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On the design of empirical stock–flow consistent models

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While the literature on theoretical macroeconomic models adopting the stock–flow consistent (SFC) approach is flourishing, few contributions cover the methodology for building an SFC empirical model for a whole country. Most contributions simply try to feed national accounting data into a theoretical model inspired by Godley/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, compared to the relevant research question to be addressed. We illustrate our arguments with examples for Greece and Italy. We also provide some suggestions on how to consistently use the financial and non-financial accounts of institutional sectors, showing the link between SFC accounting structures and national accounting rules.

Keywords: *empirical stock–flow, consistent models, Greece, Italy*

JEL codes: *E12, E42, F45*

1 INTRODUCTION

The number of contributions to macroeconomics which adopt the stock–flow consistent (SFC) approach is rapidly growing.[1] Most of the new contributions are theoretical, extending the approach laid out in Godley/Cripps (1983), Godley/Lavoie (2007) and Dos Santos/Zezza (2008) in different directions. By *theoretical* contributions we mean models where there is no attempt at fitting model variables to the actual data of an economy, and where 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 the main interest in Godley's work since the 1970s, when he was analysing the economy of the United Kingdom,[2] and continued with models for Denmark (Godley/Zezza 1992) and later for the United States, when he moved to the Levy Institute

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1. See Nikiforos/Zezza (2017) for a recent survey.
2. See Cripps/Godley (1976) and the full list of Godley's publications in Lavoie/Zezza (2012).

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The Lypiatts, 15 Lansdown Road, Cheltenham, Glos GL50 2JA, UK
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of Economics.[3] Part of the reason for the increasing popularity of the SFC approach is due to the effectiveness of the empirical work in this tradition in providing timely warnings about coming recessions and financial instability,[4] or in producing more realistic projections, relative to those of mainstream models.[5]

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

In this contribution we discuss an alternative view to lay out the structure of an empirical SFC model for a whole country, showing that the approaches which start from one of the pedagogical models in G&L may lead to misleading results.

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 2008* (SNA2008 from now on).[6] We next detail how to cope with the problems that emerge, that is, 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 and Italy.

Section 4 concludes.

2 MAIN SFC PRINCIPLES AND DATA AVAILABILITY

Referring to G&L and Nikiforos/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.

3. Godley (1999) is considered to be the contribution which brought attention to the SFC approach in recent times, since it accurately predicted 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/Zezza (2006) and Godley et al. (2007) as timely warnings of the 2007 recession.
5. See Papadimitriou et al. (2013a) for an analysis of the Greek crisis.
6. See European Commission et al. (2009).

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).[7]
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 fluctuations in the market price of the asset.[8] 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 behaviour 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 these 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 non-financial corporations are relevant for our economy, we will only need to identify dividends paid by this sector to the owners of the equities, and this helps with the fulfilment of requirement No 5 (stocks of equities imply dividend payments) and No 1 (non-financial firms pay dividends; household, and possibly non-residents, get the dividends).

Balance-sheet data are published – when available – in the 'Financial accounts of institutional sectors',[9] a statistic usually compiled by central banks on the basis of data obtained mainly from financial institutions. It is important to check, for any specific country, how the data have been manipulated, and in particular whether assets and liabilities have been netted out, or consolidated, for each sector,[10] or whether statistics refer to the gross (or net) stocks of assets/liabilities.

7. See European Commission et al. (2009: ch.3) on quadruple accounting in national accounts.
8. 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.
9. See OECD (2017) on the possible uses of financial accounts, with a note on Godley's work in De Bonis et al. (2017).
10. See European Commission et al. (2009: ch. 11) where it is recommended not to net out all transactions, but on the other hand, 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.

The benefit of adopting an SFC methodology in empirical model building – against 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.
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 net capital transfers. Real wealth k and net financial wealth NFA should increase according to

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

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

$$NFA_t = NFA_{t-1} + NL_t + NKG_t, \tag{3}$$

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).[11] For example, Eurostat estimates the net stock of capital for European economies in the AMECO database 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 non-residential 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 practice is to start from a 'reasonable' value in relation to GDP. For instance, in AMECO a value of 200 per cent for the net capital stock relative to GDP at constant prices has been used for several countries.[12,13]

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 US), otherwise the price deflator for gross fixed capital formation

11. See European Commission et al. (2009: 416) for a more accurate estimation method based on the perpetual inventory model, when enough data are available.
12. Bulgaria, Croatia, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia all start from a ratio of 200 per cent of GDP in 1995.
13. Note that the choice of a benchmark value for the stock of capital will have consequences on the properties of the model. See Franke (2017) for a discussion which, however, focuses on productive (non-residential) capital.

can be used as an approximation, which however will not capture housing bubbles such as the ones experienced in the US, Spain, Greece and elsewhere between 2002 and 2006.

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 non-financial accounts, on the base of identity (1), and from the flow of funds published by the central bank. The latter is measured as

$$NL = \Delta FASS - \Delta FLIAB, \tag{4}$$

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 measure accurately all the involved variables, 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 below).

