The Stock-Flow Consistent Method: Analytical Tools, Evolution, and a Critique of the Mainstream

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The Stock-Flow Consistent Method: Analytical Tools, Evolution, and a Critique of the Mainstream

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RESUMO

O presente trabalho tem por objetivo explorar as técnicas do método Stock-Flow Consistent (SFC) como uma alternativa e ferramenta potente de crítica ao mainstream e, desta forma, de construção futura de um arcabouço para unificar o pensamento heterodoxo. O trabalho discute as principais características dessa metodologia, apresenta uma resenha dos trabalhos recentes e identifica as críticas ao mainstream. O trabalho mostra as falhas contábeis dos modelos Mundell-Fleming, neoclássico padrão e de um texto para discussão do Fundo Monetário Internacional.

PALAVRAS-CHAVE: Método Stock-Flow Consistent; Mainstream;.

ABSTRACT

The present work seeks to explore the techniques of the Stock-Flow Consistent (SFC) method as an alternative to and tool for criticizing the mainstream economics and, therefore, of developing in the future a framework for unifying the heterodox thought. The paper discusses the main features of that methodology, presents a survey of the recent SFC literature, and critically analyzes the mainstream. Some accounting flaws are exposed in the Mundell-Fleming model, in standard neoclassical models, as well as in a recent IMF discussion paper.

KEYWORDS: Stock-Flow Consistent Approach; Mainstream

Jel codes: A10; B40; E12;

Área 3: História do pensamento econômico e método

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1 Introduction

According to Backhouse (2004), it is possible to identify two broad paradigms in economics. The first one, the *mainstream*, encompasses the majority of researchers and dominates the academic research worldwide. Its common theoretical characteristics are the modeling of maximizing individuals, in markets usually taken as efficient, and inserted in a context of general equilibrium. The second paradigm is the *heterodox*, which sums up "(…) views systematically excluded from the mainstream of the economics profession" (BACKHOUSE, 2004; p. 262). Taylor (2004a) calls the heterodox approach *structuralist*", encompassing schools and traditions that receive labels such as "[original, neo-,post-]–[Keynesian, Kaleckian, Ricardian, Marxian]" (p. 1). The heterodox/structuralist paradigm, in contrast to the mainstream, is not based on a common underlying methodology.

The main feature of the Stock-flow Consistent (SFC) method discussed in this paper is, as its own name suggests, a consistent modeling of stocks and flows. This could be at first regarded as a rather simple and harmless feature, but, as will be shown, it has important consequences, mainly regarding the identification of identifying flaws in the mainstream. One of the most important advantages of the method is that "[…]there are no black holes: every flow comes from somewhere and goes somewhere" (GODLEY, 1996; p. 7). According to Dos Santos (2002, p.1), SFC models are "crucial for sound macroeconomic reasoning in general and, therefore, its widespread adoption would increase both the transparency and the logical coherence of most macro models".

Lavoie and Godley (2001-2002) reinforces the message:

> In our methodology, we can justify every point by reference to a precise system of relationships. If others disagree, they can be challenged to say precisely what simplification or parameter is inappropriate. Every relationship can be changed, and one can find out whether the change makes any difference to the results. This method ought to be helpful to resolve some controversial issues (LAVOIE; Godley, 2001-2002, p. 308).

On the other hand, Lavoie (2008) underlines the potential of the SFC models for the heterodox economics:

> [models with] stock-flow consistency with simple adjustment reaction functions, often linking stock-flow targets, can play an essential role in heterodox macroeconomics, as it provides a potential for common ground for all heterodox schools, just like the maximizing representative agent seems to be the standard of mainstream economics (p. 332-333).

The objective of the paper is therefore to present the SFC method and to address its potential for identifying flaws and offering an integrated heterodox approach alternative to the mainstream. The paper is organized into four sections, including this introduction. The second one presents the basic features of SFC models. The third provides a survey of the recent literature. The fourth presents criticisms based on the SFC perspective against the mainstream. The last section concludes the article.

2 Basic features of the stock-flow consistent method

In this section we introduce two foundations of the SFC methodology, based on Godley and Lavoie (2007), in order to provide a basic understanding of the mechanisms behind it.

The first modeling step in the SFC method is to make explicit the sectoral accounting interrelationships, which consist of two matrices: The Balance Sheet Matrix, which deals with assets and liabilities of the different sectors of the economy (representing therefore the stocks), and the Transactions-Flow Matrix, that records all the monetary transactions in an economy (representing therefore the flows).

The complexity of these matrices varies in accordance with the intentions of the researcher. Let us start with a very simple one, presented in the chapter 2 of Godley and Lavoie (2007). The first model is a rather simplified case of a closed economy without government. There are two kinds of assets: Tangible capital and money deposits. Table 1 presents the respective macroeconomic balance sheet.

Table 1 – Balance sheet of a simple model

	Households	**Firms**	**Banks**	**Σ**
Money deposits	$+ M_h$	$+ M_f$	- M	0
Tangible Capital		+ K		+K
Loans		$- L_f$	$+ L_f$	0
Balance (net worth)	$- NW_h$	$- NW_f$	0	- K
Σ	0	0	0	0

Several points must be emphasized here. First, the choice of sectors for the model is an important decision, representing the underlying simplifications and assumptions. A second aspect considers the signals of the matrix entries. A positive sign indicates an asset, whereas a negative one represents a liability. Households for example have only one asset: Money deposits (M_h). The entire value appears on the liability side of the balance sheet as their net worth (NW_h). Firms have two assets, money deposits (M_f) and tangible capital (K), and two liabilities, loans (L_f) and their respective net worth (NW_f). Banks' assets are loans (L_f), and liabilities are in the form of deposits (M), with zero net worth. A third point concerns the sum of the columns and rows. The columns have to sum to zero, because the accounting rules ascertain that the assets must have the same value as liabilities. Liabilities have to sum to zero as well, except for the row dealing with tangible capital. Rows dealing with financial assets and liabilities must sum to zero, because they are "claims of someone against someone else" (GODLEY; LAVOIE, 2007, p. 32), leading to the need for mutual compensation. The tangible capital, in contrast, appears just once, in the entry of its owner.

