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#2022-035

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Published 26 October 2022

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UNU-MERIT Working Papers
ISSN 1871-9872

Maastricht Economic and social Research Institute on Innovation and Technology
UNU-MERIT

The macroeconomic implications of financialisation on the wealth distribution – a stock-flow consistent approach[1]

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Abstract

Deregulation and globalization since the early 1990s caused a boom in the current global financial cycle, which cumulated in the financial crisis in 2007. Austerity fiscal policies after the financial crisis induced Central Banks all over the world to intervene by stimulating 'unconventional' monetary policies. In earlier papers, we developed several stock flow consistent models for an open Euro Area economy to investigate various aspects of the impact of these developments, with special attention to the role of the Central Bank with low interest policy and quantitative easing. We analysed the influence on mortgage growth and house prices, the growing amount of funded pension savings held abroad and the destabilising impact of low interest rates on pension claims, and the phenomenon that firms more and more use their savings for share buy-backs and (speculative) investments abroad – see Muysken and Meijers (2022) for an overview. However, we did not pay explicit attention to the distributional consequences these developments might have.

The social and economic impact of the COVID crisis since early 2020 stimulated the awareness in the literature and the policy debate that the increase in house prices and asset prices invigorated wealth inequality. These developments create social tensions and therefore can have severe economic consequences.

In the present paper, we bring all our earlier models together in one stock-flow consistent model, which we estimate and simulate for the Netherlands. The model is based on a stock-flow consistent set of macroeconomic data, which we collected for the Netherlands. In line with our previous research we argue that these phenomena can be captured very well by a stock flow consistent model in the tradition of Godley and Lavoie, which we estimate and simulate for the Netherlands. From simulations with our model we show that both housing price bubbles and asset price bubbles occur due to low interest rates and riskier bank behaviour, induced by a central bank policy of Quantitative Easing. The intended aim of this central bank policy – enhancing economic growth – is not reached, because the monetary stimulus is absorbed by the financial sector. Moreover, a presumably unintended consequence of Quantitative Easing in the Netherlands is an increase in wealth inequality.

JEL Code: E44, B5, E6, F45, G21, G32

Key words: financialisation, wealth distribution, inequality, stock-flow consistent modelling

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[1] We thank the participants of the EAEPE conference in Naples (2022) and of the FMM conference in Berlin (2022) for their constructive comments.

1. Introduction

The increased financialisation of the economy, together with deregulation and globalisation, has led to a strong decrease of productive investment and hence domestic economic growth through two channels. First, household savings were progressively absorbed by increased house prices and pension portfolios held abroad, while firm savings were diverted through share buy-backs and speculative investments abroad. Second, credit creation in the financial sector eased the re-routing of household and firm savings and created additional problems of increased volatility and higher risks to the financial system (Werner, 1997; Bezemer and Muysken, 2015).

In the present paper, we capture these developments in a comprehensive framework. We integrate the results of previous versions of a model we developed for a Euro Area economy. We analysed (1) the impact of the housing bubble on mortgage growth and house prices and the subsequent impact on lower leverage of the banking sector through the deposit financing gap; (2) the result of pension savings held abroad and the destabilising impact of low interest rates on pension claims; and (3) the consequence that firms more and more use their savings for share buy-backs and (speculative) investments abroad. (See Meijers, Muysken and Sleijpen 2015, 2014 and 2016, respectively). We also paid explicit attention to the influence of financial asset price bubbles and the role of the Central Bank in quantitative easing (Meijers and Muysken, 2016). In the present paper, we bring all our earlier versions together in one stock-flow consistent model, which we estimate and simulate for a Euro Area economy like the Netherlands, based on data especially collected for this purpose. However, we did not pay explicit attention in our earlier models to the distributional consequences these developments might have.

Figure 1

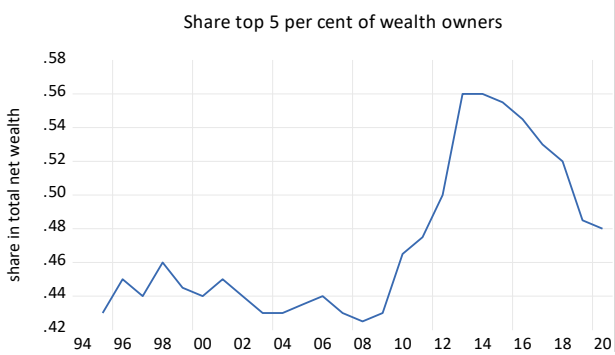
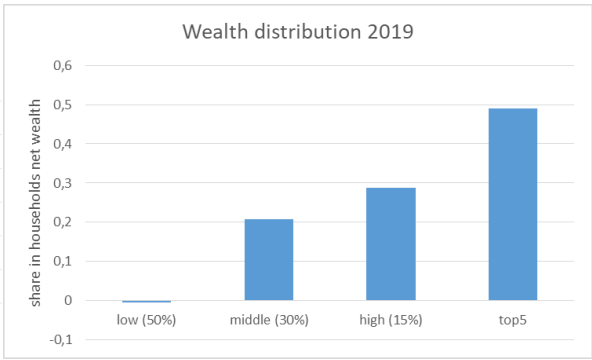


Figure 2



A recent study revealed that wealth inequality is much larger in the Netherlands than is usually perceived in the public debate (van der Geest et al., 2022). Moatsos et al. (2022) show how wealth inequality in the Netherlands decreased steadily during the period 1880 – 1980 but jumped upwards in the late 1980s. It then stabilised for almost two decades, but then rose sharply after the financial crisis in 2008 and decreased after 2013. We reproduced this development for the wealth share of the top5 households for the period 1994 – 2020 in Figure 1 (for details see Appendix B). Van der Geest et al. (2022) analyse carefully and in detail the wealth distribution for 2019 – cf Figure 2. They are quite concerned about the high level of wealth inequality and point out that there are severe dangers which are well documented in the literature when wealth inequality is too large. Examples are that political and economic power becomes too concentrated in one group. Moreover, that group will use its influence to become very persistent in its position at the top of the wealth distribution, for instance,

because it will successfully lobby for favourable tax treatments and succession rights. Finally, there turns out to be a close correlation between wealth inequality and income inequality. As a consequence, persistent and growing wealth inequality also leads to persistent and growing income inequality.

The social and economic impact of the COVID crisis since early 2020 stimulated awareness in the literature and the policy debate that the increase in house prices and asset prices invigorated wealth inequality. In this paper, we want to show how our model can be used to explain the development of wealth inequality from a macroeconomic perspective. We will argue that the lowering of the interest rate after the financial crisis and later Quantitative Easing induced first and increase in asset prices and later an increase in house prices. These developments turn out to be important drivers of the development of wealth inequality as observed in Figure 1.

We start in section 2 with a brief overview of empirical stock-flow consistent macroeconomic models – these are few only, due to the complicated nature of finding appropriate data. We also discuss the problems in collecting a comprehensive set of stock flow consistent macroeconomic data. In particular, we point out that the presence of tax vehicles (so-called Special Financial Institutions) muddles the data on the financial sector considerably and that we have to rely on external sources to eliminate these from our data.

In section 3, we present the data we collected for the Netherlands for the various sectors of the economy in a stock-flow consistent way, together with a description of the main features of the model – for a detailed version of the model see the appendix. We point out that the financisalisation of the economy is pervasive in all sectors. The households accumulate large claims on the pension funds from which future benefits should be paid out (about 200 per cent of GDP). This is due to the funded nature of the pension system and the low interest rate. Next to that, the volatility of house prices accompanied by high mortgages has affected consumption negatively. Firms use their retained earnings not to invest in physical capital but to buy foreign assets abroad (outward direct investments). Finally, foreign countries buy a lot of domestic equity (inward direct investments). This process is accompanied by soaring equity prices. Foreign assets and equity, instead of physical capital and loans, therefore dominate the balance sheet of firms (about 200 per cent of GDP for both foreign assets and liabilities).

In the financial sector, the fragility of the pension system leads to higher contributions and lower benefits, which has a negative impact on consumption. Moreover, pension funds use the majority of contributions by households to buy equity abroad (over 150 per cent of GDP). Banks also increased their foreign exposure considerably over time, with foreign assets and liabilities currently around 200 per cent of GDP. Finally, the Dutch economy has a trade balance surplus, which increased from 6 per cent in 1996 to around 10 per cent in 2019. The current account surplus is lower, however, reflecting adverse valuation changes and rates of returns in foreign assets and liabilities. Nonetheless, net debt held by the foreign sector increased over time until a level of 100 per cent of GDP in 2019.

Since our data cover a limited period, 1995 – 2020, and are on annual basis, it is hard to find reliable estimation results for the model. This is complicated by the adverse developments, which occurred during this period – the dot-com bubble, the financial crisis, the Euro-crisis and Quantitative Easing (QE). We explain in section 4 how we used the available data to estimate the model and discuss the simulation results. We also present a base run until 2030, which we will use for our simulation

experiments. We are also able to reproduce the development of wealth inequality over time as presented in Figures 1 and 2.

In section 5 we present the simulations with our model. We show how the economy reacts to various shocks: a decrease in the interest rate, an increase in the risk appetite of banks and QE. This enables us to explain (a) why housing price bubbles occur (due to riskier bank behaviour); (b) why asset price bubbles occur (also due to speculation by firms); (c) why QE does not have a direct impact on the real sphere (because of leakages abroad); (d) how the vulnerability of the financial sector is aggravated by QE (larger foreign exposure); and last but not least how the wealth distribution among households (e) becomes more skewed due to these developments; (f) except that share of the top5 decreases in the case of sharp increases in housing prices.

Section 6 concludes.

