CLAUDIO H. DOS SANTOS

A stock-flow consistent general framework for formal Minskyan analyses of closed economies

Abstract: This paper proposes a fully consistent and general “Minskyan artificial economy” and uses it to analyze a small but representative sample of “formal Minskyan” models. It concludes that these models often assume oversimplified hypotheses that do not do justice to Minsky’s literary analyses and, more seriously, do not always take into full consideration the logical implications of these hypotheses.

Key words: financial fragility, Minsky, stock-flow consistency.

This paper attempts to offer a contribution to the literature that has discussed formalizations of Hyman Minsky’s concept of “financial fragility.” More precisely, we argue that virtually all models in this influential “formal Minskyan” literature (FML hereafter) can be phrased as special cases (or “closures”) of a particular stock-flow consistent 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

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1 See, for example, Delli Gatti et al. (1994), Lavoie (1986–87), Nasica (2000), and Skott (1994), as well as many of the articles collected in Bellofiore and Ferri (2001b), Dimsky and Pollin (1994), Fazzari and Papadimitriou (1992), and Semmler (1989). Kregel called this literature “dynamic Post-Keynesian,” though only for the lack of a “better name” (2000, p. viii).

2 As put by Taylor, “[f]ormally, 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” (1991, p. 41).
attempt to discuss the nature and the implications of the simplifying or implicit assumptions usually adopted in the FML. Such systematization, we believe, is a prerequisite to the development of a future consensual “formal Minskyan” model that is both rigorous and flexible enough to be applied to the analysis of macroeconomic policies in actual economies.

The stock-flow consistent approach

The bulk of macroeconomic research assumes the form (or is done with the help) of mathematical models or literary descriptions that fail to take systematically into consideration the logical (“economy-wide”) constraints that apply to any economy when considered “as a whole.” The basic insight of the stock-flow consistent literature (SFCL hereafter) is that these constraints introduce considerable structure to an otherwise virtually intractable macroeconomic reality.3

SFC practitioners, therefore, base their models on 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. Besides that, and maybe more important, they allow one to identify with precision the logical interrelations 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. 7) that only “come to life as . . . economic model(s)” (Backus et al., 1980, p. 262) when behavioral assumptions are added to it. 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.”4

3 The expression “stock-flow consistent” is used by Davis (1987) and Patterson and Stephenson (1988), among others, to designate ideas broadly associated with Tobin (e.g., 1982), Godley and Cripps (1983), and, ultimately, to an earlier “flow of funds” literature initiated by Copeland (1952).

4 It is also recognized that most existing macroeconomic models and literary descriptions are based (explicitly or not) on some kind of accounting framework, but emphasis is put on the fact that these models almost invariably focus only on flows or deal with stocks and flows inconsistently. As a consequence, these works fail to identify or take into consideration all “systemwide” implications of their hypotheses.
In somewhat schematic terms, the SFC methodology consists of three “steps”: (1) do the (SFC) accounting; (2) establish the relevant behavioral relationships; and (3) perform “comparative dynamics” exercises (generally with the help of computer simulations) to see how the model behaves. The remainder of this section is dedicated to a brief discussion of these “steps.”

The first thing an SFC theorist must do in order to analyze a given issue is to construct a SFC “artificial economy” in which to study it. What one gets from this 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” (Turnovsky, 1977, p. 3), that is, the fact that flows and capital gains and losses necessarily increase or decrease stocks and these, in turn, influence future flows. Second, there are the “sectoral budget constraints,” that is, 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, that is, 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 all these logical requirements differentiates SFC macro models from conventional Keynesian ones.

The accounting structure obtained in the first step affects the choice of the behavioral equations of the model in important ways. First, by making the interrelations among all the variables assumed in the model explicit to the theorist, it helps preventing unintended “hidden” assumptions (see the “Inflation and Capacity Utilization in the FML” subsection below). Second, and related to the first, it makes the number of degrees of freedom in the system explicit to the theorist.

The output of the first two steps is, invariably, a system of difference/differential equations. The third step, naturally, is to perform a series of comparative dynamics exercises to evaluate the sensitivity of the model to changes in parameters and key exogenous variables. Given that ana-

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Although it is 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, “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” (1982, p. 188).
lytic 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 clearer when conventional models are analyzed from an SFC perspective. That is what we plan to do in what follows. Due to space limitations, however, we will limit ourselves to the analysis of the logical structures of the models, leaving aside complications related to comparative dynamics exercises.

A general framework for Minskyan analyses of closed economies

Most analysts would agree that a fair depiction of Minsky’s “Wall Street paradigm” requires an economy with households, firms, banks, and a government (including a central bank). It seems to us that any reasonably realistic model of such an economy would include not only money “proper” and markets for bank loans and government bills but also a stock market and an explicit treatment of central bank loans to private banks. These are the features of reality the “artificial economy” presented here aims to capture.

Minsky wrote that “an ultimate reality in a capitalist economy is the set of interrelated balance sheets among the various units” (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” (ibid., p. 70). We, therefore, begin our exposition with the balance sheets of the sectors in our “artificial Minskyan economy.” These are depicted in Table 1, which we hope the reader will find self-explanatory.