Let's take the example of the United States, a country which supposedly has enough financial capability 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[14] and the Federal Reserve.[15]

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, that is, 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 take a decision on how to *square* the matrix.[16]

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 non-zero 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 US 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 non-financial corporations to finance part of investment expenditures, in Table 1 non-financial corporations have been buying more equities than they have

14. At https://www.bea.gov/data/special-topics/integrated-macroeconomic-accounts.

15. At https://www.federalreserve.gov/releases/z1/current/default.htm, in the last part of the 'Financial accounts of the United States'.

16. Without going into further details, two possible strategies may be adopted: (i) we could close the accounting identities by adding appropriate variables for discrepancies, which will usually be left as exogenous unexplained variables, or (ii) we could allocate the discrepancy to one or more variables. The pros of the former strategy is 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 are that variables of the model will only approximate the data.

Table 1 United States: 2017 flow of funds (billions US$)

	H	NFN	NFC	FIN	FG	SL	RoW	SUM
Net acquisition of financial assets	*1469.3*	*432.4*	*1118.0*	*2841.3*	*198.2*	*26.0*	*1454.7*	*7539.9*
Gold & 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	1481.5
Loans	−64.7	3.7	−50.7	1161.8	99.8	−4.5	100.0	1245.4
Equity and inv. fund shares	741.3	10.3	190.8	−43.3	0.6	−0.2	447.8	1347.3
Insurance, pension, etc.	457.9	3.5	13.7	593.5	–	–	13.5	1082.2
Other	19.6	345.1	666.3	118.1	269.3	25.0	46.6	1490.1
Net incurrence of liabilities	*593.9*	*487.4*	*1203.2*	*2515.4*	*647.1*	*307.0*	*1156.3*	*6910.3*
Gold & SDR allocations	–	–	–	–	–	–	0.1	0.1
Currency and deposits	–	–	–	771.0	–	–	256.9	1027.8
Debt securities	2.2	–	302.3	359.1	447.0	−3.7	374.6	1481.5
Loans	574.1	248.3	161.7	50.8	–	0.4	−10.6	1024.8
Equity and inv. fund shares	0.0	121.0	−66.8	813.0	–	–	480.2	1347.3
Insurance, pension, etc.	1.8	0.0	46.4	547.4	172.8	266.4	47.4	1082.2
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	1111.0	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); non-financial non-corporate business (NFN); non-financial corporate business (NFC); financial business (FC); federal government (FG); state and local government (SL); rest of the world (RoW). The 'net lending' row is emboldened to emphasise the difference between 'net acquisition of financial assets' and 'net incurrence of liabilities' above, and should be compared to 'net lending from capital account' below.
Source: BEA Integrated Macroeconomic Accounts.

sold: the simple theoretical approach suggesting that equities are issued to finance investment would therefore not be appropriate, and a more sophisticated model is needed.[17]

As we will discuss in Section 3 with reference to some specific countries, we suggest simplifying the balance sheet of a model according to which assets 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.

The analysis of balance-of-payments data, as well as government budget data, is often crucial, since these statistics have usually 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 instance, 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 also stems from consistently taking into account future income payments related to debt positions. The problem of matching creditors to debtors arises also in the accounting of income from capital. In Table 2 we report, as an example, the data for the United States in 2017.

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 payments received by households ($INTR^H$) from

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

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 households on each financial asset: a piece of information which is usually not available. A feasible way out, when no further statistical information is available, requires the identification of only one financial asset on which a sector pays interest, so that the *ex post* interest rate can be computed from the interest paid, say, by the government on the stock of debt outstanding:

$$rg_t = INTP_t^G / GS_{t-1}. \tag{6}$$

Can the same interest rate be applied to compute interest payments received by households, banks and other creditors? The *ex post* implicit interest rate will be a weighted average of the interest rate on securities issued at different times, possibly with different maturities. If each creditor sector 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

17. See Dallery/van Treeck (2011), for an example.

Table 2 United States: 2017 property income (billions US$)

	H	NFN	NFC	FIN	FG	SL	SUM	RoW
Property income (received)	*4333*	*32*	*591*	*2319*	*135*	*86*	*7497*	*–257*
Interest	1524	32	173	1770	29	69	3597	192
Distributed income of corp.	2809	–	114	497	101	6	3527	–201
Dividends	1109	–	114	497	101	6	1826	–201
Withdrawals from income of quasi-corporations	1700	–	–	–	–	–	1700	–
Reinvested earnings on US FDI	–	–	304	52	–	–	356	–248
Rents	–	–	–	–	6	11	17	–
Property income (paid)	*577*	*1918*	*1416*	*2562*	*481*	*286*	*7240*	–
Interest	577	262	491	1692	481	286	3789	–
Distributed income of corp.	–	1657	817	852	–	–	3326	–
Dividends	–	–	817	808	–	–	1625	–
Withdrawals from income of quasi-corporations	–	1657	–	44	–	–	1700	–
Reinvested earnings on foreign FDI	–	0	90	18	–	–	108	–
Rents	–	–	17	–	–	–	17	–

Notes: Household (H); non-financial non-corporate business (NFN); non-financial corporate business (NFC); financial business (FC); federal government (FG); state and local government (SL); rest of the world (RoW).
Source: BEA Integrated Macroeconomic Accounts.

in the income account? The answer is obviously negative, and the model should incorporate in (5) a residual variable to take account of the discrepancy.

