# Are there policy alternatives to Ireland's austerity?

Stephen Kinsella
University of Limerick *

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**Abstract**

Ireland's economic crisis began as the bursting of a property bubble, followed by a blanket guarantee of all banking assets and liabilities, the loss of sovereign creditworthiness, and a period of economic restructuring and recession as austerity policies were applied to force fiscal consolidation, bank deleveraging and deflation through the wage channel. Using first a calibrated, and then an estimated, stock flow consistent macroeconomic model, I ask whether there were in fact alternatives to Ireland's austerity and assess the prospects for recovery for this small open economy. I find higher taxes and a slower, prolonged fiscal adjustment would have smoothed the return to post bubble normality. I conclude with a further estimation strategy for future work.

*JEL Codes*: E17, E27, E37.

*Keywords*: Ireland, austerity, stock flow consistent modeling.

## 1 How did no one foresee Ireland's collapse?

The goal of this paper is to examine the recovery prospects of Ireland, a small and highly open economy within the Eurozone, using a stock flow consistent macroeconomic model.

Ireland has been held up as the poster child for austerity policies[1]. The country's exit from its loan facility in December 2013 may well be viewed as a validation of austerity policies. Indeed, Ireland's pre-'Celtic Tiger' period was also used as evidence of the theory of expansionary fiscal contraction (Giavazzi and Pagano (1990)).

In this paper we ask whether there were, or are now, policy alternatives to the course of action the Irish and European authorities have decided upon using two stock flow consisent models, one calibrated, the other estimated.

No model predicted Ireland's financial, and then fiscal, collapse in 2007 and 2008[2]. Why not?

Looking back before 2007, all the signs of an unsustainable, financialised property boom were apparent (Kelly, 2007; Van Treeck, 2009; Kinsella, 2012).

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[1] We define 'austerity' following Blyth (2013): "Austerity as policy is cutting the states budget to stabilize public finances, restore competitiveness through wage cuts, and create better investment expectations by lowering future tax burdens"

[2] Three separate reports into the Irish banking and fiscal crisis have established that macro prudential regulation was lax, that fiscal policy, and in particular Ireland's fiscal stance, was inappropriate given our membership of the Euro zone, and finally that Ireland's political elite was enmeshed with property developers, whose interests were served before those of the national interest. Each report also noted with dismay the failure of macroeconomic models used by Ireland's Department of Finance and the European Central Bank to accurately predict the crisis (Honohan (2010); Regling and Watson (2010); Nyberg (2011). In particular, the lack of a detailed treatment of the financial side of the economy was identified as a serious modelling issue that needed to be addressed.

Irish banks were lending more than 40% more in real terms to property developers alone in 2008 than they had been lending to everyone in Ireland in 2000, and 75% more as mortgages. Bank lending grew to 200 per cent of national income by 2008. Ireland's major banks were being financed by lending flows from abroad. Ireland's largest banks were almost entirely funded by domestic deposits in 1997, but by 2008 over half of Irish bank lending was funded by wholesale borrowers through bonds and inter-bank borrowing. The sudden stop in inter-bank liquidity prompted by the collapse of Lehman Brothers sounded the death knell for Ireland's property boom. Figure 1 traces out the details in growth rates for GDP, Unemployment, and Debt to GDP. Levels are quarterly.

And yet, Ireland's Department of Finance issued a 'Pre-Budget Economic and Budgetary Outlook' in 2007, as the economy collapsed, forecasting the following:

> The economic and fiscal outlook over the period 2008 - 2010 is as follows: GDP is forecast to expand at an average rate of 3.5% per annum (GDP by just under 3.5%). The average annual increase in employment is projected to be just under 11.5%, with unemployment assumed to average about 5.5%. (Department of Finance, 2007, pg. A.3)

In that 2-year period, output as measured by real gross domestic product fell by almost 11%, unemployment rose from just under 4% to over 9%. Recent estimates of the mean squared error of Ireland's forecasted tax take show an error over the 2008-2010 period of 128, relative to errors in the 5-10 range from other periods (Irish Fiscal Advisory Council, 2013, pp. 30-31).

Why did the models get it so wrong? None of the projections based on dynamic stochastic general equilibrium (DSGE) or computable general equilibrium (CGE)-type approaches took account of the intersectoral dependencies of the entire economy, including its financial sector. Thus, when household credit grew unsustainably essentially because domestic banks were borrowing wholesale credit from the rest of the world to lend to them, models which did not take these flows into account were bound to fail.

In addition to all sectors of the economy experiencing a large increase in debt during the construction bubble years from 2002 to 2007, the bursting of the Irish property bubble has left a large fiscal deficit, a series of banks with damaged balance sheets, and a sovereign borrowing crisis.

Since November 2010 Ireland has been in a programme of adjustment with the EU and IMF. It is not hard to see why. From 2008, the debt to GDP ratio increased rapidly from 44% to 121% in 2012 due to a significant increase in government expenditures, coming mainly from welfare enhancing automatic stabilisers and spending to restore banks' balance sheets while unemployment increased from 4% in 2007 to 15% in 2011, and has been decreasing since 2011 due to emigration. The ratio of household disposable income to debt in at the end of 2012 was 206%.

Ireland's story is well told by simply staring at the sectoral balances within the economy. The sectoral balances are given in identity by

> Change in net household financial income = current account surplus + government deficit + change in business non-financial assets

Or more concisely: Private (households - business) balance = Public deficit + Rest of World.

As part of the strategy of deficit correction, the Irish government initiated a significant reduction in public expenditure and an increase in taxation, or more colloquially, an austerity policy as defined by Blyth (2013).

Figure 2 shows the evolution of these balances from Q1, 2002 to Q1 2013. Essentially with the public deficit very close to zero, Ireland's openness, reflected by its current account, is equal to its private sector balance. The economy is finely (im)balanced, and the adverse impact austerity policies are having on the Irish economy. The domestic private surplus is decreasing due to domestic deleveraging while the rest of the world, that is, the current account, is increasing in its income to the State.

The data show a large buildup in economy activity, particularly credit-driven activities, followed by a drop in credit availability and a consequent collapse in real and financial economic output.

## 1.1 Data and methods

Our goal is to build a stock flow consistent model of the Irish economy. We must, of course, keep track of, and ensure consistency between, the stocks and flows of our model. In order to do this we will rely on the flow of funds data generated by the institutional sector accounts of Ireland's Central Statistics Office, and the quarterly financial accounts generated by Ireland's Central Bank.

