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A STOCK-FLOW CONSISTENT GENERAL FRAMEWORK FOR FORMAL MINSKYAN ANALYSES OF CLOSED ECONOMIES

by

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INTRODUCTION

This paper attempts to offer a contribution to the Post-Keynesian/structuralist literature that has discussed formalizations of Hyman Minsky's concept of "financial fragility."[1] In our view, the models and findings of this influential "formal Minskyan" literature (FML from now on) can be better appreciated in the context of another—closely related and only slightly older—literature, sometimes called "stock-flow consistent" (SFCL from now on) and associated with the names of James Tobin and Wynne Godley[2].

More precisely, we argue that virtually all "closed economy" models in the FML can be phrased as special cases (or "closures")[3] of a particular SFC accounting framework that, in this sense, can be deemed "general." The use of such a framework appears to us, therefore, as indispensable to any rigorous attempt to discuss the nature and impact of the (several) simplifying and/or implicit assumptions usually adopted in the FML. In other words, we propose here a systematic, "general," way to approach the FML. Such a systematization, we argue, is a pre-requisite to the development of a future consensual "formal Minskyan" model that is both rigorous and flexible enough to be applied to the analysis of fiscal and monetary policies in actual economies.

We aim to make these points in five steps. First, we discuss the general tenets of the SFCL. Second, we present a brief description of the FML. Third, we present our "general" SFC accounting framework. Fourth, we discuss the representative models of Taylor and O'Connel (1985), Lavoie (1986-1987), Franke and Semmler (1989), Skott (1994), and Delli Gatti et. al. (1994) in light of our "general framework," and access—in an introductory and non-exhaustive way—the impact of the simplifying and/or implicit assumptions adopted in these writings. Fifth,

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[1] See, for example, Lavoie (1986-87), Delli Gatti et.al. (1994), Skott (1994), Nasica (2000), as well as many of the articles collected in Semmler (1989), Fazzari and Papadimitriou (1992), Dymski and Pollin (1994), and Bellofiore and Ferri (2001b, vol. 2). Kregel (2000, p.viii) called this literature "dynamic Post-Keynesian," though only for the lack of a "better name." Other labels such as "financial structuralism," or "dynamic theories of monetary market economies" have also been used to describe it.

[2] Examples of Yale-type models are Backus et.al. (1980) and Tobin (1982). The "British team" is represented by Godley and Cripps (1983, especially chapter 6), Godley (1996 and 1999a), and Lavoie and Godley (2001-2002) among others. It's interesting to notice that Tobin himself didn't call his models "stock-flow consistent." Yale people (like Fair, 1984, p.40 for example) called Tobin's the "pitfalls approach," in a reference to the seminal paper by Brainard and Tobin (1968). The expression "stock-flow consistent" is commonly associated with the works of Wynne Godley (though used also by Davis 1987a, and 1987b; and Patterson and Stephenson, 1988, among others), but it seems to us that it can and should be applied more generally.

[3] As put by Taylor (1991, p.41), "Formally, prescribing a closure boils down to stating which variables are endogenous or exogenous in an equation system largely based upon macroeconomic accounting identities, and figuring out how they influence one another."

we phrase the path-breaking model by Taylor and O'Connel as a "closure" of our "general framework" to illustrate what exactly can go wrong when the SFC approach is not adopted. The sixth part of this paper summarizes and concludes.

1 – THE STOCK FLOW CONSISTENT APPROACH

The bulk of macroeconomic research assumes the form (or is done with the help) of mathematical models and/or literary descriptions that fail to take systematically into consideration the logical ("economy-wide") constraints one knows for sure to exist in any economy considered "as a whole." The basic insight of the SFCL is that these constraints introduce considerable structure to an otherwise virtually intractable macroeconomic reality.

SFC practitioners, therefore, base their models on detailed accounting frameworks that consistently integrate financial flows of funds with a full set of balance sheets. These frameworks not only provide a concise (and yet careful) description of the model, but also a consistency check mechanism to its theoretical hypotheses (since they ensure that every assumed flow comes from somewhere and goes somewhere and savings and capital gains add to stocks of wealth and/or debt). Besides that, and maybe more important, they allow one to identify with precision the logical inter-relations between the transactions among the sectors, both in a given period (or Post-Keynesian "short run") and between periods. It is recognized, of course, that accounting frameworks are "skeletons" (Taylor, 2004, p. 1), that only "come to life as (...) economic model(s)" (Backus et.al., 1980, p. 262) when behavioral assumptions are added to it[4]. But it is precisely the alleged completeness and consistency of their "skeletons" that lead SFC authors to believe their models are closer than others to the goal of providing macroeconomists with logical equivalents of (fully coherent) "artificial economies."[5]

In somewhat schematic terms, the SFC methodology consists of three "steps": (i) do the (SFC) accounting first; (ii) establish the relevant behavioral relationships after that; and then

[4] See Terzi (1986-1987) for evidence that the distinction between economic models and accounting exercises is not always clear in the literature.

[5] It's recognized also that most existing macroeconomic models and literary descriptions are based (explicitly or not) on some kind of (social) accounting framework, but emphasis is put on the fact that these frameworks almost invariably focus only on flows or deal with stocks and flows inconsistently. As a consequence, these works fail to identify and/or take into consideration all "system-wide" implications of their hypotheses. While it's true that for many applications this (often neglected) bias may not be relevant, SFC authors argue that this has to be proved rather than simply asserted. As put by Tobin (1982, p. 188), "a model whose solution generates flows but completely ignores their consequences may be suspected of missing phenomena important even in a relatively short-run, and therefore of giving incomplete or even misleading analyses (…)."

(iii) perform "comparative dynamics" exercises (generally with the help of computer simulations) to see how the model behaves. The remaining of this section is dedicated to a brief discussion of these "steps."

The first thing a SFC theorist must do in order to analyze a given issue is to make sure he or she has an "adequate" SFC accounting framework to deal with it. What the theorist gets from this accounting exercise is the whole set of "system-wide" logical implications of his or her own hypotheses. These come in three kinds. First, there is the "intrinsic SFC dynamics of the system," i.e. the fact that flows and capital gains and losses necessarily increase or decrease stocks and these, by their turn, influence future flows. Second, there are the "sectoral budget constraints," i.e. the fact that in each accounting period the decisions of economic agents alone and in the aggregate are constrained by what they have in the beginning of the period, what they earn during the period and their access to credit. Third, there are the "adding up" constraints, i.e, the fact that accounting identities imply that the whole must necessarily equal the parts and certain (combinations of) stocks and flows must necessarily equal others. Concentrated attention on these logical requirements differentiates SFC macro models from conventional Keynesian ones. Many authors explored some implications of some of these logical requirements in the past, but very few of them realized/emphasized the importance of **always** trying to explore **all** the implications of **all** of them.

A careful analysis of these requirements has important implications also for the choice of the behavioral equations of the model, the second step of the SFC approach. First, the use of SFC accounting frameworks makes clear the necessity to theorize about stock-flow ratios (since they have non-trivial dynamic implications). Second, and perhaps more obvious, the use of any accounting framework implies a given number of degrees of freedom to the system and this limits the number of possible "model closures." Note, however, that in complex accounting structures the nature of these degrees of freedom may not be obvious at first sight. In particular, the use of a water-tight SFC accounting framework implies that in an economy with n sectors, the financial flows of the nth sector are completely determined by the financial flows of the other n-1 sectors of the economy.[6] This fact has nothing to do with the neoclassical concepts/assumptions such as Walras's Law, utility maximizing individual agents, market equilibrium and etc. It happens simply because what sectors 1 to n-1 (in the aggregate) pay to sector n is equal to what sector n receives from these sectors and vice-versa.