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 (ibid.)

since banks can finance loans on the interbank market, from the central bank, or from their 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 record interest paid from banks to households for bank deposits by multiplying the reference rate by the stock outstanding, and interest received on loans 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 will result 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 contribution of the financial sector to GDP.[18]

Let us illustrate the point with an example. Assume that:

Stock of deposits	\$2000	Interest rate on deposits	1%
Stock of loans	\$2100	Interest rate on loans	5%
		Reference rate	2%
In reality		*In national accounts*	
Households receive	\$20	Households receive	\$4
Firms pay	\$105	Firms pay	\$42
Banks earn	\$85	Households spend \$20 in purchases of financial services	
		Firms spend \$63 in purchases of financial services	
		Banks earn \$85	

18. See Assa (2017).

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 closely as possible, she should consider modelling the relevant interest rates appropriately.

We hope that this discussion makes 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 behavioural equations to determine the behaviour of each sector, the closer the model accounting structure reproduces the data, the smaller will be the distances between model simulations and historical data. The answer, however, is not straightforward, since a more detailed structure, as we have seen, 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 the 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 G&L for which the software code is readily available, and add the required degrees of complexity.

If the purpose of model building is to investigate the specific features of a country, we believe that a similar procedure, that is, developing an empirical model from a simple, unified benchmark, may be less fruitful, against the alternative that we discuss in this section. Mainstream dynamic stochastic general equilibrium (DSGE) models start from a benchmark model, 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, stock–flow consistent approaches? 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?

Some of the recent empirical SFC models seem to start from theoretical models, and then select country data to fit the theoretical model as closely as possible. With reference to recent contributions, for example, Michelena/Guaita (2017) propose a model for Argentina which 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 DSGE-type assumptions for households' and other agents' decisions, again resulting in calibrated parameters, and only a loose connection to the national accounting and balance-sheets data for the country they model, South Africa.

Burgess et al. (2016), which is the most complex empirical SFC model published so far, starts from a theoretical structure for the balance sheet of seven sectors (households, non-financial 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.[19] Some model parameters are calibrated, while others are estimated.[20] As will become clearer in the following, the approach to flow modelling in Burgess et al. (2016) is similar to ours, while their approach to modelling balance sheets differs.

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.

By contrast, we suggest starting by differentiating the *research question* at hand from the *data availability*. For instance, if our main interest is to track the dynamics of public and foreign debt – as in the case of Greece discussed below – the model may be built with an aggregated 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 the government account, should the accounts of institutional sectors be unavailable.

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 of the balance sheet of the main non-banking financial institutions, disaggregating the financial sector in Table 1 into its main components: a procedure which requires detailed monetary and financial statistics.

In the following we will discuss our procedure with reference to Greece and Italy.

3.1 Greece

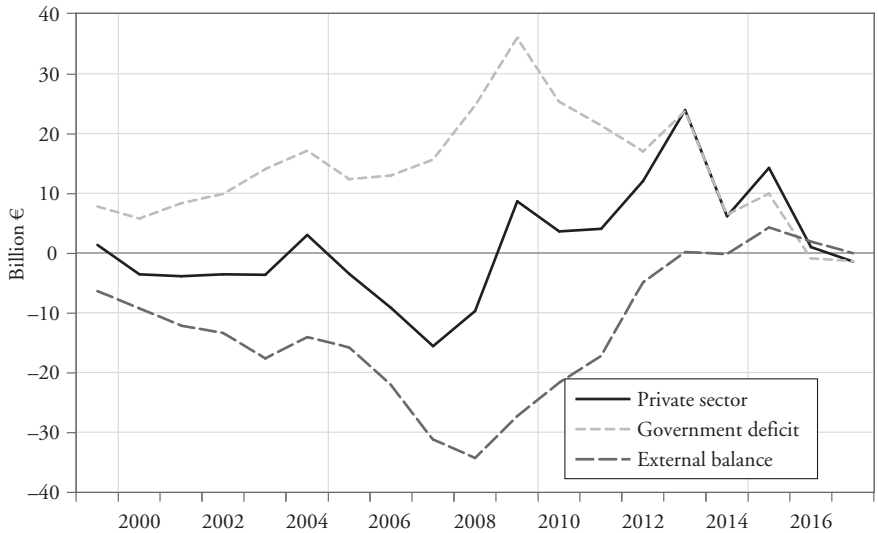
Balance-sheet data for the institutional sectors of the Greek economy are published by the Bank of Greece (BoG) on a quarterly basis, starting from 1997Q4. A good starting point[21] to set up a model for this country is to look at the financial balances for the institutional sectors, reported in Figure 1, on the basis of income and expenditure accounts produced by the Hellenic Statistical Institute (ElStat).

Financial balances are given by the identity linking the net lending/borrowing position of institutional sectors:[22]

$$NAFAp = GDEF + CA, \tag{7}$$

where *NAFAp* is the net acquisition of financial assets of the private sector, that is, 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.