Table 1 summarizes many theoretical assumptions. In particular, its empty cells make clear that we are simplifying away bank loans to house-

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5 Even though simpler “formal Minskyan” models have been proposed, for example, by Lavoie (1986–87) and Skott (1994). This is not to say, of course, that Minskyan analyses are not valid in open economy contexts. Most writers in the FML seem to agree, however, that the essence of Minsky’s insights can be captured in a closed economy framework.

6 In this sense, it is similar to the ones discussed by Godley (1996) and Zezza and Dos Santos (2004). A more detailed construct can be found in Godley and Lavoie (2002, ch. 11).

7 Similar tables often appear in the FML. See, for example, Delli Gatti et al. (1994), Franke and Semmler (1989), and Taylor and O’Connell (1985). Note also that, since any financial asset must have a counterpart financial liability, rows 1–5 and 7 in Table 1 must add up to zero.
Table 1
Balance sheets in our “artificial economy”

<table>
<thead>
<tr>
<th></th>
<th>Households</th>
<th>Firms</th>
<th>Banks</th>
<th>Central bank</th>
<th>Government</th>
<th>Row totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. High-powered money</td>
<td>+Hh</td>
<td></td>
<td></td>
<td>–H</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2. Central bank advances</td>
<td>+A</td>
<td></td>
<td>–A</td>
<td>+A</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>3. Bank deposits</td>
<td>+Mf</td>
<td>+Mh</td>
<td>–L</td>
<td>–M</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>4. Bank loans</td>
<td>–L</td>
<td></td>
<td>+L</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>5. Bills</td>
<td>+Bh</td>
<td></td>
<td>+Bb</td>
<td>+Bc</td>
<td>–B</td>
<td>0</td>
</tr>
<tr>
<td>6. Capital goods</td>
<td></td>
<td>+p · K</td>
<td></td>
<td></td>
<td></td>
<td>+p · K</td>
</tr>
<tr>
<td>7. Equities</td>
<td>+E · pe</td>
<td>–E · pe</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>8. Net worth (column totals)</td>
<td>+Vh</td>
<td>+Vf</td>
<td>0</td>
<td>0</td>
<td>–B</td>
<td>+p · K</td>
</tr>
</tbody>
</table>

Notes: A (+) before a variable denotes an asset and (−) denotes a liability, pe stands for the price of one equity, and E stands for the number of equities issued.
holds and money holdings of the government. We also assume that banks
(1) neither issue nor hold equities, and (2) distribute all their profits, so
their net worth is zero. Despite these simplifications, the “artificial
economy” assumed here is still complete enough to encompass the ones
in the FML as special cases (see the third section).

Minsky also stresses that the “items in the balance sheets set up cash
flows” (ibid., p. 118). More precisely, “cash flows are the result of (1) the
income-producing system, which includes wages, taxes and nonfinan-
cial 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”
(ibid., p. 118). In fact, Minsky went as far as stating that his own “alter-
native interpretation [of Keynes] can be summarized as a theory of the
determination of the effective budget constraints [of the various macro-
conomic sectors],” and that “the economics of the determination of the
budget constraint logically precedes and sets the stage for the econom-
ics of the selection of particular items of investment and consumption”
(ibid., p. 132).8 Tables 2 and 3 aim precisely to model these cash flows
and budget constraints rigorously.9

Table 2 is easier to understand when considered as a logical “flow”
counterpart of Table 1. In particular, rows 7 through 10, depicting the
interest and dividend payments among sectors, are directly implied by
their liability structures, our assumptions being that (1) the interest rates
on money deposits (rm), bank loans (rl), government bills (rb), and cen-
tral bank advancements (ra), are all fixed during a given accounting pe-
riod; and (2) interest on loans obtained in period t are paid in period t + 1
at rates predetermined in t. We assume also that (1) banks do not pay
taxes; (2) banks distribute all their “current profits” (Fb), so that their net

8 It is, therefore, 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, we do not know the reasons for Minsky’s skepticism. Of
course, the composition of Ponzi, hedge, and speculative finance in any given sector
can fluctuate without any changes in the aggregate balance sheet, provided that the
increase in Ponzi finance is counterbalanced by improvements in the balance sheets of
the remaining hedge and speculative units. Minsky did, however, use aggregate vari-
ables as proxies of financial fragility in many occasions (see, e.g., Minsky, 1982, chs.
1 and 2).

9 Tables 2 and 3 are based on “flow of funds” concepts originally proposed by
Copeland (1952). The particular way we present these matrices follows closely the
work of Godley (1996; 1999a). Note that Table 2 follows the FML in neglecting
inventories (i.e., it assumes, for simplicity, that firms get the point of effective demand
“right”). See Godley (1999a) for a more general treatment.
Table 2
Transactions in our “artificial economy”