[6] See Godley (1996 and 1999a).

After the first two steps what one generally gets is a complicated system of non-linear difference/differential equations. The third step, naturally, is to perform a series of comparative dynamics exercises to evaluate the sensitivity of the model dynamics to changes in parameters and key exogenous variables. Given that analytic solutions to these systems are seldom available, SFC practitioners often must use computer simulations to approximate them.

The relative merits of the SFC approach are perhaps clearer when conventional models are compared to their SFC counterparts. That's what we plan to do in the following sections. Due to space limitations we will limit ourselves to the analysis of the formal structures of the models, leaving aside complications related to the third step above.

2 – A QUICK LOOK AT THE FML

At the risk of oversimplification, one can divide the literature dealing with Minskyan themes in three main groups. A first group, exemplified by many of the papers in Fazzari and Papadimitriou (1992) and Bellofiore and Ferri (2001a, vol. 1), deals with literary and/or exegetical analyses of Minskyan topics. A second group, nicely surveyed in Nasica (2000, chapters 5 and 6), deals with (formal) New Keynesian analyses of these same topics. Here we will be concerned with a third (smaller) group, that according to Nasica (2000, p. 75) has embedded "simple financial variables (interest rates and indebtedness ratios) or more complex ones (indicators of fragility and financial tranquility) into standard macroeconomic frameworks" and "provided evidence that, under certain circumstances, such models produce fluctuations analogous to those imagined, but not modeled, by Minsky."[7]

These authors do agree that "Minsky's theories are both microeconomic detailed and institutional (…) [and] this detail is rich and illuminating but beyond the reach of mere algebra"

[7] Our negligence of the "New Keynesian" literature has four main reasons. First, it's not unfair to argue that the New Keynesian literature has been more concerned with microeconomics than with macroeconomic modeling. In particular, many possible microfoundations have been suggested in this literature and it's not obvious how to choose among them and/or incorporate them in a macroeconomic structure such as the one discussed above. Second, no matter how rational or irrational firms, households, banks, central bankers and government officials (we'd like, of course, to provide rationales for the actions of all these sectors, not just for a representative "Robinson Crusoe") are, the logical implications discussed in the previous section will not change. Third, when and if someone comes up with good and reliable microfoundations for all the sectors mentioned above, their aggregate behavioral counterparts can be easily phrased as a "closure" to the accounting framework presented above. Fourth, the simplified macro models proposed by New Keynesian authors (see, on this respect Fair, 2002 and Arestis and Sawyer, 2002) for example, are particularly bad as depictions of reality and, therefore, are not suited to "explain" (in the Post-Keynesian sense of, say, Lavoie, 1992, p. 6-10) it adequately. For an interesting New-Keynesian style model with a Minskyan flavor, see Hannsgen (2003).

(Taylor and O'Connell, 1985, first page). In particular, Minskyan concepts of "fragility and tranquility are multidimensional (…) and financial innovation and institutional change imply that precise definitions of these dimensions must depend on the historical and institutional contexts" (Skott, 1994, p. 52). On the other hand, they would also agree (explicitly or not) with Nasica's (2000, p. 51) point that "the absence of modeling has sometimes made the consistency of Minsky's arguments seem difficult to check." In fact, their collective view was elegantly summarized by Foley (2001, p. 58), according to whom "mathematical models are tools to clarify our understanding of simplified, imaginary systems that we hope represent coherent aspects of a complex economic reality. They are possibly the only reliable tool for exploring the response of such imaginary worlds to parametric changes."

The FML is therefore admittedly biased. It has focused on modeling only the "core" Minskyan insight, i.e. the idea that capitalist economies left on their own are prone to "financial fragility" and recurrent financial crises. Invariably, the FML has tried to do so with the help of "clever" investment functions (i.e. ones that cause the model to exhibit explosive, chaotic, or permanent cyclic behavior), which are made to depend (*a la* Minsky) on a variety of financial variables or indicators. The papers in this literature therefore differ on the specific "clever" investment function they use and on how (if at all) financial markets are modeled. In the best Minskyan/Keynesian tradition, consumption expenditures are not seen as a source of instability in the FML.[8] Moreover, this literature is relatively young[9] and most papers have been admittedly exploratory and/or pedagogical. The FML has succeeded in demonstrating that Minskyan processes can happen in a variety of circumstances but, as far as we know, it hasn't produced a consensual formal "Minskyan" model so far.

We do believe that the first step to consensus-making is systematization. The next sections will, therefore, be dedicated to the analysis of some (representative, in our point of view) model specifications that have been discussed in the FML, with particular emphasis on their common features, simplifying assumptions, and internal logical consistency. Before we do that, however, we need to discuss an important methodological point, i.e. the emphasis some authors in the FML (e.g. Nasica, 2000, ch. 4) put on the alleged "superiority" of models that

[8] Minsky firmly believed that "consumer and housing debt can amplify but (…) cannot initiate a downturn in income and employment" (Minsky, 1982, p. 30). It is interesting to note, in this context, the relative perplexity with which recent developments in the indebtedness levels of the U.S. household sector has been treated by "broadly Minskyan" authors such as Godley (1999b) and Papadimitriou et. al (2002).

[9] Taylor and O'Connel (1985) is widely seen as the paper that inspired the FML.

produce "chaotic" dynamics over ones that do not. The basic idea is that since most economic data do exhibit a heavily irregular cyclic behavior, models with such results (i.e. "chaotic" ones) are "better" or "more appropriate" than linear ones (that either converge to a dynamic steady state or "explode"/"implode") and/or non-linear "limit cycles" ones (that produce cycles "too regular to be true").

This view can be criticized on several grounds. First, when subjected to continuous random shocks, linear models can easily replicate the irregular cyclic behavior that characterizes macroeconomic data. Whether or not complex phenomena should be modeled as arising from (deterministic) chaotic dynamics or as a result of mere randomness is an issue that has entertained many scientific minds of our time and, as far as we know, no definitive conclusion has been reached so far. Second, from a more strict Minskyan perspective, the dynamics of "real" economies in historical time depend crucially on exogenous (from a "pure economic" point of view) factors. As phrased by Delli Gatti et. al. (1994, p.2) "in modern economies incipient or realized incoherence will lead to government interventions. (…) cycles result from a combination of endogenous interactions that can lead to incoherence and the impact of institutions and interventions that aim to contain these trusts towards incoherence." Indeed, virtually all economists agree that parametric, institutional and historical change are not entirely determined by economic factors, so that the "relevant model" to describe the economy may and do change in true historical time. From this perspective, nothing prevents one from conceptualizing the economy as a simple linear explosive model whose behavior precipitates regime-changing interventions that generate a period of "tranquility" and a later resurgence of explosive behavior and so forth. Third, from a purely formal point of view, the dynamic behavior of a macroeconomic model may depend less on the "theoretical view" underlying it than on the specific functional forms assumed. In other words, it is relatively easy to come up with a non-linear version of, say, the Taylor-O'Connel model (that, according to Nasica, 2000, p.51, can be criticized "in particular" for its "linear nature"), provided small changes in either the functional forms (of, say, the investment function) or the simplifying assumptions (such as the absence of inflation) are made.

