The impact of Quantitative Easing in the Netherlands: a stock-flow consistent approach*

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Abstract

The Netherlands is a prosperous, small open economy with a large financial sector and a trade balance surplus. Current observations suggest that the quantitative easing (QE) initiated by the ECB has a strong impact on the financial sector and international capital flows, while the impact on economic growth is relatively weak in the Netherlands. We analyse these stylised facts using the stock-flow consistent (SFC) approach which builds on earlier work.

We develop an open economy SFC model for the Netherlands with an elaborated financial sector, including pension funds which invest to a large extent abroad, and recognise that firms invest a considerable part of their financial assets abroad. This enables us to explain that the direct effects of QE are relatively small due to substantial foreign selling of Dutch government bonds and recapitalisations of the financial sector. The indirect effects of QE are much stronger. They influence the economy through low interest rates and exchange rate appreciation, but may have unintended consequences through increased housing prices and asset prices – the latter two are endogenous in our model.

We calibrate the model to mimic the observed stylised facts for the Netherlands and perform some policy experiments.

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1. Introduction

After the financial crisis in 2008 the Netherlands experienced a double-dip recession, in line with the Euro Area developments. Fiscal policy was dominated by concerns about government debt and aggravated the recession (de Grauwe and Yi, 2013; Stiglitz, 2016). Alarmed by these developments the ECB, and many central banks world-wide, have been following an expansionary monetary policy. However, the effects were very limited – growth in the Euro Area lagged behind that of the UK and the US. Moreover inflation continued to fall. As a desperate measure the ECB resorted to a policy of quantitative easing in 2015, long after the FED in the US and the Bank of England followed similar policies. In the Netherlands president Klaas Knot of De Nederlandsche Bank (DNB) was opposed to this measure and warned repeatedly against adverse effects to the Dutch economy (DNB, 2016b). The effects are on the one hand too high a mortgage burden for the already highly indebted households and too much debt for firms which are also highly indebted relatively to the Euro Area average. On the other hand the low interest rate poses problems for pension funds because of the increased liabilities, since these liabilities are discounted at the market interest rate. It also poses problems for banks and insurance companies because their profits decreased considerably due to the low interest margin.

A fascinating observation is that although the ECB has been injecting almost 8 per cent of GDP on an annual basis in the economy since early 2015, largely through the DNB, the effects are hardly visible in terms of higher growth and inflation in the Netherlands. The reasons for this are not yet well identified and the present paper intends to contribute to an analysis of the absent impact of QE. Our analysis will be based on the stock flow consistent approach, summarized in Godley and Lavoie (2007a), which promises a very interesting way to model the interaction between the monetary and the real sphere in a coherent framework. The explicit role of balance sheets and portfolios of financial assets of the various sectors in the model, together with the detailed impact of wealth effects on consumption, enables us to identify the impact of QE in detail. For instance the negative effects mentioned by DNB (2016b) which we summarised above can be explained form our analysis. We also identify the danger of a new house price bubble.

We have developed an open economy stock-flow consistent model, with a separate banking sector and government, in Meijers, Muysken and Sleijpen (2015) – MMS (2015) from hereon. In this paper we add a pension fund which invests to a large extent abroad, see also MMS (2014), and recognise that firms invest a considerable part of their financial assets abroad (MMS, 2016). This enables us to explain on the one hand the abovementioned phenomena observed for the Dutch situation and on the other hand that QE is not effective because most of the impact of QE leaks away – it either leaks away abroad or remains within the financial sector with no discernible impact on the real economy.

After a review of the literature below, we present the stylised facts for the Dutch economy discussed above more in detail in section 2. In section 3 we present the full model. However, as is the case with most stock-flow consistent models this model is analytically intractable and its properties can only be analysed numerically. For that reason the model is analysed in section 4 by means of numerical simulations in order to reproduce the stylised facts for the Netherlands discussed above. In particular we focus on the channels through which QE leaks away to the financial sector and abroad. Section 5 concludes.

1.1 Survey of the literature[1]

Quantitative Easing (QE) is a policy of purchasing assets (bonds), financed by central bank reserves, to stimulate aggregate demand (nominal spending).[2] The literature distinguishes between various channels through which QE is supposed to affect the economy. Next to a direct channel, resulting from an increase in money supply, there is also the portfolio rebalancing channel, induced by a rebalancing of portfolios by the private sector and a more favourable exchange rate. That is "asset purchases should lead to an increase of the prices of government bonds ... the implied rise in the value of portfolios and the lower cost of external finance should lead to a boost in consumption and investment spending in the economy."(Bridges and Thomas, 2012, p. 5). Finally, Dunne, Everett and Stuart (2015) also mention the signalling channel, affecting expectations. We elaborate these channels below.

Transmission channels of QE

The direct effect of the QE policy follows from the central bank buying bonds from banks without a repurchase agreement, i.e. the bank does not have to repurchase the bonds. The banks then are supposed to use their increased bank reserves to increase lending and thus stimulate the economy (McLeay et al., 2014).[3]

The majority of the bonds will not be purchased directly from banks. In the domestic case the central bank buys assets from pension funds and banks will simply act as intermediary (Gros et al., 2015).[4,5] Although the transaction in this way leads to increased money supply, the main impact of this transaction on the economy, if any, will be through increasing bond and equity prices, i.e. the portfolio rebalancing channel (Valiante, 2015).[6] The empirical evidence with respect to the impact of this channel on investment, consumption and GDP growth is rather mixed – for two contrasting views see Gern et al. (2015) and Gagnon (2016).

An important aspect of the purchases in the secondary bonds market is that many assets are held abroad. For instance Valiante (2015) points out that the majority of eligible assets is held by non-banks in France and Italy as far as Euro Area countries are concerned. Next to that a large amount of

[1] This survey closely follows Muysken (2016).

[2] In the case of the Euro Area QE is represented by the expanded asset purchase programme and the vast majority of this programme will under the public sector purchase programme (PSPP) "through which bonds issued by euro area central governments, agencies and European institutions will be purchased in secondary markets." (Dunne, Everett and Stuart, 2015, p. 70).

[3] "..banks cannot directly lend out reserves. Reserves are an IOU from the central bank to commercial banks. Those banks can use them to make payments to each other, but they cannot 'lend' them on to consumers in the economy, who do not hold reserves accounts. … the newly created reserves do not, by themselves, meaningfully change the incentives for the banks to create new broad money by lending."(McLeay et al., 2014, p. 12)

[4] However, one should realise that "There is a widespread view that banks will be the largest (potential) sellers of government securities to the ECB. But this remains to be seen. At any rate, banks did not hold large amounts of government bonds in the US and, to a lesser extent in the UK. In these two countries, the central banks thus bought the bonds from non-bank institutions, with banks being only intermediaries." (Gross et al., 2015, p.7).

[5] "In the UK most sales came from pension funds and other non-bank financial intermediaries. This might have been the result of a combination of moral suasion by the Bank of England on pension funds to sell at least part of their large holdings and the regulatory reasons for commercial banks to keep their holdings of government debt."(Bridges and Thomas, 2012, p.8)

[6] Valiante also stresses the importance of the signalling channel.

eligible assets is held outside the Euro Area. This might also be an important source of leakages countering the direct impact of the QE impulse as we elaborate below.

The signalling channel also works mainly through the foreign sector – see Lavoie and Daigle (2011) for an interesting analysis of expectations on exchange rate movements using balance sheets and a stock-flow consistent model.

From the literature we identify two types of leakages of the QE bond purchases which negatively affect the money shock or the stimulation of the economy: (i) effects which impair bank lending; and (ii) purchases of bonds from non-residents. Next to that we identify (iii) indirect effects following from low interest rates and exchange rates. We discuss these briefly.

Leakages which impair bank lending

Bridges and Thomas (2012) identify two effects of QE which worsen bank lending for the UK. The first effect is that banks use the favourable conditions to recapitalise themselves, i.e. issuing more equity (which for simplicity is assumed to be held by pension funds). In that case no money is created, in spite of the QE operation by the ECB. According to Bridges and Thomas (2012) the reparation of bank balance sheets implies a leakage of about 30 per cent of QE in the UK.

When discussing the second effect Bridges and Thomas (2012) observe for the UK that it is implausible that QE increased the supply of credit through the money multiplier.[7] In their view it is more plausible that the demand for credit increased as a result of QE, for instance by private non-financial institutions (i.e. firms) issuing bonds and equity to pay down bank debt. This process accelerated the shift in the UK from bank finance to the capital markets. Bridges and Thomas (2012) find that the acceleration of the shift from bank finance to the capital markets implies a leakage of another 8 per cent.[8]

For both effects we could not find relevant figures for the Netherlands, but one should take into account that banks and pension funds in the Netherlands have a huge foreign exposure as we elaborate below.

Leakages resulting from buying bonds abroad

The purchase of domestic bonds held by non-residents is briefly discussed by Bridge and Thomas (2015) as a potential leakage of QE. However, they do not find any significant leakage from bond sales abroad. The preliminary findings on the current situation in the Euro Area are quite different and work mainly through the Intra Euro System Balances (Target2).

The most obvious purpose of Target2 is to facilitate cross-border payments resulting from importing and exporting goods and services. However, the purchase of domestic bonds held by non-residents will also influence Target2.[9] In that respect Westermann (2016) elaborates on two mechanisms through which the Target2 balances are affected by QE: cross-border bond transactions and capital

[7] This is in line with McLeay et al. (2014) who emphasise the intermediary function of banks and therefore categorically argue against a misconception of QE as facilitating the money multiplier.

[8] Cizel et al. (2016) point out that the latter shift is also due to more intensive macro-prudential policy, which is focussed on the banking sector. They argue in favour of extending the policy beyond banking.

[9] This point is elaborated extensively in Muysken (2016) who also surveys the discussion of Target2 imbalances initiated by Sinn and Wollmershäuser (2011).

flight. As for the first mechanism central banks purchase bonds from foreign as well as domestic holders. For instance, if the Bundesbank purchases a German bond from an Italian pension fund and this investor – after selling the bond – keeps the liquidity in Italy, this creates Target-2 balances. What actually happens is that the Bundesbank acquires bonds by increasing its liabilities to the Target2 system, but since the liquidity is kept in Italy, foreign banks can pay back advances to the foreign central bank.

Interestingly, Westermann observes that "Weidmann [the president of the Bundesbank] concluded that this changes the interpretation of Target-2 balances away from a signal of financial market tension towards a direct effect of QE".[10] A similar conclusion can be found in DNB (2016a), who point out that it was the funding stress of banks following the capital flight which led to the tensions in 2012. However, DNB (2016a) also observes that it is highly implausible that the Italian pension fund will keep the liquidity in Italy, also when Italian bonds are bought by the Banca d'Italia. As a consequence QE leads to a new wave of capital flight, when the domestic bond holder uses the acquired liquidity to buy foreign assets.[11] This mechanism is explicitly discussed by Minenna (2016).[12]

In the examples above we focussed on transactions within the Euro Area. However, the leakage effect of buying domestic bonds by national central banks can also happen outside the Euro Area. In that case the exchange rate will also be affected which leads to important secondary effects as we discuss below.

