Working Paper No. 919

On the Design of Empirical Stock-Flow-Consistent Models

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January 2019

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ISSN 1547-366X

ABSTRACT

While the literature on theoretical macroeconomic models adopting the stock-flow-consistent (SFC) approach is flourishing, few contributions cover the methodology for building a SFC empirical model for a whole country. Most contributions simply try to feed national accounting data into a theoretical model inspired by Wynne Godley and Marc Lavoie (2007), albeit with different degrees of complexity.

In this paper we argue instead that the structure of an empirical SFC model should start from a careful analysis of the specificities of a country's sectoral balance sheets and flow of funds data, given the relevant research question to be addressed. We illustrate our arguments with examples for Greece, Italy, and Ecuador.

We also provide some suggestions on how to consistently use the financial and nonfinancial accounts of institutional sectors, showing the link between SFC accounting structures and national accounting rules.

KEYWORDS: Empirical Stock-Flow-Consistent Models; Ecuador; Greece; Italy

JEL CLASSIFICATIONS: E12; E42; F45

1. INTRODUCTION

The number of contributions to macroeconomics that adopt the stock-flow-consistent (SFC) approach is rapidly growing.[1] Most of the new contributions are theoretical, extending the approach laid out in Wynne Godley and Marc Lavoie (2007), Godley and Francis Cripps (1983), and Claudio Dos Santos and Gennaro Zezza (2008) in different directions. By "theoretical" contributions, we mean models where there is no attempt at fitting model variables to actual data for an economy, and parameter values are not obtained by either econometric estimates or calibration for a specified economic system.

There is also a growing interest in applying the SFC approach to data for a particular country. This was Godley's main work interest beginning in the 1970s, when he was analyzing the economy of the United Kingdom,[2] and continued with models for Denmark (Godley and Zezza 1992), and later for the United States, when he moved to the Levy Economics Institute of Bard College.[3] Part of the reason for the increasing popularity of the SFC approach is due to the effectiveness of the tradition's empirical work in providing timely warnings about coming recessions or financial instability,[4] or in producing more realistic projections compared to mainstream models.[5]

However, a complete description of the methodology adopted by Godley and his associates is missing, apart from some notes in Godley (1999) and G. Zezza (2009). Some empirical SFC models were therefore based on attempts to fit real data to models from Godley and Lavoie (2007). More recently, Burgess et al. (2016) presented a complex SFC model for the United Kingdom that adopts a mixture of econometric estimates and calibration, which—being published as Bank of England working paper—greatly helped spread interest in the SFC approach.

In this contribution, we discuss an alternative view to laying the structure of an empirical SFC model for a whole country, showing that the approaches that start from one of the pedagogical models in Godley and Lavoie (2007) may produce misleading results.

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[1] See Nikiforos and Zezza (2017) for a recent survey.
[2] See Cripps and Godley (1976) and the full list of Godley's publications, as reported in Lavoie and Zezza (2012).
[3] Godley (1999) is considered to be the contribution that brought attention to the SFC approach in recent times, since it made a timely projection of the 2001 recession at a time when commentators were praising the "Great Moderation" and the end of business cycles.
[4] See Bezemer (2010), who identifies Godley and Zezza (2006) and Godley et al. (2007) as timely projections of the 2007 recession.
[5] See Papadimitriou, Nikiforos, and Zezza (2013) for an analysis of the Greek crisis.

The paper contributes to the development of empirical SFC models in two ways. The first, dealt with in section 2, is how—working with real-world data—flows can be connected to stocks in a consistent way. We briefly recall the main principles of the SFC approach, and contrast them with the available data sources for a generic country adopting the standards of the System of National Accounts (SNA) 2008 (European Commission et al. 2009). We next detail how to cope with the problems that emerge, i.e., how to estimate a stock when only flow data are available, how to reconcile contradicting flows (such as estimates of net lending from different sources), and how to compute payments between sectors based on the available data for the stock of assets and liabilities of each sector.

The second contribution pertains to the discussion on how to choose the level of detail and realism of the balance sheets of the various sectors, since in reality every sector holds almost every asset and liability. Thus, in section 3, we propose that the structure of the model needs to be designed after a careful examination of the national and financial accounts of the economy and how they were estimated, with reference to the economic circumstances of the economy, its structural characteristics, the questions that the model wants to answer, and, of course, the data availability. We will show that this process suggests quite different structures, offering examples for Greece, Italy, and Ecuador. Section 4 concludes.

2. MAIN SFC PRINCIPLES AND DATA AVAILABILITY

Referring to Godley and Lavoie (2007) and Nikiforos and Zezza (2017) for more details, the main principles of stock-flow consistency require:

1. Horizontal consistency. Model accounting should record each payment as an outflow for one sector and an inflow for a different sector (payments from a component of one sector to another of the same sector, such as interest paid from one bank to another, should be consolidated), identifying who pays whom.

2. Vertical consistency. Each payment/receipt should be recorded once in the current account of the sector involved, and at least once more as a change in the assets/liabilities of that sector. The first two principles, taken together, imply the quadruple accounting practice

introduced by Copeland (1947, 1949).[6]

3. Flows-to-stocks consistency. Any stock of real and financial assets at current prices, at the end of an accounting period, is given by $S_t = S_{t-1} + F_t + NCG_t$ where F_t is the relevant flow during the accounting period, and NCG_t measures net capital gains due to fluctuation of the market price of the asset.[7] This implies path dependence, and provides an important dynamic component for SFC models.

4. Balance sheet consistency. Financial assets of a sector must match financial liabilities of one or more sectors, possibly matching creditors to debtors. This principle applies both to changes in the balance sheets (flow of funds) and end-of-period stocks.

5. Stock-to-flows feedbacks. Financial liabilities imply future payments from one sector (debtor) to another (creditor). Taking these flows properly into account reinforces the path-dependence characteristic of SFC models. In addition, if a stock is introduced into a model, the implication for behavior must be taken into account: for instance, positive household saving implies the accumulation of real and financial assets, and the value of the stock of such assets must be relevant, in turn, for consumption/saving decisions.

Addressing all of the data problems implied by the five principles would require a very lengthy paper, so we will focus here on balance sheet consistency, which we suggest using as a guide for model design.

The idea is that we want to start from a complete description of the balance sheet of all institutional sectors, for all financial assets for which we have data, and then proceed to reduce the degree of complexity according to the specific features of the economy we are studying. Once the desired level of detail has been obtained, the complexity of the transaction matrix will also be specified. For example, if we are able to identify that only equities issued by domestic nonfinancial corporations are relevant for our economy, we will only need to identify dividends paid by this sector to the owners of the equities,

[6] See European Commission et al. (2009, ch.3) on quadruple accounting in national accounts.
[7] Assets without a market price, such as bank deposits, obviously do not generate capital gains or losses. The accounting identity should also take into account write-downs in assets/liabilities, for instance when a household defaults on a mortgage.

and this helps fulfilling requisites number 5 (stock of equities imply dividend payments) and number 1 (nonfinancial firms pay, and households and possibly nonresidents get the dividends).

Balance sheet data are published—when available—in the "financial accounts of institutional sectors,"[8] a statistic usually compiled by central banks on the basis of data obtained mainly from financial institutions. For any specific country, it is important to check , how the data have been manipulated and, in particular, whether assets and liabilities have been netted out or consolidated for each sector,[9] or whether the statistics refer to the gross (or net) stocks of assets/liabilities.

The benefit of adopting an SFC methodology in empirical model building—compared to flow models—is in laying down the interconnections between balance sheets and flows of payments. When using real-world data, two sets of problems must be addressed:

1. The stock of real and net financial assets for each sector must be connected to the flows of investment and the net lending/borrowing position, respectively; and
2. Financial liabilities for one sector must imply (interest or dividend) payments to the sector holding the corresponding assets.

2.1 From Saving to the Flow of Funds

The first problem can be stated in the following terms: given gross saving, *S*, and gross fixed capital formation, *I*, we have:

$$NL = S - I + NKT \tag{1}$$

where *NL* is net lending, and *NKT* are net capital transfers. Real wealth, *k*, and net financial wealth, *NFA*, should increase according to:

$$k_t = k_{t-1} \cdot (1 - \delta_t) + I_t / pi_t \tag{2}$$

[8] See OECD (2017) on the possible uses of financial accounts, with a note on Godley's work in De Bonis et al. (2017).
[9] See European Commission et al. (2009, ch.11) where it is recommended not to net out all transactions, but rather to consolidate data for some subsectors, such as different government institutions, to provide measures of the consolidated stock of the debt of the general government.

where δ is the depreciation rate, and *pi* the investment deflator, and:

$$NFA_t = NFA_{t-1} + NL_t + NKG_t \quad (3)$$

where *NKG* are net capital gains.