<table>
<thead>
<tr>
<th></th>
<th>Nonfinancial firms</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Households</td>
<td>Current</td>
<td>Capital</td>
<td>Government</td>
<td>Banks</td>
<td>Central bank</td>
</tr>
<tr>
<td>1.</td>
<td>Consumption</td>
<td>$-C$</td>
<td>$+C$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Government expenditures</td>
<td>$+G$</td>
<td>$-G$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Investments</td>
<td>$+p \cdot \Delta K$</td>
<td>$-p \cdot \Delta K$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Accounting memo: “final” sales at market prices $\equiv S \equiv C + G + p \cdot \Delta K \equiv W + FT + IT$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Wages</td>
<td>$+W$</td>
<td>$-W$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Taxes</td>
<td>$-DT$</td>
<td>$-IT$</td>
<td>$+T$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Interest on loans</td>
<td>$-r_{-1} \cdot L_{-1}$</td>
<td>$+r_{-1} \cdot L_{-1}$</td>
<td>$+r_{-1} \cdot A_{-1}$</td>
<td>$- r_{-1} \cdot A_{-1}$</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Interest on bills</td>
<td>$+r_{-1} \cdot B_{-1}$</td>
<td>$-r_{-1} \cdot B_{-1}$</td>
<td>$+r_{-1} \cdot Bb_{-1}$</td>
<td>$+r_{-1} \cdot Bc_{-1}$</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Interest on deposits</td>
<td>$+m_{-1} \cdot Mh_{-1}$</td>
<td>$+r_{-1} \cdot M_{-1}$</td>
<td>$+r_{-1} \cdot Mf_{-1}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Dividends</td>
<td>$+Ff + Fb$</td>
<td>$-Ff$</td>
<td>$+Fc$</td>
<td>$-Fb$</td>
<td>$-Fc$</td>
</tr>
<tr>
<td>11.</td>
<td>Column totals (current)</td>
<td>$SAVh$</td>
<td>$Fu$</td>
<td>$SAVg$</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes: A (+) before a variable denotes a receipt, and (–) denotes a payment.
Table 3
Flows of funds

<table>
<thead>
<tr>
<th>Changes in</th>
<th>Changes in Households</th>
<th>Changes in Firms</th>
<th>Changes in Banks</th>
<th>Changes in Central bank</th>
<th>Changes in Government</th>
<th>Row totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>+ΔHh</td>
<td>+ΔHf</td>
<td>−ΔH</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Central bank advances</td>
<td>−ΔA</td>
<td>+ΔA</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Bank deposits</td>
<td>+ΔMh</td>
<td>+ΔMf</td>
<td>−ΔM</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Loans</td>
<td>−ΔL</td>
<td>+ΔL</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Treasury bills</td>
<td>+ΔBh</td>
<td>+ΔBb</td>
<td>+ΔBc</td>
<td>−ΔB</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Capital</td>
<td>+p · ΔK</td>
<td></td>
<td>+p · ΔK</td>
<td>+p · ΔK</td>
<td>+p · ΔK</td>
<td>+p · ΔK</td>
</tr>
<tr>
<td>Equities</td>
<td>+ΔE · pe</td>
<td>−ΔE · pe</td>
<td>0</td>
<td>0</td>
<td>SAVg</td>
<td>SAV</td>
</tr>
<tr>
<td>Column totals</td>
<td>SAVh</td>
<td>Fu</td>
<td>0</td>
<td>0</td>
<td>SAVg</td>
<td>SAV</td>
</tr>
<tr>
<td>Δnet worth (accounting memo)</td>
<td>SAVh + Δpe · E₁ - Δp · K₁</td>
<td>Fu - Δpe · E₁ + Δp · K₁</td>
<td>0</td>
<td>0</td>
<td>SAVg</td>
<td>SAV + Δp · K₁</td>
</tr>
</tbody>
</table>
worth is zero; (3) the central bank distributes all its “current profits” ($F_c$) to the “government” (understood here as a “Treasury”), so its net worth is zero; and (4) firms retain a part ($F_u$) of their after-tax profits (or Marshallian “quasi-rents”). Note also that $DT$ stands for “direct taxes” (paid by the households on their income), $IT$ stands for “indirect taxes” (paid by the firms on their total receipts), and $FT (= S - W - IT \equiv Fu + Ff + rl_{-1} \cdot L_{-1} - rm_{-1} \cdot Mf_{-1})$ stands for firms’ total “gross profits” in production, a variable that plays a crucial role in the FML.\footnote{However, all models discussed in the third section assume that $A = Mf = 0$; that is, that firms have no liquid assets, and banks never need central bank loans.}

Table 2 makes sure that “every financial flow comes from somewhere and goes somewhere” (Godley, 1999a, p. 394), and this is crucial to our analysis of the FML (see the third section). Note, in particular, that adding up the “current” saving of households ($SAV_h \equiv W + Ff + Fb + rb_{-1} \cdot B_{-1} + rm_{-1} \cdot Mh_{-1} - C - DT$), firms’ retained earnings ($Fu \equiv S + rm_{-1} \cdot Mf_{-1} - IT - W - FF - rl_{-1} \cdot L_{-1}$), and government’s saving ($SAV_g \equiv T + Fc - G - rb_{-1} \cdot B_{-1}$), one gets the economy’s total saving ($SAV$), which, ex post, is identical to investment ($p \cdot \Delta K$).

The columns in Table 3, in turn, demonstrate how the sectoral balance sheets are modified by current flows. In this sense, these columns can be interpreted as aggregated sectoral budget constraints. The net worth of the sectors in Table 1 is related to the capital account flows in Table 3 by the accounting identity:

$$NW_{a_t} = NW_{a_{t-1}} + SAV_{a_t} + CG_{a_t},$$

or, in words, the net worth of a sector $a$ is increased by its current saving plus the capital gains ($CG$) arising from changes in the market value of its assets.