Indirect effects resulting from a low interest rate and exchange rate

Obviously QE is accompanied by a low interest rate which stimulates the economy through its positive impact on consumption and investment. As we already mentioned above DNB (2016b) points at the dangers of a mortgage burden for the households and too much debt for firms. Moreover the low interest rate poses problems for pension funds because of the increased liabilities, since these liabilities are discounted at the market interest rate. It also poses problems for banks because their profits decreased considerably due to the low interest margin.

An additional effect is that QE will lead to a depreciation of the Euro. The resulting impact of QE on the exchange rate is widely observed to be highly relevant for the Euro Area through its stimulating impact on net exports (Gros et al., 2015).

[10] Actually Weidmann gave the example of Banca d'Italia buying domestic bonds from a German resident. The resulting increase in Target2 assets for Germany then is not an indication of funding stress in Italy, opposite to the case in 2012.

[11] "If the Banca d'Italia purchases the bond domestically, and the previous bondholder uses the money to buy a house in Berlin, this will drive up Target-2 balances. The condition is that the previous house owner keeps the liquidity in the country and does not balance the transaction, for instance, by buying real estate in Italy." Westermann (2016)

[12] "A new source of capital flows has emerged and become the primary driver of Italy Target2 negative net balance: a shift in Italy's private non-banking sector from government and banking bonds to foreign shares and mutual funds."(Minenna, 2016).

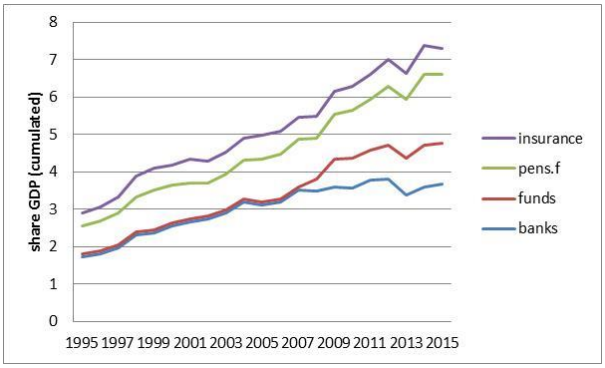
2. *The Dutch economy and quantitative easing in the Netherlands, some stylised facts*

In this section we present stylised facts for the Netherlands which will influence the choice of the sectors in our model, the composition of the balance sheet of each sector and the flows between the sectors. We will discuss the financial institutions in section 2.1, households, firms and government in section 2.2 and the foreign sector in section 2.3. We then conclude with a description of the role and potential impact of quantitative easing in section 2.4.

2.1 Financial Institutions

From Figure 1 one observes that the Netherlands has a very large financial sector compared to European standards: that is the assets of the Dutch financial sector are currently over 700 per cent of GDP whereas the average in the Euro Area is below 500 per cent. As is elaborated in Bezemer and Muysken (2015) this is mainly due to the presence of large pension funds (and investment funds, as we elaborate below).[13]

Figure 1 Total assets of financial institutions[14]
(relative to GDP, cumulated), 1995 – 2015



Source: DNB statistics

From the composition of the financial sector presented in Figure 1, one observes that the size of the banking sector (banks – MFIs in statistical terms) increased relative to GDP, from below 200 per cent in 1998 till above 350 per cent in 2008. However, after the financial crisis in 2008 it has stagnated around that level. Interestingly enough, this stagnation has initially been compensated by the increasing importance of investment funds (funds), which took over the role of banks in asset management for pension funds and households. Together total assets of banks and funds are at a level of almost 500 per cent of GDP.

The remaining part of the financial sector consists of pension funds and insurance companies, which together have increased consistently relative to GDP, from 150 per cent of GDP in 1998 to about 250 per cent in 2015. Given their importance for the financial sector in the Netherlands, we discuss the banking sector (MFIs) and the pension funds in more detail below.

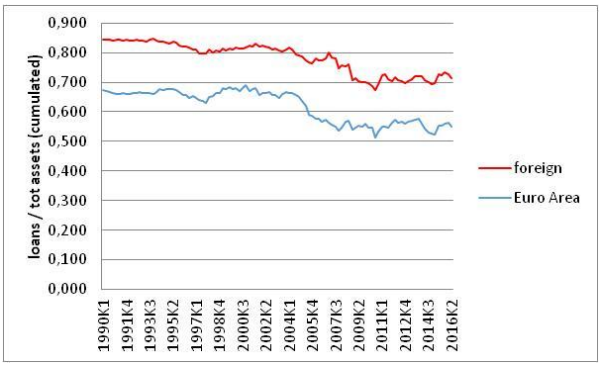
[13] We ignore the so-called special financial institutions (SFI) which comprise both a large shadow banking sector and many companies ("brievenbus firma's") that are established in the Netherlands for tax reasons. The total assets (and liabilities) of these institutions vary in recent years between 500 and 600 per cent of GDP – see Bezemer and Muysken (2015) and CPB (2016) for concerns on the impact of these institutions on the financial system.

[14] The fluctuations in the various statistics are due to definition changes.

The banking sector

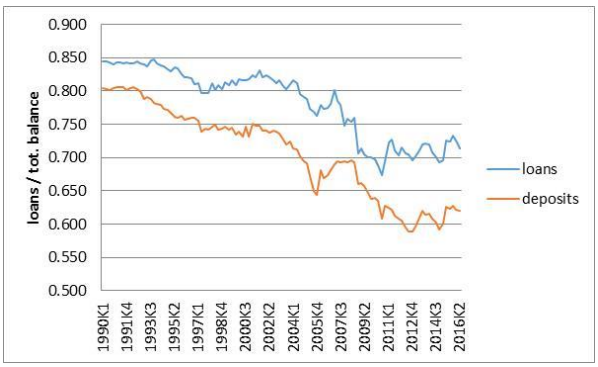
The assets of MFIs mainly consist of loans as appears from Figure 2. These loans comprise around 70 per cent of total assets and the majority is issued within the Euro Area. In Figure 3 one observes that the total of outstanding loans is not covered by deposits.[15] This is a manifestation of the so-called "deposit financing gap". As we elaborate in MMS (2015) this gap poses a considerable problem for banks because outstanding debt is insufficiently matched by deposits, whereas other funding possibilities of banks have increasingly been constrained. In that case banks have to resort to foreign funding which is much more volatile and relatively expensive. About 20 per cent of foreign liabilities is borrowed outside the Euro Area.

Figure 2 Assets banking sector (MFI) (cumulated), 1990:I – 2016:II



Source: DNB statistics

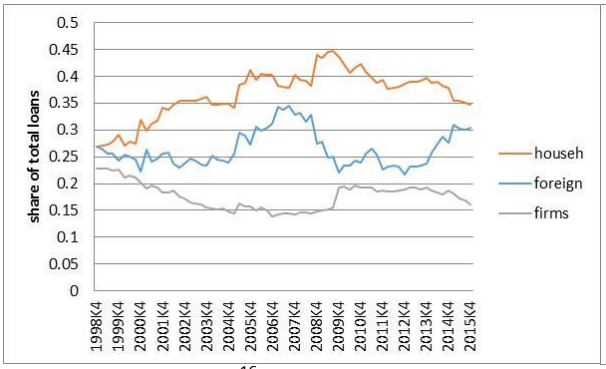
Figure 3 Loans and deposits of banks 1990:I – 2016:II



Source: DNB statistics

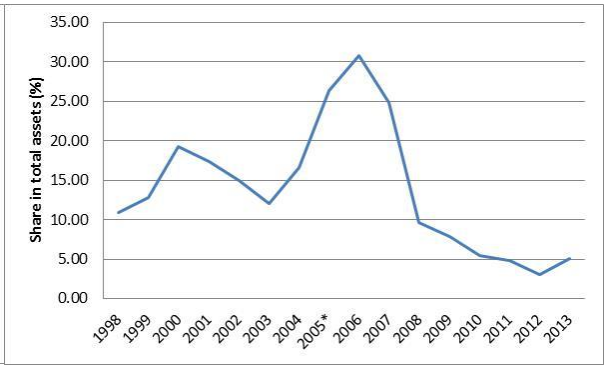
As appears from Figure 4, over 35 per cent of loans consists of mortgages ("househ"); loans to firms cover almost 20 per cent and abroad ("foreign") between 25 and 30 per cent. As is elaborated in Bezemer and Muysken (2015) banks prefer to issue mortgages to households, which are considered to be safe investments and there is much discussion in the Netherlands that in particular small and medium sized firms are being discriminated against (credit squeeze). The relatively large share of loans abroad reflects the open orientation of the banking sector and the recent increase indicates capital flight from Southern Europe as we discuss in section 1.1.

Figure 4 Distribution of loans of banks 1998:IV – 2016:II



Source: DNB statistics[16]

Figure 5 Net open position of shares in banks 1998 – 2015



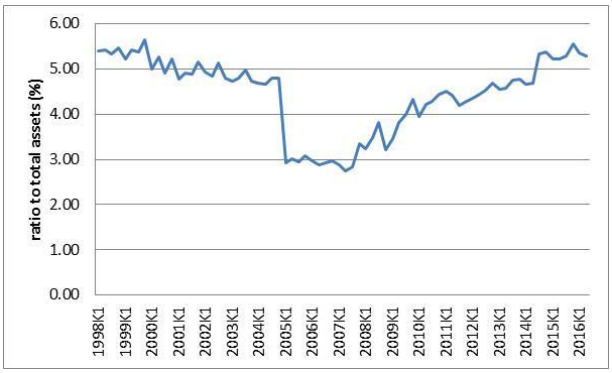
Source: DNB statistics

[15] Deposits should be understood here to include savings accounts and related accounts.

[16] The distribution of loans presented in the financial stability indicators has been supplemented with SPVs.

Banks also hold financial assets, partly for trading purposes and partly related to asset management. From Figure 5 one might conclude that accumulating financial assets by banks for trading purposes has decreased dramatically after the financial crisis.[17] Also asset management has been taken over by investment funds as we elaborate below. A final observation relates to liabilities. After the financial crisis the capital ratio of banks has increased consistently till 2014 – see Figure 6. It is remarkable that this ratio has not increased further in the last years.