Be that as it may, in what follows we will be more interested in the "spirit" of the formalizations adopted by the FML than with its (very often non-robust) specific dynamic conclusions.

3 — A GENERAL FRAMEWORK FOR MINSKYAN ANALYSES OF CLOSED ECONOMIES

Virtually all analysts would agree that a fair depiction of Minsky's "Wall Street Paradigm" requires a model with at least households, firms, banks, and a government (including a central bank).[10,11] There is wide consensus also on the crucial role played by financial markets in Minskyan analyses. There is much less agreement, however, on how the financial structure of the economy should be modeled. It seems to us that an economy with such sectors would naturally have not only markets for bank loans and government bills, but also a stock market and an explicit treatment of the "discount" loans banks get from the Central Bank. These features of reality are often "simplified away" in the FML, despite playing a crucial role in Minsky's literary writings.

Following Godley (e.g. 1996, 1999a), we use tables (1)-(3) below to summarize the accounting structure of our "artificial closed economy"—i.e., the balance sheets of all macroeconomic sectors assumed to exist in it, as well as the flow of funds and the uses and sources of funds matrixes (a la Copeland, 1952) associated to them.[12] Minsky often stressed the fact that "an ultimate reality in a capitalist economy is the set of interrelated balance sheets among the various units" (Minsky, 1975, p. 118), so that "one way every economic unit can be characterized is by its portfolio: the set of tangible and financial assets it owns and the financial liabilities on which it owes" (Minsky, 1975, p. 70). We therefore begin our exposition with the (nominal) balance sheets of the sectors in our "artificial economy." These are depicted in table 1 below, which we hope the reader will find self explanatory (the only non-trivial pieces of notation are "pe" for the price of one equity, and "E" for the number of equities issued).[13]

[10] Even though some illustrative "formal Minskyan" models of closed economies without a government have been proposed, for example, by Lavoie (1986-1987) and Skott (1994).

[11] This is not to say, of course, that Minskyan analyses are not valid in open economy contexts. We are fully aware of both the stream of papers (see, for example, Gray and Gray, 1994; Felix, 1994; and Wolfson, 2002) that have argued precisely the opposite and the recent SFC open economy literature that can be used to formalize them (see, for example, Godley, 1999c and Godley and Lavoie, 2003). However, most writers in the FML seem to agree that the essence of Minsky's insights can be captured in a closed economy framework.

[12] The "artificial economy" discussed here is essentially the same discussed in Zezza and Dos Santos (forthcoming), though we chose to present table 2 differently. The only differences are that here firms hold bank deposits and do not pay direct taxes on their profits.

[13] Similar tables do appear often in the FML. See, for example, Taylor and O'Connel (1985), Franke and Semmler (1989), and Delli Gatti et. al (1994).

Table 1 summarizes many theoretical assumptions. In particular, its empty cells make clear we are simplifying away some facts of life, such as bank loans to households, money holdings of the government, and equity issues and holdings of banks (hence our emphasis on the artificiality of the economy discussed here). These simplifications, as well the assumption that the net worth of banks is zero (or macroeconomically "very small"), are common in both the FML and the SFCL. The economy assumed here is actually more complete than the ones described in the FML, though, for we don't simplify away central bank advances and money holdings of firms—both of which play a crucial role in Minskyan analyses in our view.

Table 1. Balance sheets in our "artificial economy"
A (+) sign before a variable denotes an asset while a (-) sign denotes a liability

	Households	Firms	Banks	Central Bank	Government	Total
1 - High powered money	*+Hh*		*+Hb*	*-H*		*0*
2 - Central Bank advances			*-A*	*+A*		*0*
3 - Bank Deposits	*+Mh*	*+Mf*	*-M*			*0*
4 - Loans		*-L*	*+L*			*0*
5 - Bills	*+Bh*		*+Bb*	*+Bc*	*-B*	*0*
6 - Capital		*+K*				*+K*
7 - Equities	*+E pe*	*-E pe*				*0*
8 - Net Worth	*+ Vh*	*+ Vf*	*0*	*0*	*-B*	*+K*

Table 1 also makes clear some logical implications of our theoretical assumptions. In particular, the identities in the first four columns and rows (1), (3), (5) and (8) play relevant roles in SFC models of economies like this one, as discussed in Zezza and Dos Santos (forthcoming).

Minsky often stressed also that the "items in the balance sheets set up cash flows. Cash flows are the result of (1) the income-producing system, which includes wages, taxes and non-financial corporate gross profits after taxes, (2) the financial structure, which is composed of interest, dividends, rents, and repayments on loans, and (3) the dealing or trading in capital assets and financial instruments. For all except dividends, the cash-flows determined by the financial structure are contractual commitments" (Minsky, 1975, p. 118). He actually went as far as stating that his own influential "alternative interpretation [of Keynes] can be summarized as a theory of the determination of the effective budget constraints [of the various macroeconomic sectors]. The economics of the determination of the budget constraint logically precedes and sets the stage for the economics of the selection of particular items of investment

and consumption" (Minsky, 1975, p. 132).[14] Tables 2 and 3 below aim precisely to model these cash flows and budget constraints rigorously.

Indeed, Table 2 is easier to understand when considered as a logical "flow" counterpart of Table 1. In particular, rows (7)-(10) depicting the interest and dividend payments of the economy are directly implied by the liability structure of the economy presented in Table 1, our implicit assumptions being that: (i) the nominal interest rate on money deposits (*rm*), bank loans (*rl*), government bills (*rb*), and central bank advancements (*ra*), are all fixed during a given accounting period; and (ii) interest on loans obtained in period "t" are paid in period "t+1" at rates pre-determined in "t." Other non-trivial notation below includes *Ff, Fb, Fc* (that stand, respectively, for the distributed profits of firms, banks and the central bank), our assumptions being that: (i) banks do not pay taxes and distribute all their (nominal) "current profits" (or Marshallian "quasi-rents"), so that their net worth is zero; (ii) the central bank distributes all its "current profits" to the "Government" (understood here as a "Treasury"), so its net worth is zero; and (iii) firms do retain a part of their (after tax, current) profits, so that *Fu* stands for firms' retained earnings. Moreover, *DT* stands for "direct taxes" (paid by the households on their income), while *IT* stands for "indirect taxes" (paid by the firms on their total receipts). This distinction is important, as we'll discuss in more detail below.

[14] It is therefore, very surprising to know that Minsky "was skeptical of the notion of sectoral budget restraints except for government" (Chick, 1992, p. 81), even though he "was very encouraging" about Chick's SFC attempt. Given that Chick did not elaborate on the issue, it is impossible to know exactly what were the reason's for Minsky's skepticism. One possible reason would be the fact that the composition of ponzis, hedge and speculative finance (and therefore financial fragility) can fluctuate without any changes in the aggregate balance sheets, provided, say, that the increase in ponzi finance is counterbalanced by improvements in the balance sheets of the remaining hedge units. Minsky did, however, use aggregate variables as proxies of financial fragility in many occasions (see e.g. Minsky, 1982 ch. 1 and 2).