Having identified the main characteristics of the Irish balance sheet, we calculate the net value of each variable, checking for any asymmetry between the domestic economy and the rest of the world, which allows us to have a zero for each row of the balance sheet matrix of the economy, and then compute the net wealth of each sector as the difference between asset and liability in nominal terms. This value must be the same compared to the total net wealth of each instrument, to be sure to have zero for each column. Our data processing did not in any way alter the net wealth of sectors.

Institutional sectors are not exclusively characterised by the use financial instruments: they have income and profit distribution activities, as well as productive activities, and our model captures all of this.

We proceed from an empirical stock flow consistent balance sheet to a calibration exercise in section 2 Here the parameters are set to closely correspond to some theoretical moment or stylized fact of data, in this case long run stock flow norms. The model is estimated via OLS in section 3 We conclude with a look towards a VAR-SVAR estimation in section 4.

We do this in order to increase the real-world applicability of the approach, to include as much of the information from the data and the model as possible, and to be as useful to policy makers as this approach can be.

Calibration is a much used, and therefore much misused, empirical tool in economics Ruge-Murcia (2007). Here we use calibration not as an end in itself but as a route to understanding the model itself, as well as the long run properties of the data. We then proceed to an estimated model of the type devised by Davis (1987).

We build a model from the quarterly financial and national accounts of the Irish economy from the first quarter of 2002 to the second quarter of 2013, the latest available data[3].

We first calibrate a model from the balance sheets of the Irish economy. This calibration uses a fixed period of the financial balance sheet, quarter 4, 2007, but like all calibrations, relies on underlying economic trends. The calibration method allows the modeller to calibrate and simulate a theoretical model with values having constraints that generate consistent ratios, or what Godley and Lavoie (2006) refer to as 'stock-flow norms. The issue with using calibration for an economy like Ireland's is the clear break from 2002 to 2007 and 2007 onwards–any 'norm' will not work pre 2007, and any period chosen to calibrate forwards from will give relatively different values. The results are therefore proportional to the calibrated values we choose.

The estimated model is designed to be stock flow consistent in its closures as well as its estimates, to retain the detail of the real and financial sectors of the economy, in the same vein as Barwell and Burrows (2011).

This is built to reflect Ireland's situation as precisely as possible. Full details of both models are available in an online appendix.

[3]There are several important measurement issues with the data we must be aware of when modelling the Irish economy. First, these data are quarterly, while other data are lower and higher frequency. This may seem trivial, but when attempting to model, say, securities other than shares yields; to be consistent one must use a quarterly estimate of the yield on Irish securities other than shares. Given the fluctuations we have seen recently, different aggregations will lead to different securities other than shares figure.

Second, the data for Non-financial corporations have serious measurement issues. Irish subsidiaries of foreign companies and the Irish branches of foreign companies operating in Ireland on a branch basis are included, while the foreign subsidiaries of Irish companies and the foreign branches of Irish companies operating abroad are excluded (they form part of the Rest of the world sector).

Third, the Rest of the World figures represent the Irish economys transactions with financial claims and liabilities to non-residents. The conceptual definition is the same as in the balance of payments (BOP) and international investment position (IIP) statistics. In particular, non-residents include foreign subsidiaries of Irish companies, the foreign branches of Irish

## 2 Model

We build a five sector model to calibrate, made up of: Financial Corporations, Non-Financial Corporations, Households, the Government, and the Rest of the World (see Godley and Lavoie (2006) for a simple exposition of this type of model). The model is constructed to equate stocks and flows within the economy according to the balance sheet approach. Table 1 shows a schematic of the model's financial side. The real side is standard.

One of the novelties of the model the institutional specificity of the financial balance sheet, which we detail below.

| Sectors | NFC | FC | Govt | HH | ROW |
|---|---|---|---|---|---|
| Flows | GDP, I, X, IM, C, W, $T_G^N$, $P^N$, $P_N^N$ | $P^F$, $P_F^F$ | G, T, $P_F^G$ | C, $T_G^H$, $Y_d$, $P_H^N$ | CAB |
| Instruments | Deposits | - | - | - | - |
| | - | - | Securities | - | Securities |
| | Equities | Equities | - | - | - |
| | - | Loans | Loans | - | - |

Table 1: *Schematic of the financial side of the economy, including the flow variables and the originating sectors of the various financial instruments. The model is a simple open economy model, whose structure is in accordance with the financial balance sheet of Irish data combined with those of aggregate demand in the real economy in the usual way. Thus Gross Domestic Product (GDP) is a flow variable for non financial corporations, as are wages $W$, Investment $I$, Profits $P$, Imports, $IM$ and Exports $X$. The government's flow variables are expenditure $G$, taxation, $T$ and profits from the Central Bank $P_F^G$. Households consume $C$, pay taxes $T_G^H$ and reap dividends $P_H^N$, and the rest of the world is captured using the current account balance, $CAB$. In the pre-crisis period, the Irish government lent money into the real economy, hence we include Loans being generated from the government sector.*

The Non-financial corporation sector (NFC) includes all private firms, but also other corporate bodies. The financial corporate sector (FC) includes all financial institutions and the Central Bank of Ireland, General government (Govt) and Households (HH) are standard, while the Rest of the World (ROW) describes the economy's interactions with non-residents. In these types of models we respect standard balance sheet conventions, so for example the assets of the rest of the world represent Irish liabilities to non-residents. Similarly, liabilities of the Rest of the World represent Irish non-residents' assets. The domestic economy exchanges with the Rest of the World (ROW) which represents the fifth sector. Our matrix is uniquely specific to the Irish economy during the 2007-2013 period, including the various institutional specificities the economy exhibits.

Non financial corporations are characterised by the wealth accumulation equation $\Delta V^N = P_N^N - \alpha_v^N * K^N$, which is a simple capital accumulation equation. Financial corporations have to deal with profit flows $P$ to various sectors and issue equities. This sector's wealth is simply what it does not remit in the form of dividends. The government's balance constrain will be discussed later, but it issues securities and reacts to changes in government expenditure, taxation, and the profits from the central bank it receives. Households react to changes in consumption, taxes, disposable income ($Y_d$) and dividends. The rest of the world is captured using the current account balance, and it's wealth is the residual of the rest of the domestic economy plus special drawing rights $SDR^F$, such that $V^R = -\sum(V^i) + SDR^F$.

Table 2 describes the interactions of the five sectors through their holdings of financial assets. This table mirrors the data's representation in the quarterly financial accounts.

Assets and liabilities are aggregated according to the methods used in the Irish Quarterly Financial Accounts issued by the Central Bank of Ireland.