We finish this accounting tour de force by reminding the reader that all accounts presented so far were phrased in nominal terms. Assuming a single price deflator $p$, all stocks and flows in Tables 1 and 2 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,

$$Sk \equiv S / p \equiv C / p + p \cdot \Delta K / p + G / p \equiv Ck + \Delta Kk + Gk.$$

Things are different, however, with capital gains and losses. Only firms and households can have nominal capital gains/losses in the economy.
above (from fluctuations in $p$ and $pe$), but the real value of all financial assets declines with inflation. Accordingly, households’ real capital gains in a given period, for example, are given by

$$CGhk \equiv \Delta pe_t \cdot E_{t-1} / p_t - \Delta p \cdot Vk_{t-1} / p_t.$$ 

**An SFC look at the FML**

At the risk of oversimplification, one can divide the literature dealing with Minskyan themes into three main groups. A first group, exemplified by many of the papers in Fazzari and Papadimitriou (1992) and Bellofiore and Ferri (2001a), deals with literary analyses of Minskyan topics. A second group, surveyed in Nasica (2000, chs. 5–6), deals with New Keynesian analyses of these same topics. Here, we will be concerned with a third group, which, according to Nasica, 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” (ibid., p. 75).

This FML is admittedly biased. It has focused on modeling only the “core” Minskyan insight—that is, the idea that capitalist economies 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 on a variety of financial variables. Its results have been mixed. On one hand, the FML

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11 We assume that capital does not depreciate and Treasury bills last exactly one period, so fluctuations in the market value of equities and in the replacement cost of firms’ stock of capital are the only sources of nominal capital gains and losses in this economy.

12 FML authors candidly recognize that their models cannot do justice to the richness of Minsky’s literary descriptions. On the other hand, they observe that “the absence of modeling has sometimes made the consistency of Minsky’s arguments seem difficult to check” (Nasica, 2000, p. 51).

13 In the best Keynesian tradition, consumption expenditures are not seen as a source of instability in the FML. Minsky firmly believed that “consumer and housing debt can amplify but . . . cannot initiate a downturn in income and employment” (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).
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has had considerable success in proving that Minskyan-type outcomes are formally possible in many theoretical contexts. On the other hand, it has not been able to produce a relatively consensual “formal Minsky model” yet.

We do believe that the first step to consensus making is systematization. Accordingly, this section is dedicated to the analysis of a representative sample of formal Minskyan models, with particular emphasis on their common features, simplifying assumptions, and internal logical consistency. In fact, the models discussed here—that is, the ones proposed by Delli Gatti et al. (1994), Franke and Semmler (1989), Lavoie (1986–87), Skott (1994), and Taylor and O’Connell (1985)—played a crucial role in creating and consolidating the FML as a line of research.14 On the other hand, they are all exploratory or pedagogical attempts admittedly less than general, often for different reasons. One has, therefore, a lot to learn from looking closely at their (dis)similarities and inconsistencies.

Lack of space prevents us from analyzing the formal properties of all models in our sample. Accordingly, we proceed here with a typology of simplifying hypotheses/modeling strategies adopted by these models and their logical consequences. A more formal analysis of the Taylor–O’Connell model, arguably the most influential FML paper, is presented in the Appendix.

Effective demand in the FML

As already mentioned, most of the “action” in formal Minskyan models depends on the investment function. In analyzing the specifications in Table 4, one identifies three basic strategies used to model the effect of “financial fragility” on aggregate investment. A first strategy is based on Taylor and O’Connell’s $\phi$ 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.” 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.

As Franke and Semmler (1989, p. 39) and Nasica (2000, p. 53) point out, Taylor and O’Connell’s seminal formalization (see Table 4) does not address directly the role of firms’ debt commitments. Franke and Semmler’s proposal to solve this problem is to make the rate of growth

14 The possible exception is Delli Gatti et al. (1994), a very interesting, though not well known, FML attempt coauthored by Minsky.
Table 4
Investment functions in the FML

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taylor and O’Connell (1985, p. 873)</td>
<td>[ \Delta K = [g_0 + h \cdot (r + \phi - rb)] \cdot K ] “where ( rb ) is the current interest rate [in government bills], ( \phi ) reflects the difference between anticipated return to holding capital and the current profit rate ( r = FT/(p \cdot K) ). ( 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.”</td>
</tr>
<tr>
<td>Franke and Semmler (1989)</td>
<td>Same used by Taylor and O’Connell.</td>
</tr>
<tr>
<td>Lavoie (1986–87)</td>
<td>[ \Delta K = (ret \cdot u \cdot pi \cdot K)/(v \cdot (1 - x)) ] where ( ret ) ((= Fu/FT)) stands for the retention ratio of firms on gross profits, ( pi ) ((= FT/S)) stands for the share of profits in total sales, ( u ) ((= S/(p \cdot Potential Output))) stands for the capacity utilization ratio, ( v ) ((= K/Potential Output)) stands for the technological capital–capacity ratio, and ( x ) ((= 1 – Fu/(p \cdot \Delta K))) stands for the share of investment that is financed through external sources.*</td>
</tr>
<tr>
<td>Delli Gatti et al. (1994)</td>
<td>[ p \cdot \Delta K = a \cdot v_i + b_1 \cdot (FT - rp_{-1} \cdot L_{-1}) ] where ( a ) is a constant, ( v_i ) stands for Minsky’s price of capital (( Pk )), and ( rp ) is the ratio of the gross payments due on firms’ outstanding debt with banks (interest and principal). The function ( b_1 = b_{01} + b_{11} \cdot arctg(FT_{-1}) ) is nonlinear and increasing in ( FT_{-1} ), and ( b_0 ) represents the “liquidity preference of firms.”</td>
</tr>
<tr>
<td>Skott (linear specification) (1994)</td>
<td>[ \Delta K = [a \cdot \sigma + b \cdot F + c \cdot T + d] \cdot K ] where ( a, b, c, ) and ( d ) are constants, ( \sigma ) stands for the actual output–capital ratio ( S/(p \cdot K) ), and ( F ) and ( T ) are “hybrid values” depicting both the “fragility” and the “tranquility” of the system.</td>
</tr>
</tbody>
</table>