2. Estimating stock flow consistent models and the nature of the data

It is not surprising that there are only few empirical stock flow consistent models, since it is very hard to construct a stock flow consistent set of macroeconomic data for a country which covers the economy reasonably well. Also, the scarcity of data makes it very difficult to capture the dynamics of the model in a reasonable way. In this section, we survey the few empirical stock flow consistent models that we have found in the literature and discuss the problems we encountered when collecting a stock flow consistent set of macroeconomic data for the Netherlands.

2.1 Empirical stock flow consistent models

We are aware of only four recent publications where an effort is made to estimate or implement a stock flow consistent model to actual data of an economy.[2,3] All these analyses circulate as working papers.

The oldest model is Papadimitriou et al. (2013) which is estimated for the Greek economy – the LIMG model.[4] An important stylised fact that the model intends to analyse is the interaction between the government deficit, the external balance and private investment minus saving. However, as we elaborate in MBM (2017) the model is quite rudimentary. The same holds for the model estimated for the UK economy by Gudgin et al. (2015) – the UKMOD model. Here the authors ignore the financial sector and model the rest of the world only in a rudimentary way.

The analysis of Miess and Schmeltzer (2016) aims to implement a stock flow consistent model for Austria. The main contribution of the paper is a presentation of the data which are necessary for that purpose in a detailed way, consistent with the national account data (but they ignore data on the capital stock and the housing stock). These data also include the financial sector and allow for various assets. Interesting observations are that the financial assets of firms increased from 30 per cent of GDP in 1995 to 100 per cent in 2015 (the comparable figures for liabilities are 100 and 165 per cent, respectively); assets and liabilities of the financial sector were just over 300 per cent of GDP in 2015. While their treatment of the data is highly sophisticated, the model they use is very simple, using the data in a very elementary way, mainly relying on fixed coefficients and exogenous variables. Therefore, their analysis lacks a deeper insight into the determinants of the development of the Austrian economy.

The paper by Burgess et al. (2016) provides the most elaborate model, which is applied to the British economy. The authors point out that "the macroeconomic policy consensus at the time [of the financial crisis] did not provide clear answers as to how policymakers should respond to either financial imbalances or the rapid growth of potentially unsustainable debt burdens, at a time when the real economy appeared to be stable."(pp.1-2) The aim of their model is to analyse these phenomena in a coherent way. They distinguish between households, firms, government, a detailed

[2] An interesting early empirical stock-flow consistent model is presented in Davis (1987a,b).

[3] For an overview see Nikiforos and Zezza (2017) and Zezza and Zezza (2019).

[4] The authors refer on several places to 'the Levy Institute US model', but don't provide any references for that model. On the website of the Levy institute for several years a strategic analysis for the US economy is provided, apparently based on this model "Underlying the main conclusions of this Strategic Analysis is an econometric model in which exports, imports, taxes, and public and private expenditures are functions of world trade, relative prices, tax rates, stocks of debt, and flows of net lending."(Papadimitriou et al., 2011, p. 12) but no reference to this model is provided.

financial sector and the rest of the world. Moreover, they distinguish between various assets and model the prices of these various assets – enabling them to include revaluation effects in their analysis. Since they do not provide detailed data for the UK economy, it is difficult to analyse to what extent they cover the relevant stylised facts. One omission which the authors identify themselves is that they assume that pension funds hold all of UK's equity claims against the rest of the world, while in reality "Many of those are held by NFCs, through foreign direct investment" (p. 15).[5] They also do not employ data on the capital stock, although they use a Cobb Douglas production function.[6] However, they employ data on the housing stock.

The model of Burgess et al. (2016) is described in a detailed way and several interesting simulations are performed.[7] These simulations show the importance of incorporating financial flows in the model. This is obvious for the two simulations which refer directly to the financial sphere: (1) a rise in bank's capital requirements of one percentage point (leading to a fall in GDP of 0.1 per cent) and (2) a 'sudden stop' on the current account by lowering the demand for UK bonds and equity by foreign investors by 20 per cent (leading to an increase in GDP, which the authors consider implausible). However, also for the other simulations the impact of including financial flows in the model is important: (3) an exogenous increase in investment of 10 per cent (leads to an increase in GDP of 2 per cent, but also to higher net lending by banks and an increase the current account deficit of 0.6 per cent point); (4) an increase in house prices by 10 per cent (leads to an increase of GDP of 0.6 per cent through increased consumption, but also to higher net lending by banks and an increase the current account deficit of 0.3 per cent point);[8] and (5) fiscal expansion through an increase in government spending of 10 per cent (leading to an overall increase in GDP of 2 per cent, a worsening of government debt of 1 per cent point and a higher current account deficit of 0.7 per cent point). In all these scenario's there is an important feedback of wealth effects on consumption and of net lending on the current account, which is moderated by the financial sector.

With respect to the estimation of the model, Burgess et al. use quarterly data, which enables them to capture the dynamics of the model better compared to annual data. However, the period remains relatively short and therefore the authors are restricted to perform simple OLS estimations per equation. We will follow the same procedure when estimating our model.

Zezza and Zezza (2022) also present a very elaborate model for the Italian economy, which is estimated using quarterly data. They succeed in tracking the actual developments reasonably well with their model, but refrain from presenting simulation results resulting from policy shocks. They also

[5] A probably related issue is that the authors adjust the proportion of firm liabilities which consist of equity in their parameter set from 0.84 to 0.10 since the first value is considered to be "unrealistically high".(p. 19)

[6] Their calculated capital-output ratio varies between 400 and 440 per cent on an annual basis (Figure 10). The authors claim that this roughly matches the UK data (p. 19), referring to Oulton and Wallis (2015). However, the latter present a capital-output ratio which is about 200 per cent – see their Chart 10.

[7] Two points which are not clear in the model are (1) while the authors state that bank equity "is assumed to be privately held and not traded by investors in the rest of the world" (pp. 10-11), they allow for "dividend paid out by the banks to their foreign shareholders"(p.11). The corresponding equation (64) is the only place where bank equity shows up; it is not included in the portfolio of the rest of the world – equation (74). (2) the central bank "doesn't pay interest on reserves"(p. 12), although banks set the interest rate on deposits "as a mark down on the rate of interest the central bank pays them on their holdings of reserves."(p. 12) – see also equation (70).

[8] This is consistent with the analysis of the deposit financing gap in Meijers, Muysken and Sleijpen (2015).

emphasize that the model is too big to be maintained by single researchers.[9] The latter does hold also for the model of Burgess et al. (2016).

2.2 The nature of the data used

We estimate and simulate the model using data for the Netherlands. The data are provided by Statistics Netherlands (CBS), unless indicated otherwise. The data are available from 1995 onwards on an annual basis till 2020. We present the data in section 3 below.

Our first attempt to collect data in a stock-flow consistent way for the Netherlands is presented in Muysken, Bonekamp and Meijers (2017) – MBM (2017) from hereon. In Muysken and Meijers (2022) we update this analysis and elaborate on the implications of the Netherlands as a conduit country, harbouring many tax vehicles.

When using the data, there are three main problems. The first one is that the national account data provide a consistent framework for flow data over all sectors of the economy, but the balance sheets presented for the economy are not reflecting this framework in two respects. The entries in the balance sheets for the financial assets and liabilities do not have clear counterparts in the national account data.[10] Also, the net wealth accumulation in the balance sheets, excluding valuation changes, does not match net savings per sector – although overall net savings match total net capital accumulation. We solve this problem by adding a correction factor to the sectoral savings data where the correction factors add up to zero . We also observed that valuation changes can be an important source of changes in stock data, which are identified separately in the national accounts.

The second problem is that there is a huge bias in financial data in relation to special financial institutions (SFIs) in the Netherlands, which are created for tax reasons.[11] The national accounts identify the SFIs in the banking and the foreign sector, but not in the firm sector. We consider the presence of tax vehicles to be a significant problem in the first two sectors, but not in the firm sector.[12] We therefore subtract the assets and liabilities of SFIs from both the banking data and the foreign sector. Also the flow data of the financial sector are used in our model net of SFIs, such that stock and flow data remain consistent.

The third problem is that many items found in the national account flow data have no clear meaning in our model – for instance imputed interest payments and social security payments and capital transfers. We solved this problem by adding a correction item in the national account data y_{corr}. This term should be added to the row in the social account matrix of each sector (Table 7B in the Appendix) to make total income consistent across rows and columns.

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[9] "Intuitively, the structure of a model like the one we presented here needs a team for the regular updates of the databases, revision of the estimates, and overall model development, which, as mentioned, is a task that can be handled by institutions that regularly produce policy analysis, but not by a single independent researcher."(Zezza and Zezza, 2022, p. 139)

[10] The balance sheets for non-financial assets (physical capital and housing) do have clear counterparts, but these are separate statistics, with a lot of valuation problems – see MBM (2017) for a further discussion.

[11] The total assets (and liabilities) of the SFIs comprise 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.

[12] The reason is that the full CBS data are consistent with firm net savings in the balance sheets and y_{corr} for firms is relatively low. However, the precise nature of the data is a question for further research.

3. Modelling developments in the Netherlands

It is important to look at the data carefully for two reasons as we explained in the introduction: observing relevant stylised facts and finding parameters to use in the model. The model then should be able to reproduce the relevant stylised facts.

In this section, we present the main features of the model and illustrate these using our data, which we collected in a stock-flow consistent way for the Netherlands. A detailed description of the model is provided in Appendix A. We analyse each sector of the economy separately below. In the next section, we then discuss the simulation results of the model and the base run.