Table 2. Flows of Funds in our "artificial economy" **A (+) sign before a variable denotes a receipt while a (-) sign denotes a payment**							
	Households	Non Financial Firms Currrent	 Capital	Govt	Banks	Central Bank	Total
1 - Cons.	$-C$	$+C$	-	-		-	0
2 - Govt. Expenditures		$+G$	-	$-G$		-	0
3 - Invest.	-	$+\Delta K$	$-\Delta K$	-		-	0
4 - Accounting Memo: "Final" Sales at market prices ≡ $S \equiv C + G + \Delta K \equiv W + FT + IT$							
5 - Wages	$+W$	$-W$	-	-	-	-	0
6 - Taxes	$-DT$	$-IT$	-	$+T$	-	-	0
7 - Interest on Loans		$- rl_{-1}*L_{-1}$	-	-	$+ rl_{-1}*L_{-1} - ra_{-1}*A_{-1}$	$+ ra_{-1}*A_{-1}$	0
8 - Interest on Bills	$+ rb_{-1}*Bh_{-1}$		-	$- rb_{-1}*B_{-1}$	$+rb_{-1}*Bb_{-1}$	$+rb_{-1}*Bc_{-1}$	0
9 - Interest on Deposits	$+rm_{-1}*Mh_{-1}$	$+rm_{-1}*Mf_{-1}$	-	-	$-rm_{-1}*M_{-1}$	-	0
10-Dividends	$+Ff + Fb$	$-Ff$	-	$+Fc$	$-Fb$	$-Fc$	0
11- Total (Current)	Sh	Fu	-	Sg	0	0	SAV

Table 2 above makes sure "every financial flow comes from somewhere and goes somewhere," (Godley, 1999a, p.394) and allows one to derive some important identities. In particular, adding up Sh ($\equiv W + rb_{-1}*Bh_{-1} + rm_{-1}*Mh_{-1} + Ff + Fb - C - DT$), i.e. the "current" savings of households, Fu ($\equiv S - IT - Ff - rl_{-1}*L_{-1} + rm_{-1}*Mf_{-1}$), firms retained earnings, and government's savings ($Sg \equiv T + Fc - G - rb_{-1}*B_{-1}$) one gets the economy's total savings (SAV) that, as one would expect, ex-post is identical to investment (ΔK). In what follows, the variable FT ($\equiv S - W - IT$), or firms' total "gross profits" in production will appear quite often.[15]

While table 2 above summarizes the "current" flows of funds between sectors logically implied by the stocks presented in table 1, table 3 below does the same with the "capital flows," i.e., those that change the balance sheets of the sectors (including current savings and financial and real (dis)"investments"). In this sense, its columns can be interpreted (when its components are viewed as ex-ante variables) as aggregated budget constraints of their respective sectors. In other words, table 3 demonstrates how stocks (that will constrain the flow behavior in the next period) are modified by current flows. Indeed, the net worth of the sectors in Table 1 is related to the capital account flows in Table 2 by the accounting identity:

$$NW_t = NW_{t-1} + S_t + CG_t$$

[15] However, all models discussed here assume that Mf = 0, i.e. that firms have no liquid assets and, therefore, no "financial income."

or, in words, the net worth of a sector is increased by its current savings during the period, plus capital gains *CG* arising from changes in the market value of its assets during the period.[16]

Table 3. Sources and uses of funds[17]

Changes in	Households	Firms	Banks	Central Bank	Govern-ment	Total
Cash	$+\Delta Hh$		$+\Delta Hb$	$-\Delta H$		0
Central Bank advances			$-\Delta A$	$+\Delta A$		0
Bank deposits	$+\Delta Mh$	$+\Delta Mf$	$-\Delta M$			0
Loans		$-\Delta L$	$+\Delta L$			0
Treasury Bills	$+\Delta Bh$		$+\Delta Bb$	$+\Delta Bc$	$-\Delta B$	0
Capital		$+\Delta K$				$+\Delta K$
Equities	$+\Delta E \cdot pe$	$-\Delta E \cdot pe$				0
Total	Sh	Fu	0	0	Sg	SAV
Δnet Worth (Accounting Memo)	$Sh + \Delta peE_{-1}$	$Fu - \Delta peE_{-1}$	0	0	Sg	SAV

We finish this accounting "*tour de force*" reminding the reader that all accounts presented so far were phrased in nominal terms. Assuming a single price deflator *p* for all the variables, all stocks and flows in tables 1 and 2 above have straightforward "real" counterparts given by their nominal value divided by *p*. Adding a *k* to the variable name to denote its deflated value we have, for example:

$$Sk = S/p = C/p + I/p + G/p = Ck + Ik + Gk$$

Things are somewhat different, however, with capital gains and losses. The purchasing power on the stock of equities will be increased by real capital gains arising from fluctuations in its market value, and decreased by changes in the price level, while the real value of all other assets will decline with inflation. Accordingly, the value of, say, the households' real stock of wealth is given by:

$$Vk = Vk_{-1} + Yk - Ck + \Delta pet \cdot E_{-1}/pt - \Delta p \cdot Vk_{-1}/pt$$

A final point to make is that the real interest received ex-post on any asset can never be known ex-ante. Indeed, while the best one can know in time *t* is the nominal interest rate and general price level in *t*, the interest on loans made in t will only be received in *t+1*. In the following sections we will follow the authors in the FML and avoid inflation issues, though.

[16] We assume that treasury bills last exactly one period, so that the only nominal capital gain in this model is obtainable from fluctuations in the market value of equities.

[17] The Δ operator before a variable X stands for a discrete change in X, i.e. $\Delta X = X_t - X_{t-1}$

4 – A SFC LOOK AT THE FML

We do believe the seminal models to be discussed here—i.e. the ones proposed by Taylor and O'Connel (1985), Lavoie (1986-1987), Franke and Semmler (1989), Delli Gatti et.al. (1994[18]), and Skott (1994)—are representative of the FML. In particular, they all played a crucial role in creating and consolidating the FML as a line of research. On the other hand, they are all exploratory attempts (most of the times) admittedly less than stock-flow consistent and/or general, often for different reasons. One has, therefore, a lot to learn from analyzing their (dis)similarities and inconsistencies.

Rather than listing equations, a tedious procedure that has been known to scare readers away from the SFC approach, we proceed here with a typology of hypotheses/modeling strategies adopted by these models and their logical consequences. A more careful and formal analysis of the Taylor-O'Connel model is presented in the next section.

4.1 – Investment Functions in the FML

Minsky "characterized Keynes's *General Theory*, as advancing an investment theory of business cycles and a financial theory of investment" (Friedman and Laibson, 1989, p. 175). Indeed, his literary descriptions of the determinants of investment are so rich as to be deemed by Kregel (1992, p. 86) "the more important and distinguished characteristic" of his work. The FML not always does justice to this richness, however, as depicted in table 4 below.

Analyzing the specifications above one identifies three basic strategies used to model the impact of "financial fragility" on aggregate investment. A first one based on Taylor and O'Connel's Φ expectational parameter; a second one, more in line with the models by Lavoie and Delli Gatti et. al., which emphasizes (no matter which specific functional form is used) the role of "internal finance availability;" and a third one, represented by Skott's "hybrid variables." They do have a lot in common, as it turns out.

[18] A very interesting, though not well known, FML attempt co-authored by Minsky himself.