Table 2 represents the transactions-flow matrix of the model, including the circuit of money. In this case, the respective signs have a different meaning. A positive sign means that the entry in question is a source of funds, whereas a negative sign represents a use of funds. Households have only one source of funds, their wages (WB), and two possible kinds of expenditures, consumption (C) and increases in money deposits (ΔM_h). Firms have two columns, representing current and capital transactions, in order to account for investments (I), which means that an intra-firm purchase needs to be

identifiable within the matrix, as well as the resources necessary for additional funding of investment in excess of profits (ΔL_f)[3].

Table 2 – Transactions-flow matrix of a simple model

		Firms		**Banks**	
	Households	Current	Capital	Capital	**Σ**
Consumption	- C	+ C			0
Investment		+ I	- I		0
Wages	+ WB	-WB			0
Δ Loans			$+ \Delta L_f$	- ΔL	0
Δ Deposits	$- \Delta M_h$		$- \Delta M_f$	+ ΔM	0
Σ	0	0	0	0	0

As above, every column must sum to zero in this case, too. The reason lies in the fact that every purchase from one sector is a sale from another. In the case of non-commercial transaction the sum must be zero because a payment from one sector is a receipt to another. In the latter case, the columns show the budget constraint of each sector. It must sum to zero, because every fund either represents purchases of goods or an increases in assets.

It is important to note that, so far, no behavioral aspects were considered

> beyond what is implied by logical constraints (e.g. that every buyer must have a seller) or by the functions that have been allocated to the various sectors (e.g. that firms are responsible for all production, banks for making all loans) or by the conventional structure and significance of asset portfolios (e.g. that money is accepted as a means of payment) (GODLEY; LAVOIE, 2007, p. 42).

One feature of the transaction-flow matrix is the principle of quadruple entry. Every purchase implies at least two operations: a negative one as a use of funds, and a counterpart representing an income source (for example, the "wages" entry in the table 2), or a reduction in an asset (or increase in a liability, as in the case of a loan). Also, because every transaction involves two sectors, there must be at least four entries in the matrix in order to account for every transaction.

An example in Godley and Lavoie (2007) clarifies these aspects. Assuming a loan that banks grant to firms, (–ΔL on table 3). Firms receive resources ($+ \Delta L_f$) and deposit them ($-\Delta M_f$), which represents a use of funds by firms and a source of funds to banks. The second step is the use of the resources by firms, presented on table 4. Firms withdraw their deposits (ΔL_f entry) and use the resource to acquire new investment goods. The production process involves wage payments (–WB) to households in the form of income (+WB), who then deposit them ($-\Delta M_h$).

[3] In the household column, this difference was disregarded. For the sake of coherence, they would have to have a "capital" column too, showing the increases (or decreases) in money deposits.

Table 3 – The first step in a quadruple-entry example

		Firms		Banks	
	Households	Current	Capital	Capital	**Σ**
Consumption					0
Investment					0
Wages					0
Δ Loans			$+ \Delta L_f$ ←	$- \Delta L$ ↑	0
			↓		
Δ Deposits			$- \Delta M_f$ →	$+ \Delta M$	0
Σ	0	0	0	0	0

The balance sheets and the transactions-flow matrices of the SFC models can be modified according to different assumptions, for example, the inclusion or omission of sectors. Some sectors can be simplified away and other sectors can be introduced, like the LP model of Godley and Lavoie (2007, chapter 5), which subtracts private banks and adds government and central bank. Tables 5 and 6 show, respectively, the balance sheet and the transaction-flow matrix for this case.

Table 4 – The second step in a quadruple-entry example

		Firms		Banks	
	Households	Current	Capital	Capital	**Σ**
Consumption					0
Investment		+ I ←	- I		0
Wages	+WB	-WB			0
Δ Loans	↓		$+ \Delta L_f$	$- \Delta L$	0
Δ Deposits	$- \Delta M_h$			$+ \Delta M$	0
Σ	0	0	0	0	0

Table 5 – Balance sheet of Model LP

	Households	**Firms**	**Government**	**Central Bank**	Σ
Money	+ H			- H	0
Bills	$+ B_h$		- B	$+ B_{cb}$	0
Bonds	$+ BL.p_{bl}$		$- BL.p_{bl}$		0
Balance (net worth)	- V		+ V		0
Σ	0	0	0	0	0

There are four sectors in this economic model: Households, firms, government and central bank. Households have three kinds of assets: Money (H), bills (B_h) and bonds (BL); and one liability, their net worth (V). The government's liabilities are bills and bonds, on the asset side is its net worth. The central bank bills are its assets, and the high-powered money H as its liability.

The transactions-flow matrix includes specific entries for Central Bank profits and interest payments. It must be noted that the very configuration of the matrix tells a lot about the underlying assumptions. In the first place, the split of companies' account into current and capital is eliminated. This reflects the assumption that firms do not invest in tangible capital. Second, the row "Central Bank profits" is introduced to deal with the assumption that all the Central Bank profits are transferred to the government. The last row deals with "capital gains". This fact raises some questions, since capital gains obtained by price changes are not transactions, but increase the wealth of the sectors, that is, they modify their balance sheet.

