, note that accounting identities derived from the accounting in Table 25.1 or Table 25.2 imply that one row, or column, can be uniquely determined from the others. This implies that one of the identities can – and should – be dropped from the model, since it is implied by the others[12].

Model consistency

The previous section has considered the accounting requirement related to the presentation of the variables in any given SFC macromodel. We now add additional requirements that must be present for logical consistency, namely:

5) Interest and dividend payments must be endogenously determined from the accumulated stock of assets/liabilities. In theoretical models, the flow of interest payments on debt S at time t is given by an interest rate r over the opening stock of debt outstanding, and the determination of the interest rate will depend on the theory adopted by the researcher. These quasi-identities introduce another dynamic dimension to SFC models, on top of the stock-flow identities as (25.8), with an important impact on the trajectories of the model, and the analysis of debt sustainability. Last, but not least, these identities usually introduce non-linearities in the model;
6) When financial assets/liabilities are included in a model, they must feed back on the behavior of at least one sector. For instance, if we assume in a model that banks do not distribute all profits and therefore accumulate real or financial wealth, there must be some behavioral rule which shows the implications of the increase in wealth over banking behavior. If such rule is omitted, the model may easily generate an ever increasing (or decreasing) level of banking wealth relative to income, which may be stock-flow consistent but is entirely implausible

[11] See Graziani (2003) and Zezza (2011).
[12] Godley named the dropped identity "missing equation", and used it to check the consistency of the accounting structure of the model.

Model closures

The description of SFC models so far has concentrated on model accounting and logical consistency. In any given model, accounting identities are used to identify a first set of *K* variables that are necessarily given by the values of a remaining set of *M* variables.

The next step in model building usually follows a more conventional methodology. Economic theory is used to identify a subset *L* of the yet-to-be-modeled *M* variables, and to specify a relationship among them and the initial K variables, conditional on a set of parameters.

In a linear model, for each time period *t*, this implies a specification such as

$$\mathbf{B} \cdot \boldsymbol{Y_t} \ = \ \mathbf{C} \cdot \boldsymbol{X_t} + \mathbf{D} \cdot \boldsymbol{Y_{t-1}} \ \{+\boldsymbol{u_t}\} \quad (25.9$$

where, with *N=K+L* variables explained in the model, **Y** is a (*N*1*) vector of endogenous variables, determined either through accounting identities or through "behavioral" functions; **X** is a (*P*1*) vector of exogenous variables (with *P=M-L*); and **B**, **C**, **D** are matrices of model parameters of appropriate dimensions. In empirical models adopting and econometric estimation of model parameters, a vector **u** is also added to represent random shocks.

In any SFC model, the initial values of the stocks will exert their influence on the solution for the current time period, so that the **D** matrix is never empty, and comparative static analysis between two different time periods makes little sense.

As a simple example, expanded from Godley & Cripps (1974), we can model a closed economy where the value of production, and thus income, is given by private expenditure plus government expenditure (25.10), government deficit – given by the difference between government outlays and an income tax–is financed by issuing bonds (25.11) and since bonds are the only financial asset[13], the demand for new bonds is equal to saving (25.12).

$$Y_t = PE_t + G_t \quad (25.10$$

$$\Delta B_t^s = G_t + r_t \cdot B_{t-1} - \mathrm{t} \cdot (Y_t + r_t \cdot B_{t-1}) \quad (25.11$$

[13] See Godley – Lavoie (2007, ch.3) for a similar model where government money is the only financial asset. We chose to have bonds in our example to stress the relevance of tracking interest payments, although a model with no explicit representation of money creation/destruction may be logically inconsistent. Introducing money would greatly increase the complexity of our example. See Godley – Lavoie (2007) for further examples of increasing complexity. On the other hand, setting the interest rate to zero transforms bonds in this model into "money".

$$\Delta B_t^d = (1-\mathrm{t}) \cdot (Y_t + r_t \cdot B_{t-1}) - PE_t \qquad (25.12$$

Equations (25.10)-(25.12) form the accounting of the model, determining Y, B^s and B^d, given *PE, G, r* and *t*. Using (25.10) in (25.12) it is straightforward to show that the supply of new bonds, from (25.11), will always be equal to demand in (25.12), so that an "equilibrium" condition $B = B^d = B^s$ is not needed.