Table 4: Investment Functions in the FML	
Model	**Investment Function**[19]
Taylor and O'Connel (1985)	$\Delta K = [g_0 + h(r + \Phi - rb)]*K$ "where '*rb*' is the current interest rate [in government bonds](…) Φ reflects the difference between anticipated return to holding capital and the current profit rate *r*. (…)g_0 is a constant reflecting autonomous capital stock growth and the coefficient *h* measures firms' investment response to the expected difference between profit and interest costs" (Taylor and O'Connel, 1985, p.873).
Franke and Semmler (1989)	Same used by Taylor and O'Connel
Lavoie (1986-1987)	$\Delta K = \frac{ret * u * pi}{v * (1 - x)} K_{-1}$, where *ret* stands for the retention ratio of firms on gross profits *(Fu/FT), pi (= FT / S*) stands for the share of profits in total sales, *u* stands for the capacity utilization ratio *(S/C), v* stands for the technological capacity ratio *(C =K/v),* and *x* stands for the share of investment which is financed through external sources[20].
Delli Gatti Et. al. (1994)	$\Delta K = av_t + b_t (FT - rp_{-1}*L_{-1})$ where "a" is a constant; v_t stands for Minsky's "Pk," "*rp*"is the ratio of the gross payments due on firms' outstanding debt with banks (interest and principal), and, last but not least, $b_t = b_0 + b_1*arctg(FT_{-1})$, where $b_1*arctg(FT_{-1})$ is a non-linear increasing function and b_0 represents the "liquidity preference of firms."
Skott (1994, linear specification)	$\Delta K = [a\sigma + bF + cT + d]*K$ where *a, b, c and d* are constants, σ stands for the actual output-capital ratio *(S/K),* and *F* and *T* are "hybrid values" depicting both the "fragility" and the "tranquility" of the system.

Indeed, all of them try to capture the idea that investment growth can be good for a number of good "tranquil" years, before a crisis ensues. Taylor and O'Connel's Φ expectational parameter is a good example. In Taylor and O'Connel's original paper Φ's rate of growth is assumed to be positive (negative) if the difference between the "current" interest rate and a "normal" (exogenous) long run interest rate is negative (positive), so a sudden rise (fall) in interest rates can initiate a cumulative decrease (increase) in investment and, therefore, a "debt deflation" ("boom") process. As both Franke and Semmler (1989, p. 39) and Nasica (2000, p.53) pointed out, this particular formalization does not take into account the role of firms'

[19] Some notations of the original texts were adapted to the ones used in section 3 above.

[20] The formula above can be rewritten as an identity between the money spent in and received from investment expenditures. Lavoie, however, interprets it as an ex-ante behavioral assumption (even though he doesn't advance any behavioral assumption for key variables such as "ret" and "x"). For a more recent Lavoie-type specification in which the negative role of the interest rate is made explicit, see Lavoie and Godley (2001-2002).

indebtedness and debt commitments in investment decisions—also emphasized, for example, by Delli Gatti et. al (1994) and Lavoie (1986-1987). However, as Franke and Semmler have showed, it's perfectly possible to adapt the model to make the rate of growth of Φ a function of firms' loans to capital ratio (*L/K)*, therefore bridging the apparent gap between the two families of models. Given the relationship between "*r*," "*rl*" and Minsky's *Pk*, a Taylor and O'Connel specificaton with Φ depending negatively on *L/K* is not so different from, say, a Delli Gatti et.al specification. The same is true for a Lavoie specification, given the relationship between "*u*," "*pi*" and "*r*," and the relationship between "*ret*," "*x*" and *L/K*.

Differences are more apparent than real also as far as Skott's approach is concerned, though the point here is subtler. Skott (1994, p.53) correctly points out that the identification of historical-institutional concepts like, say, "financial fragility" with a "single well defined element of the financial system ["e.g. 'the interest rate'"]—and the exclusion of other aspects of the system would need to be justified, and the constant evolution of the financial system makes it difficult to provide such a justification." It might very well be the case, and no author in the FML would deny it,[21] that in a given historical and institutional context, financial fragility can be a function of firms' loans to capital ratio (*L/K)* and the interest rate paid on firms' loans (*rl*), while in other contexts it might be more appropriate to define it as a function of, say, firms' liquid assets to loans ratio *(Mf/L)* and the "interest plus repayment" rate on firms' loans to banks *(rp)*. Note, however, that the particular specifications of both "fragility" (*F*, or the sensibility of investment to negative shocks) and "tranquility" (*T*, or the firms' ability to pay their financial commitments) used by Skott are not necessarily in line with the spirit of the FML. Indeed, he makes *T* a negative function of *F* and a positive function of the rate of profits (*r*), while *F* is assumed to be a positive function of both F_{-1} and *T*, what leaves the role of the interest rate and the debt commitments of firms somewhat in the air. Reasonable redefinitions of *T* and/or *F* would bring his analysis much closer to the rest of the FML, however.

4.2 – How is Investment Financed? The Role of Banks and Financial Structures

One doesn't need the accounting above to argue in favor of the (often implicit) overall coherence of investment functions in the FML. Things change, however, as far as the analysis of the "dual" of these investment decisions, i.e. the financing decisions of firms, are concerned.

[21] As Lavoie (1986-1987, p. 259) acknowledges, "it's not an easy task to find a macroeconomic variable (…) [to] represent financial fragility." Minsky himself (1982, ch. 1 and 2) and Niggle (1989), for example, used many of them.

Given Minsky's crucial hypothesis that "the economy "naturally" moves towards a more fragile financial system" (Lavoie, 1986-1987) and the crucial connection between the concept of financial fragility and the debt structures and commitments of (macroeconomic sectors in general and) firms (in particular), one would expect the FML to pay special attention to these decisions. Yet, most models in the FML have under-developed financial structures and, therefore, generally treat financing issues with oversimplified hypotheses that don't do justice to the richness of Minskyan analyses.

In particular, anyone working with a "Minskyan" economy such as the one depicted in section 3 above has to provide explanations to at least 3 interest rates (*rl, rb* and *rm*), as well as for *Pe* (the price of equities). It so happens that the financing decisions of firms affect all of them either directly (as in the case of *rl* and *Pe*) or indirectly (through the impact of *rl* and *Pe* on the portfolio choices of households). Given the feedback effects of these variables in the "financial fragility of firms" (through, for example, debt repayments), heroic assumptions about them are bound to hurt the overall consistency/plausibility of the model. SFC models are particularly good on many of these issues, as we'll discuss below[22]. The same cannot be said of the FML, however, as table 5 makes clear:

[22] See, for example, Backus et. al. (1980), Godley (1999a), Lavoie and Godley (2001-2002), and Zezza and Dos Santos (forthcoming) .