Table 6 – Transactions-flow matrix of Model LP

				Central Bank		
	Households	**Firms**	**Government**	Current	Capital	Σ
Consumption	- *C*	+ C				0
Government expenditures		+ G	- G			0
Income = GDP	+ Y	- Y				0
Interest payments on bills	+ $r_{b-1}.B_{h-1}$		- $r_{b-1}.B_{-1}$	+ $r_{b-1}.B_{cb-1}$		0
Interest payments on bonds	+ BL_{-1}		- BL_{-1}			0
Central Bank profits			+ $r_{b-1}.B_{cb-1}$	- $r_{b-1}.B_{cb-1}$		0
Taxes	- T		+ T			0
Change in Money	- ΔH				+ ΔH	0
Change in bills	- ΔB_h		+ ΔB_h		+ ΔB_{cb}	0
Change in bonds	- $\Delta BL.p_{bl}$		+ $\Delta BL.p_{bl}$			0
Σ	0	0	0	0	0	0
Memo: capital gains	- $\Delta p_{bl}.BL_{-1}$		+ $\Delta p_{bl}.BL_{-1}$			0

Capital gains are accounted as follows. One entry is indicated in the row 'Change in bonds' and the counterpart in 'memo: capital gains'. This can be proved by the Ostergaard diagram below, and also algebraically. The large rectangle in the Ostergaard diagram represents the end of period value of an asset. Bonds are used in this example, but any other asset can be subject to price changes. The small rectangle represents the end of previous period value of bonds. The changes are given by their respective differences: One comes from the new acquisition of bonds, the other from price variations that alter the value of the previously held bonds.

The algebraic proof given by Godley and Lavoie is as follows. The difference between the new and the former value of the stock of bonds is, by definition, equal to $(p_{bl}BL - p_{bl-1}BL_{-1})$, which leads to equation 1:

$$(p_{bl-1} + \Delta p_{bl}).(BL_{-1} + \Delta BL) - (p_{bl-1}BL_{-1}) = (p_{bl-1}BL_{-1}) + (\Delta p_{bl})BL_{-1} + (p_{bl-1}\Delta BL) + (\Delta p_{bl}\Delta BL) - (p_{bl-1}BL_{-1}) \quad (1)$$

Note that the first and the last parenthesis in the right-hand side of the equation cancel out. So:

$$(p_{bl-1}\Delta BL) + (\Delta p_{bl}\Delta BL) + (\Delta p_{bl})BL_{-1} = (p_{bl-1} + \Delta p_{bl})\Delta BL + (\Delta p_{bl})BL_{-1} \quad (2)$$

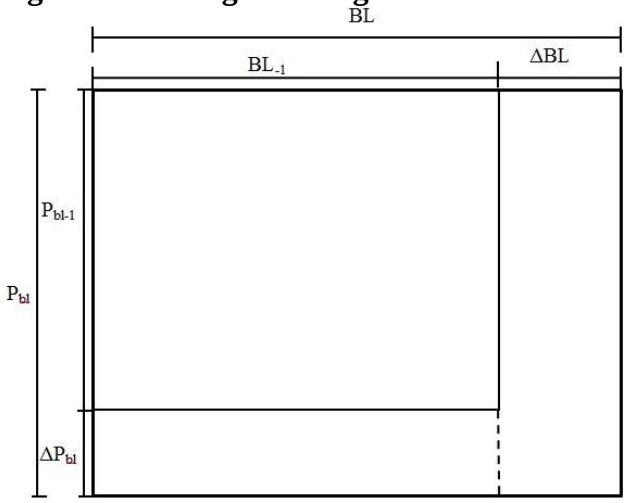
This boils down to:

$$(\Delta BL)p_{bl} + (\Delta p_{bl})BL_{-1} \quad (3)$$

The first term represents the changes in bonds and the second term is the value of the row 'memo: capital gains'.

The complexity of the SFC models can be further increased, with the addition of more sectors and assets. Each asset adds at least two rows to the transactions-flow matrix, one for the interest payments (or distributed profits, in the case of equity) and another for new asset. New sectors add at least one column to the matrix. If it is important to differentiate between current and capital transactions, a sector adds two columns to the matrix. For the case of an open economy model, a duplication of the columns in order to represent the other country is a common practice. The rows sum to zero after exchange rate adjustments.

Figure 1 – Ostergaard diagram



Source: Godley and Lavoie (2007, p. 135)

So far, we have not dealt with the sector-specific behaviors, that is, the supply and demand equations, and the solutions of an SFC model. The behavioral equations vary between models, according to the theoretical background and research emphasis. For example, an investment function can include expected sales, or capacity utilization, or both. The behavior of a sector, banks for example, can vary from a simple deposit taker and loan supplier to the complexities of credit rationing and mark-up procedure in the interest rates charged.

SFC models are usually solved by the identification of a steady-state and the introduction of an exogenous shock variable. This approach of making simulations has the shortcoming of providing only local equilibrium. A global equilibrium can be found analytically. However, it is not a common procedure, since the models are usually very large (with more than 100 equations) and may involve non-linearities.

Next section presents the evolution of the model in order to highlight the most important issues discussed over the years.

3 Literature review

3.1 The Origins of SFC method

Some basic features of SFC method, such as the study of balance sheet interrelations between sectors, and the budget constraint that they face, have a long history in the economic thought. Kinsella (2011) argues that William Petty's *Verbum Sapienti* book, written in 1664, "present a balance sheet approach to the study of national income and expenditure" (p. 3). Bezemer (2010) claims that the "circular flow" view of the monetary economy, which "was present in classical thought from the start" (p. 679), is the starting point of the SFC approach. Francois Quesnay's *Tableau Economique* adopted that method, as well as Adam Smith's *Wealth of Nations* and Jean Baptiste Say's *Treatise on Political Economy*[4]. Karl Marx identified the "profit puzzle" with a circular flow view of the economy. Schumpeter's *Theory of Economic Development* is based on the context of a circular flow of traded goods.