Figure 6 Capital ratio of MFIs, 1998:I – 2016:II[18]

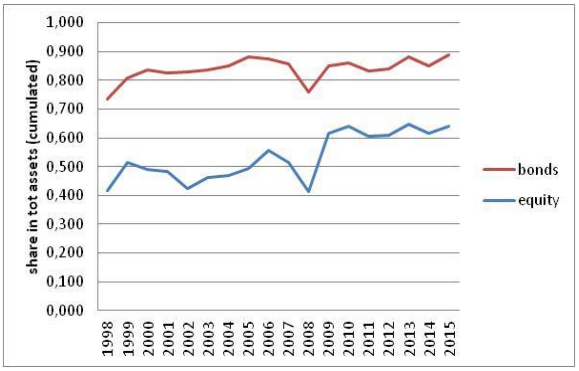


Source: DNB statistics

Pension funds

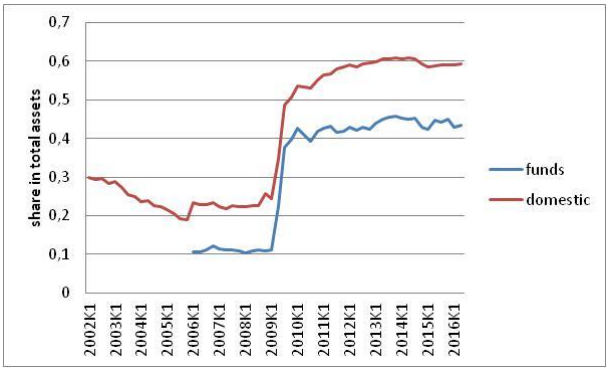
The Netherlands has a funded pension system according to which wage earners (and employers) are obliged to contribute to their pension fund by paying a premium based on their wage. When retiring, the pensioners receive a pension benefit. As a consequence the Netherlands has a very large pension sector.[19] For that reason we elaborate the structure and problems of the pension funds below.

Figure 7 Composition assets pension funds[20] (cumulated) 1998 – 2015



Source: DNB statistics

Figure 8 Domestic share assets pension funds 2002:I – 2016:II



Source: DNB statistics

[17] In this context one should realise that the banking sector in the Netherlands essentially consists of four large banks. Three banks have been bailed out after the financial crisis and two of these banks are still (dominantly) state owned.

[18] The shift in 2004 is due to a change in definition as well as the jump in 2014.

[19] Also the majority of the insurance consists of life insurances, which have a financing structure which is quite similar to that of pension funds.

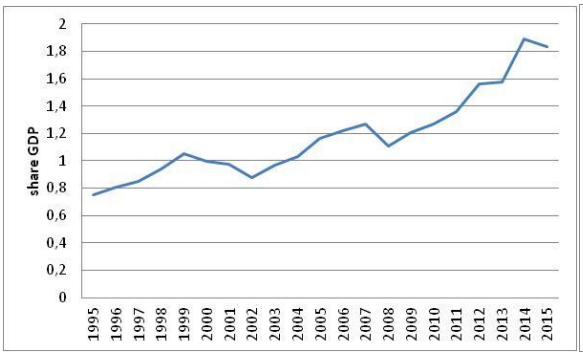
[20] The dip in 2008 is due to the fall in share prices. Since GDP growth dropped from 3.7 per cent in 2007 to 1.8 per cent in 2008 and – 3.8 per cent in 2009 this does not explain the sharp increase after 2008.

The composition of assets of pension funds is presented in Figures 7 and 8. As is illustrated in Figure 7 the share of equity in total assets of pension funds increased consistently over time – for a further discussion of the historical development see Bezemer and Muysken (2015). As we already discussed above, from 2009 onwards a substantial part of the portfolio of pension funds is handled by investment funds: the corresponding assets appear as equity on the balance sheet of pension funds. However, only 20 per cent of the portfolio of investment funds consists of bonds – hence equity remains dominant on the pension funds' balance sheet.

Another characteristic of the assets of pension funds is the foreign exposure, as appears from Figure 8. Till 2008 the share of domestic assets of pension funds decreased till below 25 per cent of total assets. The increase till 60 per cent after 2008 is due to the introduction of investment funds, which are registered domestically. However, investment funds only invest about 20 per cent of their assets domestically. As a consequence indirectly the share of foreign assets remains about 75 per cent of the total assets of pension funds.

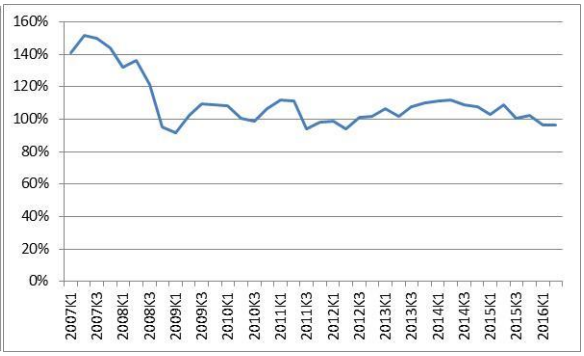
The liabilities of the pensions sector are predominantly liabilities to households. One should realise that future liabilities of pension funds are discounted at the market interest rate. This implies that a decrease in the interest rate then leads to higher liabilities on the balance sheet of the pension fund. Thus the low interest rate from 2008 onwards explains why the liabilities of the pension funds have increased dramatically after the financial crisis: from 120 per cent of GDP in 2007 to 180 per cent in 2015 – see Figure 9. As a consequence the reserve ratio of pension funds has fallen below the critical threshold of 110 per cent in recent years. This forced pension funds to increase contributions and decrease benefits. It also initiated a debate about the desirability and the nature of the funded pension system.

Figure 9 Liabilities pension funds 1995 – 2015



Source: DNB statistics

Figure 10 Reserve ratio pension funds 2007:I – 2016:II



Source: DNB statistics

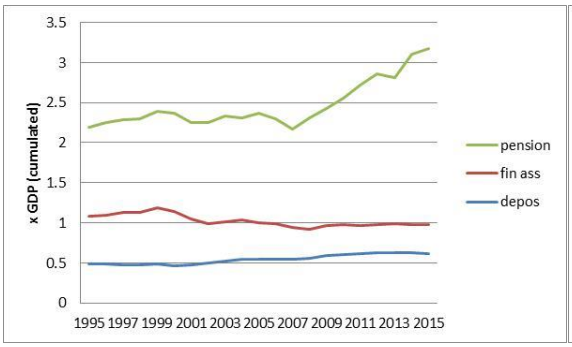
2.2 Households, firms and government

Next we present stylized facts on the balance sheets of households, firms and government.

Households: pension claims and the deposit financing gap

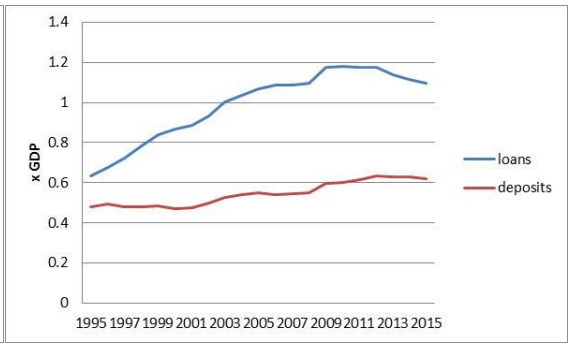
Ignoring homeownership, the assets of households consist of deposits, financial assets and claims on pension funds and life insurance – see Figure 11. The financial assets decreased to 40 per cent of GDP.[21] This is consistent with the decrease in voluntary individual savings, which is related to the increase in housing prices as explained in MMS (2015). The forced savings due to the funded pension system contributed to large pension claims – over 100 per cent of GDP prior to 2008. The sharp increase in these claims (including life insurances) after 2008 follows from the low interest rate as we discussed above.

Figure 11 Assets households (cumulated), 1995 – 2015



Source: CBS statistics

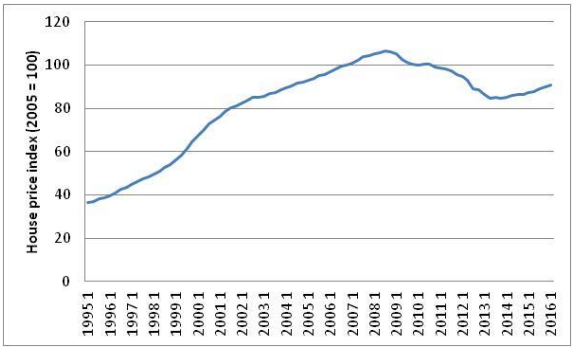
Figure 12 Liabilities households (and deposits) 1995 – 2015



Source: CBS statistics

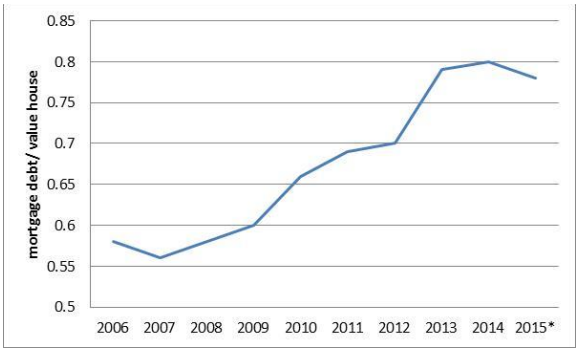
The liabilities of households consist predominantly of mortgages. Figure 12 reflects the increased mortgage burden, since loans consist predominantly of mortgages issued by banks. We also added deposits held by households to illustrate the deposit financing gap discussed above. The increase in the mortgage burden reflects increased house prices. Between 1995 and 2008 these prices increased by 250 per cent as can be seen from Figure 13. As we explain in MMS (2015) this reflects both the eagerness of banks and other financial institutions to provide mortgages and tax advantages which

Figure 13 House prices, 1995:I – 2016:II



Source: CBS statistics

Figure 14 Mortgage debt/value house 2006 -2015



Source: CBS statistics

[21] Only 20 per cent of these assets are financed through investment funds – hence we ignore this for households.

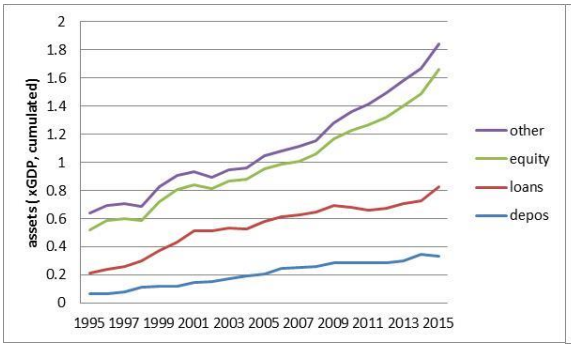
allow interest payments on mortgages to be deducted from pre-tax annual income. The house price bubble did burst after the financial crisis and house prices decreased after 2007. However, house prices started to increase again in 2013 fuelled by the low interest rates (and stagnating supply of new houses). DNB (2016b) is consistently warning against the potential dangers of low interest rates as we mentioned in section 1. This warning is also illustrated in Figure 14: the mortgage debt relative to the value of the house for house-owners with a mortgage has increased from 56 per cent in 2007 to 78 per cent in 2015. This increase reflects the decrease in house prices which started in 2007. In spite of the recent rebound of house prices, 32 per cent of all households in the Netherlands had a mortgage debt larger than the value of the house in 2016, compared to 13 percent in 2007.

A remarkable feature is that on the one hand households on average have a large mortgage debt, mainly held by banks, and on the other hand have a large claim on pension funds – compare Figures 11 and 12. An important issue in the discussion on the potential reforms of the funded pension system is to look for ways to net these assets and liabilities out, at least partially.