Notes: Some notations of the original texts were adapted to the ones used in the second section. * For a more recent Lavoie-type specification in which the negative role of the interest rate is made explicit, see Lavoie and Godley (2001–2).
to provide such a justification” (1994, p. 53). Note, however, that hardly any author in the FML would disagree with this statement. Skott’s proposal of dealing with this issue by defining investment functions in terms of “fragility” \( F \), or the sensibility of investment to negative shocks) and “tranquility” \( T \), or the firms’ ability to pay their financial commitments) does not seem to be too controversial either. At the end of the day, it all depends on how one defines \( F \) and \( T \), and reasonable definitions of these variables would bring Skott’s analysis closer to other formal Minskyan papers.

Turning our attention to consumption, we note that the FML usually follows Minsky in adopting a simplified Kaleckian specification in which consumption equals total wages \( (W) \) plus a fraction \( (1 - sav) \) of “profits.” Indeed, the exceptions in our sample—that is, the models by Lavoie (which neglects consumption altogether) and Skott (which makes consumption equal to a fixed fraction of total income)—are explained by the admittedly pedagogical/exploratory nature of these papers. Two observations are in demand here though, both of which relate to the absence of a clear treatment of the flows of funds among the institutional sectors (see Table 2) in the FML.

First, Kalecki’s simplified specification has to be adapted in models with a government sector. The FML pays little explicit attention, however, to the redistributions of income between the public and private sectors (i.e., taxes \([IT\text{ and } DT]\) and interest on government bills \((rb_{-1} \cdot B_{-1})\) and central bank loans \((ra_{-1} \cdot A_{-1})\)), which do affect “disposable” wages and profits. In fact, the FML completely ignores \( A \) (implicitly assuming banks never need loans from the central bank). Moreover (in our sample), formal Minskyan models with an explicit government sector either heroically assume that all taxes are zero (such as Delli Gatti et al., 1994) or “fix taxes as a proportion of expenditures” (such as Taylor and

---

\(15\) As Lavoie acknowledges, “it’s not an easy task to find a macroeconomic variable . . . [to] represent financial fragility” (1986–87, p. 259). Minsky (1982, chs. 1 and 2) and Niggle (1989), for example, used many of them.

\(16\) Skott (1994, p. 53) formally defines \( T \) as a negative function of \( F \) and a positive function of the rate of profits \( (r) \), whereas \( F \) is assumed (ibid., p. 55) to be a positive function of both \( F_{-1} \) and \( T \). This logically implies that (despite their status of “financial variables”) \( F \) and \( T \) are, in fact, determined solely by real variables in Skott’s model. But Skott (ibid., n. 13) discusses alternative (more conventional) definitions of \( F \), therefore implying that his definitions are merely simplifying assumptions.

\(17\) In their own words, “heroically, we ignore taxes and interest payments on public debt” (Delli Gatti et al., 1994, p. 9). Given that government expenditures are a part of aggregate demand, we interpret it as an assumption that \( T = 0 \), and government deficits are financed exclusively with the emission of high-powered money.
O’Connell, 1985, and Franke and Semmler, 1989) without specifying which taxes and expenditures they are talking about. Delli Gatti et al. and Franke and Semmler also simplify away government bills (therefore making $rb_{-1} \cdot Bh_{-1} = 0$ and avoiding the issue of how private disposable income is increased by government’s interest payments on its debt). Taylor and O’Connell, in turn, adopt the more realistic hypothesis that the government issues both high-powered money and bills, but only at the cost of hurting the logic consistency of their model (see the Appendix).

Second, the FML does not pay enough attention to the role of retained profits ($Fu$) in reducing households’ income. Taylor and O’Connell and Franke and Semmler, for example, avoid the issue assuming (à la neoclassicals) that $Fu = 0$. The models in our sample that recognize the role played by $Fu$ in investment, in turn, say nothing about how the share of $Fu$ in total gross profits ($FT$) is determined (with the exception of Delli Gatti et al., who implicitly assume that $Fu = FT$). Finally, no mention is made of banks’ retained earnings in the FML, which justifies our assumption that they are zero in Table 2.

We finish this section noting that most models in our sample follow Minsky in trying to address the role of “big government” explicitly (the exceptions, again, being the ones by Skott and Lavoie). In particular, given that supply constraints are not explicitly modeled in the FML, the government can always adjust its expenditures in order to achieve whatever level of output it wants. We return to this issue in the “Inflation and Capacity Utilization in the FML” subsection.