At the end of the 1960's and beginning of the 1970's, the government budget constraint received academic attention. Ott and Ott (1965) criticized the fiscal and monetary policy models of their time blaming them for not paying attention to the government budget and its impacts in the creation of private sector wealth. Christ (1967; 1968) models the interdependency of the fiscal and monetary policy that arises when the government budget is fully considered. Blinder and Solow (1973) extend a simple IS-LM model, showing that some of its standard conclusions do not hold when the government budget is correctly modeled, especially in the case of interest payments.

These examples make clear that the recognition and theorization about balance sheets interconnections, budget constraints, and monetary flows, are not new in the economic thought. What is new is the emphasis and their explicit modeling of these aspects as a systematic method of inquiry.

Besides the works cited above, it can be said that the origins of the systematic SFC method lies in the works of two research groups: the Yale (or New Haven) school, led by James Tobin; and the Cambridge Economic Policy Group (CEPG, also known as New Cambridge School), whose main contributors are Wynne Godley and Francis Cripps.

Brainard and Tobin (1968) represents the seminal work of the Yale School. In the very first page, where the authors explain their objective, it is possible to see the importance of this work for the future SFC literature:

> "In this paper we argue for the importance of explicit recognition of the essential interdependences of markets in theoretical and empirical specifications of financial models. Failure to respect some elementary interrelationships – for example, those enforced by balance-sheet identities – can result in inadvertent but serious errors of econometric inference and of policy" (BRAINARD; TOBIN, 1968, p. 99).

This work was extended by Tobin (1969)[5]. Another contribution is the portfolio choice theory, which is the same used in contemporaneous SFC models. These models have

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[4] Bezemer (2010) states that "Say's Law as stated by Say so is an accountant's logical equality: all sold output will be bought. It is a tautology (...)" (pg. 679).

[5] These two works have led to debates about the proper specification of the portfolio allocation, all of them published in the *American Economic Review*. A first debating group can be identified with

been estimated by Backus et al (1980). In his Nobel Lecture, Tobin (1982) points out to the principal features of his framework, which is still present in SFC models. These are: (i) precision regarding time; (ii) tracking of stocks; (iii) several assets and rates of return; (iv) modeling of financial and monetary policy operations; and (v) Walras' Law and adding-up constraints.

The CEPG was founded by Wynne Godley in 1970, when he moved from the British Treasury to Cambridge University (MATA, 2012). One of the main projects of the CEPG was to issue a yearly forecast of the British economy. The first formal presentation of the CEPG model is found in Cripps and Godley (1976). According to the authors, their model "lies squarely within the postwar tradition of keynesian model building" (p. 335). One of their main assumptions and features of the "New Cambridge School" is the Private Expenditure Function, an aggregation of households and firms expenditures.

In 1978, the Carnegie-Rochester Conference Series on Public Policy organized a publication discussing the economic problems of Great Britain, and Fetherston and Godley (1978) presented the issues using the CEPG model. They were criticized by Blinder (1978), Frenkel (1978), Hall (1978), and Russel and Wakeman (1978). Another critique of the CEPG model is available in Chrystal (1981), which is addressed by Anyadike-Danes (1983). Chrystal (1983) is a rejoinder.

The seminal work of the CEPG is Godley and Cripps (1983). Their book presents a series of models that explicitly consider the budget constraints of the sectors and of the economy as a whole. A characteristic feature of their models is the small number of behavioral parameters that follow the stock-flow norms. According to the authors,

> we must exploit logic so far as we possibly can. Every purchase implies a sale; every money flow comes from somewhere and goes somewhere; only certain configurations of transactions are mutually compatible. The aim here is to show how logic can help to organize information in a way that enables us to learn as much from it as possible (GODLEY; CRIPPS, 1983; p. 44).

In the early 1980s, the CEPG funding was cut off. Godley remained in Cambridge until his retirement in 1993, and then went on to the Levy Economics Institute of Bard College (PAPADIMITRIOU, 2012). There, he started to develop what today is the overarching, up to date SFC method. Godley (1996) is the work that leads off the recent scholarship in this tradition, presenting a balance-sheet, a transactions flow matrix of four sectors, and a series of behavioral equations that reach a steady-state and then undergo some shocks. Godley (1997) and Godley (1999a) are very similar to the previous paper. Godley (1999b) presents an open-economy model, and Godley (1999c) is an application of the method to the US economy. Lavoie and Godley (2001-2002) provide a better connection of the approach, taking into account the post-keynesian literature. After this work, Dos Santos (2002) coined the term "Stock Flow Consistent".

Ladenson (1971, 1973), Clinton (1973) and Smith (1975). A second group includes the works of Purvis (1978), Smith (1978), and Owen (1981).

3.2 Recent SFC models

A recent survey of the SFC method is provided by Carvezasi and Godin (2015). In order to avoid repetitions, we focus here only on research that has been published since then, or not included in their review, and therefore provide a complement to their survey. One of the main strengths of the SFC method is its treatment of the linkages between real and financial sectors. Several authors have explored a better conceptualization of the financial side in an SFC environment. Pilkington (2008) represents the first attempt at inserting the shadow banking system into an SFC model. His effort is preliminary, since he only presents the accounting framework, without introducing behavioral equations or carrying out simulations. Fischer and Bernardo (2014) model the political economy behind the shadow banking. One interesting feature of their model is the influence that the business sector exerts upon government. The higher is the workers strength, the higher is the business pressure for the government to scale back its spending. Lainá (2015) analyzes an economy with a full-reserve banking system. He finds that money creation through government spending leads to a temporary increase in GDP and to a permanent reduction in consolidated government debt.