A simple "behavioral" rule can be added from economic theory: assume for instance that private expenditure is a function of disposable income and the opening stock of wealth (25.13)

$$PE_t = \alpha_1 \cdot (1-t) \cdot (Y_t + r_t \cdot B_{t-1}) + \alpha_2 \cdot B_{t-1} \qquad (25.13$$

The model is now complete, in the sense that the remaining exogenous variables (G, r, t) and parameters (α_1, α_2) may be expected to be given, i.e. not influenced by the values of the endogenous variables.

Alternative theories of the determination of private expenditure may replace (25.13) while keeping the stock-flow accounting consistency.

The determination of parameter values in the model – α_1, α_2 in our simple example – may be challenging. The standard practice in theoretical models is (1) to adopt parameter values which arise from stylized facts in real economies, and (2) to start from parameter values which should avoid explosive behavior[14]. In empirical models, parameter values are usually obtained through econometric estimation.

One of the most frequent critiques to SFC models is the arbitrary choice of parameter values. It is therefore a standard practice to verify the robustness of model results under alternative parameter specification, which is usually feasible using computer programs. Another standard practice is to publish the full list of parameter values adopted in the model, so that results can be reproduced.

Stock-flow norms and the steady state

One of the interesting features of SFC models is the analysis of stock-flow and flow-flow ratios obtained from model solutions, usually obtained by numerical simulations, as well as the properties of steady-state solutions, when they exist.

In our simple model, for instance, a steady-state solution is easily obtained by computing the values which correspond to a stable stock of wealth: $B = B_t = B_{t-1}$. It turns out that steady-state income is given by a

[14] For instance, in a model where $Y_t = \sigma \cdot Y_{t-1} + \cdots$, values of $\sigma > 1$ imply an explosive path for *Y*.

multiplier over government expenditure[15], and in the steady state the ratio of wealth to income depends only on model parameters and the interest rate[16]. For models this simple, out-of-equilibrium dynamics can be obtained analytically, and explored through phase diagrams: see Godley – Lavoie (2007, ch.3) or Zezza – Dos Santos (2008).

The adjustment to a new steady state after a shock to government expenditure is reported in Figure 25.1.

[FIGURE 25.1 ABOUT HERE]

This chart illustrates the method for analyzing the properties of more complex models: shocking one exogenous variable or one parameter at a time, numerical simulation allows verifying the dynamics and the stability of the model. In this simple case, income converges monotonically to its new steady state level. In empirical models, Godley placed some emphasis on the *mean lag* of the adjustment to the new steady state, which is given , for a shock to Y in t, by

$$ML = \frac{\sum_{i=0}^{\infty} i \cdot \Delta Y_{t+i}}{\sum_{i=0}^{\infty} \Delta Y_{t+i}} \qquad (25.14$$

As shown in Figure 25.1, the adjustment to the new steady-state can take a considerable amount of "time" (simulation periods), and the mean lag is the number of periods it takes for a shock to exert half of its total effect. Estimating the mean lag in an empirical model is relevant: for instance, a government wishing to provide a fiscal stimulus to reduce unemployment will want to know if it takes months, or years, to achieve its target.

More generally, the SFC literature usually places greater attention to time than other modeling approaches. Godley's theoretical models are usually built around the notion of a "production period". Similarly, some SFC models adopt the concept of a "financing period", which starts when credit is granted as initial finance for the production process, and ends when credit is reimbursed[17].

Empirical SFC models are usually loosely grounded in theoretical models, but adopt the time frequency which is compatible with data availability – usually quarters or years. We note, in passim, that some authors prefer to develop their theoretical models using continuous time, but either need to adapt the model to

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[15] Namely, $Y = \frac{\alpha_2 - \beta}{\alpha_2 \cdot t - \beta} \cdot G, where\ \beta = (1-\alpha_1)(1-t)r$. For r=0, this reduces to $Y = \frac{G}{t}$.

[16] Namely, $\frac{B}{Y} = \frac{(1-\alpha_1)(1-t)}{\alpha_2 - (1-\alpha_1)r}$

[17] See Zezza (2011) for a discussion of Godley's approach in relation to the Theory of the Monetary Circuit.

discrete time when testing it against the data, or simply verify model results with some stylized facts from a real economy.

A very relevant feature of SFC models, as illustrated in Figure 25.1, is the analysis of stock-flow and flow-flow ratios. In our simple model, for instance, the ratio of the stock of wealth to income depends on the parameters in (25.13) and the interest rate. A shock to government expenditure will therefore not change this ratio, to which the economy returns to in steady state.