3.1 Household behaviour and wealth inequality

3.1.1 Household behaviour

Two remarkable features of the financial situation of Dutch households are the funded pension system and the huge mortgage debt. Due to the funded pension system households have to pay each year a contribution to a pension fund until the retirement age is reached. Afterwards, they receive each a benefit, related to the wage they earned in the past. Consequently, households accumulate large claims on the pension funds from which future benefits have to be paid out. This is illustrated in Figure 3. The sharp increase in pension claims follows from the low interest rate after the financial crisis – as we elaborate below, this low interest rate creates huge problems for the pension funds. Pension claims are around 220 per cent of GDP, whereas the financial assets of households, deposits plus participations,[13] together are around 100 per cent of GDP over the whole period.

Figure 3

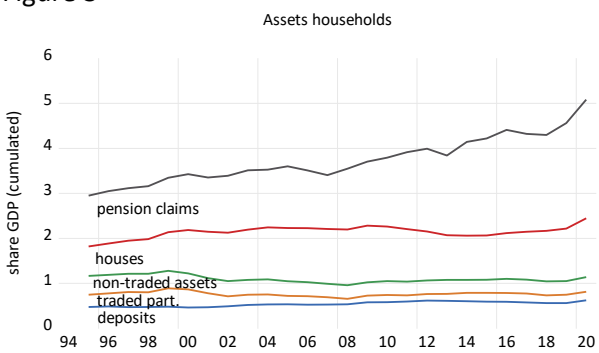
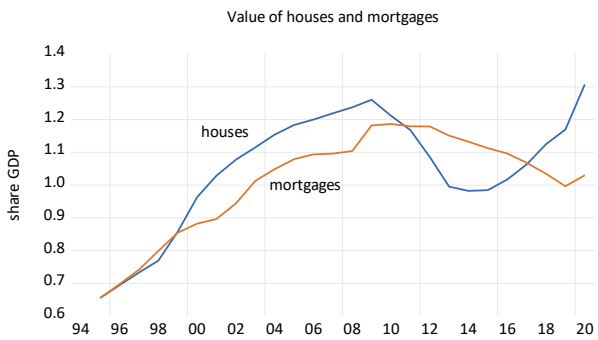


Figure 4



The value of houses and mortgages is presented in Figure 4. After the financial crisis, the housing market collapsed and house prices fell dramatically. Mortgages followed with some delay. But households suddenly realised their vulnerable debt position and started to pay back mortgage debt. However, banks remained very active in stimulating mortgages by systematically lowering their maximum loan-to-income ratio. DNB (2020) argues that this is the main reason for the explosion in house prices after 2013. Our model does reproduce these developments.

[13] The financial assets which households hold next to deposits consist to some extent of bonds and equity, but a large part is managed through "other financial institutions" (OFIs). Households hold claims on these OFIs – see MBM (2017) for a detailed discussion. We therefore denote the financial traded assets held by households next to deposits as "participations". Moreover, wealthy households hold a considerable amount of non-traded financial assets, as we elaborate below.

Using simple estimations for the Netherlands, we find that the growth rate in house prices depends positively on the income of households, and on the decreasing maximum loan-to-income ratio. The change in mortgages depends positively on the housing stock and on the house price.

We analyse the impact of these developments on consumption and savings. From Figure 5 one observes that consumption has dropped consistently relative to GDP since the dot com crisis in 2001, with a sharp fall prior to the financial crisis in 2008. Our simple estimation results for the Netherlands show that consumption depends positively on the disposable income of households and on wealth – we distinguish between net housing wealth and financial wealth. Disposable income declined sharply relative to GDP in the period prior to the financial crisis, from 73 per cent in 2000 to 67 per cent in 2007, mimicking the fall in the wage share during that period. While it stabilised after the financial crisis initially, the value of houses relative to mortgages started to fall, depressing consumption further. The development of consumption is mirrored in that of savings. Household net savings increased from virtually zero in 2008 to a level of around 5 per cent of GDP in 2018 – it increased further in 2019 and 2020 during the corona crisis.

Figure 5

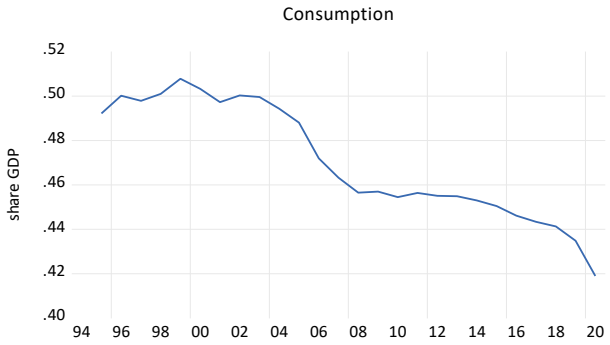
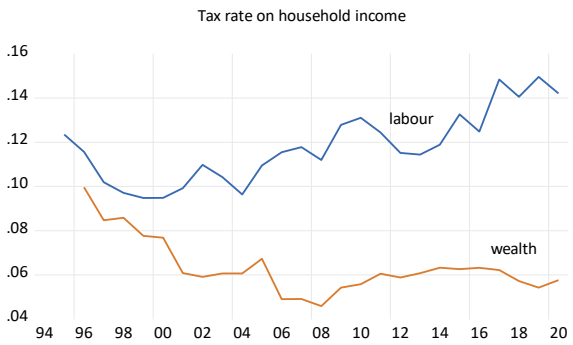


Figure 6



The development of taxes on income and wealth is presented in Figure 6. The tax rate on labour income increased from 9 per cent in 2000 till 15 per cent in 2015, and stabilized afterwards. The tax rate on wealth decreased from 10 per cent in 1996 to 5 per cent in 2008 and stabilized around 6 per cent afterwards.[14]

One should understand that these tax rates are taken from macroeconomic data, i.e. the amount of direct taxes on wages and wealth income from households related to the wages and wealth income as described above. These are obviously not equal to the tax rates (including social contributions and pension payments) on wages as used in discussions on the income distribution. However, the trend of increasing taxes on labour income relative to wealth income is present in our data, as is the relatively low rate of taxes on wealth income. This development is criticized by van der Geest et al (2022, Ch. 3), who recommend an increase in taxes on wealth(income).

We present the other aspects of household behaviour, like the choice of financial assets in a portfolio, in detail in the model in the appendix A.

[14] Wealth includes financial wealth, attributed income to housing and household profits.

3.1.2 Wealth inequality

As we discussed in the introduction, wealth inequality is surprisingly large in the Netherlands and increased sharply after the financial crisis till 2013 – it decreased somewhat thereafter. The wealth distribution can be identified from the CBS data for the period 2006 – 2020.[15] We distinguish between 4 groups of households: (1) low wealth, (2) middle wealth, (3) high wealth and (4) top5. These groups refer to the bottom 50% of households in the wealth distribution for low, the next 30% for middle, the next 15% for high, and the highest 5% for top5. In Figure 7 we observe how the wealth distribution developed in the Netherlands for the period 2006 – 2020.

Figure 7

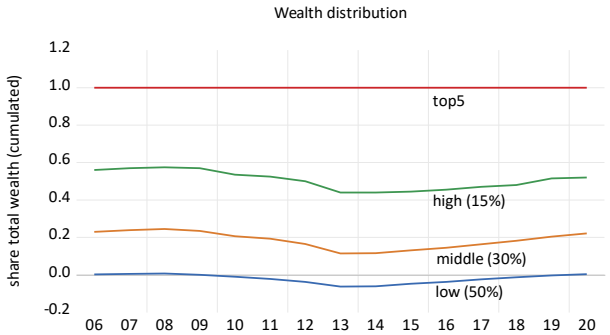
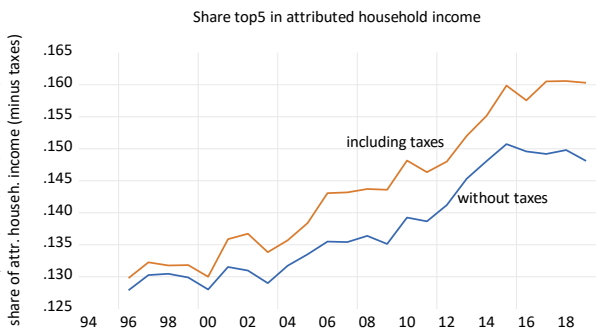


Figure 8



The share of the low wealth group is around zero and even negative from 2009 until 2018. This is consistent with the observation of van der Geest et al (2022, section 2.3.3) that financial wealth of households is concentrated among house owners, hence excluding the low wealth group. The low wealth group could not survive without borrowing money in the period 2009 – 2018. The very low share in total wealth of the middle wealth group around 2013 is due to the observation made in Figure 4 that in the period 2010 – 2017 the amount of mortgages exceeded the value of houses, hence net housing wealth was negative. The top 20 per cent of households then holds all financial wealth (except a small amount of deposits held by the middle category) and owns more than 75 per cent of total wealth of households. The top5 per cent of households owns around 50 per cent of total wealth of households. See Appendix B for more details.

To mimic the wealth distribution in our model we assume that the low wealth category has no wealth and all other categories own houses and hold deposits. With respect to housing wealth net of mortgages we assume that the top5 category owns 25% of total net wealth, the high wealth category owns 45% and the middle wealth category owns 35% – these assumptions are also in line with the CBS data.[16] Next to that, only the top5 and high hold participations (traded assets) and the top5 owns all non-traded assets and – these assumptions are in line with the CBS data.[17]

Based on these assumptions we find that the increase in wealth inequality observed after 2008 can be explained by the low interest rate driving up the value of the relatively large financial wealth of the top5 due to an increase in financial asset prices *pa* and *pant*. However, the wealth of the other house

[15] In addition, data on the distribution of wealth over various assets are only available from 2015 onwards for quintiles. For that reason, we have to calibrate the components of household wealth in Figure 3 for the period 2006 – 2020 in order to mimic the wealth distribution as presented in Figure 7.
[16] After 2015 the top 20% owns over 60 per cent of the net housing value according to CBS.
[17] After 2015 the top 20% owns over 90 per cent of the risky assets according to CBS.

owner groups relative to the housing wealth of the top5 increased. This is due to a growing number of house owners outside the top5 and the increase in house prices after 2014. As a consequence, the wealth share of the top5 starts to decrease again.