The classes of assets are quite simple: basically comprising deposits ($M$), securities other than shares ($B$), loans ($L$) and equities ($E$). In this model, only the NFC sector accumulates a physical capital stock

| | NFC | | FC | | Govt | | HH | | ROW | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | L | A | L | A | L | A | L | A | L | $\sum$ |
| Deposits | $M^F_{N,d}$ | | | $M^F_s$ | $M^G_{N,d}$ | | $M^H_{F,d}$ | | $M^R_{F,d}$ | | 0 |
| Securities | $B^N_{GR,d}$ | | $B^F_{GR,d}$ | | | $B^G_s$ | $B^H_{GR,d}$ | | | $B^R_s$ | 0 |
| Loans | | $L^N_{F,d}$ | $L^F_s$ | | $L^G_s$ | | | $L^H_{F,d}$ | | $L^R_{F,d}$ | 0 |
| Equities | | $E^N_s$ | | $E^F_s$ | $E^G_{NF,d}$ | | $E^H_{NF,d}$ | | $E^R_{F,d}$ | | 0 |
| Net value remaining | $NR^N$ | | | $NR^F$ | $NR^G$ | | $NR^H$ | | $NR^R$ | | $SDR^F$ |
| Wealth (A-L) | | $V^N$ | | $V^F$ | | $V^G$ | | $V^H$ | | $V^R$ | $-SDR^F$ |
| Sum (A-L) | | 0 | | 0 | | 0 | | 0 | | 0 | 0 |

Table 2: *Financial Assets in the model. Read each entry in the table using the super- and sub- scripts to understand what is going where, and what comes from where. So, for example, $B^N_{GR,d}$ shows the monetary value of bonds held by the Non Financial Corporation from the Government (G) and the rest of the world (R). The subscript 'd' identifies these bonds are demanded by the NFC sector from the government and the rest of the world. The subscript 's' identifies the 'supplying' sector.*

$K^N$, though it does not change the results of the model to allocate some of the accumulation of physical capital to the households.

The Financial corporate sector aggregates Ireland's central bank and its commercial banks. This sector holds deposits $M^F_{N,d}$ provided by other sectors, which we denote using the relevant subscript in table 2. Financial corporations grant loans $L$ which are required by all other sectors. Investment evolves according to:

$$I^N = \gamma_k(K^N_{T,t} - K^N_{t-1}) + \delta^N K^N_{t-1}, \tag{1}$$

where $\gamma$ and $\delta$ represent propensities to invest relative to a 'target' capital stock, $K_{T,t}$, which provides this model with an ability to over and undershoot in any given scenario.

The general government and the rest of the world are net issuers of securities other than shares $B$ held by other sectors. Non-financial and financial corporations are net issuers of equities held by the other sectors. Bondholders and equity owners have a portfolio composed of two assets which unfortunately cannot be clearly distinguished in the financial balance sheet.

Each sector's wealth $V^i$ is obtained as the difference between the quarterly value of assets and liabilities, and can thus be positive or negative. Regardless, the value of wealth is always recorded as a liability, so that the balance sheet of each sector is in equilibrium and is zero when we calculate the difference running down a column between assets and liabilities. So in table 2, the zeros can be explained as follows: all assets of the Irish economy have counterpart liabilities relative to its bilateral partners which we group as the rest of the world.

Viewed from the vantage point of the quarterly financial accounts, for example, the NFC sector produces goods and services and accumulates the capital stock, as mentioned above, but this sector also distributes wages, pays taxes to the government and provides a share of its profits to households. It is also the main sector of exchange of goods and services produced with the rest of the world. The NFC sector's flow is connected to the financial balance sheet's stock by the wealth accumulation equation of the NFC sector, which we use as the closure of the model across each of the sectors. The NFC sector's wealth accumulation $V^N$ depends on its past wealth $V^N_{(t-1)}$ plus the NFC's sector profits $P^N_N$ which not distributed to households, minus a share of capital stock $\alpha^N_v * K^N$.

The main activities of the financial corporations are based on the deposits that they hold in other sectors, in government securities, and securities from the rest of the world they purchase. Financial corporations issue equity and, of course, provide loans to other sectors. All these operations enable this sector to reap profits $P^F$, including the central bank, as the central bank's revenue surplus is repaid to general government $P^G_F$ (these are counted as non-tax revenues) - and the other share $P^F_F$ is maintained in the accounts of commercial banks. Wealth accumulation for financial corporations depends on past wealth $V^F_{t-1}$ and a profit

share undistributed income $\alpha_v^F * P_N^F$.

We assume government expenditure is exogenous in our model in order to understand the effects of the spending shocks to the economy during the 'austerity' phase of the Irish economy from 2008 onwards.

The government receives tax revenues $T$ from various non financial corporations and households, and a share of the central bank's profits $P$ as well as dividends on securities other than shares issues $B$ and their dividend yield $r_b$, interest on deposits $r_{m,t-1}^F$ and dividends $r_{e,t-1}^{N,F} * E_{N,F,d,t-1}^G$. The government's wealth accumulation equation $V^G$ depends on the securities other than shares issues $B_s^G$ and their dividend yield $r_b^G$, on the interest rates on deposits $r_m^F$, dividend yield $r_e^{NF}$ on the equities purchased, and on the interest rates $r_l^F$ on loans received from financial corporations. The government budget constraint is given by

$$\Delta B_s = G^G - T^G + r_{b,t-1}^G * B_{s,t-1}^G + r_{l,t-1}^F * L_{F,d,t-1}^G - r_{m,t-1}^F * M_{F,d,t-1}^G - P_F^G - r_{e,t-1}^{N,F} * E_{NF,d,t-1}^G \quad (2)$$

Equation 2 shows us the financialised nature of the government's balance sheet, and the implicitly (or perhaps explicitly) financial concerns within the State-level debt-dynamics calculations undertaken by both the government of Ireland and the international markets when assessing fiscal sustainability. Clearly the flow variables around loans, bond issuances, and dividends, $r_{b,e}$ control a large part of the value of the government position with respect to its borrowing over time, and it is this measure, rather than a simpler gross debt to GDP ratio, which should be measured to understand debt sustainability in the medium term.

Households receive wages $W$, consume $C$, pay taxes to the government $T_G^H = (\theta^G/(1-\theta_G)) * Y_d$, and receive a share of profits $P_N^H$ from the non financial sector. Following (Godley and Lavoie, 2006, Chapter 2), households are assumed to be 'procedurally rational' in the sense that they do not model the future explicitly but use the past to set targets which they try to reach.