Table 5: Financial Structures in the FML	
Model	**Financial Structure**
Taylor and O'Connel (1985)	There are markets for government bills, cash and corporate stocks, but equity emission is the only way firms have to finance their investment (since all profits are assumed to be distributed and there are no bank loans)[23]. Banks (i.e. "financial intermediaries") are not formally modeled.
Franke and Semmler (1989)	Develops Taylor and O'Connel's model incorporating explicitly banks and a market for bank loans. It assumes that the rate of growth of L depends (negatively) on L/K and positively on $(r + \Phi - rl)$ i.e. the difference between the "expectation adjusted" rate of profits and the interest rate on loans. Besides that, it assumes that the net worth of firms is zero, and the stock market is always in equilibrium, so that given ΔK, ΔL, and households' demand for stocks, PeE is determined. Given the (neoclassical, Modigliani-Miller type) hypothesis of zero net worth of firms, the role of retained profits is disconsidered (as in Taylor and O'Connel). No particular attention is paid to banks' profitability in determining *rl*.
Lavoie(1986-1987)	No discussion of "financing" issues is provided.
Delli Gatti et. al. (1994)	The only sources of finance are retained earnings and bank loans (so there's no stock markets and "equity investment grows by means of retained earnings"). *Ff* is implicitly assumed to be equal to zero. Government finance (and therefore the market for bills) is "heroically ignored" (even though the role of government expenditures in total profits is explicitly modeled). The composition of the balance sheets of households and banks are also ignored. The only market that is explicitly modeled is the market for bank loans (the supply of loans by banks is assumed to be a increasing function of *rp*, while the demand of loans is given by $\Delta K - FT - rp_{-1} * L_{-1}$. Banks' profitability has no role in determining *rp*.
Skott (1994, appendix)	The only sources of finance are retained earnings and bank loans. There's no public sector in the economy and the composition of the balance sheets of households and banks is ignored. The only financial market explicitly modeled is the market for bank loans (*rl* is assumed to be fixed; the supply of loans by banks is assumed to be horizontal until a given "credit ceiling in terms of a maximum ratio of debt to capital," while the demand of loans is given by $\Delta K - FT - rl_{-1} * L_{-1} - Ff$. Banks' profitability have no role in determining *rl*.

It seems fair, therefore, to conclude that, with the exception of the Franke and Semmler model (albeit with essentially "non-Minskyan" hypotheses), the FML has not devoted attention to modeling the financing decisions of firms. In particular, with the partial exceptions of Taylor

[23] Clearly enough, firms in the aggregate cannot use their own capital gains to finance investment (for no other macroeconomic sector is assumed to buy their capital) and, since they do not retain profits or get loans, the only way they have to finance investment is via equity emission.

and O'Connel and Franke and Semmler, no rigorous connection is made in this literature between these decisions and the portfolio decisions of households and banks in the determination of the interest rates. By limiting all the (explicit) "action" in its models to the investment functions, the financing of which it doesn't care to discuss rigorously, the FML has failed to formalize Minsky's "crucial hypothesis" mentioned above. As Lavoie (1986-1987, p. 260-261) and column 2 in table 3 above make clear, investment growth (i.e., bigger values of $\Delta K/K$) doesn't necessarily imply an increase in financial fragility (say, bigger values of $\Delta L/K$ and/or smaller values of Hf/K)[24].

In other words, even though it has showed "evidence" that "under certain circumstances" capitalist economies fluctuate in a "Minskyan way," the FML has failed to demonstrate that these circumstances are plausible ones—for it hasn't discussed the implications of the investment behavior assumed to banks' profitability, and therefore, the overall viability of the financial structures it assumes.

4.4 – Aggregate Budget Constraints in the FML

Another—more general way—to phrase the critique above, is to point out that the FML has not made a systematic effort to take into consideration the aggregate budget constraints faced by the macroeconomic sectors assumed in its models.

It so happens that these budget constraints (explicitly modeled in table 3 above) are crucial to a rigorous treatment of both the supplies of and demands for the various financial assets assumed in Minskyan analyses (and, therefore, their respective interest rates and prices). Indeed, Keynesian authors generally view these supplies and demands as being determined by the portfolio decisions of agents (or, more precisely, of the "macroeconomic sectors"), but these presuppose the aforementioned budget constraints. One can only model, say, the impact of households' portfolio decisions (or, more concretely, how they split their wealth in equities, government bills, bank deposits and cash) on (these) financial markets if one knows the size of households' wealth. The same is true for the impact of firms's and banks' liability management and portfolio decisions. In fact, Minsky's own analysis of actual policy-making—especially monetary policy-making in the U.S (see, for example, Kregel, 1992, p.96 and Minsky, 1986,

[24] In the same direction, Delli Gatti et. al. (1994, footnote 14) points out that "the greater the ratio of equity to debt financing the greater the chance the firm will be a hedge financial unit." Minskyan authors such as Nasica (2000, ch. 5) have noticed that one is more likely to find discussions of how firms finance themselves in the New Keynesian literature than in the Post-Keynesian one.

p.322)—depends crucially on these considerations. These supplies and demands, together with the actions of the government and the central bank and the "microstructure" of financial markets operate (that will determine whether they "clear" instantaneously or not and so forth) do determine in a broad Minskyan/Post-Keynesian/SFC view the actual outcomes in financial markets, being therefore crucial to formalizations of the financial fragility hypothesis.

The usual SFC way to deal with these issues is to derive the budget constraints of all macroeconomic sectors (as discussed above) and "close" them with explicit behavioral assumptions.[25] Households, in particular, are assumed to have Tobinesque demands for assets. These ensure that households respond to (expected) differentials in the rates of return of the various assets in ways deemed "rational" (i.e., a bigger expected rate of return increases the share of the asset in the sector's portfolio) and consistent (i.e., such an increase leads to a decrease in the combined share of the other assets in the sector's portfolio, so that its budget constraint is respected), but are usually modeled with no regard to Minskyan/Post Keynesian "liquidity preference" considerations. A Minskyan specification would presumably include a "liquidity preference" determinant to the elegantly constrained Tobinesque specifications.[26] The FML does not always proceed along these lines, as table 6 demonstrates.

Table 6: Budget Constraints and Financial Markets in the FML

Model	Budget Constraints and Financial Markets
Taylor and O'Connel (1985)	The budget constraint of the government sector is not respected.[27] Tobinesque specifications of households' demands for financial assets are explicitly mentioned as desirable "extensions" of the model. The determinants of the households' demand for stocks are assumed to be the same of firms' demand for investment (expected profitability and *rl*), so there's an implicit "liquidity preference" effect on the model.
Franke and Semmler (1989)	Same as Taylor and O'Connel, with the difference that banks and financing decisions of firms are explicitly modeled. Also, their hypotheses that the net worth of firms and banks are zero change the relevant budget constraints.
Lavoie (1986-1987)	Financial Markets' behavior is ignored.
Delli Gatti et. al. (1994)	The budget constraints of households, government and banks are ignored. The budget constraint of firms is only implicit. Only the market for loans is explicitly modeled, the other financial markets being ignored.
Skott (1994, appendix)	The budget constraints of households, government and banks are ignored. Only the market for loans is explicitly modeled, the other financial markets being ignored.

[25] See appendix 2 above for details. See, also, Backus et.al. (1980), Tobin (1982), Godley (1999a) and Lavoie and Godley (2001-2002).
[26] See, for example, Godley (1996, p. 23).
[27] Or, at least, not explicitly. See section 5 below for details.

4.5 – Inflation and Capacity Utilization in the FML

Inflation plays a crucial role in Minskyan analyses. As he put it himself (1982, p.57), the effects of "Big government" and lax monetary policy-making, the traditional medicines against debt deflations, are not necessarily brilliant in the long run: "stagflation is the price we pay for the success we have had in avoiding a great or serious depression. The techniques that have been used since the mid-sixties to abort the debt deflations have clearly been responsible for the stepwise acceleration of the inflation rates [in the 1970s] (…) inflation has been the corollary of the validation of an inept business structure and poorly chosen investments by government deficits and thus inflation has been associated with a decline in the rate of growth." While Minsky's particular view on this issue is debatable, it's very difficult to deny the importance of dealing with inflation in models prone to "explosive" behavior (such as many in the FML). Inflation provides, after all, the "ceiling" that—together with stock (say, of public debt, or private capital)-flow (say, of interest payments on public debt or of output) relations—makes the application of "naive" Keynesian policies unacceptable.