How is investment financed? The role of financial markets in the FML

Given Minsky’s crucial hypothesis that “the economy ‘naturally’ moves towards a more fragile financial system” (Lavoie, 1986–87, p. 258), one would expect the FML to pay special attention to the “dual” of firms’ investment decisions—that is, their financing decisions. Yet the FML shows a surprising disregard for these issues. Indeed, most formal Minskyan models treat financial issues with oversimplified hypotheses that do not do justice to the richness of Minskyan analyses (see Table 5) and, more seriously, sometimes ignore the logical implications of these hypotheses.

At this point, it is important to note that anyone interested in explaining the workings of the “financial side” of a “Minskyan economy,” such as the one depicted in the second section, has to theorize about at least three interest rates ($rl$, $rb$, and $rm$) and the value of equities ($Pe \cdot E$). It so happens that the financing decisions of firms both affect, and are affected by,
all of them either directly (as in the case of $r_l$ and $Pe \cdot E$) or through the effect of $r_l$ and $Pe \cdot E$ on the portfolio choices of the sectors. The complexities related to these interconnected issues explain, in our view, the number of omissions or simplifying hypotheses about them in the FML.

Table 5 shows the FML has often ignored “financial issues,” either completely (Lavoie) or partially (Delli Gatti et al. and Skott). In the best case, it has tackled them with very unrealistic simplifying assumptions (as Taylor and O’Connell and Franke and Semmler). Note, however, that when a formal model ignores features of reality explicitly (or

### Table 5

<table>
<thead>
<tr>
<th>Institutional sectors and financial markets in the FML</th>
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<tbody>
<tr>
<td><strong>Taylor and O’Connell (1985)</strong></td>
</tr>
<tr>
<td>There are firms, households, and a government—but no banks—in the economy. Government finances its debt issuing cash and bills. Firms can only finance themselves through equity emissions (for $Fu = 0$). There are explicit (clearing) markets for government bills, money, and stocks. Households divide their total wealth among these three financial assets. Their demand for stocks depends on expected profitability and $rb$, so there is an implicit “liquidity preference” effect.</td>
</tr>
</tbody>
</table>

| **Franke and Semmler (1989)**                         |
| Modifies the Taylor–O’Connell model incorporating banks and simplifying away government bills. There are explicit (and clearing) markets for money deposits, corporate stocks, and bank loans. The whole stock of high-powered money is unrealistically assumed to be kept by banks as reserves (so $Hh = 0$). The rate of growth of $L$ depends solely on $L/(p \cdot K)$ (negatively) and $r + \phi - r_l$ (positively), having nothing to do with the amount of banks’ deposits or reserves. |

| **Lavoie (1986–87)**                                  |
| Financial markets are not discussed. |

| **Delli Gatti et al. (1994)**                          |
| The economy has households, firms, banks, and government. Government debt is financed with high-powered money and taxes are zero. The market for bank loans is explicitly modeled and is always in equilibrium. There is no stock market, so firms finance investment with retained earnings ($F_l = 0$) and bank loans. Firms’ demand for loans is given by $L_{-1} + p \cdot \Delta K - FT + r_l^{-1} \cdot L_{-1}$, while banks’ supply of loans is a positive function of the $r_l$, having nothing to do with the amount of banks’ deposits or reserves. |

| **Skott (appendix) (1994)**                           |
| There are firms, households, and banks in the economy. $F_l > 0$ but only the financial market explicitly modeled is the market for bank loans. The firms’ demand for loans is similar to the one proposed by Delli Gatti et al. (though with $Fu$ replacing $FT$). Interest rate is fixed, and banks supply whatever loans are demanded up to a maximum $L/(p \cdot K)$ ratio. Given that there is no government in Skott’s economy, money must be some sort of bank note or “gold,” but no details are provided. |
implicitly) assumed to be part of the economy it depicts, several “hidden” assumptions are introduced in the analysis. From Delli Gatti et al.’s assumptions, for example, one is led to believe (even though this is not explicitly modeled) that their banks hold a given amount of reserves (i.e., \( Hb > 0 \)), presumably determined both by the government’s stock of debt \( = H \), for \( B = 0 \)) and by households’ demands for cash \( (Hh) \) and bank deposits \( (Mh) \). As Delli Gatti et al.’s formal model ignores these variables, the authors are formally assuming that its conclusions are valid irrespective of what might happen to them. That is where the “hidden” hypotheses enter the picture. When the authors explicitly assume, for example, that banks’ loans supply is a positive (linear) function of the \( rl \) only, they are (implicitly) assuming either that (1) stock–flow, stock–stock, and flow–flow ratios, such as \( Hb/L \), \( (rm_{-1} \cdot Mh_{-1} / rl_{-1} \cdot L_{-1}) \), \( Mh/L \), or \( L/Fu \), can fluctuate widely (and even explode or go to zero) without changing banks’ behavior; or (2) the parameters of their formal model (or the implicit rationality of the agents in their model) are such that these ratios never fluctuate wildly. From our perspective, it does not matter whether these “hidden” assumptions are intended or not: in any case, the profession is better served when they are explicitly discussed.