Measures of the stock of capital are not often available and, when they are, they are usually estimated using equation (2).[10] For example, Eurostat estimates the net stock of capital for European economies in the Annual Macroeconomic Database of the European Commission (AMECO), deducting consumption of fixed capital at constant prices from gross fixed capital formation, deflating both with the price deflator for gross fixed capital formation, and cumulating the resulting flow of net fixed capital formation from a benchmark value. This implies an estimate of a varying depreciation rate, as in (2). For countries where figures for depreciation are not available, the stock of capital can be estimated with appropriate assumptions on depreciation rates. In such cases, a separate measure for residential and nonresidential investment should be used, since the depreciation rate for housing is quite different from that of productive capital.

How should the benchmark value for the stock of capital be chosen? The current practice is to start from a "reasonable" value in relation to GDP. For instance, in AMECO, a value of 200 percent for the net capital stock relative to GDP at constant prices has been used for several countries.[11]

Once the stock of capital has been estimated at constant prices, a further estimate is needed to derive its current market value. This is usually relevant only for the stock of housing, which is the largest component of household real wealth. When available, a price index for the market value of existing dwellings is appropriate (see the Case-Shiller home price index for the United States), otherwise the price deflator for gross fixed capital formation can be used as an approximation, which, however, will not capture housing bubbles, such as the ones experienced in the United States, Spain, Greece, and elsewhere between 2002 and 2006.

[10] See European Commission et al. (2009, 416) for a more accurate estimation method based on the perpetual inventory model, when enough data are available.
[11] Bulgaria, Cyprus, Estonia, Croatia, Hungary, Lithuania, Latvia, Malta, Poland, Romania, Slovakia, and Slovenia all start from a ratio of 200 percent of GDP in 1995.

Turning now to net financial assets (*NFA*), the first problem to address is that net lending (*NL*) is published both from the statistical institute producing nonfinancial accounts on the basis of identity (1), and from the flow-of-funds published by the central bank. The latter is measured as:

$$NL = \Delta FASS - \Delta FLIAB \qquad (4)$$

where *FASS* are financial assets and *FLIAB* financial liabilities, and the Δ symbol is used to denote net issues over the accounting period.

If statistical institutes were able to accurately measure all the variables involved, the measure of net lending from (1) should match that constructed from (4). In practice, however, the two measures will differ, generating a statistical discrepancy that can be quite large (we will discuss the case of Greece in section 3.2).

Table 1. United States: 2017, Flow of Funds (billions US$)

	H	NFN	NFC	FIN	FG	SL	ROW	SUM
Net acquisition of financial assets	1,469.3	432.4	1,118.0	2,841.3	198.2	26.0	1,454.7	7,539.9
Gold & special drawing rights (SDR) allocations					0.1			0.1
Currency and deposits	283.4	63.9	254.9	240.7	-171.6	25.2	196.6	893.2
Debt securities	31.7	5.8	42.8	770.4	0.0	-19.5	650.1	1,481.5
Loans	-64.7	3.7	-50.7	1,161.8	99.8	-4.5	100.0	1,245.4
Equity and inv. fund shares	741.3	10.3	190.8	-43.3	0.6	-0.2	447.8	1,347.3
Insurance, pension, etc.	457.9	3.5	13.7	593.5			13.5	1,082.2
Other	19.6	345.1	666.3	118.1	269.3	25.0	46.6	1,490.1
Net incurrence of liabilities	593.9	487.4	1,203.2	2,515.4	647.1	307.0	1,156.3	6,910.3
Gold & SDR allocations							0.1	0.1
Currency and deposits				771.0			256.9	1,027.8
Debt securities	2.2		302.3	359.1	447.0	-3.7	374.6	1,481.5
Loans	574.1	248.3	161.7	50.8		0.4	-10.6	1,024.8
Equity and inv. fund shares	0.0	121.0	-66.8	813.0			480.2	1,347.3
Insurance, pension, etc.	1.8	0.0	46.4	547.4	172.8	266.4	47.4	1,082.2
Other	15.8	118.1	759.6	-25.8	27.3	43.8	7.7	946.6
Net lending	**875.4**	**-55.0**	**-85.3**	**325.9**	**-448.9**	**-281.0**	**298.3**	**629.6**
Gold & SDR allocations					0.1		-0.1	0.0
Currency and deposits	283.4	63.9	254.9	-530.2	-171.6	25.2	-60.2	-134.6
Debt securities	29.6	5.8	-259.5	411.3	-447.0	-15.8	275.5	0.0
Loans	-638.8	-244.7	-212.4	1,111.0	99.8	-5.0	110.6	220.6
Equity and inv. fund shares	741.3	-110.7	257.7	-856.3	0.6	-0.2	-32.4	0.0
Insurance, pension, etc.	456.1	3.5	-32.7	46.1	-172.8	-266.4	-33.9	0.0
Other	3.8	227.0	-93.3	143.9	241.9	-18.8	38.9	543.6
Net lending from capital account	734.9	-55.2	-109.1	-88.4	-515.8	-299.0	476.2	143.5
Discrepancy	-140.6	-0.2	-23.8	-414.3	-66.9	-18.1	177.8	-486.1

Notes: household (H); nonfinancial, noncorporate business (NFN); nonfinancial corporate business (NFC); financial business (FC); federal government (FG); state and local government (SL); rest of the world (ROW)
Source: BEA Integrated Macroeconomic Accounts (IMA)

Let's take the example of the United States, a country that supposedly has enough financial resources to produce good statistics. In table 1, we report the available data for the major sectors for 2017, taken from the Integrated Macroeconomic Accounts (IMA), published jointly by the Bureau of Economic Analysis (BEA)[12] and the Federal Reserve.[13]

[12] At https://www.bea.gov/data/special-topics/integrated-macroeconomic-accounts
[13] At https://www.federalreserve.gov/releases/z1/current/default.htm, in the last part of the "Financial Accounts of the

The top part of the table details the net changes in financial assets for each sector, followed by the net changes in liabilities. The difference is net lending computed from the financial side. At the bottom of the table we have reported the same measure obtained from the capital account of all sectors, i.e., from identity (1). The discrepancy is large for some sectors, notably household and the rest of the world, and it is largest for the financial sector, perhaps reflecting the difficulties in properly measuring the market value of financial instruments at a time of rapid financial innovation.

Note also that accounting consistency requires that, for each type of asset/liability, the sum of the value of assets should match the sum of liabilities. This is the case for debt securities, equities, and insurance instruments, while currency and deposits, as well as loans and the "other" category, show an additional discrepancy. In building a model of the US economy, therefore, the researcher should make a decision on how to "square the matrix."[14]

Last but not least, notice that, while in theoretical SFC models for each type of asset we usually have only one debtor and many creditors (as is the case for bank deposits) or one creditor and many debtors (as for bank loans), in real-world statistics we may have nonzero entries for all sectors in both assets and liabilities for each class of financial assets. In other words, identifying who-owes-to-whom may not be straightforward. In the example of the United States in table 1, for instance, there was a large increase in loans from domestic banks, but also an increase in net foreign loans: identifying who-owes-to-whom will require additional information. Notice also that, while in simple theoretical SFC models equities are issued by nonfinancial corporations to finance part of investment expenditures, in table 1, nonfinancial corporations have been buying more equities than they have sold: the simple theoretical approach would therefore not be appropriate.

As we will discuss in section 3, with reference to some specific countries, we suggest simplifying the model balance sheet according to which asset types are more relevant in the economy under investigation, and by making simplifying assumptions, starting from the data, to impose a who-to-whom correspondence between creditors and debtors.

United States."

[14] Without going into further detail, two possible strategies may be adopted: (a) we can close the accounting identities by adding appropriate variables for discrepancies, which will usually be left as exogenous unexplained variables, or (b) we could allocate the discrepancy to one or more variables. The pros of the former strategy are that model variables will exactly match the data, while the cons are that the number of model variables will quickly increase. The cons of the latter strategy will be that model variables only approximate the data.

The analysis of balance of payments data, as well as government budget data, is often crucial, since these statistics usually have more information for identifying payments among sectors, as well as creditor/debtor matching. Unfortunately, each of these statistics has its own manual for how to evaluate payments/receipts and allocate them to the appropriate accounts, so that the same measure—for example, net lending—may have different values in different statistics.