Firms: savings are invested in financial assets

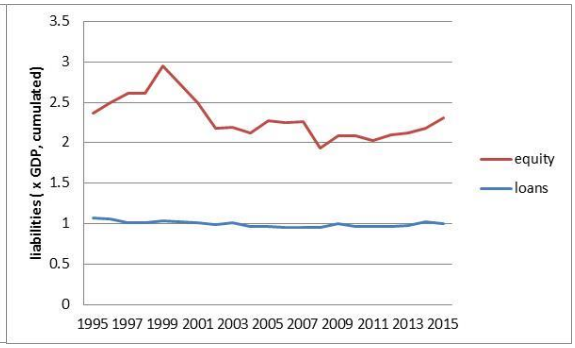
In a simple model of the economy the assets of firms consist of physical capital and deposits at banks and firm savings are invested in physical capital. However, from Figure 15 one observes that a considerable part of firm savings are invested in financial assets, both equity and loans. Moreover, the majority of these savings is invested abroad – see MMS (2016) for a further discussion.[22] The financial liabilities of firms consist mainly of loans and equity – see Figure 16.

Figure 15 Financial assets firms (cumulated), 1995 – 2015



Source: CBS statistics

Figure 16 Liabilities firms (cumulated), 1995 – 2015



Source: CBS statistics

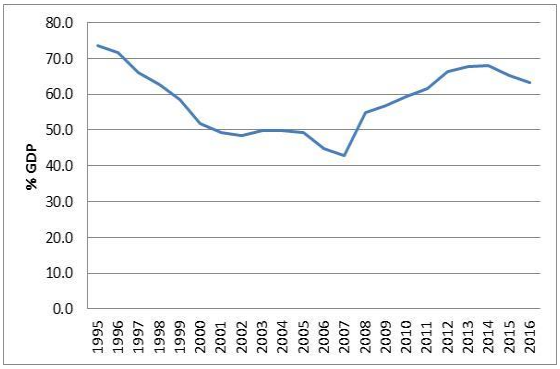
The majority of firm financial assets are held by multinational corporations and not by the small and medium firm enterprises. Bezemer and Muysken (2015) point out in that context that a dichotomy exists between these two types of firms. For the multinationals holds for instance that non-financial assets covered around 175 per cent of the value added over the period 2000 -2014, while the financial assets increased from 450 per cent in 2000 to 800 per cent in 2012.

[22] Hardly any of these assets are financed through investment funds – hence we ignore this for firms.

Government: borrows mainly abroad

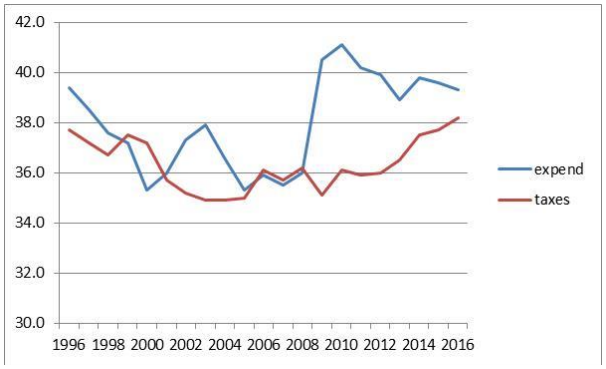
As in most countries government debt increased sharply after the financial crisis, partly due to the working of the automatic stabiliser and also to the bailing out of banks – see Figure 16. Government reacted by decreasing expenditures and increasing taxes as appears from Figure 17. Although one might argue that this exacerbated the recession and hence had an adverse effect on government debt,[23] debt started to decrease relative to GDP after 2014. In section 1.1 we discuss the question to

Figure 16 Government debt, 1995 – 2016



Source: CPB

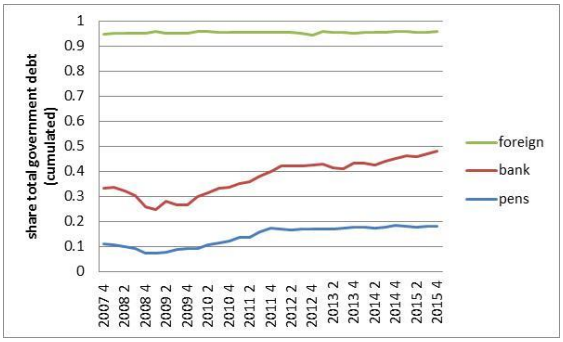
Figure 17 Expenditures and taxes, 1996 – 2016



Source: CPB

what extent the policy of quantitative easing by the ECB might have played a role. Finally an important observation is that the majority of government debt is held abroad – see Figure 18. The major domestic holders of bonds are banks and pension funds.

Figure 18 Holdings of government debt, 2007:IV – 2015:IV



Source: CBS statistics

2.3 *The foreign sector*

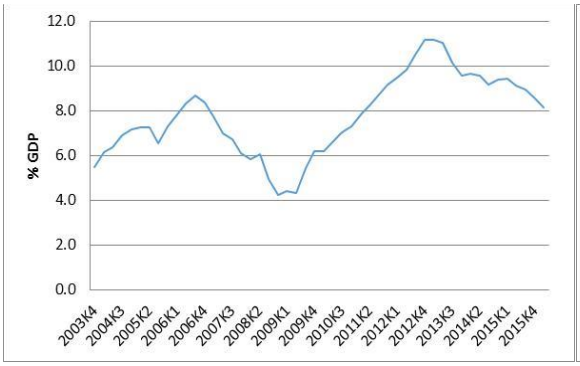
The Netherlands traditionally has a current account surplus. However, in recent years this has increased to unprecedented heights, above 10 per cent – see Figure 19. The recent fall to 8 per cent is due to lower profitability of firms (non-financial institutions): they generated less return on their foreign assets and also distributed considerably less profit to their foreign companies (DNB, 2016c).

An interesting observation is that when the cumulated current account surplus is compared to the net foreign asset position of the Netherlands strong divergences can be noted as appears from Figure 20. The difference between both lines should be attributed to valuation losses and gains on net

[23] See de Grauwe and Yi (2016) and Stiglitz (2016).

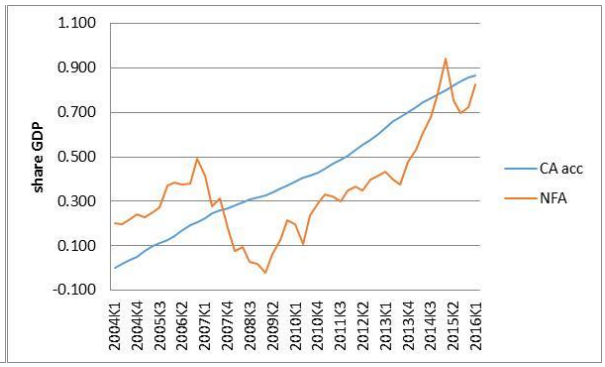
foreign assets. The dramatic fall in share prices in 2007 explains the decline in net foreign assets relative to the accumulated current account balances, whereas the recent increase in share prices explains the opposite development.

Figure 19 Current account surplus 2003:IV – 2016:I



Source: DNB statistics

Figure 20 Accumulated current account surplus 2004:I – 2016:I



Source: DNB statistics

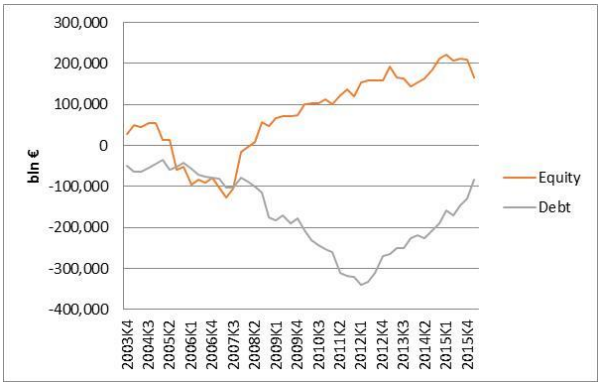
From Figure 20 one also notes that net foreign assets are about 80 percent of GDP. Actually net external debt is reasonably close approximated by the net positions of securities plus direct investment (including SFIs). However, the SFIs are mainly related to direct investments, with a counterpart in securities (debt) and net out more-or-less. As a consequence we have a closer look at net direct investment and net securities.

Net direct investments excluding SFIs have increased over time (both at market value and at book value) – see Figure 21. The net direct investments can also be mergers and take-overs (at too high a price – cf what happened in 2007). A remarkable occurrence is the stagnation in the period 2010 – 2014, followed by a sharp increase in 2015. From Figure 22 one observes that net securities have increased consistently (partly reflecting increased firm savings). An interesting development is the reversal in net debt (compensating the stagnation in direct investment in the period 2010 - 2014).

Figure 21 Net direct investment (excl. SFIs) 2003:IV – 2016:I

Source: DNB statistics

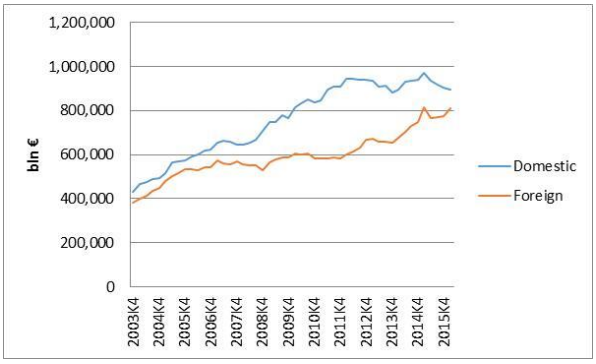
Figure 22 Net securities and net debt (excl. SFIs) 2004:I – 2016:I



Source: DNB statistics

The reversal in debt is due to stagnating foreign demand for domestic debt (domestic), while domestic demand for foreign debt (foreign) increases consistently – see Figure 23. The recent fall in foreign demand for domestic debt can probably be attributed to DNB buying domestic debt.

Figure 23 Domestic and foreign debt, 2007:IV – 2015:IV



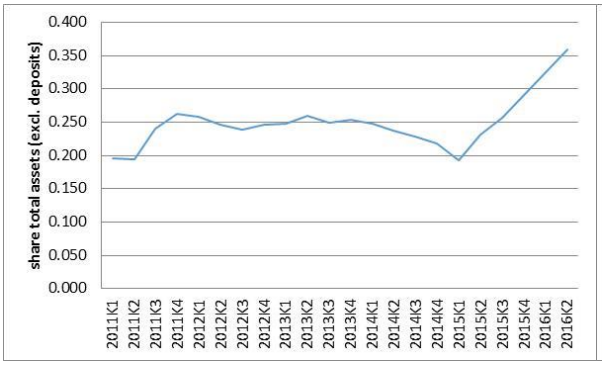
Source: DNB statistics

2.4 The impact of Quantitative Easing

As is elaborated in Muysken (2016) the QE operations are mainly carried out under the responsibility of the National Central Banks. That is each NCB buys bonds issued by its own government on the secondary market, according to the share of the various countries in the ECB's capital. However, the related profits (and risks) are not borne according to capital share, but accrue to the National Central bank.