Household wealth accumulation is equal to the wealth of the previous period plus a savings share obtained by the difference between personal disposable income $Y_d$ and consumption $C$. Household consumption evolves according to the marginal propensity to consume of out current disposable income ($\alpha_1$) and the propensity to consume out of past income, $\alpha_2 * V_{t-1}$:

$$C^H = \alpha_1^H Y_d + \alpha_2^H V_{t-1}^H, \quad (3)$$

with $\alpha_2 < \alpha_1 < 1$.

Equation 3 is a simple Keynesian consumption function, fulfilling the Haig-Simons condition and adapted for the specific Irish balance sheet we wish to model[4].

The rest of the world 'sector' realises its financial transactions through the Financial Balance Sheet of other sectors and conducts traded exchange with the domestic economy. Increasing the rest of the world's wealth is a loss of the Irish economy's wealth, and vice versa.

The behavioural equations are written to produced calibrated parameters from the data, as well as using more financial variables than we would normally use in a macroeconomic model this size. Portfolio balance equations obeying the Haig-Simons conditions and identity equations round out the model.

The current account (CA) is determined by real and financial variables:

$$CA = X - IM + r_{b,t-1}^R * B_{s,t-1}^R + r_{l,t-1}^F * L_{F,d,t-1}^R - r_{e,t-1}^{N,F} * E_{NF,d,t-1}^R - r_{m,t-1}^F * M_{F,d,t-1}^R \quad (4)$$

This produces an adjustment to the quarterly value of GDP we report in section 2.1.

## 2.1 Calibration results

Consider Ireland's economic situation after 2008. The country required a loan facility from the EU and IMF in exchange for fiscal conditionalities involving reducing government expenditure, increasing taxes, and

[4] A series of hyperbolic consumption functions were simulated using the methods outlined in George-Marios Angeletos et al. (2001), but these seemed to make little difference to the results obtained. We opted to stay with simple functional representations wherever possible.

pursuing structural reforms. Government expenditure in 2008 was roughly 60 billion euros, by 2013 they had reduced government expenditure by 13.5%.

As the model uses empirical quarterly data from 2002 to 2013 including public expenditure of this period, it is interesting to evaluate the impacts of the austerity phase from late 2007 to early 2013 on the Irish economy. Government expenditure increased from 2002 until 2007 in the fourth quarter to 7.627 billion euros per quarter and then expenditure began decreasing in the third quarter of 2008 following an emergency budget. In the fourth quarter 2008, while government expenditures reach 7.645 billion, began a long period of fiscal austerity that reduced government expenditure in 2011 to 6.747 in the first quarter. From the fourth quarter 2007 to the first quarter 2011, 1.702 billion have been cut from government expenditure, and 821 million have been raised in taxation revenues. The shock is thus to reduce 7.627 billion public expenditures of 881 million in the fourth quarter of 2007. This represents 11.5% cut in government expenditures in the fourth quarter 2007 to first quarter 2011.

We find that government expenditure drops of this magnitude do, in fact, help the government–its overall liabilities drop by 17% over this period because of the lower amounts of borrowing necessitated by an 11.5% cut in expenditure, but the stock-flow model we employ shows that this policy transfers much of the adjustment onto non financial corporations and households. Job creation and investment decline markedly, while there is a portfolio re-adjustment in all sectors, with corresponding wealth gains and losses. Credit creation collapses, as we can see in table 2.

In a second series of scenarios, we shock taxes and spending at various levels, and calculate the effects at short (T+3), medium (T+13), and longer (T+23) terms on key variables within the model, including disposable income as a percentage of GDP, consumption as a percentage of GDP, taxes as a percentage of GDP, and GDP growth.

We can see that the immediate impact of a smaller spending shock on disposable income as a percentage of GDP is quite small–only -0.73%, whereas the cumulative effect of the shock over 22 periods is -1.45%. The impact of austerity is lessened in both the short and long terms when there is more spending combined with higher taxes.

The shock leads to a decline in public spending on goods and services by 1.7% of GDP, reflected first by a decline in consumption, which then reduces the ability of the government to collect additional indirect taxes on consumption. The shock penalises household income first. The decline in the aggregate demand components of consumption is around 4% and public spending on goods and services around 1.7% leading to a contraction in output of about 6%.

The real insight of this model is its connection of the real and financial of the economy. By looking at the financial instruments in the balance sheet we can discern how the impact of the shock in the real sector will be transmitted to the financial balance sheet.

Here we are focusing only on the government and household balance sheets. Household deposits in assets from banks decline following a drop in households income. Households deleveraging (measured by the observed decline in liabilities in the balance sheet) cannot be explained by households lower incomes but mainly by banks shrinking credit availability in the face of economic activity uncertainty as a result of austerity.

The decline in financial activity is due to less demand for the purchase of new securities that fall in assets of their balance sheet. Interestingly, the empirical model also bears this finding out.

However, the effect on the balance sheet shows a reduction of government securities issued excluding equities has taken place, government loans to the banking sector have decreased, deposits and the acquisition of shares of the government have declined because, one one hand, the slowdown in economic activity preventing any additional income accruing, and on the other hand, there is an obvious need for fiscal consolidation.

These results show what we have observed with the empirical data in the households and government balance sheets concerning the evolution of the deposits, loans, equities and securities during the second phase of the crisis.

| Impact: | $Y_d$/GDP | | | | | | $C^H/GDP$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shock | Spending | | | Tax rate | | | Spending | | | Tax rate | | |
| Time | T+3 | T+13 | T+23 | T+3 | T+13 | T+23 | T+3 | T+13 | T+23 | T+3 | T+13 | T+23 |
| 10% Less | -0.73 | -1.07 | -1.45 | 1.62 | 1.86 | 2.12 | -0.45 | -0.79 | -1.16 | 1.34 | 1.6 | 1.87 |
| 20% Less | -0.84 | -1.24 | -1.68 | 0.81 | 0.92 | 1.05 | -0.52 | -0.91 | -1.34 | 0.67 | 0.8 | 0.93 |
| Base | -0.95 | -1.4 | -1.91 | - | - | - | -0.59 | -1.04 | -1.53 | - | - | - |
| 10% More | -1.07 | -1.57 | -2.14 | -0.8 | -0.91 | -1.03 | -0.66 | -1.17 | -1.71 | -0.66 | -0.79 | -0.91 |
| 20% More | -1.18 | -1.75 | -2.38 | -1.59 | -1.81 | -2.04 | -0.73 | -1.29 | -1.91 | -1.32 | -1.56 | -1.81 |
| Impact: | $T^H/GDP$ | | | | | | $\Delta GDP$ | | | | | |
| Shock | Spending | | | Tax rate | | | Spending | | | Tax rate | | |
| Time | T+3 | T+13 | T+23 | T+3 | T+13 | T+23 | T+3 | T+13 | T+23 | T+3 | T+13 | T+23 |
| 10% Less | -0.27 | -0.4 | -0.56 | -0.96 | -0.86 | -0.75 | -4.01 | -4.66 | -5.34 | 2.84 | 3.36 | 3.9 |
| 20% Less | -0.31 | -0.47 | -0.65 | -0.48 | -0.43 | -0.37 | -4.59 | -5.34 | -6.12 | 1.39 | 1.64 | 1.9 |
| Base | -0.35 | -0.53 | -0.74 | - | - | - | -5.19 | -6.03 | -6.9 | - | - | - |
| 10% More | -0.39 | -0.6 | -0.83 | 0.47 | 0.42 | 0.36 | -5.78 | -6.71 | -7.69 | -1.34 | -1.57 | -1.8 |
| 20% More | -0.43 | -0.66 | -0.92 | 0.94 | 0.83 | 0.72 | -6.37 | -7.4 | -8.47 | -2.64 | -3.07 | -3.51 |