19. 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. See Coutts et al. (1985).
20. In our view, all empirical SFC models, such as Burgess et al. (2016), which adopt the Tobinesque approach to portfolio management – as 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 reasons.
21. 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/Zezza (2017) for a discussion and further references.
22. See Appendix 1 for how to obtain this identity from GDP accounting.



Source: ElStat.

Figure 1 Greece: financial balances

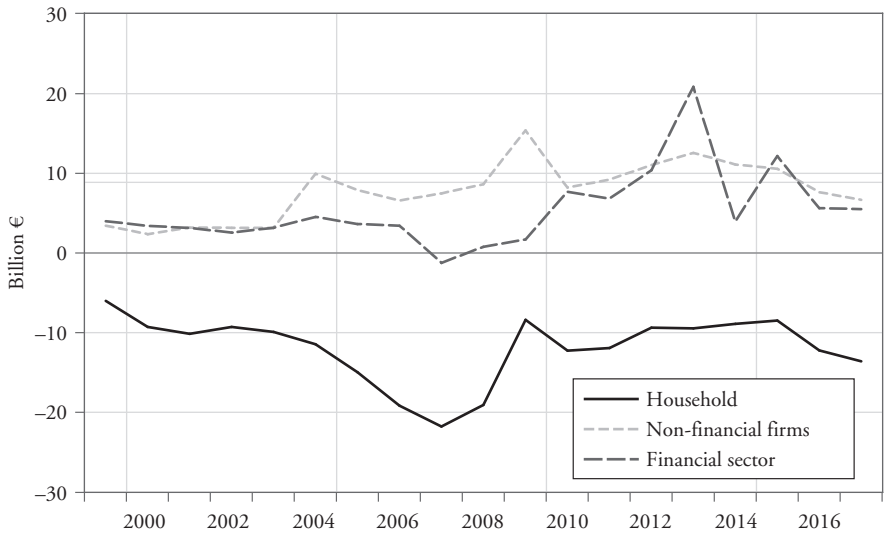
Figure 1 seems to portray a situation of *twin deficits*,[23] with the private sector in a small borrowing position (against the foreign sector), and the government deficit mirroring the external deficit.

The net lending position of the private sector (*NAFAp*) can be further split among the net lending positions of the household, non-financial and financial sectors, which are reported in Figure 2.

$$NAFAp = NAFAh + NAFAn + NAFAf \tag{8}$$

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; non-financial corporations in a net borrowing position; and financial corporations should be close to a neutral position. By contrast, during the period covered by the chart Greek households have consistently been in a net borrowing position, while for non-financial firms non-distributed profits consistently exceeded investment, resulting in a net lending position. The puzzle is partly explained by looking at the net lending positions published by the Bank of Greece on the basis of the flow of funds, which show that households have been net lenders up to 2009, while non-financial corporations were in a net borrowing position. Flow-of-fund data from the Bank of Greece (not reported here for space reasons) thus completely reverse the balances reported in Figure 2, with negative balances becoming positive and vice versa. This crucial discrepancy can probably be explained by different ways of allocating small firms to the household or the non-financial corporation sectors from the two data sources. A possible solution for model building would be to aggregate the two sectors: it turns out that the net lending position of the aggregated private non-financial sector follows a similar path when computed from ElStat data or from BoG data.

23. But see Papadimitriou et al. (2013b) for an analysis over a longer time span. On the link between the public and the foreign deficit in Greece, see also Nikiforos et al. (2015).



Source: ElStat.

Figure 2 Greece: net lending

Other important features to consider when planning an 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.

In Table 3 we report the end-of-period balance-sheet positions of institutional sectors in 2000, that is, before the introduction of the euro, which implies a dramatic fall in the cost of borrowing; in 2009, the year before the start of the Greek crisis; and in 2017, which is the last available information, at a time when the government was close to reaching the targets set by the austerity program agreed 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 conditions of adopting a package of *structural reforms*.

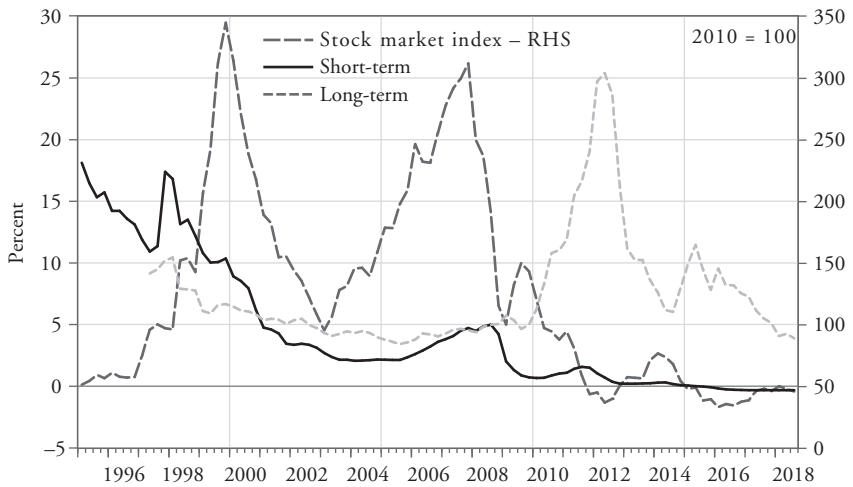
The data for 2000 show that the household sector had a relatively standard balance sheet, with a low level of debt, and financial assets distributed among money, equities, and insurance and pension claims. Specific features were a large share of wealth held in liquid form (currency and deposits amount to 45 per cent of financial assets, against a value of 10 per cent in the US in the same year) and a very low share of debt securities, against a value of total government securities at 87 per cent of GDP. The Bank of Greece provides information on who-owes-to-whom, so we can verify that government debt securities at the time were held by domestic and foreign banks, with a share of 35 and 40 per cent respectively. Less than 10 per cent 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, pocketing the difference between the interest rate on government debt and that on bank deposits.