But inflation is crucial in Minskyan-type analyses for other reasons. First and foremost, inflation affects the "real" value of financial stocks and flows, and therefore the "real" aggregate budget constraints of the macroeconomic sectors. As discussed above, our stock-flow consistent accounting framework changes considerably when "real" capital gains/losses due to inflation are considered. Inflation is far from neutral for it benefits debtors (in case their contracts are phrased in nominal terms) and hurts owners of financial wealth. Moreover, from a purely formal point of view it does make a difference whether behavioral assumptions are supposed to determine "nominal" or "real" variables in a model. If the latter is the case, then the hypotheses assumed about inflation will interfere with virtually all the variables in the model, therefore potentially changing its dynamic behavior (e.g. changing a "simple" linear model in a complicated non-linear one).

Of the FML papers discussed here, only Lavoie's discusses inflation. As he points out (Lavoie, 1986-1987, p. 263, emphasis in the original) "(…) an investment boom (…) *may* require a constant rate of growth in the share of profits (in national income), which in turn, "*ceteris paribus*" implies an increasing rate of growth of prices," especially if one adds a "feedback relation between the nominal wage rate and the share of profits" (ibid, p.264) close to the ones proposed by, among others, Minsky and Ferri (1984, p. 491) and Kaldor (1985, p. 38-39). Besides that, and perhaps more obviously, capacity utilization can't be much greater than

one indefinitely.[28] The specific "trigger mechanism" to a Minskyan debt-deflation process proposed by Lavoie (i.e. an increase in the nominal interest rate, forced by the unwillingness of rentiers to "lose purchasing power") is not, however, satisfactory in our view. It's not obvious—or even likely—that the "real" financial fragility of firms would increase with inflation in the absence of "real" (not merely nominal) increases in the interest rate.

This lacuna in the FML is particularly problematic if one considers that macroeconomic policy-making today is based on a New Keynesian "consensus," according to which monetary policy should follow "broadly specified rules" determining the level of interest rates as a function of inflationary behavior (Arestis and Sawyer, 2002). Minsky's own views on the issue are well more sophisticated than that, but it's doubtful they could be phrased with the help of the FML models discussed so far. SFC "inflation accounted" versions of these models do provide, in our opinion, a much better starting point for this kind of discussions.[29]

5 – A CLOSER LOOK AT THE TAYLOR-O'CONNEL MODEL

We singled out the Taylor-O'Connel model for various reasons. First, it is a break-through model that still remains a crucial reference in the FML. Second, the SFC approach has many elements in common with Taylor's own brand of structuralism (see, e.g., Taylor, 1991 and 2004). Third, it is our belief that the properties of the model weren't fully worked out in the original paper. In particular the model contains a series of hidden assumptions, being therefore particularly suited to our purposes.

An obvious way to start is to note that there are no banks in the Taylor-O'Connel model, so $L = Bb = A = Hb = 0$. Given that there are no banks, we can get rid also of the central bank, consolidating its accounts with the general government (so Bc becomes zero). Last, but not least, Taylor and O'Connel assume that $Mf = 0$. The balance sheets for their model are presented in table 7 below, and the reader is welcomed to derive the relevant flows of funds and uses and sources tables with the help of tables 2 and 3 above.

[28] Godley and Cripps (1983, p. 255) and Kaldor (1985, p. 37) phrase this point very carefully.
[29] See Zezza and Dos Santos (forthcoming) for a formal attempt along these lines.

Table 7. Balance sheets in Taylor and O'Connel's "artificial economy." A (+) sign before a variable denotes an asset while a (-) sign denotes a liability				
	Households (Rentiers)	Firms	Government	Total
1 - High powered money	*+Hh*		*-H*	*0*
3 – Bills[30]	*+B*		*-B*	*0*
4 - Capital		*+K*		*+K*
5 - Equities	*+E pe*	*-E pe*		*0*
6 – Net Worth	*+ Vh*	*+ Vf*	*-B – H*	*+K*

Taylor and O'Connel present their model in a most peculiar way. Even though the model has a government sector, the equilibrium conditions in the goods' market is derived for an economy without government. The basic assumptions of the model are that households can be divided (*a la* Kalecki) in workers—who spend all their wage income W and, therefore, have zero wealth—and rentiers who receive all private non-wage income ($FT–W+rb_{-1}B_{-1}$, presumably, even though interest payments on government bills are never mentioned in the text)[31] and save a fraction *s* of it. Also *a la* Kalecki the general level of prices (*p*) is given by a mark-up formula ($p = (1 + ro)*wage/prod$, where *ro* is the mark up, wage is the nominal wage rate and prod is the average labor productivity coefficient). Now, if there is no government sector and therefore no taxes and no government bills to buy (so that $B = IT = DT = 0$), then $S \equiv FT + W$, it is easy to derive a condition for the equilibrium in the goods' market that depends in a nice way on the profits rate. Indeed, in equilibrium:

$S = p*Sk = C + I,$ or equivalently,

$S – C = SAV = I = \Delta K$

So if :

$C = W + (1-s)*FT;$ and

$I = \Delta K = [g_0 + h(r + \Phi – rb)]*K$ (see table 3 above), and

$W = wage*Sk/prod$ (from the price equation)

[30] We simplify things here assuming that government debt consists only of cash and government bills, as opposed to bonds.

[31] As mentioned above, firms are not assumed to retain earnings in the Taylor-O'Connel framework.

it is easy to prove that:

$FT = S - W = (1+ro)W - W = roW$

so that

$C = W + (1-s)*roW$

$SAV = S - W - (1- s)*roW = s*roW = s*FT = s*r*K$

(if we define the profit rate "*r*" as the ratio of total profits over the reposition cost of aggregate capital, ($r = FT/K$):

The equilibrium in the goods' market in this case is give by:

$s*r*K = [g_0 + h(r + \Phi - rb)]*K$

which enables one to conclude (after dividing everything by *K*, solving for *"r"* and plugging it back in the investment function) that the equilibrium value of the "investment growth" $g = \Delta K/K$ is given by:

$g_{eq} = \Delta K/K = s[g_0 + h(\Phi - rb)]/(s-h)$

The problem with such a derivation is, of course, that it doesn't hold for an economy with a government sector. Later in the text, Taylor and O'Connel acknowledge that: "to complete the dynamics, government policy behavior must be specified." They do that by fixing "government expenditures as a proportion of the capital stock and taxes as a proportion of expenditures" and state that " on these assumptions (…) [the total fiscal debt, B+H, divided by the nominal capital stock, K] is fixed, and government spending disappears as an autonomous component of the capital stock growth rate, g." Both the statements above are problematic. First, without a full specification of the government policy behavior, one cannot get even the static equilibrium condition of the model. Second, the fact that the nominal interest on government bills is assumed to be positive, makes Taylor and O'Connel's second conclusion about the constancy of the (B+H)/K ratio to depend on "hidden assumptions." Third, and related to the other two, it's not at all clear what exactly Taylor and O'Connel mean by "government expenditures" and "taxes."