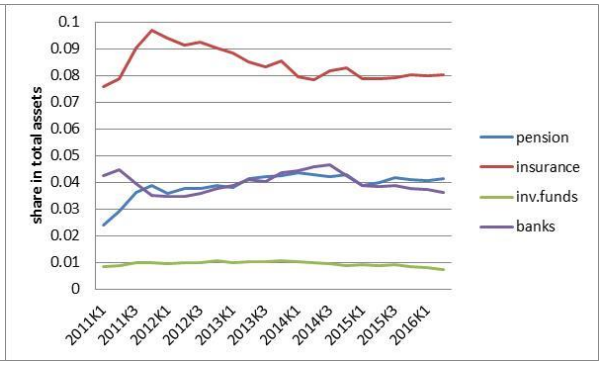
From Figure 24 one observes how the DNB started to issue government debt from 2015:I onwards. However, as Figure 25 illustrates, none of the financial institutions decreased the share of government debt in their portfolios.[24] The increase in government debt on the balance sheet of the ECB over the period 2015:I – 2016:II is € 39.758 bln, about 6 per cent of GDP, while the debt held by pension funds, insurance companies and investment funds over that period did not decrease – it increased even by € 1.254 bln. This illustrates that the intended direct impact on financial sector cannot be observed.

Figure 24 Government bond holdings DNB 2011:I – 2016:II



Source: DNB statistics

Figure 25 Government debt held by sectors 2011:I – 2016:II



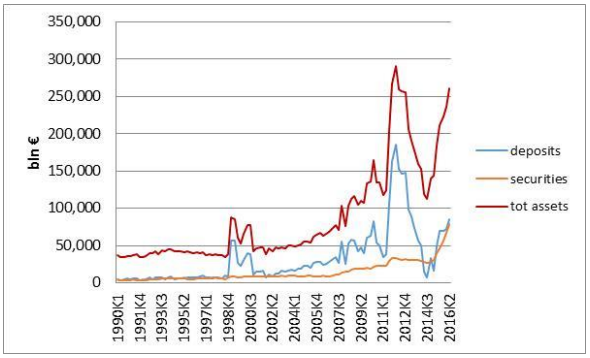
Source: DNB statistics

Taking a broader perspective, one observes from Figure 26 how total assets of the DNB soared after the financial crisis, after 2011 driven by the increase in Target2 balances – the main component of "deposits" in the figure. The increase in Target2 balances is a result from the capital flight from

[24] The share of the banking sector is for all Euro Area government debt.

Southern Europe, as we discussed in section 1.1 – see also DNB (2016a). After the situation calmed down in 2014 we observe a new surge in Target2 balances, now corresponding to the increase in government debt held by DNB – the main component of "securities" in Figure 26. This is an indication that the majority of bonds obtained by DNB has been bought by non-residents.

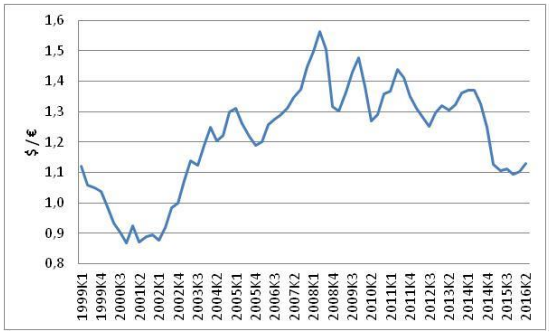
Figure 26 Asset composition DNB
1990:I – 2016:II



Source: DNB statistics

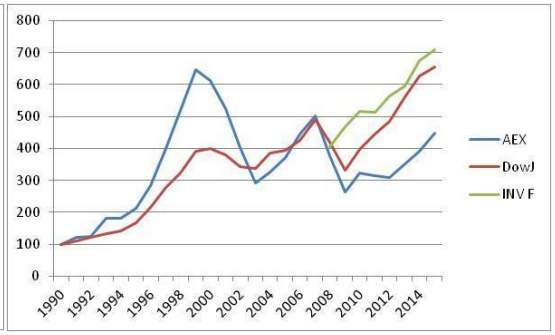
The indirect effects of QE appear through the various channels discussed in section 1.1, i.e. the mortgage burden for households and the development of house prices, the debt of firms and the decreased reserve ratio for pension funds. Two aspects which we have not presented yet are the depreciation of the Euro, which can be observed from Figure 27, and the increase in stock prices. The latter is presented in Figure 28 for the Dow-Jones index, the AEX index and from 2008 onwards returns on investment funds.

Figure 27 The exchange rate ($/€)
1999:I – 2016:II



Source: DNB statistics

Figure 28 Stock indices
1990 – 2015



Source: DNB statistics

Table 1. Balance Sheets

	Households	**Firms**	**Financial Sector**	**Central Bank**	**Government**	**Foreign**	**Total**
High powered money	*+ H_h*		*+ Hb*	*- H*			*0*
Central Bank advances			*- A*	*+ A*			*0*
Bank deposits	*+ M*		*- M*				*0*
Loans		*- L*	*+ L*				*0*
Bills	*+ B_h*		*+ B_{PF}*	*+ B_c*	*- B*	*+ B_a*	*0*
Capital		*+ p·K*					*+ p·K*
Bonds			*- B_{ba}*			*+ B_{ba}*	*0*
Equities	*p_eE_h*	*- p_eE_h+ $p_e.E_{fa}$*	*+ $p_e.E_{PFa}$ - $p_e.E_{ba}$*			*+ $p_e.E_{ba}$- $p_e.E_{fa}$ - $p_e.E_{PFa}$*	*0*
Mortgages	*- MO*		*+ MO*				*0*
Houses	*+ ph.HS*						*+ ph.HS*
Foreign Reserves				*+R*		*-R*	*0*
Total (net worth)	*+ Vh*	*+ Vf*	*+ Vfs*	*0*	*+Vg*	*+Va*	*+Vt*

Table 2. Social Accounting Matrix

	Prod.	Households	Firms	Financial Sector	Central Bank	Government	Capital Account	Foreign	Total
1. Production		*+ p·C*				*p·G*	*p·ΔK +ph.ΔHS*	*X - IM*	*p·Y*
2. Households	*+ WB*		*+FD*	*+ iM + FB*		*+ iB_h*			*+ Yh*
3. Firms	*+ FT*							*+FFA*	*+ FT*
4. Financial Sector		*+ i.MO*	*+ iL*			*+ iB_b*		*+ FPFA*	*+ Yfs*
5. Central Bank				*+ iA*		*+ iB_c*			*+ Yc*
6. Government	*+ Ti*	*+ Td*	*+ Tf*		*+ Fc*				*+ Yg*
7. Capital Account		*+ Sh*	*+ Sf =FU*	*0*	*0*	*+ Sg*		*+ Sa*	*S*
8. Foreign				*+$i_B B_{ba}$+ Fba*		*+ iB_a*			*+Ya*
TOTAL	*+ p·Y*	*+ Yh*	*+ FT*	*+ Yfs*	*+ Yc*	*+ Yg*	*p·ΔK +ph.ΔHS*	*+ Ya*	

Wealth accumulation

$\Delta Vh = Sh + \Delta pe.Eh(-1) + \Delta ph.HS(-1)$

$\Delta Vf = Sf + \Delta pe.Efa(-1) - \Delta pe.Eh(-1) + \Delta p.K(-1)$

$\Delta Vg = Sg$

$\Delta Va = Sa + \Delta pe.Eba(-1) - \Delta pe.Efa(-1)$

$\Delta Vfs = + \Delta pe.Epfa(-1) - \Delta pe.Eba(-1)$

$\Delta V = S + \Delta p.K(-1) + \Delta ph.HS(-1)$

$FD = \rho_e p_e E_h$

$FFA = \rho_{ea} p_e . E_{fa}$

$FPFA = \rho_e p_e . E_{PFa}$

$FbA = \rho_e p_e . E_{ba}$

Table 3. Accumulation and investment of savings

	Households	Firms	Fin. Sector	Central Bank	Government	Foreign	Total
Consumption	- p·C	+p.C+p.G			-p·G		0
Investment		+I + ph.ΔHS					I + ph.ΔHS
Net exports		+X - IM				-(X – IM)	0
Wages	+WB+Fb	-WB	-Fb				0
Taxes	-Td	-Tf -Ti			+Td +Ti + Tf		0
Interest Advances			$-i_a$.A	$+i_a$.A			0
Interest Deposits	+ i_mM		- i_mM				0
Interest Loans		$-i_l$L	+ i_lL				0
Interest Bills	$+i_b$.Bh		$+i_b$.Bb	$+i_b$.Bc	$-i_b$.B	$+i_b$.Ba	0
Interest Bonds			$-i_{ba}$.Bba			$+i_{ba}$.Bba	0
Interest Mortgages	$-i_{mo}$.MO		$+i_{mo}$.MO				0
Dividends Firms/Banks	+FD	-FD	- Fba	- Fc	+Fc	+ FbA	0
Dividends Abroad		+FFA	+ FPFA			-FPFA-FFA	0
Savings	S_h	S_f (FU)	0	0	S_g	S_a	S
High powered money	+ ΔH_h		+ ΔH_b	- ΔH			0
ΔDeposits	+ΔM		-ΔM				0
ΔAdvances			-ΔA	+ΔA			0
ΔLoans		-ΔL	+ΔL				0
ΔBills	$+\Delta B_h$		$+\Delta B_b$	$+\Delta B_c$	-ΔB	$+\Delta B_a$	0
ΔBonds			$-\Delta Bb_a$			$+\Delta Bb_a$	0
Δ Mortgages	-ΔMO		+ΔMO				
ΔEquity	$+p_e\Delta E_h$	$+p_e\Delta E_{fa}$ $-p_e\Delta E_h$	$+p_e\Delta E_{PFa}$ $-p_e\Delta E_{ba}$			$+p_e\Delta E_{ba}$-$p_e\Delta E_{fa}$ $-p_e\Delta E_{PFa}$	0
ΔReserves				+ΔR		-ΔR	0
ΔCapital	+ IH	+ I					+ I + IH

3. The model and quantitative easing

The model used in our analysis is based on the model we developed in MMS (2015). However, new elements are the extension of the financial sector with a pension system with large foreign investments and the introduction of financial assets of firms, which are also invested to a large extent abroad. Both elements contribute considerably to a proper understanding of the development of the Dutch foreign net assets position and the small impact of QE on the Dutch economy as we explain below. We first present the model in general terms in section 3.1 and then explain the channels through which QE affects the economy in section 3.2.

3.1 The model

In this section we will give a brief description of the model, focussing on those elements which are important to understand the impact of QE. A detailed overview of the model is presented in the appendix. We will present the model by discussing the balance sheet of the economy, together with the social account matrix and the matrix summarising the accumulation of investment and savings, presented in Tables 1 – 3 above.