While labour income and income from financial wealth is well defined in our model, the question remains how to deal with attributed income to housing wealth. We attribute the rate of return of traded assets to the value of houses in order to define wealth income from houses. Moreover, we include households' profits as a component of wealth income of the top5. Then we can calculate total wealth income.

We assume that the top5 has no labour income and their wealth income follows the allocation of wealth discussed above. Then we find that the share of income of the top5 in total household income increases over time, as presented in Figure 8. This share increases over time, indicating an increasing inequality in income. Moreover, taking into account that taxes on wages increased relative to wealth (Figure 6), including taxes shows that inequality widened over time. However, one should keep in mind that due to the nature of our data, taken from national accounts, inequality figures presented in the public debate are much larger. At least our data pick up the trend of increasing income inequality.

3.2 Firm behaviour

A standard macroeconomic model using firms would suggest that firms finance their investments in physical capital by their retained earnings (savings) and issuing equity or borrowing from banks. However, the national account data show that firm savings exceed investment by a considerable margin. Net investment of firms is very low, around 2 per cent of GDP, while net firm savings increased from 6 per cent of GDP in the late 1990s till 9 per cent in 2012 and dropped afterwards back till around 5 per cent – see Figure 9.

Figure 9

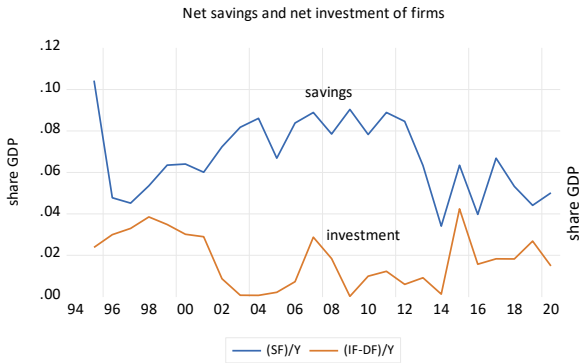
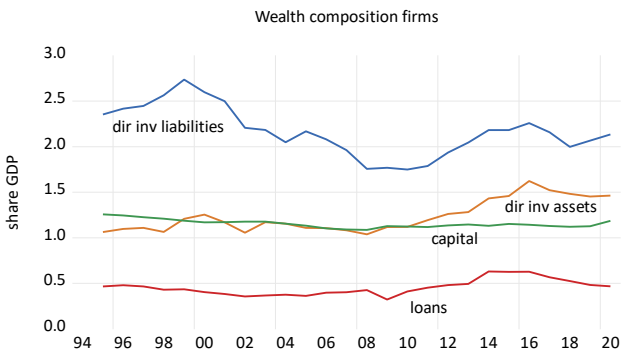


Figure 10



A related element, which is not always well recognised, is that firms do not only invest in physical capital, but also buy financial assets. The latter is often identified with direct investment abroad and we model this as equity held by firms abroad. The impact on the wealth composition of firms is demonstrated in Figure 10. On the assets side one observes that the capital stock is more or less constant relative to GDP over time around 120 per cent. Next to that, firms also have a large amount of foreign financial assets (equity in our model) on the asset side. These foreign assets developed in tandem with the capital stock till the financial crisis, fluctuating around 120 per cent of GDP. However,

they increased after 2008 to 170 per cent in 2017 of GDP, while the capital stock remained at its original level. Afterwards foreign assets stabilised again relative to GDP. In Appendix A.4 we will explain this behaviour of both assets in a portfolio model of the firm for the asset side.

On the liability side, we observe that loans developed relatively stable at a level around 50 per cent of GDP, while foreign direct investment decreased from over 250 per cent of GDP in the late 1990s to a level below 200 per cent of GDP shortly after the financial crisis.[18] It increased again somewhat relative to GDP later on. These developments are also explained using a portfolio model on the liability side in our model – cf Appendix A.4.

Net wealth of firms appears in Figure 11. It was negative in the mid-1990s, around 100 per cent of GDP, but increased to around zero net wealth at the financial crisis, and remained at that level thereafter. The increase in net wealth prior to the financial crisis was due to a decrease in foreign direct investments. In that process, asset prices play an important role. From Figure 12 one sees that both prices of equities fluctuated sharply relative to the price of GDP till the financial crisis, but have increased consistently since then. The price of equities on the liability side started to increase three years later than the price of assets, but the increase faster.[19] While the price of foreign assets in our model is exogenous, the price of foreign liabilities is endogenous in our model, as we explain in Appendix A.4.

Figure 11

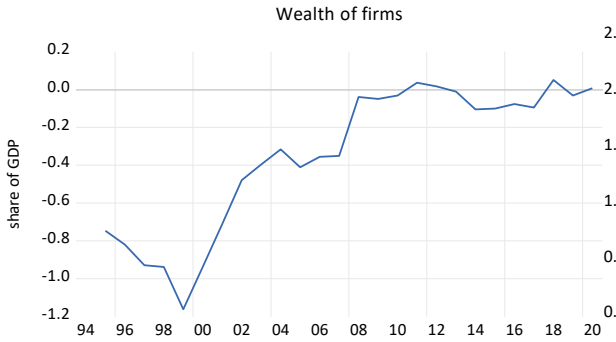
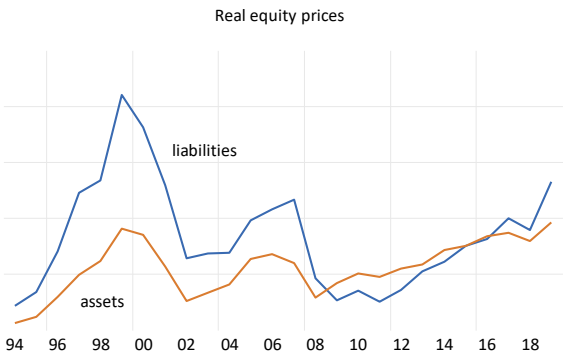


Figure 12



Next to modelling frim behaviour on the financial side – the financial firm behaviour - we also model the real firm behaviour where firms invest in physical capital, employ workers and produce goods and services. While wages and employment are modelled in a rather straightforward way, using an exogenous wage rate and employment as a fixed proportion of GDP, investment is modelled more elaborate. As we see from Figure 9, investment is very volatile, fluctuating around 2 per cent of GDP.

From a simple estimation using Dutch data we find for real firm behaviour that net investment in physical capital by firms is positively influenced by aggregate demand, measured by the utilisation

[18] About 75 per cent of the shares of multinationals in the Netherlands is owned by non-residents – the comparable figures in Germany and France are less than half of the Dutch share (Eggelte et al., 2014).
[19] The worse relative performance of firms' direct investment abroad relative to foreign direct investment is well recognised in the Dutch literature (Eggelte et al., 2014).

rate, and negatively by the costs of capital, represented by the interest on loans times relative to the capital stock. Depreciation is a fixed proportion of the capital stock.

The retained profits - i.e. the net savings in Figure 9 - are a fixed proportion of net profits. The remaining net profits flow to foreign shareholders as dividends.

We present the other aspects of firm behaviour, like mark-up pricing, in detail in the model in the appendix.

3.3 Government behaviour

Government behaviour is modelled in a standard way. Taxes are fixed proportions of GDP as can be observed from Figure 13. The discrepancy between taxes levied on firms and on households is remarkable. One sees from Figure 14 that government expenditures consist mainly of government consumption. Government investment seems rather stable over time relative to GDP but declined after 2009. Net investments were 1.2 per cent of GDP in 2009 – they decreased thereafter to 0.4 per cent of GDP in 2014 and remained at the level. Interest payments declined too relative to GDP, due to the decrease in the interest rate.

Figure 13

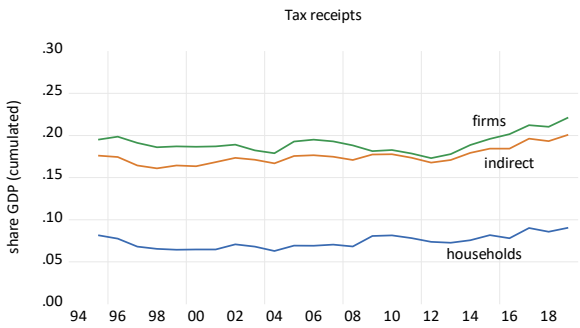
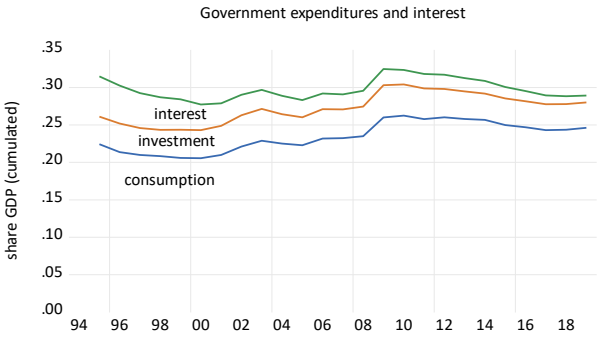


Figure 14



Tax rates are constant in the model, and government consumption is exogenous.