Non-financial corporations had a relatively low level of debt, with loans taken from banks representing 24 per cent of total liabilities (only a small portion of which was with foreign banks) and an even lower level of debt in short- or long-term securities.

Table 3 Greece: balance sheets of the institutional sectors (billions €)

	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 and 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 and 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.



Sources: OECD; Bank of Greece.

Figure 3 Greece: interest rates and stock market index

When Greece adopted the euro, banks could refinance at the same (declining) interest rate at which all other eurozone (EZ) 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 per cent at the end of 1999, and had declined to 3 per cent 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 per cent of GDP in 2000 to 52 per cent in 2009, and an increase in loans taken by non-financial firms from 37 per cent of GDP to 53 per cent in the same interval.

But the most striking change between 2000 and 2009 is the increase in foreign debt: the net asset position of the country was a negative 41 per cent of GDP in 2000, and had risen to 106 per cent of GDP in 2009. Only 39 per cent of foreign gross debt was made up of government (long-term) securities, while another 32 per cent was in very liquid assets ('currency and deposits'), including the liability position of the Bank of Greece 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.[24] 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 in 2012, and €18 billion (10 per cent of GDP!) in 2013 as transfers from the government on capital account.

The analysis for this country has shown that, at least as a first approximation, building an SFC model for Greece aggregating the private sector and focusing on a three-sector economy (private, government, rest of the world) may be sufficient to explain the evolution of the country before and during the crisis.[25]

24. See Papadimitriou et al. (2013a) and other reports in the Levy Institute Strategic Analysis series for further details on the evolution of the Greek economy.
25. See Papadimitriou et al. (2013b) for some details on the Levy Institute three-sector model for Greece.

3.2 Italy[26]

We finally discuss the case of Italy. Italy is the third manufacturing country in Europe, but it also has the second-highest public-debt-to-GDP ratio. It has experienced relatively low growth rates since the 1990s, and it is the only large country in Europe which has not yet been able to restore its real per-capita GDP to the pre-2008 level. This applies to Greece as well, but the Italian public debt is of a different order relative 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 from now on) has become part of the European System of Central Banks (ESCB), while the European Central Bank (ECB) is the (foreign) institution running monetary policy, that is, setting the (common) interest rate for refinancing, and managing the exchange rate of the euro. The quality of Greek public 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, by contrast, had – and still has – access to QE, so that an empirical model which wishes to explore the consequences of QE (and the prospective 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/Valdecantos (2014), who however do not use real-world data for their 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 non-financial assets can easily be reconstructed at annual frequency using the stocks of non-financial 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 replacement costs, available from 1995 to 2016, with the same breakdown.

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, so 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.

26. This section draws on Zezza (2018).
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/Valdecantos (2015).
29. For the statistical treatment of central banks in monetary unions, see SNA2008 (European Commission et al. 2009: 85) and BPM6 (International Monetary Fund 2009: appx 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).
30. The model in Zezza (2018) uses the historical series for the price of homes published in Cannari et al. (2016).

Turning our attention to the financial side, the balance sheets of the Italian institutional sectors are reported in Table 4, 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 us to model the main financial relations and, partly, to 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 information about who owes to whom is published.

To model central-bank operations, however, if one wishes to detail the different channels of operation of monetary policy, the information provided by financial accounts in Table 4 is insufficient. The main liability of the central bank is in the category 'Sight deposits with MFIs', at €769 billion at the end of 2017. In order to split this measure of *base money* into that held by households, banks' reserve balances, etc., one needs to use additional information:[33] for the end of 2017, BoI 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.

In Figure 4 we plot BoI assets and liabilities (solid and dashed 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.

Another key feature of the Italian economy which 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 (labelled 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 4, reveals that Italian households have decreased their direct holdings of government debt securities over time, while their holdings of financial liabilities issued by non-bank 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 fund assets, 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]

The other reason for this disaggregation is that it will help with modelling the behaviour of each sector: bank holdings of government securities are related to portfolio management, but they are 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 involved mainly purchases of public securities on the secondary market (public sector purchase program, or PSPP).

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 (MFIs), the public sector (GVT), other residents (that is, non-monetary financial corporations, OR) or the foreign sector (RoW).