Note also that models with very unrealistic explicit hypotheses are not necessarily better than “incomplete” ones—only more transparent. As pointed out by Lavoie “[Post Keynesians] require realism at the level of their initial and essential hypotheses” (1992, p. 8). Simply put, a model that assumes that government debt consists only of high-powered money kept by banks (for example, the one proposed by Franke and Semmler, 1989) does not seem to us a good depiction of Minsky’s “Wall Street paradigm.”

This relative weakness of the FML contrasts with the rigorous treatment of financial markets one finds in the SFCL. In the best Keynesian tradition, SFC authors view the demands for the various financial assets (and their supplies) as being determined by: (1) the preexisting stocks of these assets; (2) the current saving of the sectors; and (3) the portfolio decisions of the sectors. Accordingly, an adequate treatment of financial markets presupposes a rigorous derivation of sectoral budget constraints along the lines of Tables 2 and 3. One can only model rigorously, say, households’ demand for equities, government bills, bank deposits, and

---

18 Households are assumed to have Tobinesque demands for financial assets in SFC models. 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
cash if one knows the size of households’ wealth. The same is true for firms’ and banks’ liability management and portfolio decisions. In fact, Minsky’s (1986, p. 322) analysis of monetary policy making in the United States depends crucially on these considerations.

Given the effects of financial market outcomes in the “financial fragility of firms” (through, for example, capital gains and losses and debt repayments), heroic assumptions about them are bound to hurt the consistency/plausibility of Minskyan-type analyses. Thus, by limiting most (explicit) “action” in its models to the investment functions, the financing of which it does not discuss rigorously/realistically, the FML has failed to convincingly formalize Minsky’s “crucial hypothesis” mentioned above. As Lavoie (1986–87, pp. 260–261) and column 2 in Table 3 make clear, investment growth (i.e., bigger values of $\frac{\Delta K}{K}$) does not necessarily imply an increase in financial fragility (say, bigger values of $\frac{\Delta L}{(p \cdot K)}$ or smaller values of $\frac{Mf}{(p \cdot K)}$).

Inflation and capacity utilization in the FML

According to Minsky, the effects of “big government” and lax monetary policy making 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 . . . to abort the debt deflations have clearly been responsible for the stepwise acceleration of the inflation rates . . ., 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” (1982, p. 57). Although Minsky’s view on this issue is debatable, it is 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, a “ceiling” that makes the application of “naive” Keynesian policies unacceptable.

19 Similarly, Delli Gatti et al. point out that “the greater the ratio of equity to debt financing the greater the chance the firm will be a hedge financial unit” (1994, n. 14). 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 FML.
Of course, it is always possible to add a conventional supply constraint to any given model. We note, however, that this alone would not do the job, for inflation affects Minskyan-type stories more deeply than conventional ones. First and foremost, inflation affects the “real” value of financial stocks and flows, and therefore the “real” aggregate budget constraints of the macroeconomic sectors. In other words, the dynamic behavior of the “real” sectoral balance sheets changes considerably when “real” capital gains/losses due to inflation are considered. Inflation is, therefore, 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 formal point of view, it matters 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 variables in the model, potentially changing its dynamic behavior (e.g., turning a linear model into a nonlinear one).

Of the FM authors discussed here, only Lavoie discusses inflation. As he points out, “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” (Lavoie, 1986–87, p. 263), especially if one adds a “feedback relation between the nominal wage rate and the share of profits” (ibid., p. 264). 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 is 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.

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 views on the issue are more sophisticated than that but, as far as we know, have not yet been formalized. Inflation-accounted SFC models such as the ones proposed by Godley (1996) and Zezza and Dos Santos (2004) do provide, in our view, a decent starting point for these discussions.

Final remarks
Chick notes that “from writing . . . [an SFC] paper,” she “learned, gradually, that economics is not about the logical consistency of models” (1992,
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p. 81). We strongly disagree. Like Lavoie and Godley, we 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” (2001–2, p. 131).

It is uncontroversial that logically inconsistent models can behave “incoherently” for reasons quite different from the ones Minsky had in mind. But the case for the adoption of the SFC approach goes beyond that. Contrarily to the intuition of many, a relatively large SFC model is very often more transparent than ones that try to describe the behavior of “economies as a whole” with a few equations. In fact, we argued here that one should never underestimate the need to shed light on the implicit and “hidden” assumptions of these “parsimonious” models. These points are especially important to Post Keynesians, we argue, given their emphasis on explanatory over predictive power (Lavoie, 1992, p. 9).

We finish by stressing the constructive nature of the critiques made here. In particular, we acknowledge the seminal character of the FML and sympathize with its “spirit.” More importantly, the SFCL criticism contains the seeds of its own solution, for, in pointing out the inconsistencies or lacunae in existing models, it directly contributes to their development. Moreover, we hope some will agree that the “artificial Minskyan economy” presented in the third section provides a useful starting point to rigorous and transparent formal Minskyan analyses.

REFERENCES


Appendix

A closer look at the Taylor–O’Connell model

An obvious way to start is to note that there are no banks in the Taylor–O’Connell model, so \( L = Bb = A = Hb = 0. \) The relevant balance sheets are presented in Table A1 (note that \( Mf = 0 \) by assumption and the accounts of the government and the central bank are consolidated). The reader is welcome to derive the implied transactions and flows of funds tables with the help of Tables 2 and 3.