Figure 15

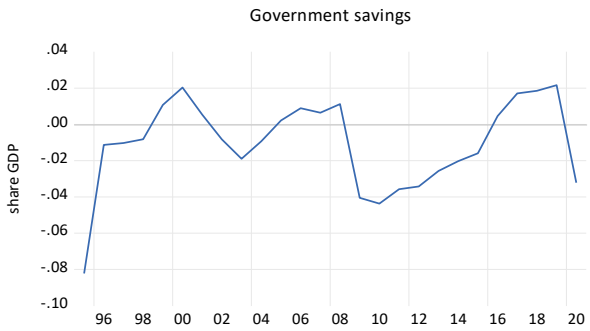
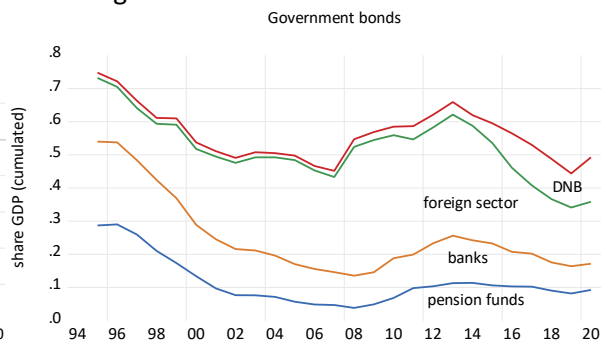


Figure 16



The government deficit fluctuated over time as can be seen in Figure 15. It decreased sharply in reaction to the dot com crisis in 2000 and the financial crisis in 2008. However, in both cases it recovered relatively fast, resulting in a surplus since 2015.[20] The corresponding fluctuations in government debt (consisting of bonds) appear from Figure 16. The figure demonstrates how government bonds are distributed over the various sectors of the economy. A substantial part of the

[20] The deficit in 2020 results from interventions due to the corona crisis.

government bonds is held abroad. The quantitative easing operations of the central bank have mainly affected foreign debt holdings as we elaborate in section 5.

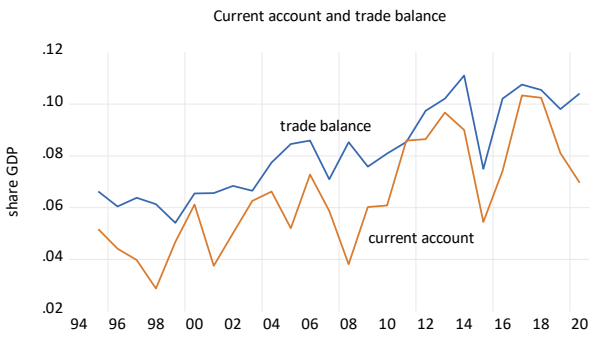
3.4 Foreign sector

The real side of the foreign sector is modelled in a standard way. As can be observed from Figure 17, both imports and exports increase relative to GDP – although the latter increases somewhat stronger. In our simulations, imports are a constant fraction of GDP, for simplicity, and exports are assumed exogenous. The result of these diverging trends is an increasing surplus on the balance of trade from 6 per cent of GDP in 1996 until around 10 per cent in 2016 – see Figure 18.

From Figure 18 one can observe that the current account behaves quite different compared to the trade balance. This reflects the strong interaction between the foreign sector and the financial sector as we discuss now.

Figure 17

Figure 18



The interaction with the financial sector

We saw already from section 3.2 that the foreign sector has a considerable amount of direct investments in domestic firms, while firms have a lower amount of direct investments abroad. This appears on the asset and liability side of the balance sheet of the foreign sector, respectively. We will discuss below that domestic pension funds also invest in foreign equity. Moreover, the banking sector has strong positions on both the asset and liability side of the foreign sector.

All these positions are presented in Figures 19 and 20, respectively. One observes that the foreign sector also holds government bonds (see also Figure 16) and borrows reserves from the central bank. Overall the domestic assets held by the foreign sector constitute about 400 per cent of GPD in recent years, whereas the liabilities are about 500 per cent. The net foreign debt towards the Netherlands in recent years is therefore about 100 per cent of GDP (Figure 21).

Figure 19

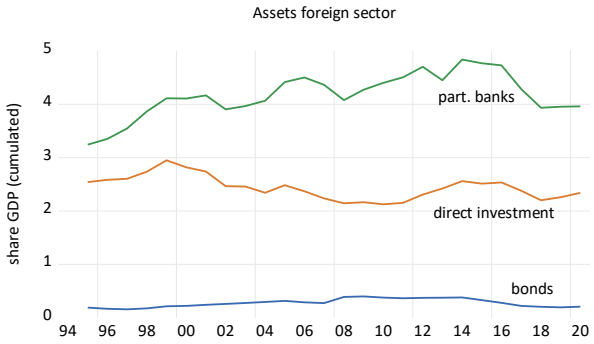
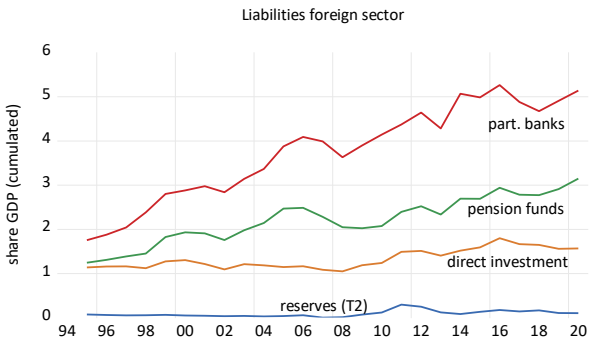


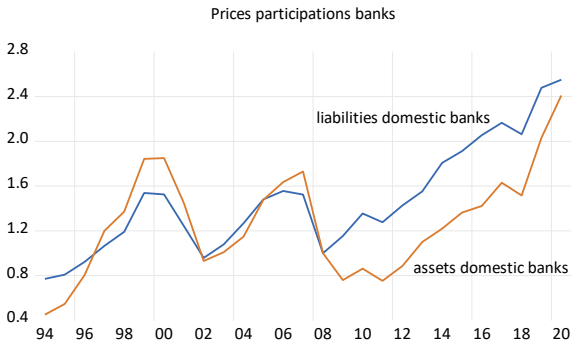
Figure 20



The increase in net foreign debt observed in Figure 21 is not surprising given the large surplus on the current account. This surplus corresponds to net savings of the foreign sector and adds to the net foreign debt, together with valuation changes. Valuation changes result from the price changes of the various assets and liabilities as presented in Figure 12 for direct investments and in Figure 22 for bank participations.

Figure 21

Figure 22



The equity positions on the liability side of the foreign sector follow from the decisions taken by firms and pension funds to buy foreign equity. We discuss bank behaviour below, and the reserves position follows from a portfolio decision as we elaborate in section A.4 of the appendix. We also use a portfolio model to mimic the decisions of the foreign sector on the composition of assets as we elaborate in section A.4 of the appendix.

3.5 Pension Funds

We already discussed in section 3.1 that households hold large and increasing claims on pension finds – see Figure 3. The corresponding assets are presented in Figure 23. One observes that pension funds use the contributions of households to buy a small amount of government bonds, a moderate amount of participations and an increasing part of foreign equity. Given the focus of this paper, where pensions are ignored in the inequality discussion, this investment behaviour exogenous in our model.[21]

[21] In an earlier version of our model we used a portfolio model (Meijers and Muysken, 2016).

Figure 23

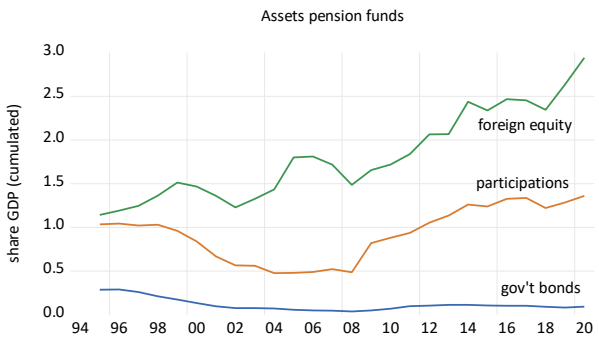
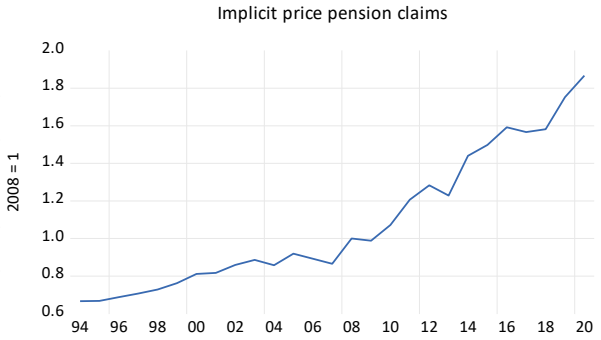


Figure 24



Pension claims increase due to ageing. But they also increase when the interest rate decreases, due to the discounted nature of claims – both aspects are elaborated in section A.5 of the appendix. A relevant observation is that while pension claims are financed by contributions provided by households, net of benefits, the claims tend to increase beyond these net contributions. We model this tendency by imputing a price on these claims, which reflects the extent to which claims are not supported by net contributions. As can be observed from Figure 24, this price has increased strongly over time, reflecting a systematic underestimation of both the ageing of the population and the decrease in the discount rate for future pension claims – see section A.5 of the appendix for details. The discount rate is presented in Figure 25.