The complexities of the financial system and the particular configuration of the housing market are some of the main drivers of the subprime crisis of 2008. Three recent SFC models address these issues. Fontana and Godin (2013) model an economy where commercial banks convert mortgage loans into tradable securities. Their assumed financial system includes commercial banks and two kinds of investment banks. Moreover, households are split up between workers and capitalists, as common in models of the housing market. Nikolaidi (2014b) develops a more complex model, in which households are split into three groups: one that takes out mortgages from commercial banks to finance their purchase of houses, another that takes only consumer loans. and a group of investor households[6]. The economy consists of institutional investors and SPVs (Special Purpose Vehicles) underwriters. The author finds that a rise in securitization practices, combined with a declining wage-income share (two stylized facts of the recent crisis), increase the instability of the system. Beckta (2015) introduces a markup in housing pricing by the firm sector. This markup is augmented when the realized inventories-to-sales ratio lies below the targeted inventories-to-sales ratio, and reduced in the opposite case. The higher housing prices increases their returns, which induces a higher demand for houses by households. The construction of houses grows until the reversion of tendencies in inventories-to-sales ratio, and then markup, prices and demand decrease.

Tied to the factors behind the crisis is the increasing inequality of households' income. Two works have been done about this subject. Dafermos and Papatheodorou (2015) model the links between functional and personal income distribution. The households of their model are split into five categories: low-skilled and high-skilled workers that can be employed or unemployed and entrepreneur-owners. They find that a rise in low-skilled workers' wage share reduces inequality, whereas a rise in the dividend payout ratio of firms causes the opposite. Jackson and Victor (2016) explore the hypothesis that lower growth rates tend to rise inequality, a point made recently by Piketty in his *Capital in the 21st Century* best-selling book. The authors show that, under certain

[6] This group corresponds to the "capitalists" that appear in papers dealing with housing market.

conditions, the hypothesis holds true, but "that there is *absolutely no inevitability at all* that a declining growth rate leads to explosive (or even increasing) levels of inequality" (p. 215, emphasis in the original). In the model, inequality positively depends on the elasticity of the substitution between labor and capital, and negatively on the workers' savings rate and on the retained profit ratio of the firms.

Still considering the financial realm, Mazier and Valdecantos (2013) elaborate a four-country model, consisting of Spain (representing southern Europe countries), Germany (representing northern countries), USA and the rest of the world. They examine different scenarios to cope with exchange rate misalignments, such as the possible introduction of two Euros (one to the south and other to the north) or Germany leaving the Eurozone, which is the authors' preferred solution. Valdecantos and Zezza (2015) construct a model to analyze global imbalances in the International Monetary System (IMS), the most important of them being the imbalance in the USA accounts: the country experiences trade deficits, but the dollar does not depreciate, because of foreign investors' demand. Their model has four "countries" (USA, China, Eurozone and the Rest of the World) and is subject to three different closures: the US dollar as the international currency, an increase in the importance of the SDR, and the introduction of the Bancor, along the lines proposed by Keynes in the Bretton Woods Conference. Only the last one eliminates the imbalances of the system.

Ryoo (2013) analyzes the interactions between banks' and firms' profitability and financial instability, in a model with long waves given by Minsky's financial instability hypothesis (FIH) and short waves given by Harrodian business cycles. There are self-reinforcing mechanisms between firms' indebtedness and banks' leverage, since the former increases the latter, which increases banks's profitability, leading to further credit expansions. When the debt burden gets so high that it reduces the aggregate demand, the cycle goes the other way around, with a reduction in indebtedness decreasing banks' leverage and profitability. Carvezasi (2013) explores the "missing macro link" in Minsky's FIH. This missing link is based on a critique raised by Lavoie and Seccareccia (2001), whose core claim is that the investment expenditures of firms are a source of income for the ones producing capital goods. Hence, the overall level of indebtedness of the firms remains unchanged, since the debt of some became the income of others. Minsky's argument is that, the higher the investment is, the more firms will need external finance. Therefore, more investment generates more debt. Using SFC accounting, Carvezasi shows that "debt-financed investments do not lead to a worsening in the financial position of the firm sector only assuming that firms do not distribute profits or, if they do, that households have a saving propensity equal to zero" (p. 21-22). Nikolaidi (2014a) focuses on the desired margins of safety of firms and banks in order to analyze the relationship between leverage and investment. He finds that the two variables can move both in the same and in the opposite direction without the need for a regime switch from a debt-burdened to a debt-led one.

Authors affiliated with the Monetary Circuit Theory (MCT) found the SFC method a useful tool to develop their theories. Passarella (2014) aims to update the MCT in order to deal with financialisation. According to him, the usual view of the theory that the money enters the system through banks' loans to firms does not hold the facts anymore, since it is a stylized fact that firms became a surplus sector, whereas the households are those who take loans. By means of an SFC approach, the author elaborates an updated monetary circuit. Sawyer and Passarella (2015) develop a "stock-flow coherent

rereading of the TMC" (p. 7) in order to deal with financialisation. The salient features of their model are a split of the financial sector into commercial banks and other financial institutions, and the securitization of the loans granted to households, which are traded in the financial market. Botta, Carvezasi and Tori (2015) use the SFC method and the MCT to analyze the shadow banking system and the assets that belong to it, such as REPO (Repurchase Agreements), ABS (Asset-Backed Securities), CMO (Collateralized Mortgage Obligations) and CDS (Credit Default Swaps).