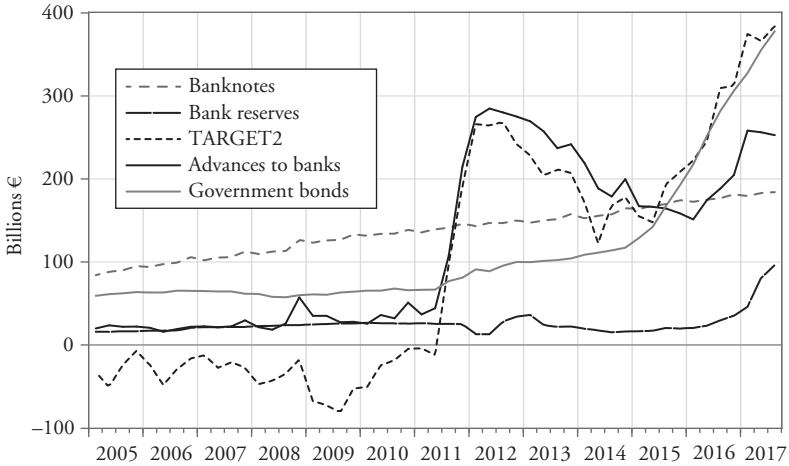
33. See https://www.bancaditalia.it/pubblicazioni/moneta-banche/.

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

Table 4 Italy: 2017 balance sheets of the institutional sectors (billions €)

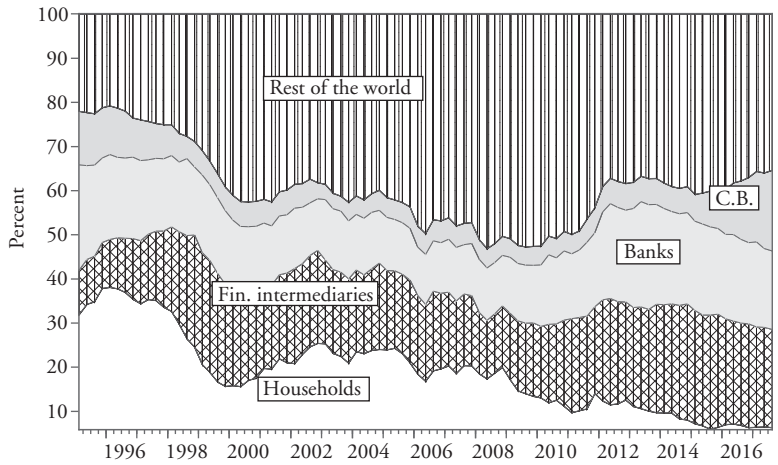
	H	NFC	Financial corporations					GOV	RoW	Totals
			CB	Banks	OFI	Fin. aux.	Ins. & pens.			
Financial assets	*4406.7*	*1816.2*	*934.9*	*3734.8*	*1003.9*	*293.6*	*934.5*	*548.6*	*2750.8*	*16424.1*
Gold, monetary reserves	–	–	92	–	–	–	–	–	8	99
Currency and deposits	1360.8	349.3	308.1	754.5	196.2	135.6	26.6	81.8	737.4	3950.3
Debt securities	304.9	65.6	523.2	765.4	218.5	68.5	571.3	39.4	1028.1	3584.8
Loans	14.6	70.6	2.0	1852.9	236.7	0.0	10.5	148.1	239.1	2574.5
Equity and inv. fund shares	1062.4	687.6	10.0	180.8	118.2	7.1	116.7	142.4	533.5	2858.6
Insurance, pension etc.	1533.2	28.9		22.7	228.6	81.5	205.1	5.4	15.5	2121.0
Other	130.7	614.3		158.5	5.7	0.9	4.3	131.5	189.4	1235.3
Financial liabilities	*927.7*	*3886.0*	*813.8*	*3583.8*	*766.8*	*91.5*	*989.0*	*2716.2*	*2649.2*	*16424.1*
Gold, monetary reserves	–	–	7.8	–	–	–	–	–	91.6	99.5
Currency and deposits	–	45.1	791.0	2623.2	–	–	–	240.9	250.2	3950.3
Debt securities	–	165.8	–	506.3	193.6	–	16.3	2135.0	567.9	3584.8
Loans	709.4	1081.1	0.2	60.9	211.8	78.9	11.4	226.1	194.8	2574.5
Equity and inv. fund shares	–	1904.1	7.5	224.4	35.0	9.1	114.6	–	564.0	2858.6
Insurance, pension etc.	37.7	93.8	7.3	10.5	323.7	–	842.6	8.0	797.7	2121.0
Other	180.7	596.2	–	158.5	2.8	3.4	4.2	106.3	183.1	1235.2
Net wealth	*+3479.0*	*−2069.8*	*+121.2*	*+150.9*	*+237.1*	*+202.2*	*−54.4*	*−2167.7*	*+101.6*	*0.0*

Source: Bank of Italy.



Source: BoI.

Figure 4 Italy: central bank balance sheet, selected components



Source: BoI.