Figure 25

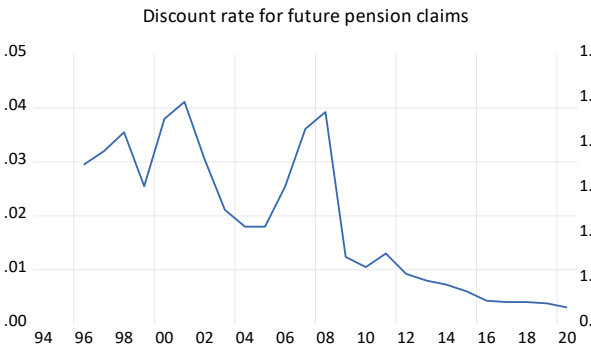
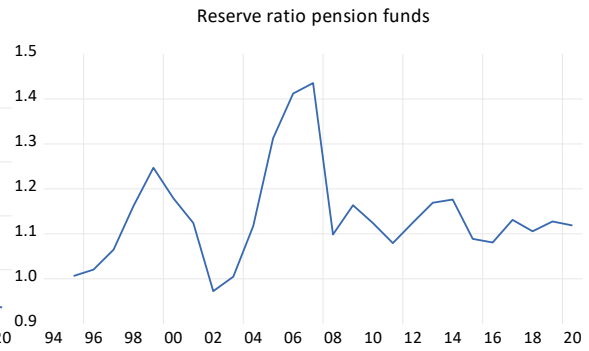


Figure 26



Because of these developments the reserve ratio of pension funds, presented in Figure 26, has fallen dramatically below its critical threshold of 120 per cent.[22] In that case pension funds must lower benefits and increase contributions in order to return to their target reserve ratio. However, in our model the benefit and contribution rates are exogenous.[23]

[22] The reserve ratio equals assets over liabilities of pension funds.

[23] In an earlier version of our model we used endogenous rates (Meijers and Muysken, 2016).

3.6 Banks and the Central Bank

As we discuss in MMS (2015) the presence of the ECB does not hinder the understanding of the Dutch situation by modelling a national central bank (DNB). We, therefore, start with a brief description of the Dutch Central Bank and then turn to the banks.

3.6.1 The Central Bank

Next to holding foreign reserves R, the Central Bank holds bills issued by the government B_{CB} and advances provided to banks A_{CB}, which include Target2 balances. Its liabilities are deposits held by banks M_{CB}. 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.

An important observation is that the Central Bank will always provide as much bills as demanded by the government, if other sectors do not buy these bills. Moreover, when it employs Quantitative Easing operations, the central bank will buy additional bills from other sectors. We elaborate on this in section 5 below and in section A6.2 of the appendix.

The Central Bank will also always accept as much deposits and provide as much advances as desired by domestic banks. It will try to influence this by setting the interest rates on reserves (Target 2 balances) and deposits. The success is mixed, as can be observed from Figures 27 and 28, respectively. We assume the interest rate on deposits held by banks r_{mcb} exogenous in our model. All other interest rates, including that on reserves r_r, are modelled by a mark-up on this rate.

Figure 27

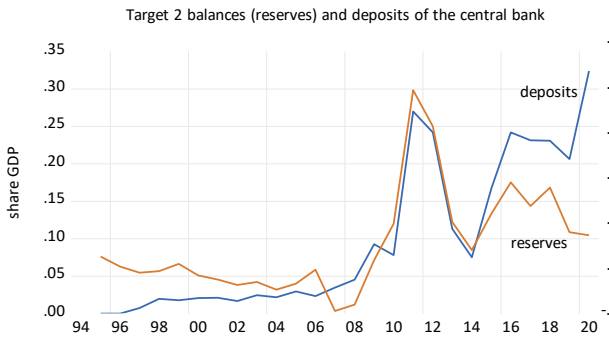
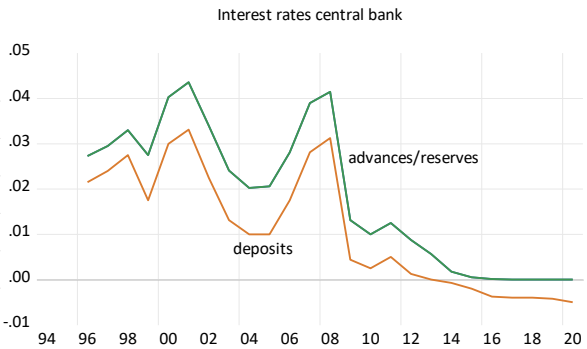


Figure 28



From Figure 27 we observe the huge increase in both reserves (Target2 balances) and deposits in the Netherlands, following the Euro-crisis in 2011 – this is a result of the capital flight from the South to the North in the Euro Area as we discuss in MMS (2016). The next increase in deposits and less in reserves (Target2 balances), follows the start of Quantitative easing in 2014 – see again MMS (2016) for a detailed discussion. The development of the deposit rate and rate on advances or reserves (both are the same) is presented in Figure 28. As is well known, the rate of deposits became negative in 2015.

3.6.2 Banks

With respect to bank assets (Figure 29) it is reasonable to assume that banks provide as many mortgages as demanded to households – and even actively encourage them to accept these

mortgages as we discussed above in relation to the increasing maximum loan to income ratio for households. We also assume that banks offer as many loans to firms as demanded.[24] For the moment being we assume the participations provided to the foreign sector to be exogenous. Bonds are assumed a fraction of outstanding domestic loans and deposits. Central bank deposits are used to clear the balance sheet.

The liabilities of banks (Figure 30) consist of deposits and assets held by households, which are all stable over time relative to GDP. The participations held by pension funds increased somewhat relative to GDP. However, the liabilities of banks held by the foreign sector increased dramatically – from virtually 50 per cent of GDP in the mid-1990s till over 200 per cent of GDP in 2014 – we still must explain why this is the case.[25] For the moment these are exogenous. All other liabilities are determined by the other sectors and accepted by the banks.

Figure 29

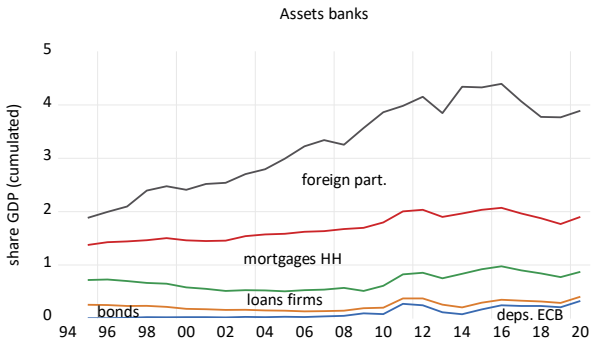
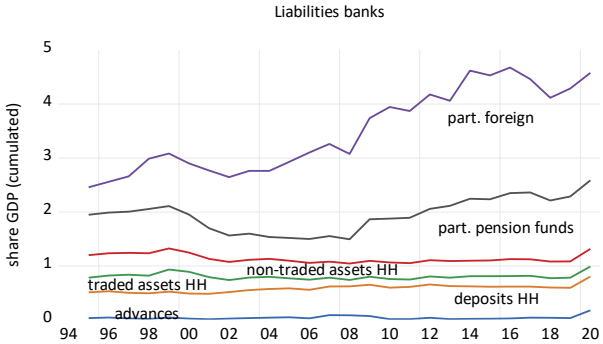


Figure 30



[24] We therefore ignore the problem of credit rationing of small firms – see Bezemer and Muysken (2015) for a discussion.

[25] We used CBS data for banks, but used DNB data to exclude the SFIs (tax vehicles) which are present in the CBS data. Hence, the surge in foreign assets and liabilities is not due to the increased use of SFIs.

4. Simulation of the model in the base run

In this section, we present the simulation of the model, based on simple estimations, in the base run.

4.1 Within sample simulation of the model

Our data cover a limited period, 1995 – 2020, and are on annual basis. For that reason, we were not able to use cointegration techniques but relied on OLS estimations, though some equations are estimated on first differences or growth rates. While the adverse developments, which occurred during this period – the dot-com bubble, the financial crisis, the Euro-crisis, Quantitative Easing, and the consequences of the Covid-crisis – complicate the estimation of the model, we had to use surprisingly few dummies to capture the actual developments well.

The model is estimated using data from 1995 until 2019, the within-sample period, and thus we ignore the impact of the Covid-19 crisis. The estimated endogenous equations are presented in appendix A which describes the model in more detail. For the within-sample simulation, the exogenous variables and the parameters that are not estimated, are based on actual data in the within-sample period. Finally, to improve the in-sample simulation results we added residual add-factors for prices on equity issued by firms, held by the foreign sector, and for the prices of houses. We present the results of the within-sample simulation together with the base run below.

4.2 The base run

The base run simulation runs from 2000 until 2040. We present both a within-sample simulation and an out-of-sample simulation.[26]

For out-of-sample simulations, we extrapolate the exogenous series and parameters for the period 2020 - 2040. That is, we employ a nominal export growth rate of 2%, labour productivity growth of 0.5%, its average growth rate over the within-sample period, and a growth of the nominal wage rate of 2.2%, also its average value over the within-sample period. The latter implies that, given a constant mark up, prices are growing by 1.8% per year. The growth rate of both real government expenditures and real government investments are set to 1% for out-of-sample simulations. The rates of return paid by the foreign sector (r_{Faf} and r_{Fapf}) are taken as an average of their within-sample values (about 3% and 2%, respectively). The growth of houses (roof count) is set to 1% whereas the growth rate of the maximum loan-to-income ratio for mortgages (max_{LTI}) is set at 1%. The rate of consumption of fixed capital by government δ_g as fraction of its capital stock is constant and taken as average of the within-sample period. The development of capital stock of the government follows directly from these numbers. All corrections made to balance sheets and incomes as explained above, i.e. y_{corr} and s_{corr} mentioned in section 2.2, are set to zero in the out-of-sample period.

For Advances *Av* and depreciation rates of fixed capital and of houses we take the sample average as value for the out-of-sample periods. Prices of equity abroad pe_{apf} and pe_{af} all follow the growth rate of nominal wages. Interest rates follow actual (calculated) data during the in-sample simulation and are set to their last observed value for out-of-sample simulations, except nominal returns of equity

[26] The first three years are missing due to various lags in the model. The out of sample period is presented till 2030 to facilitate a better visual inspection of the fit of the within sample simulation.

r_{efa} and r_{eaf}, which are set to their sample averages. For all other parameters, we take the value they have at the last year within the data sample.