2.2 From Balance Sheet Entries to Income from Capital

As we stated above, the usefulness of the SFC approach stems also from taking future income payments related to debt positions consistently into account. The problem of matching creditors to debtors also arises in the accounting of income from capital. In table 2, we report the data for the United States in 2017 as an example.

Table 2. United States: 2017, Property Income (billions US$)

	H	NFN	NFC	FIN	FG	SL	SUM	RoW
Property income (received)	4,333	32	591	2,319	135	86	7,497	-257
-Interest	1,524	32	173	1,770	29	69	3,597	192
-Distributed income of corporations	2,809		114	497	101	6	3,527	-201
--Dividends	1,109		114	497	101	6	1,826	-201
-- Withdrawals from income of quasi-corporations	1,700						1,700	
-Reinvested earnings on US foreign direct investment (FDI)			304	52			356	-248
-Rents					6	11	17	
Property income (paid)	577	1,918	1,416	2,562	481	286	7,240	
- Interest	577	262	491	1,692	481	286	3,789	
- Distributed income of corporations		1,657	817	852			3,326	
--Dividends			817	808			1,625	
--Withdrawals from income of quasi-corporations		1,657		44			1,700	
-Reinvested earnings on foreign FDI		0	90	18			108	
-Rents			17				17	

Notes: household (H); nonfinancial, noncorporate business (NFN); nonfinancial corporate business (NFC); financial business (FC); federal government (FG); state and local government (SL); rest of the world (ROW)
Source: BEA Integrated Macroeconomic Accounts (IMA)

To begin with, note that detailed data for the foreign sector are not provided in the IMA, which only report total US income payments and receipts. We have therefore computed the last column in table 1 from the difference between domestic receipts and domestic payments for each category of income from capital.

Assume that in our SFC model we want to have a representation of bank deposits (*DEP*), securities issued by the government (*GS*), and foreign securities (*FS*). All of these are likely to be held by the household sector, but how can we obtain a who-to-whom representation, starting from the data in table 2?

Assuming that we were able to estimate the value of all relevant stocks, we could estimate the interest rate received by household ($INTR^H$) from:

$$INTR_t^H = rd_t \cdot DEP_{t-1}^H + rg_t \cdot GS_{t-1}^H + rf_t \cdot FS_{t-1}^H \quad (5)$$

where the superscript indicates the value of each asset held by the household sector, and *rd*, *rg*, and *rf* are the ex post implicit interest rates on the corresponding assets. In order to compute such implicit interest rates, we should know the value of interest payments received by household on each financial asset—information that is usually not available. A feasible way out when no further statistical information is available requires identifying only one financial asset on which a sector pays interest, so that the ex post interest rate can be computed from the total interest paid, say, by the government ($INTP^G$) on the total stock of debt outstanding (*GS*):

$$rg_t = INTP_t^G / GS_{t-1} \quad (6)$$

Can the same interest rate be applied to computing interest received by households, banks, and other creditors? The ex post implicit interest rate will be a weighted average of the interest rate of securities issued at different times, possibly with different maturities. If each creditor has the same composition of securities in its portfolio, computing a single implicit interest rate should provide a good approximation.

Assume that we have successfully adopted this method to compute all interest payments in (5). Will their sum be equal to the interest received by households, as published in the income account? The answer is obviously negative, and the model should incorporate a residual variable in (5) to take the discrepancy into account.

Another possibility is to rely on current published interest rates rather than implicit ex post interest rates. In this case we would also end up with discrepancies, not only in the accounting identity for interest received, but also in the identity specifying interest paid.

2.3 A Note on Interest Payments in National Accounts

Researchers not familiar with national account conventions may be unaware that the figures published in the national income accounts as "interest received" and "interest paid" do not represent actual interest received and paid when the transaction refers to bank loans and deposits. National accounting practices adopted the view of financial institutions as "financial intermediaries": "One traditional way in which financial services are provided is by means of financial intermediation. This is understood to refer to the process whereby a financial institution such as a bank accepts deposits from units wishing to receive interest on funds for which the unit has no immediate use and lends them to other units whose funds are insufficient to meet their needs" (European Commission et al. 2009, 115). A few lines later, however, it is recognized that this is not how banks operate: "However, it is seldom the case that the amount of funds lent by a financial institution exactly matches the amount deposited with them" (European Commission et al. 2009, 115), since banks can finance loans on the interbank market, from the central bank, or from own funds. In any case, national accounts are now computing a "reference rate" (which can be an average of the interest rate on deposits and that on loans, or the interest rate in the interbank market), and recording interest paid from banks to households for bank deposits by multiplying the reference rate to the stock outstanding, and interest received on loans by multiplying the same interest rate on the stock of loans outstanding. Since the interest rate on bank deposits is usually lower than the reference rate and the interest rate on loans higher, this results in an overestimation of what households receive from banks and an underestimation of what firms pay to banks. The profit that a bank earns from the difference between the actual rates and the reference rate is considered to be the "value added" in bank intermediation, and it is recorded as the financial sector's contribution to GDP.[15]

[15] See Assa (2017).

Let us clear up the point with an example. Assume that:

Stock of deposits =	$2,000	Interest rate on deposits	1 percent
Stock of loans =	$2,100	Interest rate on loans	5 percent
		Reference rate	2 percent

In reality	*In national accounts*
Household receive $20	Household receive $40
Firms pay $105	Firms pay $42
Banks earn $85	Household spend $20 purchasing financial services
	Firms spend $63 purchasing financial services
	Banks earn $85

In theoretical SFC models these problems have not been raised, to the best of our knowledge. In empirical models, if the researcher wishes to match national accounts as close as possible, they should consider modeling the relevant interest rates appropriately.

We hope that this discussion made clear that building an empirical SFC model closely representing the data implies several simplifying assumptions, even when a country is publishing detailed statistics.

Why should an empirical SFC model imply so much pain in matching national accounting data? Since we need to rely on (arbitrary) assumptions at some stage or another, would it not be better to choose a much simpler representation of the economy? The answer depends on how the model is validated. Empirical models are usually validated by their ability to track historical data and possibly by their ability to produce realistic (hopefully accurate!) out-of-sample projections. Once the model has been "closed" by behavioral equations to determine the behavior of each sector, the closer the model's accounting structure reproduces the data, the smaller the distances between model simulations and historical data will be. The answer, however, is not straightforward, since, as we have seen, a more detailed structure usually implies a growing number of exogenous, unexplained variables to track discrepancies. From this point of view, a model with more variables will not be more informative.

3. A TOP-DOWN APPROACH TO EMPIRICAL SFC MODELS

Following its increase in popularity among young researchers and practitioners, the number of empirical SFC models, as well as theoretical ones, is now on the rise.

The usual procedure followed for developing theoretical SFC models is to start from a simple representation of the economy—usually one of the models from Godley and Lavoie (2007), for which the software code is ready available—and add the required degrees of complexity.

If the purpose of model building is to investigate specific features of a country, we believe that a similar procedure (i.e., developing an empirical model from a simple, unified benchmark) may be less fruitful compared to the alternative that we will discuss in this section. To phrase the argument differently: Should the literature try to develop a *representative* empirical SFC model to use as a starting point for empirical work? Mainstream dynamic stochastic general equilibrium (DSGE) models adopt a similar procedure, which is coherent with their approach of discussing a world inhabited by forward-looking individuals maximizing their utility. But would this methodology be useful for post-Keynesian, SFC approaches?

Most of the recent empirical SFC models seem to start from theoretical models and then select country data to fit the theoretical model as close as possible. For instance, in Burgess et al. (2016), which is the most complex empirical SFC model published so far, the authors start from a theoretical structure for the balance sheet of seven sectors (households, nonfinancial companies, the government, banks, insurance companies and pension funds, and the rest of the world) with several types of assets. They identify the most relevant flow payments among such sectors, and impose restrictions on UK data to build the model transaction matrix and balance sheet.[16] Some model parameters are calibrated, while others are estimated.[17] Michelena and Nahuel Guaita (2017) propose a model for Argentina that uses country data for a simplified representation of the economy, where model parameters are calibrated. Makrelov et al. (2018) adopt the SFC methodology for linking flows to financial stocks, while adopting

[16] A peculiar feature of the model in Burgess et al. (2016) is that it omits the accounting treatment of real variables and inflation accounting, which Godley deemed to be relevant, at least for other historical periods (Coutts, Godley, and Gudgin 1985).

[17] In our view, all empirical SFC models that adopt the Tobinesque approach to portfolio management—as it is standard in theoretical SFC models—use calibration to assign a value to the parameters in the equations specifying the demand for assets. This raises some issues on the ability to fit this approach to the data, which, however, cannot be addressed here for space considerations.