Households

Starting with the household sector, income of households consists of wage income (including bonuses paid out by banks) plus interest and dividend earned on their financial assets minus taxes and interest paid on mortgages. We assume that households invest part of their savings in houses for which they have mortgages at the bank. Next households need high powered money for transactions. They invest the remaining part of their savings in equity issued by forms and government bills, the remaining assets are invested in deposits (cf. Figure 11 above). This covers the household columns in Tables 1- 3.

An important observation in MMS (2015) is that the high incidence of mortgages in the Netherlands observed for the Netherlands can be explained by both tax reduction on interest payments and eagerness by banks to provide mortgages (cf. Figure 14). Both elements play a role in our model to drive up house prices, which are endogenous in our model. A relevant aspect of the latter is that a lower interest rate for mortgages will also drive up house prices. This has two implications as we elaborate in MMS (2015). On the one hand consumption increased through the positive wealth effect of increasing housing wealth and through additional spending capacity financed by increased mortgages on existing houses. On the other hand, interest payments on mortgages will also increase and provide a countervailing impact on consumption through decreased disposable income. Our simulation results show that in the end the latter effect becomes dominant, which explains the housing bubble that occurred in the Netherlands (cf. Figure 13).

For the moment being we ignore the impact of pensions on household behaviour (but not on the financial sector, see below). We argue in MMS (2014) that although pension wealth of households is very large, it hardly plays a role – at least till recently – in the public debate and in the analysis of Dutch household behaviour. For instance, wealth inequality figures used in the public debate (e.g. following Piketty, 2014) are typically net of pension wealth.[25] Another example is that in studies of the impact of wealth on consumption behaviour, usually pension wealth is not included – see for

[25] See, for instance , WRR (2014, Ch. 4).

instance the current CPB macroeconomic model SAFFIER-II, which is used extensively in Dutch economic policy debates (CPB, 2010).

The influence of pensions on consumer behaviour is both negative (through increased collective savings) and positive (increased benefits with aging). Through both channels, the recent fall in the interest rate had a negative impact on consumption expenditures: it increased the liabilities of the pension funds, so that they had to increase their assets and hence collective savings (cf. Figure 11). Moreover, about 8 per cent of disposable income is 'collective savings', while 'individual savings' have been falling sharply from a height of 8 per cent in the mid-1980s – these savings have become negative in 2000 and consistently negative since 2003. We will include this insight in the next version of our model.

Firms

Firms net income consists of profits based on a fixed mark up on output prices and dividend earned on financial assets held abroad. Part of this income is used to pay taxes, interest on loans to banks and dividend to households. The remaining part, retained profits, constitutes firms' savings. Part of firms' savings is used to finance investment in capital. The remaining part of firms' savings, which is considerable – see also Figure 15 above – is invested in financial assets abroad. As we elaborate in MMS (2016) this explains the increase of the net foreign asset position in the Netherlands (cf. Figures 21 – 23).

Investment of firms is determined endogenously, depending on the cash-flow rate, the leverage ratio, Tobin's q and the utilisation rate. It is partly financed by retained profits (firms' savings) and the remaining part is financed by equity issued to households and loans from banks. We did model in MMS (2016) that the distribution of the firms' assets over financial assets abroad and capital depends on the relative returns. The distribution of equity and loans to finance capital were modelled in a similar way. However, in the present model these distributions are exogenous in order to keep the model manageable. On the other hand, both the price of equity and the return on equity are endogenous, which enables us to analyse the impact of low interest rates and QE on equity prices (cf. Figure 28). This explains the firm columns in Tables 1 – 3.

The financial sector

The financial sector in our model consists of banks and pension funds. As we have already discussed above banks issue mortgages to households and provide loans to firms. Next to that banks hold cash for transaction purposes. Part of the loans and mortgages are covered by deposits of households held at banks. However, this is not sufficient to finance all assets, which results in the so-called deposit financing gap discussed extensively in MMS (2015) – see also Figures 3 and 12. The deposit financing gap is considered to be problematic since the larger the gap is, the more banks have to rely on outside capital to finance their loans. In particular in the case of mortgages this is problematic, since mortgages are outstanding long-term commitments and outside capital is of shorter duration and more risky (often foreign) – see also Figure 4. This implies that the larger the deposit financing gap is, the more expensive financial resources for banks become. In our model outside capital consists of equity sufficient to satisfy the Basel norm. This equity is issued abroad and bonds are issued abroad to cover the remaining part of the deposit financing gap.

In order to keep the analysis manageable, the balance sheet of pension funds is kept very simple. It consists of liabilities due to the pension claims households have on these funds (cf. Figure 9). These liabilities follow from the obligatory contributions of households to these funds. Since the flow implications of these contributions complicate the model considerable and are not crucial in understanding the impact of QE we assume these liabilities to be exogenous. The net contributions of households are invested by the fund in treasury bills and equity abroad (cf. Figure 7) – both as a fixed proportion of the liabilities.

Finally savings of the financial sector are zero, since the profits of both banks and pension funds are distributed to the households in the form of bonuses and lower obligatory contributions. This explains the financial sector columns in Tables 1 – 3.

The Central Bank

In the present analysis we ignore the complications which follow from the fact that the euro area, including the Netherlands, is controlled by the European Central Bank and not by a National Central Bank – but including a Central Bank balance sheet is necessary for a proper modeling of the financial sector and the analysis of quantitative easing. Moreover, QE is controlled by the National Central Bank, as we discussed in section 2.4.

Next to holding foreign reserves, which we discuss below, the Central Bank provides advances to banks and holds all remaining bills issued by the government. The liabilities are high powered money issued by the Central Bank, which is held by the public and banks. Since the revenues of the Central Bank are transferred to the government, the savings of the Central Bank are zero. This explains the Central Bank columns in Tables 1 – 3.

Government

Government expenditures G are proportional to output, hence the growth in government expenditures is equal to output growth. Value added taxes and income taxes are proportional to the relevant tax bases. The budget balance, together with profits from the Central Bank minus interest paid on government bonds, constitute government savings. These savings, which usually are negative (cf. Figure 17), are financed by supplying bills to the various sectors of the economy. As mentioned above, the Central Bank holds all remaining bills issued by the government. This explains the government columns in Tables 1 – 3.

The foreign sector

The foreign sector is introduced in a simple way. Next to consumption, investment and government goods, firms also produce net-exports. We assume exports to be exogenous and imports to be proportional to GDP. As we have discussed above, foreigners hold bills issued by the government and bonds and equity issued by banks. The liabilities of the foreign sector consist of foreign equity held by domestic firms and pension funds together with foreign reserves held by the Central Bank. The latter also include the Target2 balances.

The trade balance is part of foreign savings, together with dividends paid to domestic firms and pension funds on their foreign investment, as well as dividend received from banks, and interest received on bonds issued by domestic banks and government. These savings deplete the foreign reserves held by the domestic Central Bank, taking into account bonds acquired from domestic banks and government, net of equity issued to domestic firms and pension funds. As Godley and Lavoie (2007b) emphasize, there is no inherent mechanism for a country with a trade surplus to converge to a balanced current account, as long as it is willing to accumulate ever more foreign debt. This situation is quite relevant for the Netherlands as appears from Figure 20.

3.2 The impact of quantitative easing

The National Central Bank buys bonds from the secondary market. The various possibilities can be identified in our stock-flow structure summarised in Tables 1 – 3 above – for an elaborate description see Muysken (2016). We assume that the Central Bank always use the banks as intermediaries and finance the purchase of bonds by providing advances to the banks who then buy bonds and sell these to the Central bank.

The notion is then that banks use the advances to increase loans to firms and hence stimulate the economy. In terms of Tables 1 – 3 this implies:

$$-\Delta A = \Delta B_C = \Delta L = \ldots. = -\Delta B_{XX} \quad (1)$$

The problem is that there always has to be a counter party XX who sells these bonds. As we have seen in section 2.4 of the stylised facts it is highly implausible that banks sold bonds from their own portfolios nor did pension funds – see Figure 25 above. Hence the only plausible outlet is that these bonds are sold abroad. This is entirely consistent with the observation in Figure 26 above – see also DNB (2016a). The resulting transactions then lead to:

$$\Delta B_C = \Delta L = \Delta R = -\Delta B_a \quad (2)$$

Assuming that the banks use the proceedings of selling the bonds brought abroad to pay back the advances.[26] The loans then should be used to invest in the capital stock.

However, we do not observe these stimulating effects, which points at the various leakages. The leakage resulting from buying bonds by banks to recapitalise themselves is not plausible, the more so that we saw in Figure 6 that the banks did not increase their reserve ratio in the last two years.

What is more plausible is that the foreign bond holdings have been substituted for other financial assets. For instance:[27]

$$\Delta B_C = \Delta p_e.E_{fa} = \Delta R = -\Delta B_a \quad (3)$$

This increases foreign savings and leads to the accumulation of net foreign assets observed in Figure 20.

[26] The deposits of firms at the banks are not part of the structure since they are not relevant for our analysis, but these should increase.

[27] The deposits of abroad at the banks are not part of the structure, but these increase as can be seen from Figure 4 above.

An obvious solution to this problem is that the Central Bank provides QE not through the banking system and the secondary bonds market, but by providing money directly to the public. A typical solution would be helicopter money or as proposed by Klosse and Muysken (2016) using the money to finance a job guarantee – see also Mitchell (2015). This alternative will be investigated when simulating the model in section 4.

3 Simulation results

<to be inserted later>

Appendix A A detailed description of the model

In this appendix we present a detailed overview of the model used in our analysis. Most elements have already been presented in MMS (2015), hence the appendix overlaps considerably with MMS (2015a) – the underlying working paper. However, new elements are the extension of the financial sector with a pension system with large foreign investments and the introduction of financial assets of firms, which are also invested to a large extent abroad. Both elements contribute considerably to the a proper understanding of the development of the Dutch foreign net assets position and the small impact of QE on the Dutch economy. In the following sections we will explicitly point out the new elements in addition the analysis of MMS (2015).

A1. The financial sector and the Central Bank

In our model the financial sector consists of banks and pension funds, next to the Central Bank. We describe briefly the various sectors.

The Central Bank

Next to holding foreign reserves *R*, which include Target2 balances, the Central Bank provides advances *A* to banks and holds bills issued by the government, B_c. The liabilities are high powered money *H* issued by the Central Bank, which is held by both the public and banks.

The Central Bank provides as much high powered money as is demanded by banks and households and as much bills as demanded by the government. The amount of advances can be used as a policy instrument under QE,[28] but in normal times the advances are provided to satisfy the banks' need – see equation (A3) in the section on the banking sector. We discuss the foreign reserves in section A3 and explain why these also close the balance sheet of the Central Bank. The resulting balance sheet is presented in Table A1.