Greenwood-Nimmo (2014) is an extension of the model presented in chapter 12 of Godley and Lavoie (2007). The author introduces two innovations, in order to analyze stabilization policies. The first one is the introduction of inflationary forces arising from a conflicting claims mechanism. The second one is the endogenization of the marginal propensities to consume out of disposable income and wealth, acting now as negative functions of the real interest rate. These two forces are the motivation for the existence of stabilization policies. Five closures of the model are developed: (i) Baseline case with no stabilization policy; (ii) inflation targeting pursued autonomously by each country; (iii) leader-follower interest rate setting; (iv) autonomous inflation targeting with counter-cyclical fiscal policy; (v) leader-follower interest rate setting with counter-cyclical fiscal policy. These five closures are subject to three shocks: i) step decrease in exports from country B; ii) increase in real wage pressure in country B; iii) expansionary tax cut in country A. In terms of stabilization, the mixed approaches are better than the use of monetary policy alone.

Richardson (2015) tries to understand the common sense that there is "too much government debt". He first points out to some inconsistencies in mainstream works that advocate a crowding out effect of the government deficit, such as the absence of a surplus unit in the system that matches the deficit of the government. He then explores the claim that debt must be repaid, pointing to some liabilities that have no maturity dates, such as base money and private equity. Pedrosa and Macedo e Silva (2015) explore the effects of private financial decisions on public deficit and debt, incorporating Minsky's lender and borrower risk theory, and Fisherian debt deflation. They find that a reduction in private spending decreases private economic activity, reducing government tax revenues and inflation. They also conclude that "the higher the interest rate sensitiveness to current economic activity, the greater the deflationary trend and, as a consequence, the bigger the increase in public debt ratio" (p. 20).

Some theoretical issues are settled with the help of the SFC approach. Pérez-Caldentey (2009) develops an SFC model following the tradition of balance-of-payments constrained growth, and applies it to the Caribbean Community. The model is able to explain the main stylized facts of the region, such as stagnant growth rates and widening current account and fiscal deficits. Jackson and Victor (2015) explore the claim that capitalism has an inherent "growth imperative" caused by the charging of interest on debt, an assertion commonly found in the de-growth literature. They develop a model that is differentiated for a stationary steady state, thus contradicting the "growth imperative" hypothesis. Simulations in the model demonstrate that it is possible to move from a growth path to a stationary state without a collapse of the system. Van Suntum (2014) develops a model to compare the theories of interest rate determination of Böhm-Bawerk and Keynes. His model has a lot of mainstream features, such as the presence of overlapping generations and representative individuals that maximize a utility function.

The SFC method is versatile and has been used to study Ecological Economics. Dafermos, Galanis and Nikolaidi (2014) develop an Ecological Stock-Flow-Fund (ESFF) model, which is a unification of the SFC method with physical stocks and flows analyzes from the field of Ecological Economics, respecting the accounting principles and the laws of thermodynamics. Their accounting system is composed by four matrices: (i) the physical input-output fund matrix; (ii) the physical stock matrix; (iii) the transactions flow matrix; and (iv) the balance sheet matrix. An interesting feature of the model is the presence of natural resources, greenhouse gas emissions, green investment and the modeling of intermediate outputs, such as energy. Naqvi (2015) seeks to solve the trilemma of achieving high growth, reduced inequality, and environmental sustainability. Therefore, he models an economy composed by capitalists, workers, and firms that use energy as an input and generate greenhouse gases as a byproduct. Five policy scenarios are evaluated: lower consumption; introduction of a capital stock damage function; carbon taxes; higher shares of renewable energy; and technological shocks to productivity. The latter policy is the only one that can solve the trilemma.

There are also some works related to the meta-theory of the SFC method. Godin, Aliti and Kinsella (2012) develop a method to estimate the flows and the parameters of an SFC model. For n flow variables, m stock variables, p parameters and k constrains on these parameters, the method is composed of three steps: (i) given a model that shows consistency between stocks and flows, (ii) "Obtain the n flows as a function of the $p - k$ unknown parameters and the m observed stock values by solving analytically the model" (p. 4) and (iii) for a given variable X, minimize the absolute value between observed X and predicted X. The problem, then, is a global minimization in $p - k$ dimensions. Kakarot-Handtke (2012) argues that SFC models should free themselves from "ill-founded notions like GDP and other artifacts of the equilibrium approach" (p. 2). He formally demonstrates that the implicit notion in the GDP accounts that valued output equals factor income does not hold, and claims that more rigorous accounting proofs should be considering in the development of the model. Álvarez and Ehnts (2015) introduce graph theory as a method in order to visualizing different "closures" of an SFC model, "closure" here defined as the choice of which variables are to be set as dependent and which ones as independent. One advantage of this method is that all the possible closures of a model can be explicitly represented. Another one is that a regime change, in the sense that some dependent variables get independent and vice-versa, can be modeled.

Last, there is an ongoing discussion about the microfoundations of the SFC macroeconomic models. Lysandrou (2015) argues that a useful foundation to SFC is Marx's concept of commodity as developed in *Capital*. Caiani et al. (2016) combine the SFC approach with agent-based modeling. They develop a benchmark model that is "simple and flexible" and "can be easily employed, adapted, and changed" (p. 380). The authors also propose a methodology to calibrate the initial stock and flow variables. Lastly, they compare their results with some stylized facts.

Based on the above brief literature review, it is possible to see the ample scope of the SFC method, ranging from financialisation to ecological economics. In the next two sections, we explore some subjects that, in our view, are important paths of future research, if the SFC method is intended to gain influence in heterodox economics. We present, first, the question of textbooks models and stock-flow consistency. Next, we

criticize some mainstream models for their lack of consistency between stocks and flows.