Table 3: *Impact of alternative policies on the Irish economy. To read the table, we see the effects of changes in taxes and spending on four important variables relative to the steady state value, which we term period 0. We see the change in disposable income as a percentage of GDP, calculated in period changes as:* $(Y_{d,t} - Y_{d,0})/GDP_{t-1}$*, change in household consumption as a percentage of GDP,* $(C_t^H - C_0^H)/GDP_{t-1}$*, change in taxes as a percentage of GDP,* $(T_t^H - T_0^H)/GDP$*, and GDP Growth,* $\Delta GDP/GDP_{t-1}$*. We express each statistic as a percentage. We calculate the effects 3 period from the shock, 13 periods from the shock, and 23 periods from the shock, on both taxes and spending. So, for example, at T+3, with a small spending shock, the change in disposable income as a percentage of GDP declines by 0.73% relative to the steady state.*

# 3 Estimated model

We estimate the first version of our model using OLS. The model structure is the same as the calibrated model above with one important change.

SFC models stipulate the rows and columns in the balance sheet matrix of the economy are equal to zero.

Using this restriction, with a 6 by 7 matrix, we can write a maximum of 13 identity equations when we have 42 (6*7 ) variables. If we write 13 identity equations, we impose a strong constraint on the model.

We have imposed the lowest level accounting equation constraint, requiring that the sum of wealth in any period is equal to the issuance of SDRs.

Looking at the real sector first, the Irish labour market has always been influenced by its geographical proximity to the United Kingdom and openness to the European market, as well as cultural features which promoted emigration Cullen (1987). The working age population is sensitive to the difference between the GDP growth rate in Ireland and those observed elsewhere, and the gap in unemployment rates. Therefore, when the unemployment curve began to rise at an unsustainable level as the 15.1% high experienced in 2011/2012, it is not surprising the unemployed are turning to other labour markets as an alternative to the domestic market. We take into account the population growth rate (POPg), a net migration (NIM) variable to capture the effects of labour force inflow and outflow.

We estimate the evolution of the labour force (in logs) as

$$\text{Employment} = \alpha_0 + \alpha_1 \text{Real GDP}_{t-1} + \alpha_2 \text{Nominal Wages} + \alpha_3 \text{Time} + \alpha_4 \text{Taxes}. \tag{5}$$

Results are shown in table 4 for employment and household disposable income. Clearly, and unsurprisingly, employment depends on income, output, and nominal wages. Figure 3 shows the fitting relationship well, with the really significant drivers of the economy's employment coming from Real GDP and the

Table 4: OLS Regressions for the real economy.

| | *Dependent variable:* | |
|---|---|---|
| | Employment | HH Gross disposable income |
| | (1) | (2) |
| Lagged Real GDP | $0.897^{***}$ | |
| | (0.112) | |
| Real Wage | $0.298^{***}$ | |
| | (0.079) | |
| Time | $-0.065^{***}$ | |
| | (0.007) | |
| Wages/GDP Deflator | | $0.544^{***}$ |
| | | (0.029) |
| Taxes | | $-0.410^{**}$ |
| | | (0.188) |
| Constant | $-4.842^{***}$ | $4,389.200^{***}$ |
| | (0.773) | (1,125.892) |
| Observations | 46 | 46 |
| $R^2$ | 0.888 | 0.898 |
| Adjusted $R^2$ | 0.880 | 0.894 |
| Residual Std. Error | 0.022 (df = 42) | 846.761 (df = 43) |
| F Statistic | $111.496^{***}$ (df = 3; 42) | $189.885^{***}$ (df = 2; 43) |
| *Note:* | | $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01 |

Turning to the financial side of the economy, we estimate the relationships between financial securities. Figures 5 and 6 bring these relationships out.

Clearly the effect of the collapse on non-financial loans was negative. Running these regressions in subsamples, one sees two distinct loan regimes–pre 2007 and post 2007. But a regression was not required to tell us this. Rather, looking at the influence of government securities issued on non-financial loans in model 2 of table 5 it is clear the credit contraction affected the economy in large and uncertain ways, including the influence of the rest of the world's loans on financial corporate net worth (0.426, significant at 0.01) levels, and the negligible effect the rollback in government spending had on non financial corporate loans (-0.913, not significant).

# 4 Further estimation: VAR-SVAR

Any SFC system can be written as

$$\mathbf{BX_t} = \sum_{i=0}^{n} \mathbf{AX_{t-i}}, \tag{6}$$

where $n$ is the number of lags. Equation 6 can be directly used in its extended format as a structural VAR once error terms are accounted for Amisano and Giannini (1997). The SFC structure of our model contains information an OLS or GMM procedure will lose. The estimation may not be stock flow consistent in its parameter values. We do not want to lose the important information produced by the SFC model, and so we will adopt a VAR-SVAR methodology in estimation.

The benefits of this approach are the following: we stick to the original idea of SFC model, and we do not assume any equilibrium process at work.

Variables in a SVAR model can have contemporaneous impact on other variables, which is perfect to describe relationships in a SFC model. The SVAR model estimates the whole system, so the estimates from an SVAR (in our example consisting of only 5 equations) are considered more reliable than linear regression which only take into account the relationships contained in the equation **??** above. The SVAR model is more flexible than simple linear regression. We can define and modify the relationship between variables easily by adjusting the **A** and **B** matrices. Building a computationally intensive SVAR model for the Ireland economy, which contains about 80 equations, will require a supercomputer.

Let us take an example of simple SFC model with only five variables $(Y_t; C_t; YD_t; V_t; E_t)$ and lets see how that fits into the SVAR model.