DSGE-type assumptions for household and other agents' decisions, again resulting in calibrated parameters, and only a loose connection to the national accounting and balance sheet data for the country they model, South Africa.

In a sense, these contributions all share a bottom-up approach, starting from a simplified description of the economy and proceeding to connect the theoretical structure to the data for a specific country.

On the contrary, we suggest starting from contrasting the *research question* at hand with *data availability*. For instance, if our main interest is tracking the dynamics of public and foreign debt—as in the case of Greece, discussed below—the model may be built with a consolidated private sector without going into the details of how the components of the private sector (listed in tables 1 and 2) make their decisions. In this simple case, data requirements are minimal and are likely to be available from balance-of-payment statistics and government accounts, should the accounts of institutional sectors not be available.

If, on the other hand, we want to explore, say, the consequences of financialization and the growth of the shadow banking sector, we need to have detailed data on the balance sheets of the main nonbanking financial institutions, disaggregating the financial sector in table 1 into its main components—a procedure that requires detailed monetary and financial statistics.

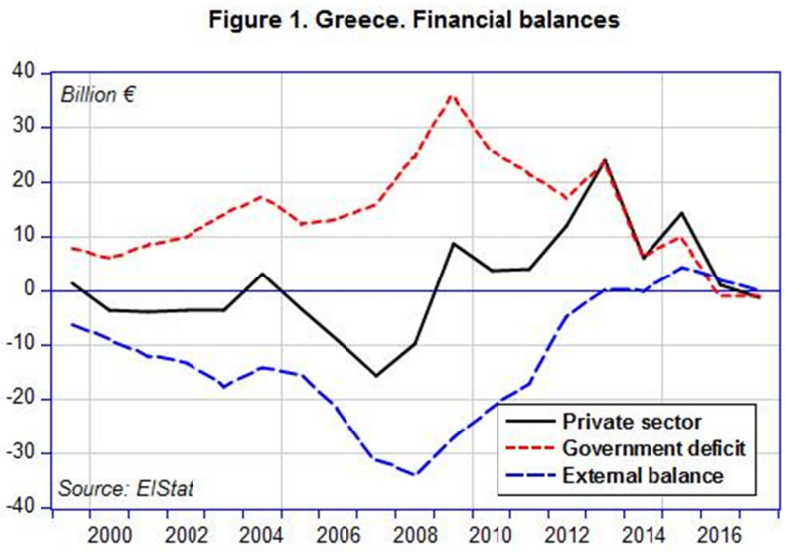
In the following we will discuss our procedure with reference to three cases: Greece, Ecuador, and Italy.

3.1 Greece

Balance sheet data for the institutional sectors of the Greek economy are published by the Bank of Greece (BoG) on a quarterly basis, starting from 1997Q4. A good starting point[18] to set up a model for this country is to look at the financial balances for the institutional sectors, reported in figure 1, on the basis of income and expenditure accounts produced by the Hellenic Statistical Institute (ElStat).

[18] Looking at net financial balances for a three-sector economy is a simple and useful starting point for any country, as it reveals, for instance, the borrowing position of the private (or the public) sector, or an export-led regime. See Nikiforos and Zezza (2017) for a discussion and further references.

Figure 1. Greece: Financial Balances



Financial balances are given by the identity linking the net lending/borrowing position of institutional sectors:[19]

$$NAFAp = GDEF + CA \quad (7)$$

where NAFAp is the net acquisition of financial assets of the private sector, i.e., its net lending position, which must be equal to the sum of government deficit (GDEF) and the current account balance (CA), which measure the net borrowing position of the government and foreign sectors, respectively.

Figure 1 seems to portray a situation of *twin deficits*,[20] with the private sector in a slight borrowing position (against the foreign sector), and the government deficit mirroring the external deficit.

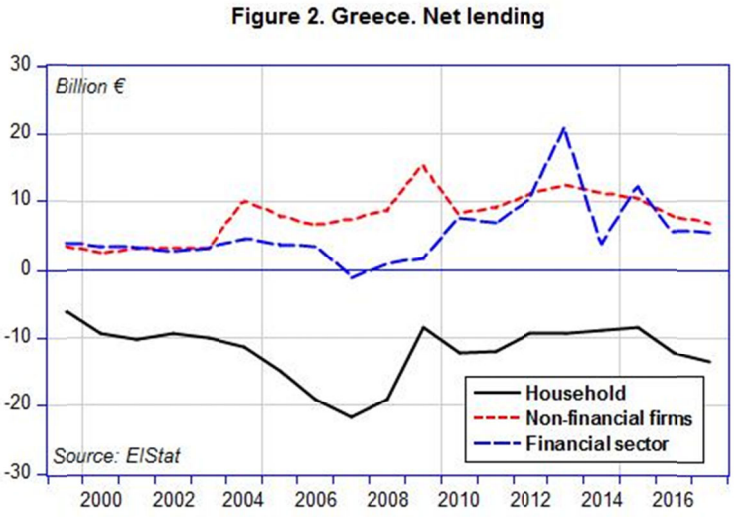
The net lending position of the private sector (NAFAp) can be further split among the net lending position of the household, nonfinancial, and financial sectors, and is reported in figure 2:

[19] See appendix 1 for how to obtain this identity from GDP accounting.
[20] But see Papadimitriou, Nikiforos, and Zezza (2013) for an analysis over a longer time span. On the link between the public and foreign deficit in Greece, see also Nikiforos, Carvalho, and Schoder (2015).

$$NAFAp = NAFAh + NAFAn + NAFAf \quad (8)$$

Figure 2 shows that the Greek institutional sectors are in a peculiar situation: in standard models, the household sector is expected to be in a net lending position, nonfinancial corporations in a net borrowing position, and financial corporations should be close to a neutral position. On the contrary, in the period covered by the chart, Greek households have consistently been in a net borrowing position; for nonfinancial firms, their nondistributed profits consistently exceeded investment, resulting in a net lending position. The puzzle is partly explained by looking at the net lending position published by the BoG on the basis of the flow of funds, which show instead that households were net lenders up to 2009, while nonfinancial corporations were in a net borrowing position. This crucial discrepancy can probably be explained by different ways of allocating small firms to the household or nonfinancial corporation sectors from the two data sources. A possible solution for model building would be to consolidate the two sectors: it turns out that the net lending position of the consolidated private nonfinancial sector has a similar path when computed from ElStat data or BoG data.

Figure 2. Greece: Net Lending



Another important feature to consider when planning a SFC model for a country like Greece, which underwent a major financial and economic crisis, is the evolution over time of the balance sheets of the institutional sectors.

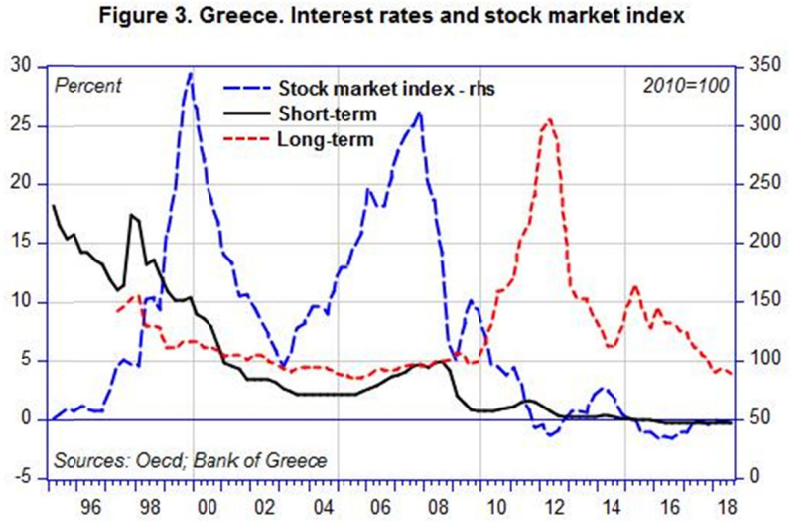
Table 3. Greece: Balance Sheets of the Institutional Sectors (billion euro)