Figure 5 Italy: sectoral holdings of public debt

Finally, the demand for Italian government securities from foreign institutions is also crucial for modelling the recent dynamics 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 now briefly to the part of model design related to the behaviour of financial institutions, in normal times, for countries outside a currency union, it is reasonable to

assume that the demand for a monetary base, coming from households and banks (as well as 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 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):

$$MB = MB_{HH} + MB_{FC} + MB_{T2}. \tag{9}$$

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 the external imbalances which is 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 about central-bank monetary policy made in G&L (2007: ch. 10) and Lavoie (2014: ch. 4). Moreover, this is explicitly stated by the ECB itself when claiming that, during the pre-crisis 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 induced central banks to adopt *non-conventional* 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 (LTROs), which induced a sizeable increase in base money (and excess reserves). This mechanism was further enhanced when the public sector purchase program (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 APP [asset purchase programme] resulted in a mechanic, direct increase in base money' (ibid.: 64). Therefore, in the presence of non-conventional 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 increases because of increases in deposits. The total monetary base is then fully determined by central banks' decisions to purchase assets (open-market operations, LTROs, etc., as in exogenous money).

The rate of interest on reserves in then exogenous and set by the central bank, even when the demand for high-powered money (that is, 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: that is, 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, that is, the rate on reserves or a rate which results from a mark-up on the base rate. The rate of interest on bonds, or its price, should therefore be endogenous, and affected by central-bank decisions tied to QE operations.

Thus, the monetary base on the asset side of the balance sheet of banks (MB_{FC}) should be split into two components, as given by equation (10): the residual liquidity (MB_O_{FC}) and the reserve requirement (MB_CR_{FC}), which vary with the reserve to deposits ratio ($coef^{res}$), and the share of sight deposits out of total deposits ($coef^{sdeps}$), as shown in equation (11). 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 (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. The amount of excess reserves sitting on the asset side of the balance sheet of banks 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 details of a potential model of the Italian economy,[35] since the purpose of the paper is just to show how the preliminary analysis of balance sheets, given a specific research question, and conditional on the availability of the data, will lead to quite different model structures.

4 CONCLUSIONS

The stock–flow consistent approach is quickly growing in popularity among both heterodox researchers, and practitioners. While the literature developing theoretical models, that is, models which do not use time series for specific countries, is expanding rapidly, contributions on the methodologies to adopt for developing models tailored to the data of specific countries is still missing, albeit with some notable exceptions.

If we want this promising line of research to gain attraction to researchers, a question immediately comes to mind: should we aim at creating a simple, *benchmark*, model akin to the simple three-equation 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 in, and indeed G&L have 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 towards a misinterpretation of the specific institutional features of the country under study.

By contrast, 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 non-financial accounts for a given country, as well as suggestions for estimating crucial stock and flow variables, should institutional accounts be unavailable. This methodology is strongly based on a (critical) application of the accounting principles in SNA2008, followed worldwide by statistical agencies and central banks, and which therefore ensure that an SFC model will track official statistics as closely as possible.

Next, we have discussed, through the examples of Greece and Italy, how SFC model design can be guided by a preliminary analysis of the balance sheet 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 modelling 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.

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

The drawback of our proposal is that it makes serious empirical SFC modelling a very complex and demanding task, requiring a good 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, which can be exploited in different academic articles. Finally, we would suggest that the 'SFC community' move in the direction of building a 'collection of empirical benchmark models', for which equation and software code are made available, rather than a one-model-fits-all, as the mainstream followers of the rational optimizing agent have chosen.

REFERENCES

Assa, J. (2017): *The Financialization of GDP: Implications for Economic Theory and Policy*, London and New York: Routledge.

Bezemer, D.J. (2010): Understanding financial crisis through accounting models, in: *Accounting, Organizations and Society*, 35(7), 676–688.

Burgess, S., Burrows, O., Godin, A., Kinsella, S., Millard, S. (2016): A dynamic model of financial balances for the United Kingdom, Bank of England Staff Working Paper No 614, September.

Cannari, L., D'Alessio, G., Vecchi, G. (2016): I prezzi delle abitazioni in Italia, 1927–2012, Banca d'Italia Occasional Papers No 333, June.

Copeland, M.A. (1947): Tracing money flows through the United States economy, in: *American Economic Review*, 37(2), 31–49.

Copeland, M.A. (1949): Social accounting for moneyflows, in: *The Accounting Review*, 24(3), 254–264.

Coutts, K.J., Godley, W., Gudgin, G.D. (1985): Inflation accounting of whole economic systems, in: *Studies in Banking and Finance*, 9(2), 93–114.

Cripps, F.T., Godley, W. (1976): A formal analysis of the Cambridge Economic Policy Group model, in: *Economica*, 43(172), 335–348.

Dallery, T., van Treeck, T. (2011): Conflicting claims and equilibrium adjustment processes in a stock–flow consistent macroeconomic model, in: *Review of Political Economy*, 23(2), 189–211.

De Bonis, R., Girón, C., Infante, L., Quirós, G. (2017): Financial accounts uses, in: van de Ven, P., Fano, D. (eds), *Understanding Financial Accounts*, Paris: OECD Publishing, 381–420.

Dos Santos, C.H., Zezza, G. (2008): A simplified, 'benchmark', stock–flow consistent Post-Keynesian growth model, in: *Metroeconomica*, 59(3), 441–478.

ECB (2017): Base money, broad money and the APP, European Central Bank, *Economic Bulletin*, issue 6.

European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations and World Bank (2009): *System of National Accounts 2008*.