Below is a sample SFC model:

$$Y_t = C_t + E_t + \epsilon_1 \tag{7}$$

$$C_t = \alpha_1 YD_{t-1} + \alpha_2 V_{t-1} + \epsilon_2 \tag{8}$$

$$YD_t = (1-\theta)Y_t - C_t + \epsilon_4 \tag{9}$$

$$E_t = E_{t-1} + \epsilon_5 \tag{10}$$

Fitting these models equations into an SVAR representation (as in equation 6, requires **B** to be a 5 by 5 matrix with diagonal values equal to 1, $\mathbf{X}_t$ being a vector of the equation's variables $\mathbf{X}_t = (Y_t, C_t, YD_t, V_t, E_t$ and $(A)$ is a matrix of lags.

By setting restrictions to matrices $(A)$ and **B**, we can adjust the SVAR model to have exactly the same form as equation 8 has.

Matrix **B** models the contemporaneous relationship between variables at time $t$, for example, $Y_t = C_t + E_t$. Matrix **A** models the relationship between variables at time t and variables at time $t-1$, for example $C_t = \alpha_1 YD_{t-1} + \alpha_2 V_{t-1}$.

After imposing restrictions into matrices $(A)$ and **B** by setting the elements in the matrices to either 1 or 0, we successfully adjust the SVAR model. The estimation is carried out by the following two step method:

Table 5: A look at the financial side of the economy.

| | *Dependent variable:* | | |
|---|---|---|---|
| | FC Securities | Non Financial Loans | Household Currency/Deposits |
| | (1) | (2) | (3) |
| FC Currency, deposits | | −0.538** | |
| | | (0.264) | |
| FC Securities | | 0.198*** | |
| | | (0.024) | |
| Government loans | −0.397 | 0.536*** | |
| | (0.401) | (0.151) | |
| ROW Currency, deposits | 1.077*** | | |
| | (0.099) | | |
| ROW Loans | 0.426*** | | |
| | (0.146) | | |
| HH Loans | −0.487 | | |
| | (0.377) | | |
| Government securities issued | | 0.254** | |
| | | (0.101) | |
| Government security holding | −1.124 | −0.913 | |
| | (1.122) | (0.546) | |
| FC securities issued | | | 0.052*** |
| | | | (0.008) |
| ROW securities holding | 0.411*** | | 0.084*** |
| | (0.063) | | (0.006) |
| ROW securities issues | | | 0.065*** |
| | | | (0.012) |
| FC loans | | | 0.067*** |
| | | | (0.007) |
| Constant | 21,803.940 | −83,217.430*** | 46,793.680*** |
| | (15,024.500) | (9,716.771) | (2,217.848) |
| Observations | 46 | 46 | 46 |
| $R^2$ | 0.974 | 0.892 | 0.994 |
| Adjusted $R^2$ | 0.970 | 0.879 | 0.993 |
| Residual Std. Error | 18,161.470 (df = 39) | 10,848.910 (df = 40) | 1,651.373 (df = 41) |
| F Statistic | 244.063*** (df = 6; 39) | 66.104*** (df = 5; 40) | 1,600.900*** (df = 4; 41) |
| *Note:* | | | *p<0.1; **p<0.05; ***p<0.01 |

Imposing restrictions to $(A)$ and $\mathbf{B}$ in $\mathbf{BX_t} = \sum_{i=0}^{n} \mathbf{AX_{t-i}}$, and in the one lag case, estimating the model $\mathbf{X}_t = \mathbf{B}^{-1}\mathbf{A}X_(t-1) + \epsilon$.

Future work will produce an 80 equation SVAR of the Irish economy.

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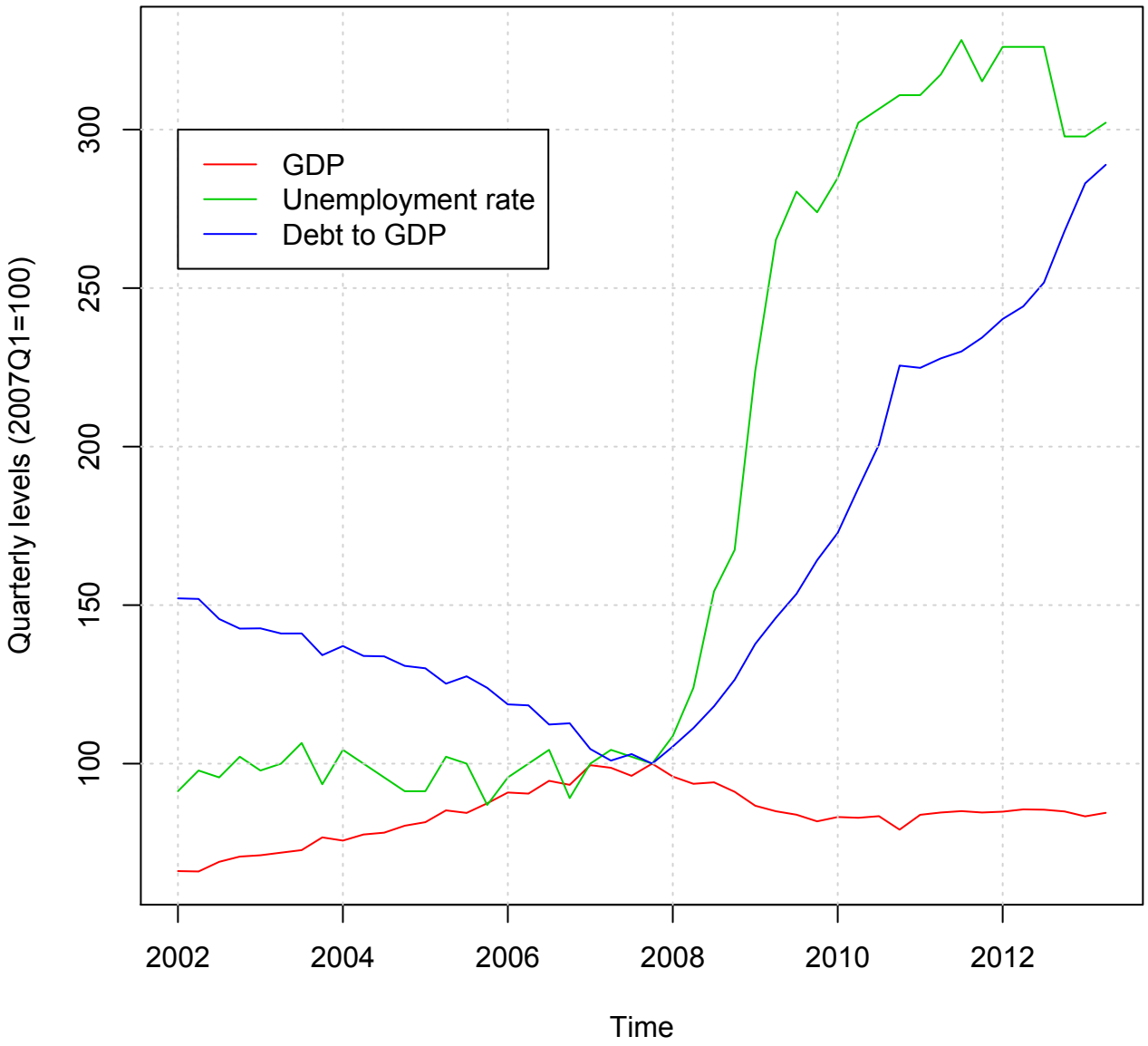