	2000					2009					2017				
	H	NFC	FIN	GOV	ROW	H	NFC	FIN	GOV	ROW	H	NFC	FIN	GOV	ROW
Financial assets	222.2	99.4	259.2	48.9	144.2	296.4	108.7	593.5	106.6	519.8	268.1	66.0	424.3	107.5	457.3
Gold & special drawing rights (SDR) allocations			0.9		0.1			3.5		0.9			3.9		0.9
Currency and deposits	101.3	24.8	69.2	5.3	21.1	211.5	55.6	180.2	11.2	165.0	163.3	33.8	37.8	27.9	99.8
Debt securities	5.6	0.7	65.8	12.4	53.3	17.2	5.8	126.8	29.5	227.2	3.3	0.6	125.2	13.1	30.1
Loans	0.0	0.2	78.5	0.3	35.9	0.0	6.1	234.8	5.3	67.9	0.1	3.7	226.2	19.6	274.3
Equity and inv. fund shares	72.0	67.4	24.5	20.1	24.4	29.2	32.8	27.0	35.9	41.7	71.5	22.6	14.1	27.4	37.0
Insurance, pension, etc.	33.1	0.9	2.1	0.6	0.3	16.9	0.8	5.0	0.5	0.3	18.7	2.6	4.7	0.6	1.7
Other	10.1	5.4	18.3	10.1	9.0	21.6	7.5	16.3	24.2	16.9	11.2	2.8	12.3	18.8	13.5
Financial liabilities	28.4	219.6	268.2	170.7	86.1	140.8	253.4	605.1	355.7	267.3	111.8	248.8	391.0	375.4	192.3
Gold & SDR allocations			0.1	0.0	0.0			0.9	0.0	0.8			0.0	0.9	0.0
Currency and deposits			165.4	0.5	55.7			503.2	1.7	118.7			296.3	9.4	57.1
Debt securities		4.8	0.4	123.8	8.8		27.7	10.1	286.0	82.7		0.7	9.2	65.9	96.4
Loans	17.7	52.4	0.7	40.0	4.1	123.2	126.6	8.2	37.0	19.1	101.3	107.8	29.4	278.9	6.5
Equity and inv. fund shares		150.6	50.4	0.0	7.4		83.9	46.5	0.0	36.0		125.1	26.2	0.0	21.3
Insurance, pension, etc.			36.7	0.0	0.3			21.2	0.1	2.2			19.5	0.1	8.8
Other	10.7	11.7	14.4	6.4	9.7	17.6	15.3	15.0	30.9	7.7	10.6	15.2	10.4	20.3	2.2
Net financial assets	193.8	-120.2	-9.1	-121.8	58.1	155.6	-144.8	-11.5	-249.1	252.5	156.3	-182.8	33.3	-267.9	265.1
Memo: GDP	141.6					237.6					177.2				

Source: Bank of Greece

In table 3, we have reported the end-of-period balance sheet positions of the institutional sectors in 2000 (i.e., before the introduction of the euro, which implied a dramatic fall in the cost of borrowing), in 2009 (the year before the start of the Greek crisis), and 2017 (which is the last available information), a time when the government was close to reaching the targets set by the austerity program agreed to with the "institutions" (the European Stability Mechanism, the European Central Bank, the International Monetary Fund, and the European Commission) who set the rules for refinancing government debt on the condition of adopting a package of "structural reforms."

Figure 3. Greece: Interest Rates and Stock Market Index



The data for 2000 show that the household sector had a relatively standard balance sheet, with a low level of debt and financial assets distributed among money, equities, and insurance and pension claims. Specific features were a large share of wealth held in liquid form (currency and deposits amount to 45 percent of financial assets, against a value of 10 percent in the United States in the same year) and a very low share of debt securities, against a value of total government securities at 87 percent of GDP. The BoG provides information on who-owes-to-whom, so that we can verify that government debt securities at the time were held by domestic and foreign banks, with a share of 35 and 40 percent, respectively. Less than 10 percent of household deposits were a liability of foreign banks, so that in 2000 we can say that government debt was evenly split between foreign creditors and Greek households, which were holding it through the "intermediation" of banks. More precisely, banks could earn a risk-free profit by buying government securities, funding such purchases with deposits, and pocketing the difference between the interest rate on government debt and that on bank deposits.

Nonfinancial corporations had a relatively low level of debt in loans as compared to banks (24 percent of total liabilities, only a small portion of which were with foreign banks) and an even lower level of debt in short- or long-term securities.

When Greece adopted the euro, banks could refinance at the same (declining) interest rate at which all other Eurozone banks could borrow. In figure 3, we report the dynamics of the short- and long-term interest rates (along with an index of prices on the stock market), which show that the short-term interest rate was still at 10 percent at the end of 1999, and had declined to 3 percent in 2002. This decline contributed to a period of debt-led growth in domestic demand, which implied an increase in household debt with banks—from 12 percent of GDP in 2000 to 52 percent in 2009—and of nonfinancial firms' loans from 37 percent of GDP to 53 percent in the same interval.

But the most striking change between 2000 and 2009 is the increase in foreign debt: the net asset position of Greece was a negative 41 percent of GDP in 2000, and had risen to 106 percent of GDP in 2009. Only 39 percent of foreign gross debt was made up of government (long-term) securities, while another 32 percent was in very liquid assets (currency and deposits), including the liability position of the BoG against, supposedly, the system of Eurozone central banks (the Target2 position).

Comparison of balance sheet positions between 2000 and 2009 confirms the picture of a debt-led growth period, ultimately financed by foreign creditors, with private debt—and not only public debt—having a relevant role.[21] It should also be considered that part of the large increase in government debt after the 2008 and 2010 crises was due to government intervention to help the domestic financial system: banks received 5 billion euro in 2012 and 18 billion euro (10 percent of GDP!) in 2013 as transfers from the government on capital account.

The analysis for Greece has shown that, at least as a first approximation, building an SFC model that consolidates the private sector and focuses on a three-sector economy (private, government, and rest of the world) may be sufficient for explaining the evolution of the country's economy before and during the crisis.[22]

[21] See Papadimitriou, Nikiforos, and Zezza (2013) and other reports in the Levy Institute's "Strategic Analysis" series for further details on the evolution of the Greek economy.
[22] See Papadimitriou, Nikiforos, and Zezza (2013) for some details on the Levy Institute's three-sectors model for Greece.

3.2 Ecuador

Let's now turn to the economy of Ecuador, a country using the US dollar as its currency and relying on oil exports to finance most of its imports. The balance sheet position of its institutional sectors is reported in table 4.[23]

A first striking divergence between the balance sheet in table 4 and the standard models in Godley and Lavoie (2007), and indeed compared to the situation of most countries, is that the government has a positive net financial position instead of being in debt. This is mainly due to the participation of the government in the capital of domestic business, and therefore requires the modeler to choose an unconventional approach to the supply and demand of shares from domestic business, as well as to the portfolio management of the government.

[23] Data from the Central Bank of Ecuador's Integrated Economic Accounts (Cuentas económicas integradas)

Table 4. Ecuador: Financial Assets and Liabilities at the End of 2012 (millions of US$)

	Households & nonprofit institutions serving households	Nonfinancial business	Financial business	Government	Total economy	Rest of the world	Total
Financial assets	**45,124**	**76,594**	**60,266**	**58,168**	**240,152**	**34,570**	**274,723**
Gold & special drawing rights (SDR)	0	0	1,427	0	1,427	0	1,427
Currency and deposits	18,180	9,357	11,423	3,279	42,239	767	43,005
Securities other than shares	396	3,617	9,839	7,655	21,507	994	22,501
Loans	5,958	15,626	26,564	6,488	54,635	17,007	71,642
Shares	13,026	6,276	4,731	19,854	43,887	5,647	49,534
Insurance, pension funds	7,156	0	0	0	7,156	0	7,156
Other	409	41,718	6,283	20,892	69,302	10,156	79,458
Financial liabilities	**36,251**	**113,996**	**55,696**	**43,540**	**249,483**	**25,239**	**274,723**
Gold & SDR	0	0	0	0	0	1,427	1,427
Currency and deposits	0	0	35,760	0	35,760	7,245	43,005
Securities other than shares	5	5,938	3,478	9,606	19,026	3,475	22,501
Loans	22,088	31,843	2,588	11,865	68,384	3,258	71,642
Shares	0	38,211	8,496	0	46,707	2,826	49,534
Insurance, pension funds	48	1,859	873	4,376	7,156	0	7,156
Other	14,111	36,144	4,501	17,693	72,449	7,009	79,458
Net financial assets	**8,873**	**-37,401**	**4,570**	**14,628**	**-9,331**	**9,331**	**0**
Gold & SDR	0	0	1,427	0	1,427	-1,427	0
Currency and deposits	18,180	9,357	-24,337	3,279	6,478	-6,478	0
Securities other than shares	390	-2,321	6,361	-1,950	2,481	-2,481	0
Loans	-16,130	-16,217	23,976	-5,377	-13,749	13,749	0
Shares	13,026	-31,935	-3,765	19,854	-2,821	2,821	0
Insurance, pension funds	7,108	-1,859	-873	-4,376	0	0	0
Other	-13,702	5,574	1,782	3,199	-3,147	3,147	0

Source: Central Bank of Ecuador's Integrated Economic Accounts

The main purpose of the model was to project the demand and supply of liquidity for the country, relative to changes in the international price of oil and to changes in the exchange rate of Ecuador's competitors against the US dollar. We therefore chose to simplify the accounting structure, consolidating the balance sheets of the private sector to form a three-sector model (private sector, the government, and the rest of the world).