4 The flaws of the mainstream economics and the stock-flow consistent method

If heterodox economics intends to provide an integrated alternative to mainstream economics, as suggested in the introduction, and if the SFC method has the potential to provide this methodological unifying framework, it must also show why the orthodox view is inconsistent and must be replaced by a superior approach. In this section, we show how the SFC literature has advanced in this field. In the first subsection, we explore the criticisms raised concerning textbooks models. The second section provides a critique of a mainstream model outside the textbooks, but inside the toolbox of institutions that take the mainstream seriously.

4.1 Criticisms to textbooks models

This section follows the arguments of Dos Santos and Macedo e Silva (2010). In order to develop the discussion, we present the so called "three balances approach", which is a derivation of national accounting identities that guarantees consistency between the flows in a given period[7]. It first appears in the SFC literature in Godley and Cripps (1983), followed by Godley (1999c), who used the approach to analyze seven unsustainable processes that were occurring in the USA. Here, we will follow the formalization by Zezza (2009)[8].

The starting point is the GDP identity:

$$GDP = C + I + G + B \tag{4}$$

Where *C* is consumption, *I* is investment, *G* is government expenditures, and *B* is the balance of trade. Next, we compute the net transfers from sector *i* to sector *j*, T_{ij}. The sectors are households (*H*), business (*B*), government (*G*) and the rest of the world (*W*):

$$GDP - T_{hg} - T_{bg} + T_{wh} + T_{wb} \tag{5}$$
$$= C + I + \left(G - T_{hg} - T_{bg} + T_{gw}\right) + \left(B + T_{wh} + T_{wb} - T_{gw}\right)$$

Note that the term in the first bracket in equation (5) is the definition of government deficit (*GD*). Note also that the term in the second bracket is the balance of payments of the current account (*BP*). Taking these two simplifications into account and defining Y_h as personal income and Y_b business gross profits, we get:

$$\left(Y_h + T_{bh} + T_{wh} - T_{hg}\right) + \left(Y_b - T_{bg} - T_{bh}\right) = C + I + GD + BP \tag{6}$$

Now, the first bracket shows the personal disposable income (YD_h) and the second gives us the undistributed profits (Π). Splitting investment into residential investment (I_r) and nonresidential investment (I_k), and rearranging terms, we get:

$$(YD_h - C - I_r) + (\Pi - I_k) = GD + BP \tag{7}$$

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[7] Some authors call this "flow-flow" consistency.

[8] For more SFC works that use the three balances approach, see Dos Santos (2004), Godley and Izurieta (2004), Godley et al (2007), Dos Santos and Macedo e Silva (2010), Kregel (2011) and Shaikh (2012).

Note that $YD_h - C = S_h$ is households saving. So:

$$(S_h - I_r) + (\Pi - I_k) = GD + BP \quad (8)$$

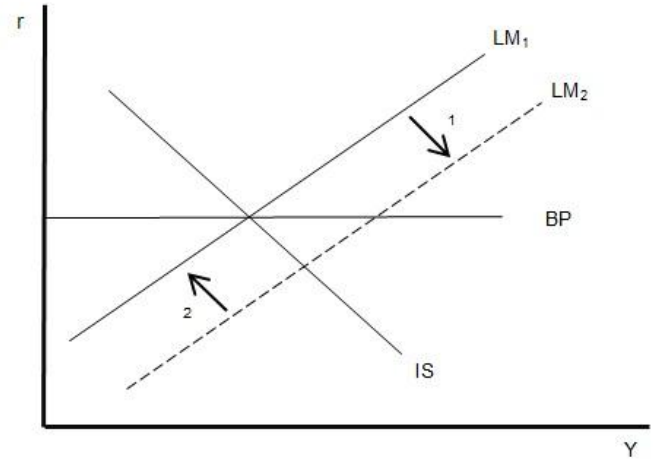
This equation can be further simplified. The left hand side can be treated as the private sector saving minus the private sector investment. Formally:

$$(S_p - I) = GD + BP \quad (9)$$

This equation reveals that the private sector surplus is equal to the government deficit plus the current account surplus.

The formalization above was applied by Dos Santos and Macedo e Silva (2010) to criticize some conclusions given by the textbook Mundell-Fleming model. A standard conclusion of the Mundell-Fleming model is that, with fixed exchange rates and perfect capital mobility, monetary policy is inefficient, in the sense that the economy will return to its initial income and interest rate levels, represented in Figure 1. The expansionary monetary policy shifts the LM curve from LM_1 to LM_2. This causes a decline in the interest rate, which is followed by a capital flight away from the economy. The resulting deficit in the balance of payments is matched by a reduction in the foreign reserves of the central bank. The result is a reduction of the monetary base, causing the *LM* curve to return to its initial position. Thus, monetary policy is deemed inefficient. The only change occurs in the Central Bank portfolio, where foreign reserves are replaced by money.

Figure 2 – Monetary policy in a Mundell-Fleming model with fixed exchange rates and perfect capital mobility



However, a closer look at the financial balances of the other sectors shows that this is not the only effect of the monetary expansion. The monetary expansion leads to a temporary increase in production and income (when LM_1 shifts to LM_2). This higher income generates higher imports, which reduces the foreign trade balance. And, since government expenditures is kept constant, the increase in income elevates the taxes receipt, which reduces the government deficit.