Taylor and O’Connell derive the equilibrium in the goods’ market as if the economy had no government at all. In this case, we have that \( (B = IT = DT = 0) \) and, therefore,

\[
C = W + (1 - \text{sav}) \cdot FT \quad \text{(A1)}
\]

(à la Kalecki, also note that \( Fu = 0 \) by assumption)

\[
\Delta K = [g_0 + h \cdot (r + \phi - rb)] \cdot K \quad \text{(A2)}
\]

(see Table 4).

Besides that, it is assumed that the general price level \( (p) \) is given by

\[
p = (1 + ro) \cdot \text{wage} / \text{prod}, \quad \text{(A3)}
\]

where \( ro \) is the markup, \( \text{wage} \) is the nominal wage rate, and \( \text{prod} \) is the average labor productivity coefficient. If this is the case, then

\[
S = Sk \cdot p = (1 + ro) \cdot \text{wage} \cdot Sk / \text{prod} = (1 + ro) \cdot W
\]

and

\[
FT = S - W = ro \cdot W.
\]

Of course, in equilibrium:

\[
S = FT + W = (1 + ro) \cdot W = C + p \cdot \Delta K,
\]

or equivalently,

\[
S - C = FT + W - C = SAV = p \cdot \Delta K. \quad \text{(A4)}
\]

\(^{20}\) As a consequence, the money supply is exogenously fixed by the government.
Replacing Equations (A1) and (A2) into (A4), one gets

\[
\text{sav} \cdot r \cdot p \cdot K = \left[ g_0 + h \cdot (r + \phi - rb) \right] \cdot p \cdot K,
\]

where \( r = FT/(p \cdot K) \). This enables one to conclude that the equilibrium value of the “investment growth” is given by \( g_{eq} = \Delta K/K = \text{sav} \cdot \left[ g_0 + h \cdot (\phi - rb) \right]/(\text{sav} - h) \).

The problem with this derivation is that it does not hold for an economy with a government. Taylor and O’Connell telegraphically note that “government policy behavior must be specified [to complete the model]” (1985, p. 880). 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 . . . \((B + H)/(p \cdot K)\) is fixed, and government spending disappears as an autonomous component of the capital stock growth rate, \( g \)” (ibid., p. 880).

As noted in the main text, it is not clear what Taylor and O’Connell mean by “taxes” and “expenditures.” If they mean that \( G \) is a fixed proportion of \( p \cdot K \) (i.e., \( G = v \cdot p \cdot K \)) and, following most textbooks, taxes are such that \( IT = 0 \) and \( DT = \tau \cdot S \),21 in equilibrium, we have that

\[
\text{SAV} = \text{SAVh} + \text{SAVg} = p \cdot \Delta K,
\]

where

\[21\] Two alternative interpretations with different qualitative implications are \( G + rb \cdot B = v \cdot p \cdot K \) and \( T = \eta \cdot G \). Others are possible, of course, but we cannot discuss all of them (or their combinations) here.
\[ SAVh = W - FT = rb_{-1} \cdot B_{-1} - C - \tau \cdot S = (1 + ro) \cdot W + rb_{-1} \cdot B_{-1} - C - \tau \cdot S \]

and

\[ SAVg = \tau \cdot S - v \cdot p \cdot K - rb_{-1} \cdot B_{-1} \]

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

\[
\begin{align*}
\left[ sav \cdot (1 - \tau) + \tau \cdot (1 + ro) / ro \right] \cdot r \cdot p \cdot K - (1 - sav) \cdot rb_{-1} \cdot B_{-1} - v \cdot p \cdot K = & \left[ g_0 + h \cdot (r + \phi - rb) \right] p \cdot K,
\end{align*}
\]

so that the equilibrium profit rate \( r \) (and, therefore, investment) will depend on past interest rates, a result not discussed by Taylor and O'Connell.

Things look better if the interest income received by rentiers is all spent. If this is the case, the term \( (1 - sav) \cdot rb_{-1} \cdot B_{-1} \) becomes zero in the previous equation, and we now have

\[
\begin{align*}
\left[ sav \cdot (1 - \tau) + \tau \cdot (1 + ro) / ro \right] \cdot r \cdot p \cdot K - v \cdot p \cdot K = & \left[ g_0 + h \cdot (r + \phi - rb) \right] p \cdot K,
\end{align*}
\]

a result more in line with Taylor and O’Connell.

Note, however, that the “LM” part of the model is also unclear. In particular, the hypotheses above imply that \( B + H = B_{-1} \cdot (1 + rb_{-1}) + H_{-1} - \tau \cdot (1 + ro) \cdot W + v \cdot p \cdot K \), and it is unclear whether or not the ratio of this expression to \( K \) will actually converge to a constant (as assumed by the Taylor and O’Connell). Then again, one possible way out of this problem is to change the fiscal assumptions to, say, \( G + rb_{-1} \cdot B_{-1} = v \cdot p \cdot K \) or \( DT + rb_{-1} \cdot B_{-1} = \tau S \). Note, however, that this procedure introduces “hidden” hypotheses about either direct taxation or government expenditures (i.e., for it implies 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” part, therefore, bringing back (in some form) the effect of the stock of government bills in the investment flows discussed above.

In sum, the specific formalization used by Taylor and O’Connell only holds under a number of “hidden” hypotheses 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 Minsky-type explosive behavior) 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.