Table A1 Balance sheet of the Central Bank

ASSETS	**LIABILITIES**
Advances to Banks (A) Treasury Bills (B_c) Foreign Reserves (R)	High powered money (H)

Since the revenues *FC* of the Central Bank are transferred to the government, the balance sheet of the Central Bank is closed without remaining net worth – see Table A1. The revenues of the Central Bank are given by:

$$FC = i_{A,-1}.A_{-1} + i_{B,-1}.B_{c,-1} \quad (A1)$$

[28] As we explain in the main text, advances are taken net of deposits by banks held at the central bank.

Here i_B is the rate on government bills set by the Central Bank and i_A is the interest rate on advances. Since inflation is exogenous, both interest rates are set exogenous too.

The Banking Sector (MFIs)

In our analysis banks finance their assets not only by holding deposits *M* from households and advances *A* from the Central bank, but also to a considerable extent by borrowing from the foreign sector. The latter is done by issuing equity $p_e.E_b$ and bonds B_{ba}.[29] Here p_e is the nominal price for equity. The main assets held by the bank are loans *L* issued to firms and mortgages *MO* issued to households. Next to that banks also hold high powered money B_{ba}.[30]

For issuing deposits *M* banks need to meet the reserve requirement by holding sufficient high-powered money H_b:

$$H_b = v_{res}.M \quad (A2)$$

Regarding the other two items on the asset side, we assume that both the demand for mortgages by households *MO* and loans by firms *L* are fully accommodated by banks.

Turning to the liabilities side we assume that the demand for deposits *M* by households is also fully accommodated by banks. With respect to advances there is a ratio between advances and deposits, v_{CB}, implicitly imposed by the Central Bank:

$$A = v_{CB}.M \quad (A3)$$

Equity is such that the leverage ratio, which is tier 1 capital/risk-unweighted long lending, should exceed a fixed proportion of the total liabilities of the banking sector, v_{bas}, determined by the Basel requirements. Hence:

$$p_e.E_{ba} = v_{bas}.(M + A + B_{ba}) \quad (A4)$$

The remaining gap on the liabilities side is financed by borrowing B_{ba} from abroad. Bonds are available from the foreign sector at a relatively high rate i_{ba}, in principle to an unlimited amount. The resulting balance sheet is presented in Table A2.

With respect to the pricing decisions, we assume that the interest rates on loans i_L, and deposits i_M, are set as a fixed mark-up on the rate on advances set by the Central Bank. Similarly, the rates on mortgages i_{MO} and bonds issued i_{ba} are fixed mark-ups on the interest rate on treasury bills. The equity price is determined endogenously – see equations (A37) and (A38) in the discussion of the firm sector.

[29] Bonds represent here all sources of outside financing. That banks borrow exclusively abroad is a simplifying assumption, which however emphasizes the stylized fact of strong foreign exposure of the Dutch financial sector.

[30] As we discuss below bonds issued by the government are held in the financial sector by pension funds.

All profits of the banking sector *FB* are distributed to the households – we interpret these as bonus payments in excess of normal wages.[31] Since we ignore retained profits which can contribute to internal funds, net worth of banking is in principle zero. However, since banks' equity appears as a liability on the balance sheet, valuation gains and losses may occur. This will affect the balance sheet because equity is booked at market value. Therefore we also introduce net worth of banking V_b, which accumulates and decumulates with valuation gains and losses. Hence holds:

$$\Delta V_b = -(\Delta p_e).E_{ba} \qquad \text{(A5)}$$

This aspect has been ignored in MMS (2015).

Table A2 Balance sheet of the banking sector

ASSETS		**LIABILITIES**
Cash (H_b)		Deposits (M) Advances Central Bank (A)
Long lending	• mortgages (MO) • firms (L)	Bonds (B_{ba}) Equity (p_eE_{ba}) Total (net worth) (V_b)

Pension funds (OFIs)

As already mentioned in the introduction to the Appendix, MMS (2015) does not recognise the existence of a pension fund. In order to keep the analysis manageable, the balance sheet of pension funds is kept very simple. It consists of liabilities L_{PF} due to the pension claims households have on these funds. These liabilities follow from the obligatory contributions of households to these funds. Since the flow implications of these contributions complicate the model considerable and are not crucial in understanding the impact of QE we assume these liabilities to be exogenous. That is, the net contributions of the households $contr_{PF}$ are exogenous and add to the liabilities:[32]

$$\Delta L_{PF} = contr_{PF} \qquad \text{(A6)}$$

The net contributions are invested by the fund in treasury bills B_{PF} and equity abroad p_eE_{PF}, which both constitute the assets of the pension fund. For simplicity we assume that a fixed proportion of the liabilities is invested abroad and the remaining part is invested in treasury bills:

$$p_e.E_{PF} = v_{PF}.L_{PF} \qquad \text{(A6a)}$$

[31] The profits are given by [(1 – tax rate)*(income from lending – costs of borrowing) – dividends on equity]. In case of losses no profits are distributed to the households and equity is issued to compensate for these losses.

[32] In MMS (2014) we developed a model with an endogenous pension system, but we did not succeed in calibrating that model to obtain reasonable steady state results.

$B_{PF} = (1 - \nu_{PF}).L_{PF}$ (A6b)

Since for the moment being we assume these liabilities to be exogenous, B_{PF} and $p_e E_{PF}$ are also exogenous. The resulting balance sheet is presented in Table A3.

Table A3 Balance sheet of Pension Funds

ASSETS	**LIABILITIES**
Treasury Bills (B_{PF})	Liabilities (L_{PF})
Equity ($p_e E_{PF}$)	Total (net worth) (V_{PF})

The profits of the pension funds are distributed to the households in the form of lower obligatory contributions.[33] Following the same reasoning as with banking, net worth of pension funds is in principle zero. However, since equity appears as an asset on the balance sheet, valuation gains and losses may occur. Hence we also introduce net worth of pension funds V_{PF} and does hold:

$\Delta V_{PF} = (\Delta p_e).E_{PF}$ (A7)

The financial sector

In order to keep the model manageable from a computational point of view, we combine the banking sector and the pension fund in the financial sector and assume the liabilities to be constant. The combined balance sheet is presented in Table A4 which is also new compared to the analysis in MMS (2015). All items on the balance sheet have already been discussed above and the only difference with the fully combined balance sheet is that liabilities of the pension fund L_{PF} have been subsumed under the net worth V_{FS} of the financial sector. As a consequence we find, since $\Delta L_{PF} = 0$:

$\Delta V_{FS} = (\Delta p_e).E_{PF} - (\Delta p_e).E_{ba}$ (A8)

The new element in Table A4 compared to MMS (2015) is the presence of both treasury bills and equity (invested abroad) on the balance sheet of the financial sector. The latter constitutes and important part of net external wealth of the Netherlands.

[33] The profits are given by (1 – tax rate)*income from lending.

Table A4 Balance sheet of the financial sector

ASSETS		**LIABILITIES**
Cash (H_b) Treasury Bills (B_{PF}) Equity (p_eE_{PF})		Deposits (M) Advances Central Bank (A) Bonds (B_{ba}) Equity (p_eE_{ba}) Total (net worth) (V_{FS})
Long lending	• mortgages (MO) • firms (L)	

A2 Households, firms and government

The housing market

In order to include housing and mortgages in the model, we assume that when banks and households decide on a loan for buying a house, the affordability of the household determines the maximum loan the bank is willing to provide, as modeled in Madsen (2012). As we argue in MMS (2015) this implies that the growth rate of the house price p_h follows from:

$$\Delta \ln p_{ht} = \psi_t + \alpha \Delta \ln Y_t^h + (1-\alpha)\Delta \ln Y_t^e - \Delta \ln[i_{MO}(1-\tau_h \tau_{MO}) + f_{MO}] - \Delta \ln HS_t \quad \text{(A9)}$$

where Y_t^h is disposable income (not net of mortgage payments) and Y_t^e is expected income for next year. The one but last term refers to the user cost of (housing) capital and includes the interest rate on mortgages i_{MO}, corrected for the fraction that is deductible for income tax, and the mortgage repayment rate f_{MO}. The fraction that is deductible from income tax is given by the income tax rate τ_h times the fraction of mortgage interest payments that is deductible τ_{MO}. The final term in the above equation refers to the number of houses on the market, *HS*. We assume housing supply *HS* to be given, due to the highly regulated housing market in the Netherlands. The crucial parameter in the equation, however, is the affordability *Ψ*, which is the total amount of housing costs that the household is able to spend (as perceived by banks), relative to its disposable income. The housing bubble was caused by an increase of *Ψ* and in reaction to overstretching their balances banks have decreased *Ψ*.

The household sector

The household sector is modelled similar to MMS (2015). With respect to mortgages *MO* we assume, in line with the affordability assumption above, that demand for mortgages is a fixed proportion φ of the housing value, while supply of mortgages is accommodating. Hence:

$$\Delta MO = \varphi . p_h . \Delta HS + \varphi . \Delta p_h . HS - morc . MO_{-1} \quad \text{(A10)}$$

where *morc* is the share of mortgage repayments.

Once the share of assets to be spent on housing is determined we assume that, in line with ZDS, the demand for money H_h is proportional to nominal consumption *p.C* and the remaining demand for assets, B_h and $p_e.E_h$, follows from a Tobin-type portfolio model. Then bank deposits *M* are determined as a residual of household wealth V_h. This implies that wealth net of housing minus mortgages and net of claims on pension funds:[34]

$$VN = V_h - (p_h.HS - MO) - L_{PF} = H_h + M + B_h + p_e.E_h \quad \text{(A11)}$$

is distributed over financial assets as follows:

$$H_h = v_1.p.C \quad \text{(A12)}$$

$$p_e.E_h /(VN^e - H_h) = \lambda_{00} - \lambda_{01}.r^e_M + \lambda_{02}.r^e_E - \lambda_{03}.Yhd^e/V^e - \lambda_{04}.r^e_B \quad \text{(A13)}$$

$$B_h/(VN^e - H_h) = \lambda_{10} - \lambda_{11}.r^e_M - \lambda_{12}.r^e_E - \lambda_{13}.Yhd^e/V^e + \lambda_{14}.r^e_B \quad \text{(A14)}$$

$$M = VN - H_h - B_h - p_e.E_h \quad \text{(A15)}$$

The expected values of variables are based on an adaptive expectations mechanism:

$$X^e = X_{-1} + \xi.(X^e - X_{-1}) \quad \text{(A16)}$$

The above items constitute the balance sheet of the households, presented in Table A5. One should realise that when presenting the balance sheet this way, claims to pension funds L_{PF} are included in the household wealth V_h.

Table A5 Balance sheet of the household sector

ASSETS		**LIABILITIES**	
High powered money	$+ H_h$	Mortgages	$+ MO$
Bank deposits	$+ M$		
Bills	$+ B_h$		
Equities	$+ p_e.E_h$		
Homes	$+ph.HS$		
		Total (net worth)	$+ V_h$

Household income consists of wages *WB* and dividends *FD* paid by firms, bonuses *FB* paid by banks and interest income:

$$Yh = WB + FD + FB + i_{M,-1}.M_{-1} + i_{B,-1}.B_{h,-1} \quad \text{(A17)}$$

Taxes are net of mortgage interest payments – this feature plays an important role in explaining the high incidence of mortgages in the Netherlands:

$$Td = \tau_h.(Yh - \tau_{MO}.i_{MO,-1}.MO_{-1}) \quad \text{(A18)}$$

[34] The subtraction of claims on pension funds is new compared to MMS (2015).

where τ_h is the tax rate on income and τ_{MO} is the tax reduction on interest payments.