Since the country is using a foreign currency, the US dollar, it is also essential to work out the channels for modeling the supply and demand of liquidity. This cannot be achieved with the aggregate data in table 4, where cash and bank deposits are collapsed into the same category. We therefore used additional statistics: the stock of cash in circulation was obtained from monetary

statistics[24] and the amount of central bank reserves was taken from a specific publication of Central Bank of Ecuador (BCE).

The disaggregation of foreign loans between loans to the government and loans to the private sector was based on BCE statistics on external debt. Finally, any residual assets were assigned to the "other net financial assets" category, which therefore include government bonds.

The hypothesis adopted allowed us to obtain a simplified balance sheet, reported in table 5.

Table 5. Ecuador: Financial Assets and Liabilities at the End of 2012 (millions US$)

	Private sector	Government	Rest of the world	Total
International reserves	2,482.5		-2,482.5	0
Cash	6,326.7		-6,326.7	0
Foreign loans	-5,159.7	-10,871.8	16,031.6	0
Equities	-24,184.2	16,451.8	7,732.4	0
Other net assets	11,997.5	-6,709.4	-5,288.1	0
Net financial assets	**-8,537.2**	**-1,129.4**	**9,666.6**	**0**

Notice that in the final model balance sheet there are some substantial discrepancies compared to the data in the previous table. Notably, the government now has a negative net financial position. This is due to: (a) the adoption of the balance of payments statistics for measuring external debt, where figures are different from that of table 4, and (b) the decision to measure the value of the stock of equities at historical prices[25] rather than at current prices, for lack of statistical information. The final model balance sheet has lost detail with respect to the available dataset, but allows us to identify the creditor-debtor relation for each financial asset (other than the residual "other net assets" category), which is important for closing the model with behavioral assumptions for each sector.

3.3 Italy[26]

We finally discuss the case of Italy. Italy is the third-largest manufacturing country in Europe, but it also has the second-highest public-debt-to-GDP ratio. It has experienced relatively low growth rates in the last three decades, and it is the only large country in Europe that has not been able to restore its real per capita GDP to the pre-2008 level. This applies to Greece as well, but the Italian public

[24] From table 1.1 of the Boletino Monetario Semanal: "Especies Monetarias en Circulación."
[25] The stock at historical prices is estimated by cumulating the quarterly flows, starting from a benchmark value for the stock. This procedure implies that fluctuations in the market price of existing equities are neglected.
[26] This section draws on F. Zezza (2018).

debt is of a different order with respect to Greek debt, and a *credit event*[27] on the Italian debt would be much more difficult to handle.

Italy belongs to the Eurozone, like Greece, and therefore, since the adoption of the euro, the Bank of Italy (BoI) has become part of the European System of Central Banks (ESCB), while the European Central Bank (ECB) is the (foreign) institution running monetary policy, i.e., setting the (common) interest rate for refinancing and managing the exchange rate of the euro. The quality of Greek pubic debt deteriorated early, so that after the ECB had purchased the (small) amount of Greek Treasuries it was allowed to hold, the country was denied admission to the quantitative easing (QE) program.

Italy, on the contrary, had—and still has—access to QE, so that an empirical model that wishes to explore the consequences of QE (and the perspective termination of that program) on the Italian financial and economic system should explicitly incorporate the central bank. This is not an easy task: theoretical SFC models usually explicitly include a central bank, but this is a domestic institution with domestic targets. The only contribution to the literature, to the best of our knowledge, is Mazier and Valdecantos (2014), which however does not use real-world data for its variables.[28]

The ECB and the ESCB represent a more complex set of institutions, which also require different accounting procedures for producing monetary statistics.[29]

Real assets have a central role in the total wealth of Italian households. The stocks of nonfinancial assets can easily be reconstructed at annual frequency using the stocks of nonfinancial assets for each institutional sector, available from 2000 to 2015 with a sufficient breakdown (homes, other buildings, productive capital, consumer durables), and stocks and flows (gross capital formation and depreciation) measured at constant 2010 prices and substitution prices, available from 1995 to 2016, with the same breakdown.

[27] A credit event is any change in the contract underlying a public bond. Should Italy exit the Eurozone and redenominate its debt in a new national currency, this would imply a *credit event*.
[28] See also Mazier and Valdecantos (2015).
[29] For the statistical treatment of central banks in monetary unions, see European Commission et al. (2009, 85) and International Monetary Fund (2009, Appendix 3). "Typically, the Currency Union Central Bank (CUCB) maintains national offices in each member economy. This institutional unit, called 'the national agency,' acts as the central bank for that economy and must be treated for statistical purposes as an institutional unit that is separate from the headquarters of the CUCB" (International Monetary Fund, 2009, 260).

Statistics on the market price of productive capital are not available, so the investment deflator may be used. For housing, the Italian Statistical Institute (ISTAT) publishes an index of existing home prices, but only from 2010; if one wants to investigate the role of the housing market during the 2008 crisis, further information is needed.[30]

ISTAT data on the components of the stock of real wealth are not published with reference to the institutional sectors, but with a breakdown by type of assets (residential, machinery, etc.), so that some assumptions are needed to allocate each component of real wealth to one of the institutional sectors in the model.

Turning our attention to the financial side, the balance sheets of the Italian institutional sectors are reported in table 6, with the same level of aggregation for assets adopted above, but with a breakdown of the financial sector.[31]

The detailed asset decomposition available in the balance sheets allows one to model the main financial relations and to (partly) reconstruct who-to-whom transactions. For most assets/liabilities, the BoI publishes the details about the issuer,[32] while information on the holders can be reconstructed by exploiting the asset side of each sector. This is relatively easy for loans or public debt, for which who-owes-whom information is published.

But, for modeling central bank operations, if one wishes to detail the different channels of operation of monetary policy, the information provided by financial accounts in table 6 is insufficient. The main liability of the central bank is in the category "sight deposits with monetary financial institutions (MFIs)," at €769 billion at the end of 2017. In order to split this measure of "base money" into that held by household, banks' reserve balances, etc., one needs to use additional information:[33] for the end of 2017, the BoI's liabilities can be split into banknotes in circulation (€188 billion), bank reserves (€142 billion), and the Target2 balance with the ECB (€439 billion), reaching a reasonable who-to-whom representation.

[30] The model in F. Zezza (2018) uses the historical series for the price of homes published in Cannari, D'Alessio, and Vecchi (2016).
[31] See https://www.bancaditalia.it/statistiche/tematiche/conti-patrimoniali/conti-finanza/index.html. "In the Italian financial accounts 'Other Financial Institutions' can be split between 'Common Funds,' and 'Other non-Common Funds'; and separate balance sheets are available for 'Insurance companies' and 'Pension funds.' Finally, the general government can be split into 'Central government,' 'Local government,' and the Italian social security system (INPS)."
[32] Monetary financial institutions (MFI), the public sector (GVT), other residents (i.e., nonmonetary financial corporations, OR), or the foreign sector (RoW).
[33] See https://www.bancaditalia.it/pubblicazioni/moneta-banche/

Table 6. Italy: 2017, Balance Sheets of the Institutional Sectors (billion euro)