The analysis of stock-flow norms in SFC models has been controversial, especially when it was first introduced as a feature of the "New Cambridge" approach, which assumed – as in our simple model – the empirical stability of the stock of private sector net financial wealth relative to income (see Godley and Cripps, 1983).

> "the stock-flow norms which are crucial to determining how actual economic systems work do, as a matter of fact, exhibit a fair degree of stability" (Godley and Crippa, 1983, p.43)

Since the private sector includes both family and households, this assumption could not be tracked back to microeconomic behavior, and therefore led to criticism from mainstream approaches which derive macroeconomic models from the optimizing behavior of representative agents. The answer to such criticism from Godley and Cripps (1983) was based on the simple mechanics of stocks and flows

> "If the flow of a river into a lake increases, the volume of water in the like will not rise for ever. At some point a new water level will become established; then (and only then) the outflow will equal the inflow." (Godley and Cripps, 1983, p. 42)

In Godley and Lavoie (2007), on the other hand, as in most of the more recent theoretical literature, household and business are modeled separately, and the stability of household wealth to income, or inventories to sales, can be rationalized as "behavior" of the aggregate sector, following the standard Keynesian and post-Keynesian methodology. More specifically:

> "The Godley & Lavoie models rely on procedural rationality, with agents reacting to past disequilibria relative to norms" (Godley and Lavoie, 2007, p. 494)

Note also that, in any model which reaches steady growth (or steady state), stocks and flows rise at the same rate, and therefore both stock-flow and flow-flow norms converge to a given value. When important stock-flow norms are changing in an economy, this is a signal of adjustment processes out of equilibrium. For instance, Godleys' predictions of the 2001 and 2007 recessions were based on the analysis of the systematic increases in the stock of private sector debt relative to income in the US (Godley, 1999), as well as of other flow-flow norms such as the US current account relative to GDP.

In post-Keynesian SFC models, adjustment towards steady state does not occur through prices instantaneously adjusting to clear any gap between supply and demand. Rather, usually adjustment operates through error correction mechanisms, with agents reacting to the distance between the target and the actual level of the variables of interest. It follows that one or more variables in the model act as a buffer. For instance, a Tobinesque approach to portfolio decisions often incorporated into SFC models imply that one of the assets – such as bank deposits – will be off target, as a result of agents inability to have accurate expectations on their end-of-period stock of wealth, etc. Price adjustments are introduced in SFC models only for financial markets, but without forcing instantaneous equilibrium. In our experience, attempts to model instantaneous market clearing in SFC models yields instability, and/or unrealistic price volatility.

Post-Keynesian SFC models: state of the art

We will not attempt to provide a survey of the literature on post-Keynesian stock-flow-consistent models here. An early assessment, covering the work of Tobin and Godley, can be found in Dos Santos (2006) and Godley – Lavoie (2007, ch.1). Godley – Lavoie (2007, pp.21-22) also provide an excellent reconstruction of the relevance of stocks and stock-flow consistency among post-Keynesian authors.

An excellent survey of more recent literature is in Caverzasi and Godin (2014). It seems to us that the literature is evolving along different, but intersected, lines of research: (1) models of the "modern" financial sector; (2) the integration of agent-based models at the micro level with stock-flow consistency at the macro level; (3) models of open economies; (4) models including personal income distribution; (5) models for developing countries; (6) models including environmental externalities; (7) development of simple SFC models for teaching; and (8) empirical models for whole countries.

Modeling the financial sector

One of the main strength of the SFC approach is the consistent integration of the real and financial sectors, which is lacking in mainstream theoretical models, and their empirical counterparts (DSGE models). However, some criticism[18] to the SFC approach has focused on its simplistic presentation of the financial system, on the face of the rapid development of a "shadow" banking sector, the increasing processes of securitization, the widespread use of derivatives, etc.

[18] See Taylor (2008).

Some authors are extending the Godley-Lavoie approach to incorporate financial innovation and a Minskian approach, while keeping the analysis at the macro level: see Le Heron (2013); Passarella (2014); and Sawyer - Passarella (2014) among many others.