Beginning by this last topic, we note that different taxes have different implications to the short run equilibrium conditions for the "real" side of the economy (the "IS" part of the Taylor-O'Connel's model). If, following most Keynesian textbooks, taxes are modeled as direct taxes (i.e., IT = 0), it is obvious that capitalists and workers will only be able to spend their disposable incomes. In this interpretation, we assume that DT = τS, so that (assuming also that government expenditures *in goods*[32] are fixed as a proportion of K, so that $G = \upsilon K$), we have that in equilibrium:

$SAV = Spriv + Sg = I = \Delta K$

where:

$Spriv = W + FT + rb_{-1}B_{-1} - C - \tau S = (1+ro)W + rb_{-1}*B_{-1} - C - \tau S$ and

$Sg = \tau S - \upsilon K - rb_{-1}B_{-1}$

and, assuming that $C=(1-\tau)W+ (1-s)*[(1-\tau)roW+ rb_{-1}*B_{-1}]$, *i.e.* that the taxation of wages and profits is the same, and that rentiers save a fraction s of their **total** disposable income, one is led to conclude that, in equilibrium:

$$[s(1-\tau)ro + \tau(1+ ro)]W - (1-s)* rb_{-1}B_{-1} - \upsilon K = [g_0 + h(r + \Phi - rb)]K$$

Or, equivalently,

$$[s(1-\tau) + \tau(1+ro)/ro]*rK - (1-s)*rb_{-1}B_{-1} - \upsilon K = [g_0 + h(r + \Phi - rb)]K \quad (*)$$

and, therefore, it is pretty obvious that the equilibrium profit rate "r" and, therefore, investment will depend on past interest rates, a hypothesis that is not discussed by Taylor and O'Connel.

Of course there are ways to save Taylor and O'Connel's "IS" formalization but all of them involve some sort of "hidden assumption," what is precisely the point we want to make here. In particular, things look much better if one assumes that the interest income received by rentiers is all spent (i.e. that rentiers treat their different incomes differently). If this is the case, the term $(1-s)* rb_{-1}*B_{-1}$ becomes zero in equation (*) above and things get considerably clearer algebraically. Indeed, we would now have:

[32] As Taylor and O'Connel say nothing about this, one could very well interpret them as assuming that $G + rb(-1)*B(-1) = \upsilon K$. The qualitative conclusions of the model wouldn't be the same, of course.

$$[\, s(1-\tau) + \tau(1+ro)/ro]*rK \; - \upsilon K = [g_0 + h(r + \Phi - rb)]K \quad (*)$$

a result more in line with Taylor and O'Connel's.

It so happens, however, that the "LM" part of the model is also unclear, again in part due to the somewhat casual specification of the government sector in the model. In particular, the hypotheses above do not necessarily imply that (B+H)/K will be constant, as assumed by the authors. Given the role played in the model by the supply of money and government bills in the determination of the interest rates and (therefore) accumulation, the issue is a crucial one.
In particular, given the hypotheses above, we have that:

$$B+H = B_{-1}*(1+ rb_{-1})+H_{-1} - \tau(1+ro)W + \upsilon K$$

So it's unclear whether or not the ratio of the expression above to K will actually converge to a constant. Then again, one possible way out of this problem is to "change" the fiscal assumptions to, say, $G + rb_{-1}B_{-1} = \upsilon K$ or $DT + rb_{-1}B_{-1} = \tau S$. The problem with these procedures are two. First, they introduce "hidden" hypotheses about either direct taxation or government expenditures (i.e., the fact that they fluctuate to accommodate changes in the interest payments to rentiers). Given that the model is based on the assumption that the two classes have different propensities to consume, these "hidden" hypotheses are bound to have real effects. Second, any such modification would have to be incorporated also in the IS, therefore, bringing back (in some form) the impact of the stock of government bills in the investment flows discussed above.

The main conclusion of this section is, therefore, that the specific formalization used by Taylor and O'Connel (1985) only holds under a number of "hidden" hypotheses all related to stock-flow consistency issues. This is not to say, of course, that the main insight of their model (i.e., the possibility of a explosive behavior, as discussed in section 4 above) is ruled out in more general cases. Whether or not this is the case, however, can only be rigorously discussed in light of the "general framework" proposed above[33].

[33] We are well aware, of course, that more general SFC frameworks can be obtained, either by including other financial assets (and, therefore, markets) and/or macroeconomic sectors in the analysis, or by simply filling up the empty spaces in tables 1-3 above. An example of such a framework can be found in Godley and Lavoie (forthcoming, ch.11). We do believe, however, that the particular "scale" we used to draw our "map" here is the adequate one to analyze existing FM models.

6 – FINAL REMARKS

Chick (1992, p.81) notes that "from writing (…) [a SFC] paper," she "learned, gradually, that economics is not about the logical consistency of models." We strongly disagree. Like Lavoie and Godley (2001-02, p.131), we do believe that the SFC approach provides an alternative [and rigorous] foundation for Post-Keynesian macroeconomic modeling, which "as reported by Chick (1995), is sometimes accused of lacking coherence, formalism, and logic."

Indeed, the criticisms made here are constructive. In particular, we do acknowledge the seminal character of the FML and sympathize with its "spirit." Besides, and more importantly, the SFCL criticism contains the seeds of its own solution, for in pointing out the inconsistencies or lacunae in existing models the SFCL is directly contributing to their development. As discussed above, many SFC versions of the FML models discussed here can be formulated. The stock-flow consistency of macroeconomic models is not, however, a mere detail. Inconsistent models can behave "incoherently" for reasons quite different from the ones Minsky had in mind. Besides, one can never underestimate the need to shed light on the implicit and hidden assumptions of "elegant" and/or "smart" and/or "parsimonious" models that try to describe the behavior of "economies as a whole" with a couple of equations. By doing that, one gets a more in-depth (and rigorous) understanding of how these economies really work, a point that concerns Post-Keynesian economists more directly than others, given their emphasis on explanatory over predictive power.

In previous sections we reviewed the general tenets of both the "Stock-Flow Consistent" and the "Formal Minskyan" literatures (sections 1 and 2) and argued (in sections 4 and 5) that the advantages and weaknesses of the latter get clearer when analyzed with the tools of the former.[34] We made this point analyzing a small but representative and influential sample of seminal "formal Minskyan" models (in section 4), particularly the Taylor-O'Connel model (in section 5) in light of a fully consistent "Minskyan artificial economy" (presented in section 3) and showing they often assume oversimplified hypotheses (that don't do justice to the richness of Minskyan analyses) and, more seriously, often ignore the logical implications of these hypotheses. Finally we argued that most of these problems can be tackled when FM models are

[34] In fact we believe the two literatures to be highly complementary. In particular, we strongly believe the SFCL has a lot to gain by incorporating Minskyan insights about the relations between financial fragility, aggregate investment and banking behavior. The papers by Lavoie and Godley (2001-2002) and Zezza and Dos Santos (forthcoming) have begun to take these issues in a SFC context, but a lot still remains to be done.

phrased as “closures” of the “general Minskyan” accounting framework described here (in section 3) and in Zezza and Dos Santos (forthcoming). Given the analytical rigor and conceptual clarity of the proposed framework, we strongly believe that such a move will make the goal of a relatively consensual “formal Minskyan model” easier to achieve.

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