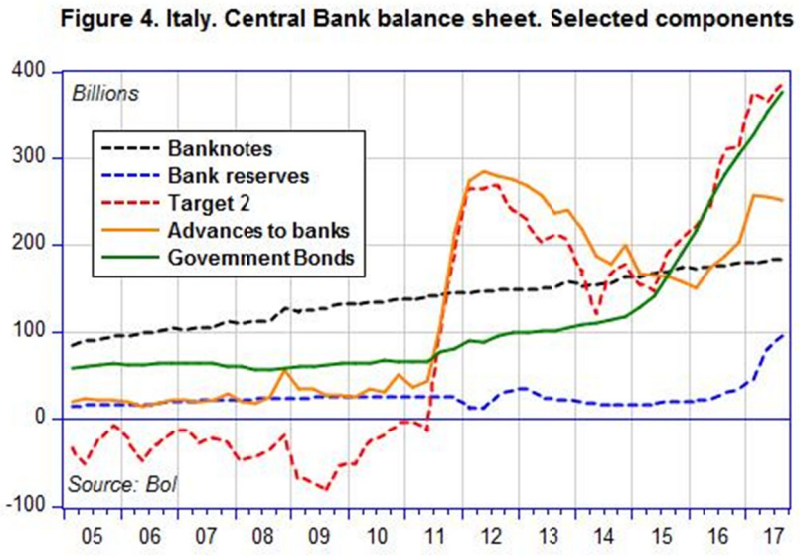
	H	NFC	Financial Corporations					GOV	RoW	Total
			CB	Banks	OFI	Fin Aux	IP			
Financial assets	**4,406.7**	**1,816.2**	**934.9**	**3,734.8**	**1,003.9**	**293.6**	**934.5**	**548.6**	**2,750.8**	**16,424.1**
Gold, monetary reserves			92						8	99
Currency and deposits	1,360.8	349.3	308.1	754.5	196.2	135.6	26.6	81.8	737.4	3,950.3
Debt securities	304.9	65.6	523.2	765.4	218.5	68.5	571.3	39.4	1,028.1	3,584.8
Loans	14.6	70.6	2.0	1,852.9	236.7	0.0	10.5	148.1	239.1	2,574.5
Equity and inv. fund shares	1,062.4	687.6	10.0	180.8	118.2	7.1	116.7	142.4	533.5	2,858.6
Insurance, pension, etc.	1,533.2	28.9		22.7	228.6	81.5	205.1	5.4	15.5	2,121.0
Other	130.7	614.3		158.5	5.7	0.9	4.3	131.5	189.4	1,235.3
Financial liabilities	**927.7**	**3,886.0**	**813.8**	**3,583.8**	**766.8**	**91.5**	**989.0**	**2,716.2**	**2,649.2**	**16,424.1**
Gold, monetary reserves			7.8						91.6	99.5
Currency and deposits		45.1	791.0	2,623.2				240.9	250.2	3,950.3
Debt securities		165.8		506.3	193.6		16.3	2,135.0	567.9	3,584.8
Loans	709.4	1,081.1	0.2	60.9	211.8	78.9	11.4	226.1	194.8	2,574.5
Equity and inv. fund shares		1,904.1	7.5	224.4	35.0	9.1	114.6		564.0	2,858.6
Insurance, pension, etc.	37.7	93.8	7.3	10.5	323.7		842.6	8.0	797.7	2,121.0
Other	180.7	596.2		158.5	2.8	3.4	4.2	106.3	183.1	1,235.2
Net Wealth	***+3,479.0***	***-2,069.8***	***+121.2***	***+150.9***	***+237.1***	***+202.2***	***-54.4***	***-2,167.7***	***+101.6***	***0.0***

Source: Bank of Italy

Notes: H=households; NFC=nonfinancial corporations; CB=central bank; OFI=other financial intermediaries; Fin Aux=financial auxiliaries; IP=insurance companies and pension funds; GOV=general government; RoW=rest of the world

In figure 4, we plot the BoI's assets and liabilities (solid and dotted lines, respectively): from the chart, the effect of QE stands out, with a growing debt position of the BoI against the ECB, matched by an equivalent increase in government bonds held by the BoI on the asset side. We will return later to a discussion of how to model QE operations.

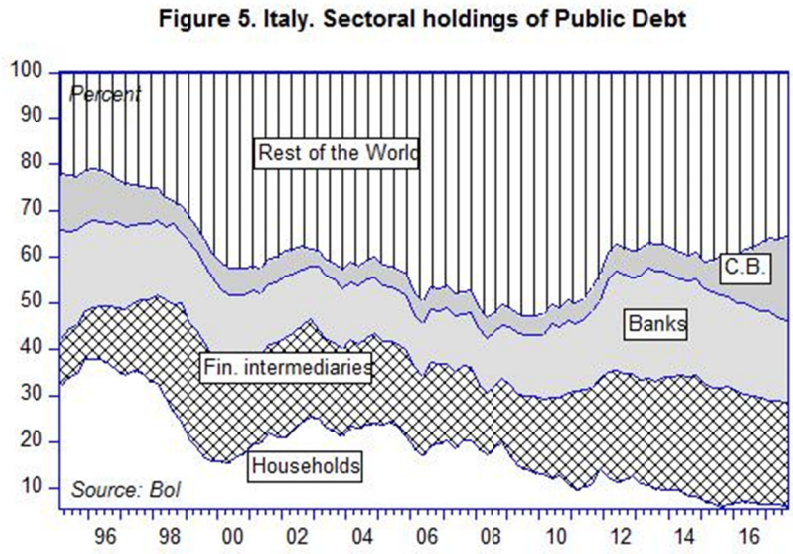
Figure 4. Italy: Central Bank Balance Sheet, Selected Components



Another key feature of the Italian economy that should drive model design is related to public debt. In figure 5, we report the share of public debt held by households, banks, the central bank, other financial institutions (labeled as "financial intermediaries"), and the foreign sector. The reason for this disaggregation is twofold: first of all, inspection of figure 5, together with the balance sheets in table 6, reveals that Italian households have decreased their direct holding of government debt securities over time, while their holdings of financial liabilities issued by nonbank financial institutions have been rising. At the same time, what we label as "financial intermediaries" have increased their holdings of government bonds, so that if we consolidate these two sectors we can greatly simplify the model structure. In practice, households have been purchasing pension funds, etc., with the so-called "shadow banking" sector using the liquidity to purchase government securities, acting as de facto intermediaries between households and the government.[34]

[34] This assumption is indeed supported by empirical studies by ISTAT and the BoI, which discuss the recent increasing role of nonbank financial intermediaries in household wealth management. See Gola et al. (2017).

Figure 5. Italy: Sectoral Holdings of Public Debt



The other reason for this disaggregation is that it will help modeling the behavior of each sector: banks' holding of government securities is related to portfolio management, but it is also driven by the need for collateral for central bank refinancing operations. The central bank is willing to hold government securities for reasons connected to monetary policy: indeed, the last part of QE mainly involved purchases of public securities on the secondary market (Public Sector Purchase Program, or PSPP).

Finally, demand for Italian government securities from foreign institutions is also crucial for modeling the recent dynamic of the Italian economy. Looking at figure 5, which shows a large increase up to the crisis and a fall when the Greek crisis (or the "sovereign debt crisis") starts in 2010, one also wonders whether this demand has been driven only by relative (risk-adjusted) rates of return. But addressing this point goes beyond our intentions here.

Coming briefly now to the part of the model design related to the behavior of financial institutions. In normal times, for countries outside a currency union, it is reasonable to assume that the demand for monetary base, coming from households and banks (and foreign institutions for reserve currencies), is accommodated by the central bank. In the Eurozone, domestic central banks are part of the ESCB and act on behalf of the ECB, so that in the BoI's balance sheet we find both credits

and debts against the ESCB. One possibility, which is appropriate for countries like Italy with a negative Target2 balance, is to model the net position vis-à-vis Target2 on the liability side, as in equation (9):

$$MB = MB_{HH} + MB_{FC} + MB_{T2} \quad (9)$$

The change in the monetary base is in turn related to changes on the asset side. In such cases, the first component would be determined by the demand for liquidity coming from households, the reserve requirement needed by banks, and that part of external imbalances that are not covered by changes in other net assets vis-à-vis the rest of the world. Indeed, this is in line with the theoretical discussions of the central bank monetary policy made in Godley and Lavoie (2007, ch. 10) and Lavoie (2014, ch. 4). Moreover, this is explicitly stated by the ECB itself when claiming that, during the precrisis period, "base money developments in the euro area were therefore largely a reflection of changes in currency in circulation and required central bank reserves" (ECB 2017, 62).

However, the Great Recession of 2008 brought central banks to adopt "unconventional" policies. In response to the crisis, the ECB supplied central bank reserves well above the demand for liquidity stemming from the banking sector, through the Long-Term Refinancing Operations (LTRO), which induced a sizeable increase in base money (and excess reserves). This mechanism was further enhanced when the PSPP was launched. In fact, when purchasing assets, the ECB supplies reserves. "Since banks are typically the only entities, apart from central government, that hold deposit accounts with the central bank, purchases are always settled through them, regardless of who the ultimate seller is. Thus, purchases conducted under the Assets Purchase Program (APP) resulted in a mechanic, direct increase in base money" (ECB 2017, 64). Therefore, in the presence of unconventional monetary policy, the amount of reserves in the system is determined by the decisions of the central bank instead of being demand driven (through the net demand for credit), as endogenous money theory would imply.