Agent based models

Agent-based modeling is developing quickly as an alternative to the microeconomics of rational representative agents. Many authors working in this tradition have recognized the need to adopt the SFC approach for obtaining macroeconomic consistency in their microeconomic simulations. On the other hand, the possibility of complementing a SFC macroeconomic model with micro behavior in the agent-based approach may allow to model speculative behavior in financial markets, which is difficult to present in a realistic way at the macro level. See Kinsella et al. (2011), and Carvalho – Di Guilmi (2014) among others.

A research group coordinated by Kinsella, Gallegati and Stiglitz is producing interesting results, as well as new freely available software code: see Caiani and others (2014)

Models of open economies

The integrated analysis of real and financial markets make the SFC approach particularly suitable for addressing international imbalances. Recent work on this line, based on the seminal work of Godley and Lavoie (2007b), include the analysis of the Eurozone imbalances (Mazier and Valdecantos, 2014), the analysis of the role of the dollar as a reserve currency (Lavoie and Zhao, 2010), and the proposal for reforms of the international monetary system (Valdecantos and Zezza, forthcoming)

The role of the personal distribution of income

Most SFC models separate household from business, and have a role for the functional distribution of income between wages and profits. More recently, some theoretical models have started to split the household sector into sub-sectors, such as "workers" and "capitalists" or "rentiers", to explore the role of the personal distribution of income on growth and financial stability. Since a growing number of researchers believe that the concentration of income and wealth is detrimental to growth, this line of research is also promising. See Zezza (2008); Dallery-van Treeck (2011); and Sawyer-Passarella (2014) among many others..

Models for developing countries

Most post-Keynesian SFC models developed so far are based on the Keynesian assumption that output is demand driven, since firms have spare capacity. This assumption may not be realistic for developing countries with a small industrial base, where the impact of a positive shock to demand may be constrained by the availability of factors of production and, when these have to be imported, by the availability of international reserves.

Incorporating supply-side constraints in the SFC methodology - possibly by the use of input-output tables - is an interesting and promising line of research, closely linked to the structuralist approach. See Valdecantos (2015).

The environment

The SFC approach is well suited to study the impact of economic growth on the environment, since some aspects of the quality of the environment – as well as the treatment of natural resources – can be modeled as stocks which are affected, say, by flows of pollution, while at the same time checking the feedback effect from the quality of the environment to growth and well-being. See Naqvi (2014).

Teaching SFC models

One drawback of the SFC approach is in its complexity against simple mainstream textbook models, and the fact it relies on numerical simulations, usually obtained through Eviews, which is a licensed software that may not be easily accessible to researchers with a tight budget constraint.

Efforts in the direction of simple SFC models to be used for pedagogical purposes include Godley – Lavoie (2007), which presents models of increasing complexity, and Zezza - Dos Santos (2008) who present analytical solutions and diagrams for a simple model, and Dos Santos – Macedo e Silva (2009).

The development of software code for solving SFC models with an open-source software, R (r-project.org) has recently become available[19] thanks to Antoine Godin and Hamid Raza, and this should enable further research.

Empirical models for whole countries

Although the SFC approach is particularly well suited for the empirical analysis of whole economic systems, only two research teams are working on such models. Researchers at the Levy Economics Institute have expanded the work of Godley (1999) on a model for the United States (see Zezza, 2009, and Papadimitriou – Nikiforos – Zezza - Hannsgen 2014 among others), and a model for Greece (Papadimitriou – Nikiforos - Zezza 2013, 2014).

[19] See sfc-models.net, a web site which holds a repository of program codes for SFC models using different software platforms.

A second research group in Limerick is developing a model for Ireland (Kinsella and Tiou-Tagba Aliti, 2012).

Other empirical work in the context of the SFC literature is being produced at Université Paris XIII (see Clevenot – Guy – Mazier, 2009, 2010).

The Levy Institute models are being developed to produce projections of a whole economic system, conditional on alternative assumptions on the future path of exogenous variables (usually, fiscal policy parameters). Their relative success in predicting the trajectories of these economies is attracting a growing interest in this methodology.

Concluding remarks

The stock-flow-consistent approach which originated in the work of Godley, Tobin and Lavoie, is perceived by a growing number of heterodox researchers as the new frontier of macroeconomic theorizing. We endorse the position of Lavoie, and - in the words of Caverzasi and Godin (2014) – believe that

> "SFC models can provide a useful tool in the consensus-making attempt within the Post-Keynesian tradition, since the theoretical discussion and the comparisons are based on a coherent, structured, and at the same time adaptable framework"

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