Figure 1: Quarterly levels of Unemployment, GDP, and Debt to GDP. Q1, 2007 = 100. Source: Central Statistics Office.

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Figure 2: Sectoral balances for Ireland, 2002Q1-2013Q1. Source: Central bank of Ireland.

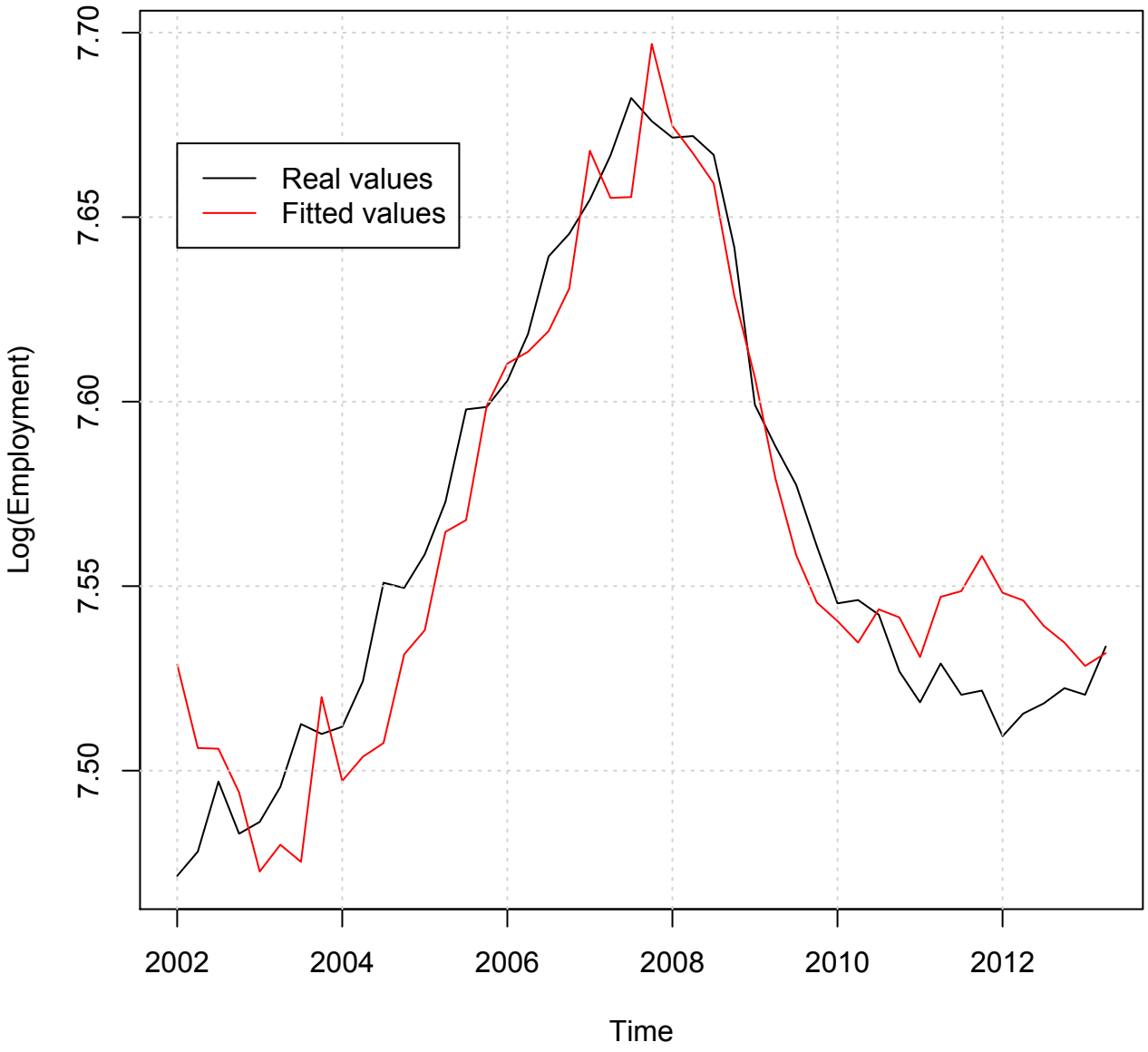


Figure 3: Employment in the Irish economy, real and estimated.