The disposable income of households is defined by deducting taxes paid by households *Td*, net contributions to the pension fund $contr_{PF}$ and interest payments on mortgages from household income *Yh*:

$$Yhd = Yh - Td - contr_{PF} - i_{MO,-1}.MO_{-1} \quad \text{(A19)}$$

We assume that households' real consumption depends on real disposable income, the opening stock of wealth V_h and on real capital gains. Capital gains can be obtained on the stock of equity, the only financial asset with a market price, and on housing. Moreover, we assume the stock of housing to have a different impact on consumption compared to financial wealth, due to its differences in liquidity. However, capital gains on housing are assumed to have the same impact as those on equity. As a consequence the consumption function is given by:

$$C = \alpha_1.yhd + \alpha_2.v_{-1} + \alpha_3.(p_h.HS - MO)/p + \alpha_4.(cge^e + cgh^e - [g^e_p/(1 - g^e_p)].v_{h,-1}) \quad \text{(A20)}$$

where small letters for variables indicate real values, f.i. yhd = Yhd/p.

Household savings are defined as the disposable income of households *Yhd* minus consumption *p.C*:

$$S_h = Yhd - p.C \quad \text{(A21)}$$

The capital gains are defined by:[35]

$$CGE = \Delta p_e.E_{h,-1} \quad \text{and} \quad CGH = \Delta ph.HS_{-1} \quad \text{(A22)}$$

The change in household wealth V_h then follows from:

$$\Delta V_h = S_h + CGE + CGH + \Delta L_{PF} \quad \text{(A23)}$$

where one should realise that since claims to pension funds L_{PF} are included in the household wealth, we should take these changes into account. However, as long as we take these claims as an exogenous constant we can ignore these.

Finally, the increase in housing should be included in the production of firms, which appears in the capital balance of the social accounting matrix - see Table 2 in the text.

Firm behaviour and wage and price formation

We combine elements of MMS (2015) and (2016) in modelling both firm behaviour and wage and price setting – in MMS (2016) we allow firms to investment of retained profits in foreign assets, which is also an important elem nt in the present analysis.

As we elaborate below, the capital stock (*p.K*) is financed by firms using domestically accumulated retained earnings (E_f), equity issued to households ($p_e.E_h$), and loans at banks (*L*). Moreover, firms

[35] The term $-[g^e_p/(1 - g^e_p)].v_{-1}$ is valuation gain on wealth, with g^e_p as expected inflation.

hold part of their retained earnings in foreign assets ($p_e.E_a$). This constitutes the balance sheet of firms presented in Table A6. The net worth of firms is $V_f = E_f + p_e.E_a$.

Table A6 Balance sheet of firms

ASSETS		**LIABILITIES**	
Capital	+p.K	Loans	+ L
Equity acquired	+ $p_e.E_a$	Equity issued	+ $p_e.E_h$
		Total (net worth)	+ V_f

Retained earnings follow from profits. Profits from production *FP* result by deducting the wage bill *WB* and indirect taxes $T_i = \tau_i.p.Y$ from nominal income *p.Y*. Hence:

$$FP = p.Y - WB - T_i \quad \text{(A24)}$$

Price *p*, net of indirect taxes τ_i, is set as a mark-up *m* on unit labour cost.[36] Unit labour cost are defined as nominal wages *w* times the exogenous labour-output ratio *a*. Hence:

$$p.(1 - \tau_i) = [1 + m].w.a \quad \text{(A25)}$$

Given the labour-output ratio, employment *N* follows from *N = a.Y*, where *Y* represents real output. The wage bill then follows from:

$$WB = w.N \quad \text{(A26)}$$

Nominal wages are exogenous.[37]

When calculating total profits *FT*, we should include the returns on foreign assets $p_{ea}.E_a$, next to nominal income *p.Y*. The rate of return on foreign assets ρ_a is an exogenous mark-up on domestic return ρ. Hence:

$$FT = FP + \rho_{a,-1}.\ p_{ea,-1}.E_{a,-1} \quad \text{(A27)}$$

A fixed proportion $(1 - \phi)$ of the total profits is kept as retained earnings, *FU*, and the remaining part is paid out as dividend or interest payments. Retained earnings therefore are given by:

$$FU = FT - \rho_{-1}.\ p_{e,-1}.E_{h,-1} - i_{L,-1}.L_{-1} \quad \text{(A28)}$$

where i_L represents the rate of interest on loans *L* and ρ is the return on equity $p_e.E_h$ – the latter is endogenously determined.

[36] Hein assumes a positive impact of the rate of return on equity ρ on the mark-up, i.e. $m'(\rho) > 0$ – we leave this out for simplicity. However, we include indirect taxes, which are ignored by Hein, since he does not include government in his analysis.

[37] We ignore in this version of the model the determination of unemployment and its potential interaction with wage determination and social security expenditures. That is left for further research.

The retained earnings *FU* also constitute firm's savings S_f. They are used to invest in both the capital stock and in foreign assets. Whereas in MMS (2016) we model the distribution of retained earnings according to a portfolio model, we use here an exogenous distribution. That is:

$$\Delta(p_{ea}.E_a) = inv_a.FU \quad \text{(A29)}$$

And the remaining part of retained profits is used to finance investment.

Investment is determined by four variables. First the cash-flow rate, *rfc*, which is a source of self-financing of investment:

$$rfc = FU/(p.K_{-1}) \quad \text{(A30)}$$

The second determinant of investment is the interest payments on the leverage ratio, *lev*:

$$lev = L/(p.K_{-1}) \quad \text{(A31)}$$

The third determinant is Tobin's q:

$$q = (L + p_eE) /(p.K_{-1}) \quad \text{(A32)}$$

and the fourth determinant is the utilization rate, *u*, with normal utilization defined at *u**:

$$u = Y/(\kappa.K_{-1}) \quad \text{(A33)}$$

As a consequence we find for the growth of the capital stock:

$$g_K = \gamma_0 + \gamma_1.rfc_{-1} - \gamma_2.r_{L-1}lev_{-1} + \gamma_3.q_{-1} + \gamma_4.(u_{-1} - u^*) \quad \text{(A34)}$$

Gross investment is financed by domestically retained earnings $(1-\phi).FU$, equity issued to households ΔE_h and loans from banks ΔL. With respect to equity we assume that new equities are issued as a fixed proportion of the amount of external funds required to finance investment:

$$p_e.\Delta E_h = €.(p.\Delta K - (1- inv_a).FU) \quad \text{(A35)}$$

Bank loans then are used to close the remaining financing gap:

$$\Delta L = p.\Delta K - FU - p_e.\Delta E_h \quad \text{(A36)}$$

The equilibrium price of equity p_e follows from equating (A35) and (A13) and return on equity follows from:

$$\rho = \phi.FT/(p_{e,-1}.E_{h,-1}) \quad \text{(A37)}$$

Remember that retained earnings *FU* constitute firm's savings S_f, which contribute to the wealth of firms. Next valuation changes should be taken into account. Hence holds:

$$\Delta V_f = S_f + (\Delta p_e).E_{fa} - (\Delta p_e).E_h + (\Delta p).K \quad \text{(A38)}$$

Government

Since we assume government expenditures G proportional to output, growth in government expenditures is equal to output growth:

$g_G = g_{y,-1}$ (A39)

Value added taxes, profit taxes and income taxes are proportional to the relevant tax base. The budget balance, together with profits from the Central Bank *FC* minus interest paid on government bonds $i_B.B$, constitute government savings S_g:

$S_g = Ti + Td + Tf + FC – p.G – i_B.B$ (A40)

These savings, which usually are negative, are financed by supplying bills to the various sectors of the economy:

$\Delta B = - S_g$ (A41)

Accumulated government debt therefore equals $B = B_c + B_{PF} + B_h + B_a$, which is also the financial net worth of government.

A3. The foreign sector

The foreign sector is introduced in a simple way. Next to consumption, investment and government goods, firms also produce net-exports (*X – IM*). This does not affect their balance sheet, however, nor does it affect their flow of funds. We assume exports *X* to be exogenous and imports *IM* to be proportional to GDP with a fraction *im*. Hence the trade balance is given by:

$TB = X – IM = X – i_m.p.Y$ (A42)

Since foreigners hold bills issued by the government (B_a) and bonds (B_{ba}) and equity ($p_e.E_{ba}$) issued by banks, these appear as assets in the balance sheet of the foreign sector. The liabilities of the foreign sector consist of foreign equity held by domestic firms and pension funds, $p_e.E_{fa}$ and $p_e.E_{PF}$, respectively, and by foreign reserves (*R*) held by the Central Bank. The balance sheet of the foreign sector is given in Table A7 below.

Table A7 Balance sheet of the foreign sector

ASSETS	**LIABILITIES**
Bills (B_a)	Equity ($p_e.E_{fa}$)
Bonds (B_{ba})	Equity ($p_e.E_{PF}$)
Equity ($p_e.E_{ba}$)	Foreign Reserves (R)
	Total (net worth) (V_a)

The trade balance is part of foreign savings S_a, together with dividends paid to domestic firms and pension funds on their foreign investment, $\rho_a.p_e.E_{fa}$ and $\rho_a.p_e.E_{PF}$ respectively, as well as dividend received from banks $\rho_{ba}.p_e.E_{ba}$, and interest received on bonds issued by domestic banks and government, $i_{ba}.B_{ba}$ and $i_a.B_a$ respectively:

$$S_a = i_{a,-1}.B_{a,-1} + i_{ba,-1}.B_{ba,-1} + \rho_{a,-1}.\ p_e.E_{ba,-1} - TB - \rho_{a,-1}.\ p_e.E_{fa,-1} - \rho_{a,-1}.\ p_e.E_{PF,-1} \quad \text{(A43)}$$

These savings deplete the foreign reserves held by the domestic Central Bank, taking into account bonds acquired from domestic banks and government, net of equity issued to domestic firms and pension funds:

$$\Delta R = \Delta B_a + \Delta B_{ba} + \Delta\ p_e.E_{ba} - \Delta\ p_e.E_{fa} - \Delta\ p_e.E_{PF} - S_a \quad \text{(A44)}$$

As Godley and Lavoie (2007b) emphasize, there is no inherent mechanism for a country with a trade surplus to converge to a balanced current account, as long as it is willing to accumulate ever more foreign debt. This situation is quite relevant for the Netherlands as appears from the stylised facts.

Finally foreign savings S_a contribute to the net foreign wealth. Next valuation changes should be taken into account. Hence holds:

$$\Delta V_a = S_a + (\Delta p_e).E_{ba} - (\Delta p_e).E_{fa} \quad \text{(A45)}$$

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