These notions are summarised in Table 1 for the parameters and in Table 2 for the out-of-sample values of the exogenous variables.

Table 1. Out-of-sample values of parameters

Variable name	*Description*	*Variable name*	*Description*
Average of in-sample values:			
m	Markup	δ_g	Depreciation rate government capital
p_{pf}-b_{pf}	Net contribution pension fund as share of wages	av	Advances
Last value of actual data:			
δ	Depreciation rate firms	τ_h	tax rate income (direct taxes)
T^o	Expected lifetime after retirement (longevity)	τ_{mo}	Tax reduction due to mortgages
N^o/N^y	Grey pressure	τ_f	Tax rate on gross profits
im	Imports (as fraction of GDP)	τ_i	Indirect tax rate
κ	Capital productivity	All interest spreads	
b_{pf}	Fraction of pension benefits of wages	Exogenous shares portfolio pension funds	
Set to zero out-of-sample:			
baserate	Base interest rate (set by central bank)		
scorr, ycorr	All correction factors in Balance sheet and social accounting matrix		

Table 2. Out-of-sample values of main exogenous variables

Variable	***Out-of-sample value***
Growth rate exports	2%
Growth rate real houses	1%
Growth rate labour productivity	0.5%
Growth rate loans-to-income ratio	1%
Growth rate nominal wages	2.2%
(Inflation, endogenous)	(1.7%, average value of in-sample-values)
Growth rate of p_{ant}, p_{eaf}, p_{eapf}, p_{aab}, p_{aba}	2.2%
Growth rate p_b	0%
Growth rate real government expenditures	1%
Growth rate real government investments	1%

Though the model is rather stable and can be simulated over more than 100 years, some variables such as the trade balance (relative to GDP), are not converging to stable values such that simulating the model over the very long run is less meaningful.[27] We therefore simulate the base run until 2040.

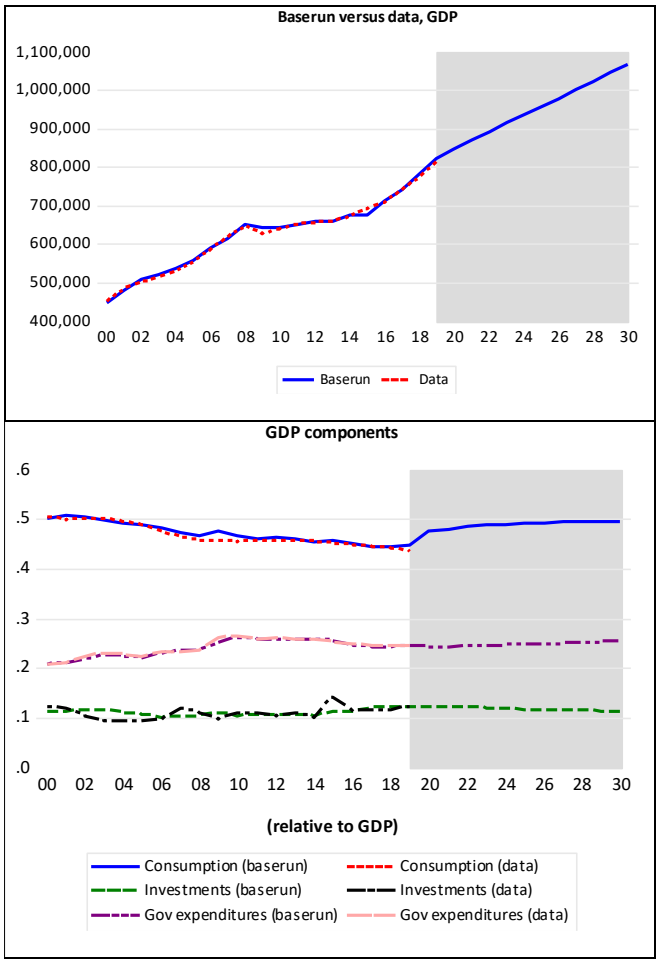
[27] In earlier papers we included feed-back loops on the trade balance and government expenditures to avoid strong divergences. This should be taken up in a refinement of the model.

4.3 The results for the base run

In most cases the simulation results for the base run show a good fit with the data for the within-sample simulation. Only for the financial sector, some results are still unsatisfactory as we discuss below. We present the most relevant outcomes in this section, starting with GDP and its components.

GDP as simulated follows actual GDP fairly well in the in-sample period. After the financial crisis, we see a slight overestimation of GDP. Since we did not make any adjustments to capture the consequences of the Covid crisis in the model, the in-sample period ends in 2019. After some small initial adjustments, also due to changes in the taxes rates, the growth rate of GDP adjusts quickly to 1% in the out-of-sample period (first panel in Figure 1).

Figure 1



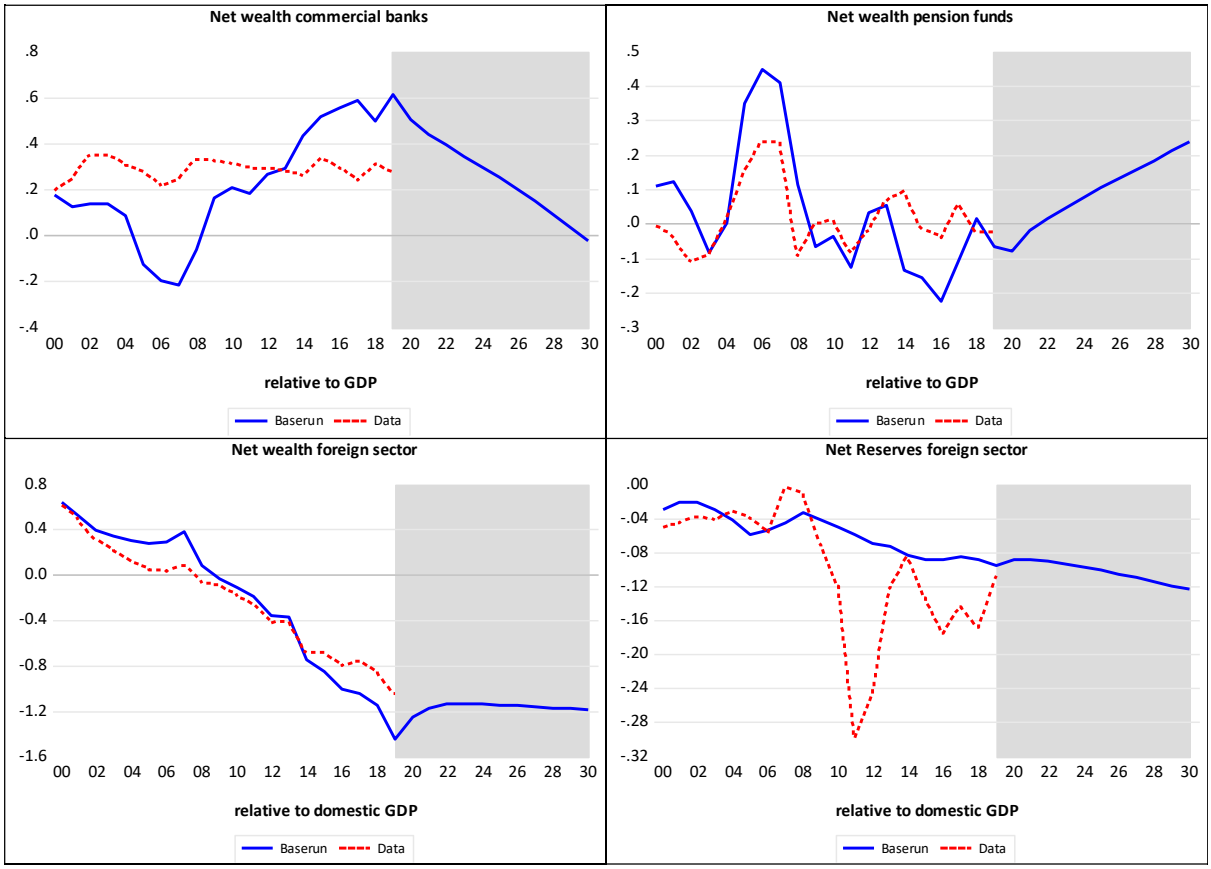
The various components of GDP are presented in the second panel of Figure 1. One observes that these follow the actual data rather well, except for investments which are slightly overstated in the period 2003-2006 and also do not follow the data well in 2014-2015. Since the exports are exogenous and imports are based on an exogenous (and slightly varying) fraction of GDP and thus follow GDP, these are not displayed.

Turning to the real sectors, one should note that the wage rate, tax rates and interest rates are exogenous and based on actual data. With respect to households and firms, the net wealth to GDP ratio follows data rather well (First and second panel of Figure 2, respectively). The same holds for the government debt and deficit (third and fourth panel of Figure 2, respectively) although the simulated government deficit ratio drops in 2020 and as a consequence, the debt ratio decreases sharply in 2020.

Figure 2

Turning to the financial sectors, the within-sample simulation results are less satisfactory. The net wealth of commercial banks is clearly understated in the base run simulation, cf. first panel in Figure 3. The net wealth of pension funds follows the data rather well, except around the financial crisis and around 2016 (second panel of Figure 3). The deviations in both net wealth of banks and net wealth of pension funds are related – they follow from a deviation of between the estimated asset prices and the observed asset prices leading to a misrepresentation of valuation changes. We leave this for further research.

Figure 3



Finally, the third panel of Figure 3 shows that the development of the net wealth of the foreign sector, follows data rather well, although the increase in the foreign debt is overestimated in recent years. The net reserves of the foreign sector do not follow the data well around the Euro-crisis.