Franke, R. (2017): A simple approach to overcome the problems arising from the Keynesian stability condition, in: *European Journal of Economics and Economic Policies: Intervention*, 14(1), 48–69.

Godley, W. (1999): Seven unsustainable processes: medium-term prospects and policies for the United States and the world, Strategic Analysis Report, Annandale-on-Hudson, NY: Levy Economics Institute.

Godley, W., Cripps, F.T. (1983): *Macroeconomics*, London: Oxford University Press.

Godley, W., Lavoie, M. (2007): *Monetary Economics: An Integrated Approach to Credit, Money, Income, Production and Wealth*, Chippenham, UK: Palgrave Macmillan.

Godley, W., Zezza, G. (1992): A simple stock flow model of the Danish economy, in: Brink, H. (ed.), *Themes in Modern Macroeconomics*, London: Palgrave Macmillan, 140–179.

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

Godley, W., Zezza, G. (2006): Debt and lending: a cri de coeur, Levy Economics Institute Policy Note (4), 6.
Godley, W., Papadimitriou, D.B., Hannsgen, G., Zezza, G. (2007): The U.S. economy: is there a way out of the woods?, Levy Economics Institute, Strategic Analysis: 11.
Gola, C., Burroni, M., Columba, F., Ilari, A., Nuzzo, G., Panzarino, O. (2017): Shadow banking out of the shadows: non-bank intermediation and the Italian regulatory framework, Banca d'Italia Occasional Papers No 372, February.
International Monetary Fund (2009): *Balance of Payments and International Investment Position Manual: Sixth Edition (BPM6)*, Washington, DC: International Monetary Fund.
Lavoie, M. (2010): Changes in central bank procedures during the subprime crisis and their repercussions on monetary theory, in: *International Journal of Political Economy*, 39(3), 3–23.
Lavoie, M. (2014): *Post-Keynesian Economics: New Foundations*, Cheltenham, UK and Northampton, MA: Edward Elgar Publishing.
Lavoie, M., Zezza, G. (eds) (2012): *The Stock–Flow Consistent Approach: Selected Writings of Wynne Godley,* Basingstoke, UK: Palgrave Macmillan.
Makrelov, K., Arndt, C., Davies, R., Harris, L. (2018): Stock-and-flow-consistent macroeconomic model for South Africa, World Institute for Development Economic Research (UNU-WIDER), Working Paper No 7, January.
Mazier, J., Valdecantos, S. (2014): A detailed representation of the Eurosystem and the current crisis in the Eurozone: a stock flow consistent approach, CEPN Document du travail 2014-02.
Mazier, J., Valdecantos, S. (2015): A multi-speed Europe: is it viable? A stock–flow consistent approach, in: *European Journal of Economics and Economic Policies: Intervention*, 12(1), 93–112.
Michelena, G., Guaita, N. (2017): Modelo de Stock-Flujo Consistente para el Análisis Macroeconómico (SFARG), URL: https://doi.org/10.13140/rg.2.2.16223.15529.
Nikiforos, M., Zezza, G. (2017): Stock–flow-consistent macroeconomic models: a survey, in: *Journal of Economic Surveys*, 31(5), 1204–1239.
Nikiforos, M., Carvalho, L., Schoder, C. (2015): 'Twin deficits' in Greece: in search of causality, in: *Journal of Post Keynesian Economics*, 38(2), 302–330.
OECD (2017): *Understanding Financial Accounts*, Paris: OECD Publishing.
Papadimitriou, D.B., Nikiforos, M., Zezza, G. (2013a): The Greek economic crisis and the experience of austerity: a strategic analysis, Strategic Analysis Report, Annandale-on-Hudson, NY: Levy Economics Institute.
Papadimitriou, D.B., Nikiforos, M., Zezza, G. (2013b): A Levy Institute model for Greece, Levy Economics Institute Technical Report.
Zezza, F. (2018): *Stock–Flow Consistent Macroeconomic Models: Theory, Practice and Applications*, Unpublished PhD Thesis, University of Siena, URL: http://phdeconomics.wp.unisi.it/thesis.
Zezza, G. (2009): Fiscal policy and the economics of financial balances, in: *Intervention. European Journal of Economics and Economic Policies*, 6(2), 289–310.

APPENDIX 1 FROM GDP ACCOUNTING TO NET LENDING

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

$$GDP = WAG + GOS + NIT = CONS + GCF + G + EXP - IMP. \qquad \text{(A1)}$$

We can rearrange the terms in (A1) 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)	$WAG + GOS^h - CONS - GCF^h +$
Non−financial 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)	$WAG + GOS^h + Z^{*h} - Z^{h*} - CONS - GCF^h +$
Non−financial 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)	$WAG + GOS^h + Z^{*h} - Z^{h*} + T^{*h} - T^{h*} - CONS - GCF^h +$
Non−financial 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)	$S^h - GCF^h +$
Non−financial 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 adding capital transfers received, and subtracting capital transfers paid (K^{ab}):

Households (h)	$\{NL^h =\} S^h - GCF^h + K^{*h} - K^{h*} +$
Non−financial 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

$$\{NL^h + NL^n + NL^f\} + NL^g + NL^w = 0, \tag{A2}$$

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