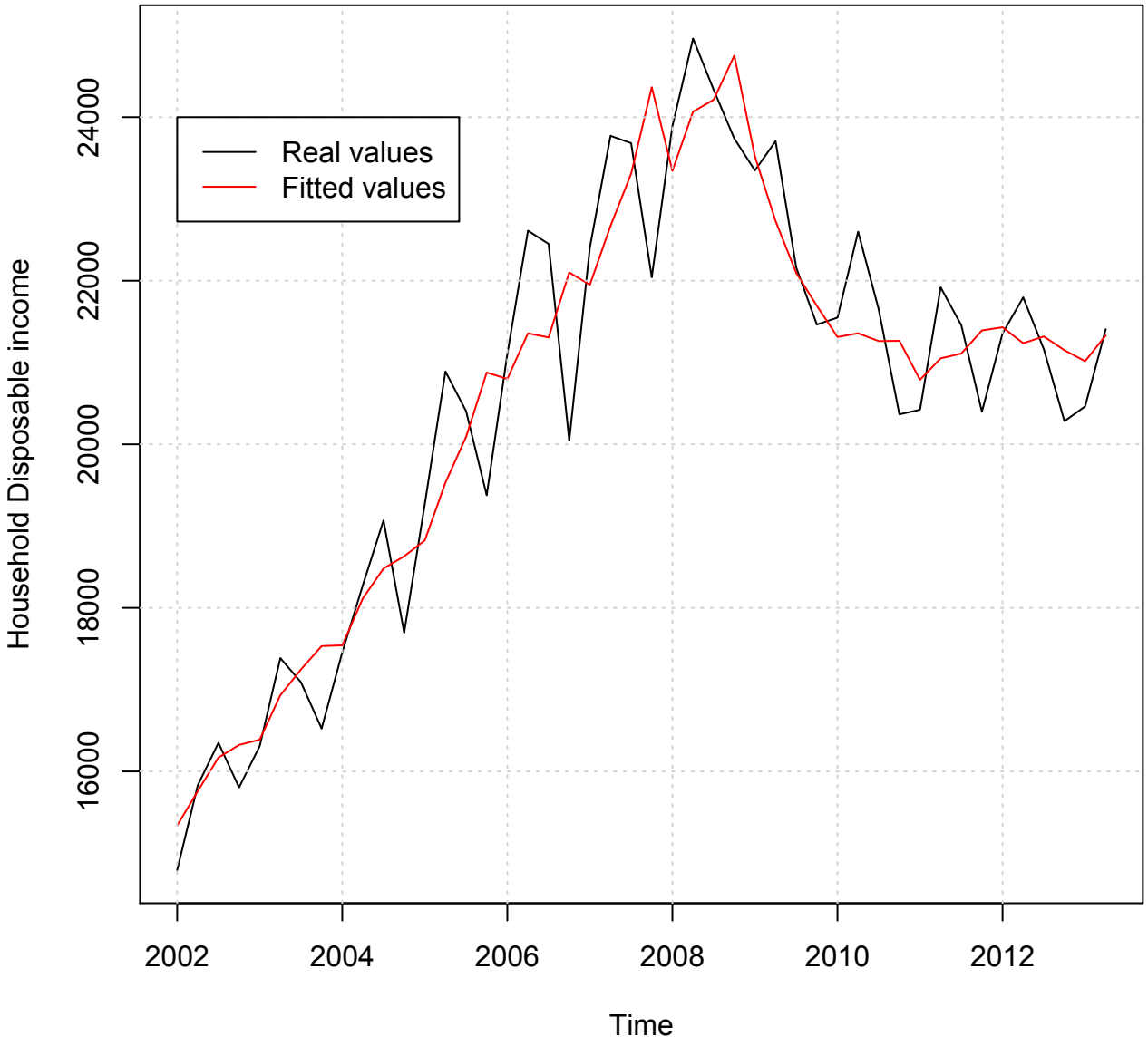


Figure 4: Household disposable income in the Irish economy, real and estimated.

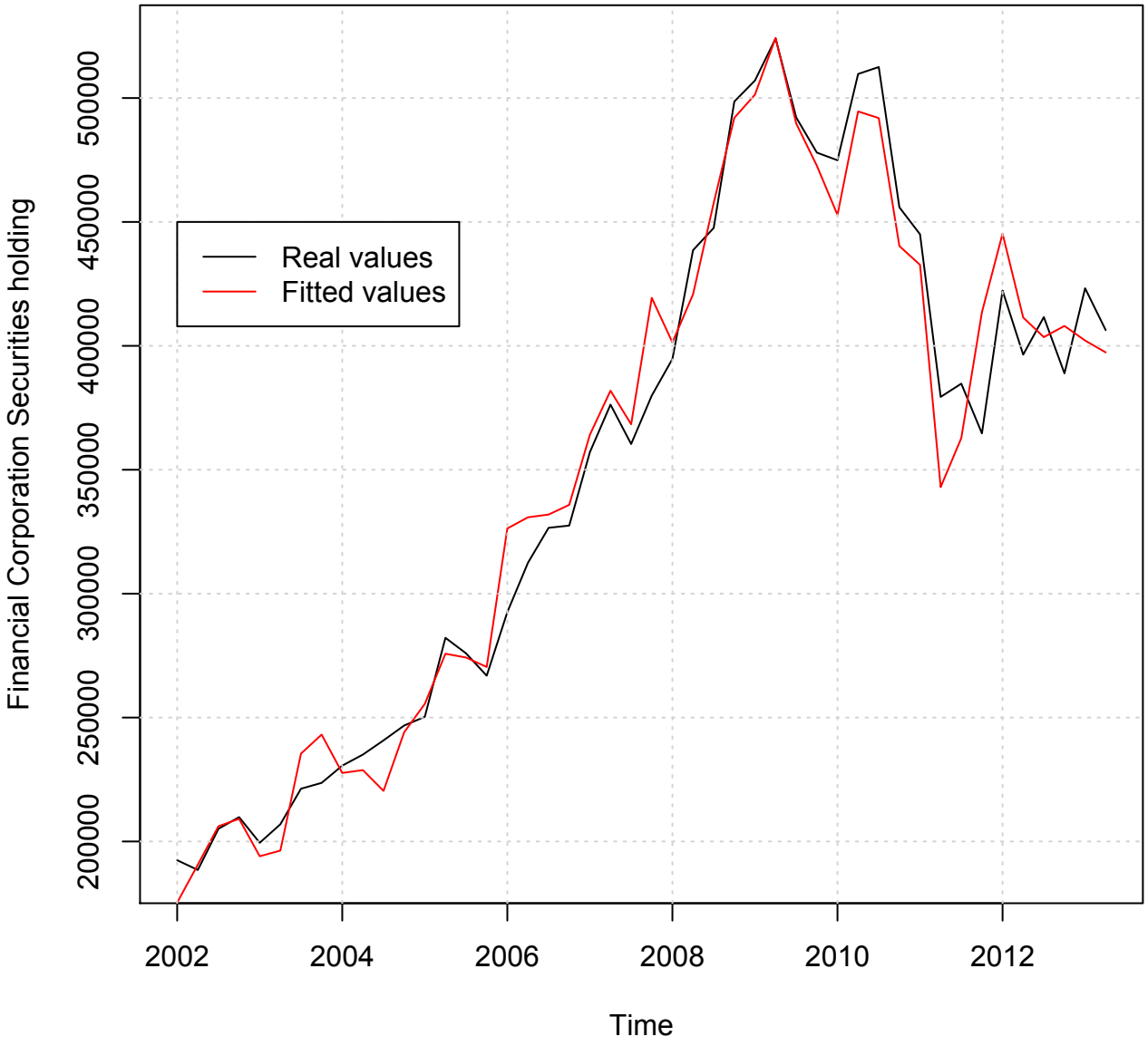


Figure 5: Financial corporate securities holdings in the Irish economy, real and estimated values.


Figure 6: Non financial corporate loans in the Irish economy, real and estimated values.