There is nothing that the banks can do to reduce the amount of reserves. The only thing they can change is excess reserves, which diminish when their demand for compulsory reserves increase because of increases in deposits. The total monetary base is then fully determined by central banks' decisions to purchase assets (open market operations, Targeted Long-Term Refinancing Operations

[TLTROs], etc., as in exogenous money).

The rate of interest on reserves is then exogenous and set by the central bank, even when the demand for high-powered money (i.e., compulsory reserves plus banknotes) is not equal to the supply. This is so because, with QE, the central bank must operate under the *floor system*, so as to keep control over interest rates: i.e., the target rate and that on reserves must be equal (Lavoie 2010). Accordingly, if the central bank wants to keep control over the bill rate, then the central bank has to buy the residual amount of bills in the system at its chosen interest rate, i.e., the rate on reserves or a markup on the base rate. The rate of interest on bonds, or its price, should therefore be endogenous, and affected by the central bank's decisions on QE operations.

Thus, the monetary base on the asset side of banks' balance sheets (MB_{FC}) should be split into two components, as in equation (10): the reserve requirement (MB_CR_{FC}), which varies with the reserve ratio to deposits ($coef^{res}$), and the share of sight deposits in total deposits ($coef^{sdeps}$), as in equation (11), and the residual liquidity (MB_O_{FC}). Residual liquidity may be driven, on the one hand, by the demand for excess liquidity connected to financial instability, but on the other it has been the outcome of unconventional monetary policy (namely, QE). As the ECB buys government bonds and other financial assets from banks in exchange for liquidity, the banking sector as a whole cannot but accumulate such liquidity if it doesn't use it for issuing new loans. The excess stock of the monetary base in banks' portfolio should therefore be determined as a residual:

$$MB_{FC} = MB\_CR_{FC} + MB\_O_{FC} \tag{10}$$

where

$$MB\_CR_{FC} = coef^{res} * coef^{sdeps} * DEPS \tag{11}$$

We will not go into further detail about a potential model of the Italian economy,[35] as in this paper we just wanted to show how the preliminary analysis of balance sheets, given a specific research question and conditioned on the availability of the data, will lead to quite different model structures.

[35] The interested reader may refer to F. Zezza (2018) for full details.

3. CONCLUSIONS

The SFC approach is quickly growing in popularity among heterodox researchers and practitioners. While the literature developing theoretical models (i.e., models that do not use time series for specific countries) is expanding rapidly, contributions to the methodologies adopted for developing models tailored to specific-country data of is still missing, albeit with some notable exceptions.

If we want this promising line of research to gain traction with researchers, a question immediately comes to mind: Should we aim at creating a simple, *benchmark* model, akin to the simple three-equations model of the New Consensus? A simple benchmark model would provide the benefit that new researchers entering the field could use it as a starting point to develop extensions in the directions they are interested, and indeed Godley and Lavoie (2007) has provided a number of such benchmark models that have paved the way for a growing number of contributions.

In this paper we have argued that a single benchmark model, applicable to any country and any period, may not be a good starting point and indeed may lead the researcher toward a misinterpretation of the specific institutional features of the country under study.

On the contrary, in this paper we tried to provide two contributions. We have laid down—in section 2—some elements of a methodology for using the financial and nonfinancial accounts for a given country, as well as suggestions for estimating crucial stock and flow variables, should institutional accounts not be available. This methodology is strongly based on a (critical) application of the accounting principles in European Commission et al. (2009), followed worldwide by statistical agencies and central banks, and which therefore ensures that an SFC model will track official statistics as closely as possible.

We have discussed—through examples for Greece, Ecuador, and Italy—how SFC model design can be guided by a preliminary analysis of the balance sheets of institutional sectors, both at a recent point in time and on how the major assets and liabilities evolved over the period the researcher is interested in. As Wynne Godley used to say, SFC modeling is not a search for a "true" model of the economy: the aim is to build "tools for thinking," which will differ according to the question to be explored.

The drawback of our proposal is that it makes serious empirical SFC modeling a very complex and demanding task, requiring solid knowledge not just of economics, but also of national accounting principles and econometrics. The construction of such models may require too much time for a young researcher, who is more and more pressed to "publish or perish" in the academic world.[36]

To counter this critique, we would first of all point out that the process of building an SFC model for a country usually leads the researcher to several findings that can be exploited in different academic articles. Finally, we would suggest the "SFC community" moves in the direction of building a "collection of empirical benchmark models" for which equations and software code are made available, rather than a one-model-fits-all, as the mainstream followers of the rational optimizing agent have chosen.

[36] We are grateful to Yannis Dafermos for raising this point in a private conversation.

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APPENDIX: FROM GDP ACCOUNTING TO NET LENDING

Using data from national accounting conventions, in order to obtain the relation among net lending of institutional sectors in (7), we can start from the well-known GDP identity:

$$GDP = WAG + GOS + NIT = CONS + GCF + G + EXP - IMP \qquad (A.1)$$

We can rearrange the terms in (A.1) by sector, using a superscript when needed to identify, for instance, the recipients of gross operating surplus (GOS) or the sector spending on gross capital formation (GCF):

Households (h)	:	$WAG + GOS^h - CONS - GCF^h +$
Nonfinancial firms (n)	:	$GOS^n - GCF^n +$
Financial sector (f)	:	$GOS^f - GCF^f +$
Government (g)	:	$GOS^g + NIT - G - GCF^g$
Rest of the world (w)	:	$IMP - EXP =$
Total		0

We can now add property income paid from sector *a* to sector *b* (Z^{ab}), where (Z^{a*}) denotes all property income paid by sector *a*, and (Z^{*b}) all income received by sector *b*:

Households (h)	:	$WAG + GOS^h + Z^{*h} - Z^{h*} - CONS - GCF^h +$
Nonfinancial firms (n)	:	$GOS^n + Z^{*n} - Z^{n*} - GCF^n +$
Financial sector (f)	:	$GOS^f + Z^{*f} - Z^{f*} - GCF^f +$
Government (g)	:	$GOS^g + NIT + Z^{*g} - Z^{g*} - G - GCF^g +$
Rest of the world (w)	:	$IMP - EXP + Z^{*w} - Z^{w*} =$
Total		0

We next need to add current transfers (T^{ab}), which include tax payments, social contributions, and benefits, etc.:

Households (h)	:	$WAG + GOS^h + Z^{*h} - Z^{h*} + T^{*h} - T^{h*} - CONS - GCF^h +$
Nonfinancial firms (n)	:	$GOS^n + Z^{*n} - Z^{n*} + T^{*n} - T^{n*} - GCF^n +$
Financial sector (f)	:	$GOS^f + Z^{*f} - Z^{f*} + T^{*f} - T^{f*} - GCF^f +$
Government (g)	:	$GOS^g + NIT + Z^{*g} - Z^{g*} + T^{*g} - T^{g*} - G - GCF^g +$
Rest of the world (w)	:	$IMP - EXP + Z^{*w} - Z^{w*} + T^{*w} - T^{w*} =$
Total		0

We have now taken into account all sources and uses of funds for each sector, so that we can obtain saving (*S*) for each sector from the difference between current sources of funds and current uses:

Households (h)	:	S^h - GCF^h +
Nonfinancial firms (n)	:	S^n – GCF^n +
Financial sector (f)	:	S^f – GCF^f +
Government (g)	:	S^g – GCF^g +
Rest of the world (w)	:	S^w { = - CAB} =
Total		0

Net lending for each sector can now be obtained by adding capital transfers received and subtracting capital transfers paid (K^{ab}):

Households (h)	:	{ NL^h =} S^h - GCF^h + K^{*h} – K^{h*} +
Nonfinancial firms (n)	:	{ NL^n =} S^n – GCF^n + K^{*n} – K^{n*} +
Financial sector (f)	:	{ NL^f =} S^f – GCF^f + K^{*f} – K^{f*} +
Government (g)	:	{ NL^g =} S^g – GCF^g + K^{*g} – K^{g*} +
Rest of the world (w)	:	{ NL^w =} S^w + K^{*w} – K^{w*} =
Total		0

So that:

$$\{NL^h + NL^n + NL^f\} + NL^g + NL^w = 0 \qquad \text{(A.2)}$$

where the sum of the first three terms in curly brackets measures the net lending of the private sector as a whole.