Looking at equation (8), it is possible to see that the decrease in *GD* and in *BP* must be matched by a reduction in the financial balance of households, or firms, or both. It is worth noticing that it is reasonable to suppose that the households' income have increased, whereas it is also reasonable to assume that the lower interest rate increases

firms' investment[9].The decrease in *GD* and *BP* and the increase in households' financial balances are matched by a reduction in the firms' financial balances. As Dos Santos and Macedo e Silva (2010) argue, "the explanation for the fall in firms' financial balance is pretty simple: the decrease in trade balance reduces firms' profits" (p. 13).

It is natural to ask now if these outcomes have any implication to the model. The answer is yes. Households' asset holdings have increased, government debt has been reduced, the international investment position has worsened, and firms' indebtedness increased. In the words of Dos Santos and Macedo e Silva (2010):

> Those changes in stocks of financial assets and liabilities will implicate changes in internal and international interest flows in the next short run, changing the configuration of the system. Therefore, each short period carries in itself the seeds of the next (and inevitably different) short period (DOS SANTOS; MACEDO E SILVA (2010), p. 14).

A scenario not analyzed by the authors is the backward movement of *LM*, which is briefly treated here. The shift of LM_2 back to the initial equilibrium causes a reversal to the changes in the financial balances: incomes start to fall, the current account balance improves, government deficit increases again, and the households' income declines. It is possible that the balances return to their initial position, but the time that the LM needs to shift has to be considered. If it requires many periods to return to the initial position, it implies that many interests payments and receipts will flow in the meantime, and this can change the results of the model. So, the monetary policy is not, inevitably, ineffective.

The example above shows that the SFC method can expose some challenges to mainstream models. Of course, nobody really believes that textbooks models are a good representation of reality. We are not arguing that textbooks must be abandoned because they have flaws. Simple models, even with flaws, are pedagogically important. But the usage of *only* textbooks models, without the presentation of any alternative or the exposure of their flaws, seems to be a bad choice. SFC models fulfill both requirements: they not only clarify the wrong conclusions of the models, but also provide an alternative.

4.2 Mainstream models: do they have stock-flow consistency?

The critiques raised against the mainstream are not confined to the textbooks models. In this section, we present three works that use the SFC method to criticize some mainstream models. The first one is Godley and Shaikh (2002). The authors explore the standard neoclassical model, with four markets (labor, commodities, bonds, and money), firms that maximize profits, households that maximize utility, workers' remuneration determined by marginal productivity, and firms distributing all their profits to households. This last assumption is crucial to the argument, since there is only

[9] The increase in investment implies a shift in the *IS* curve. Dos Santos and Macedo e Silva (2010) emphasized the increase in investment, but did not pay attention to the effect on the *IS* curve. Notice also that there is a question of time: if the LM goes back and forth quickly, then the effect over investment is null. But if it takes time sufficient to the firms raise its investment, then the *IS* curve will shift.

one financial instrument that can enable this distribution: bonds. The flow of interest payments of these bonds is not, however, necessarily equal to the profits. The authors solve this problem by distinguishing between households' income (wages and interest payments) and value added (wages and profits). It seems to be a simple distinction, but it has severe consequences. The most striking one is the dichotomy between real and nominal variables, which no longer applies. The mechanism is the following: a change in price level changes the real value of the bonds, and hence modifies the real interest payments. Since these payments form part of the households' income, the modification induces a change in consumption. The conclusion is that, if stocks and flows are consistently modeled in a standard neoclassical model, nominal changes (price level) affect real variables (consumption).

The second example is provided byTaylor (2004b). The author criticizes open-economy portfolio balance models, as well as the Mundell-Fleming approach. According to him, both models consist of three independent equations which determine three variables: the domestic and foreign interest rates and the exchange rate. However, if the accounting is right, in the sense that "economic actors satisfy standard balance sheet and portfolio allocation restrictions" (p. 205), there will be only two independent equations, because the determination of the exchange rate is beyond the models' reach. The implication of this flaw is twofold: (i) the dichotomy between fixed reserves/floating rate and floating reserves/fixed rate does not apply, and (ii) econometric models based on these models are bound to fail. The author proposes an alternative that corrects these problems, based on a two-country IS-LM model, constructed along the lines of SFC models.

The last work is Richardson (2015), who criticizes an IMF discussion note authored by Ostry, Ghosh and Espinoza (2015). Richardson's intention is to discuss whether increased government borrowing crowds out other interest sensitive spending, especially private investment. In order to do so, he develops a representative agent model with an independent government, whose objective is to maximize the agent's utility. The weakness pointed out by Richardson (2015) is that, in spite of the presence of bonds in the budget constraint of the agent, there is no net deficit or surplus between the agent and the government. Moreover, "new bond issues are not needed because changes in the capital stock (private or public) are made out of current production" (p. 4). Another problem lies in an equation of the IMF note, which states that consumption plus investment exhaust national income. There are no funds left out to purchase the bonds.

The articles presented above show that the lack of consistency between stocks and flows can lead to wrong conclusions of modeling results. The SFC method, again, seems to be a powerful tool to assess the flaws of mainstream models and also to provide alternatives to the modeling problems.

5 Final remarks

The present paper gave a brief overview on the SFC method. It offered a survey of the recent literature in the field. Lastly, it explored the potential of the method in developing critiques on the mainstream framework. Some conclusions can be derived. In first place, it seems that the SFC literature has not exhausted its potential to identify flaws in the mainstream literature. The only work that criticized textbooks models focuses on the Mundell-Fleming model. There is a wide range of models yet to be criticized. Again, we do not argue that textbooks must be abandoned, but their logical inconsistencies must be

shown, and the alternative framework highlighted. Second, there is a great potential for further research in pointing out the inconsistencies in mainstream models, which we assume to exist on a large scale. We believe that a sweeping analysis and critique of recent orthodox models, in terms of their stock-flow inconsistency, can reinforce the heterodox alternative.

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