All out-of-sample simulations seem quite reasonable – they do not deviate sharply from the within-sample developments.

Although some questions remain, the base run is interesting enough to use as a background for simulation experiments. These are presented in the next section.

5. Simulation of various scenarios

This section describes the effects of some scenarios where we study the impact of low interest rate and QE on the economy. For all scenarios, we keep the nominal values of exports exogenous and equal to the base run. In all scenarios, we give a shock in 2015 and a reverse shock in 2020 and we present the deviations from the base run over the period 2010-2040.

We discuss below three scenarios:

1. decreasing the interest rates on deposits, mortgages, firm loans, government bonds and the central bank deposit rate for the foreign sector
2. increasing riskier bank behaviour
3. quantitative easing by decreasing interest rates on bonds

We first present the effects of these scenarios on the macro economy and afterwards, we will focus on wealth inequality developments in these scenarios.

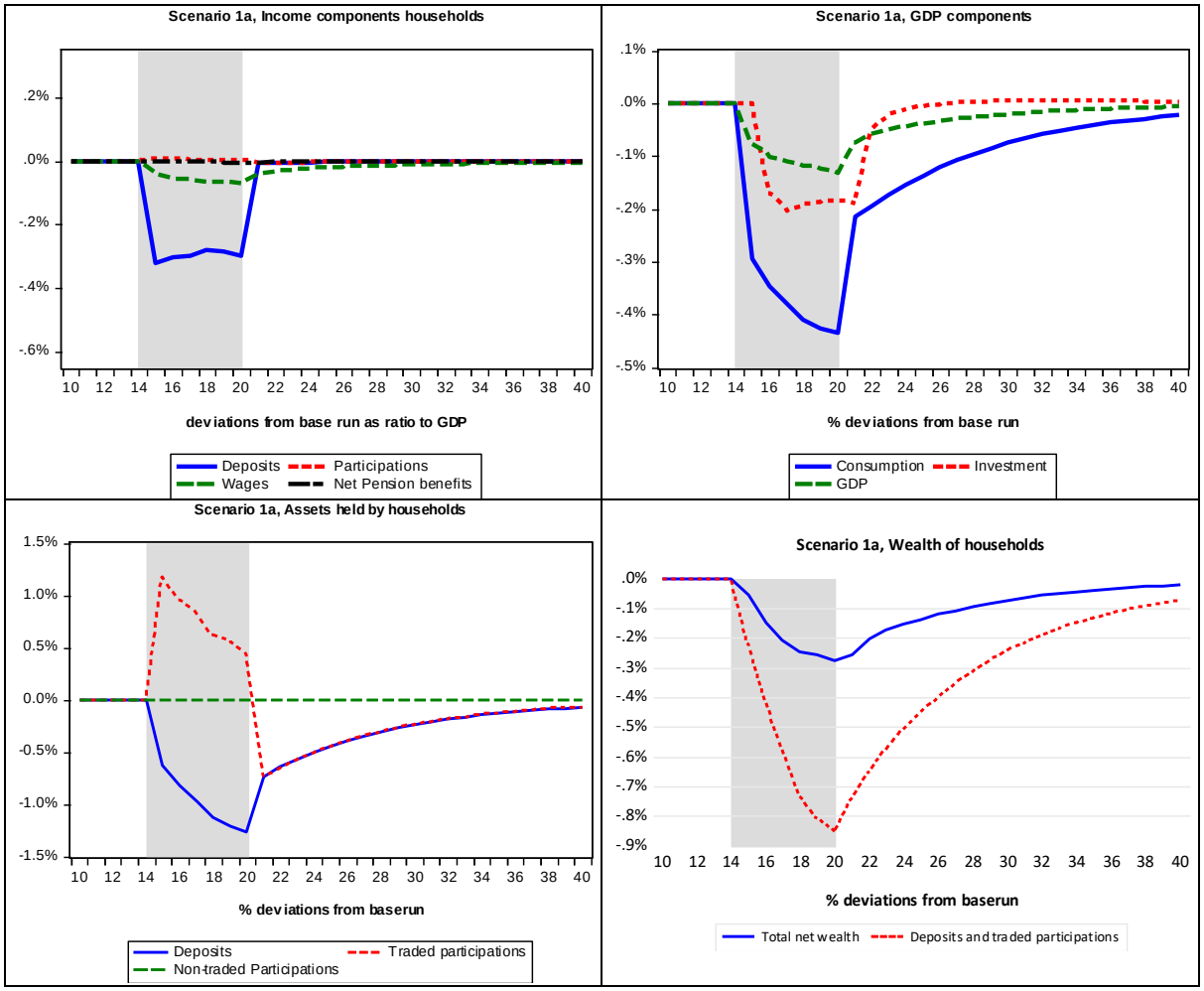
5.1 Decreasing the interest rates

We analyse the impact of a decrease in various interest rates step by step and finally analyse the combined effect. So, in five steps we analyse a decrease in the interest rate on household deposits (1a), a decrease in the mortgage rate (1b), a decrease in the rate of loans provided by banks to firms (1c), a decrease in the bond rate (1d), and finally by decreasing the rate on Central Bank deposits as used by the foreign sector (1e). Finally, we analyse the combined effect of all steps taken together 1a-1e. Note that we do not change the discount rate of future pension claims, which would have strong effects on these claims and consequently on the pension contributions and benefits. The latter are taken as exogenous in the current version of the model.

Scenario 1a: a decrease in the interest rate on household deposits (r_m) by 0.5%-point, i.e. by 50 basis points.

In this scenario, we decrease the interest rate on household deposits during the period 2015-2020 and we compare the simulation results with the results obtained in the base run[28]. In this scenario household income from deposits obviously decreases (first panel of Figure 1) and therefore total household income decreases, leading to lower consumption, lower GDP and to lower investments (lagged by one year), see the second panel in Figure 1. Because of lower GDP, employment will slightly drop, and wages received drop too, albeit very modest (first panel). Households also shift their portfolio from deposits to traded participations (third panel of Figure 1). The decrease in income has a small effect on total net household wealth as is displayed in the fourth panel of Figure 1. However, since all other components such as houses and mortgages are not affected, the value of deposits and traded participations show a relative higher decline, of almost 1% in 2020 (fourth panel). This also explains why the relative deviations of deposits and traded participations in the third panel are below their base run values in 2020 and only slowly revert to their original values in 2040.

Figure 1. Scenario 1a, decrease in the deposit rate

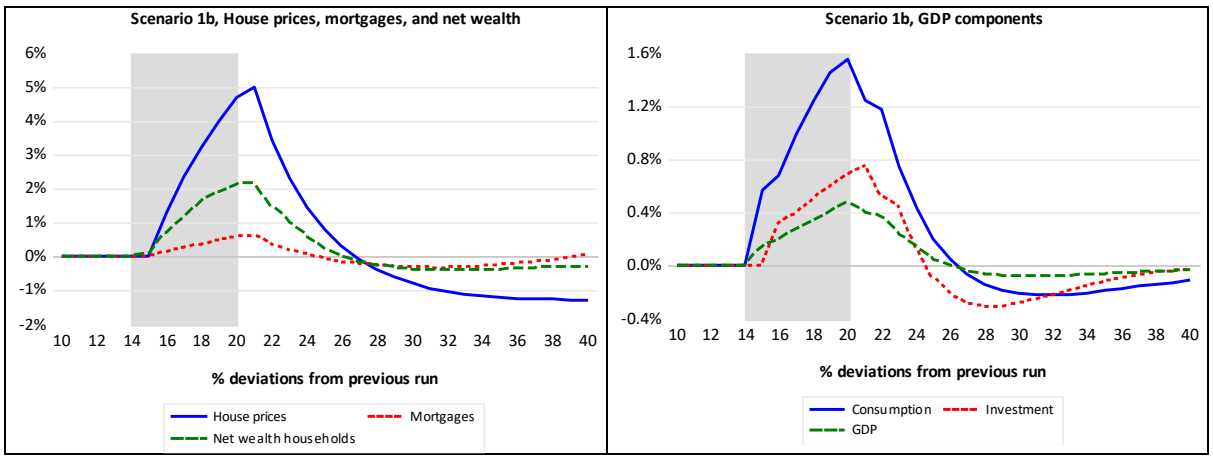


[28] Note that in most cases we present relative differences of scenario results (x_s) compared to the alternative (i.e. base run) results (x_b), so as $({}^{x_s}/_{x_b} - 1)$, while in some cases, i.e. in the first panel of Figure 1, we use deviations of both results, relative to GDP $\left({}^{x_s}/_{y_s} - {}^{x_b}/_{y_b}\right)$

Scenario 1b: Additionally, a decrease in the interest on mortgages (r_{mo}) by 50 basis points.

Following the discussion in section 3.1, a decrease in the interest on mortgages has a positive effect on the prices of houses and a positive effect on net housing wealth and net total wealth of households (first panel of Figure 2, where we compare the outcomes of this scenario with the previous scenario, i.e., with scenario 1a). The increased housing wealth induces an expansion in consumption which increases output and investment, the latter being one year delayed as before. The effect of increased house prices on mortgages is positive, albeit that effect is small (first panel of Figure 2). House prices do not revert to their original values after the shock in the mortgage rate has been restored. This has several reasons. First, the negative growth rate of house prices is slightly higher than the initial positive ones[29] and second, the growth rate of real (expected) output, which has a positive impact on house prices, see equation (6) in the appendix, is lower after the shock. This is caused by higher consumption out of wealth during the shock. Both reasons cause net household wealth to be lower compared to its original value once the shock has been reversed, see the first panel in Figure 2.

Figure 2. Scenario 1b, decrease in the interest rate on mortgages



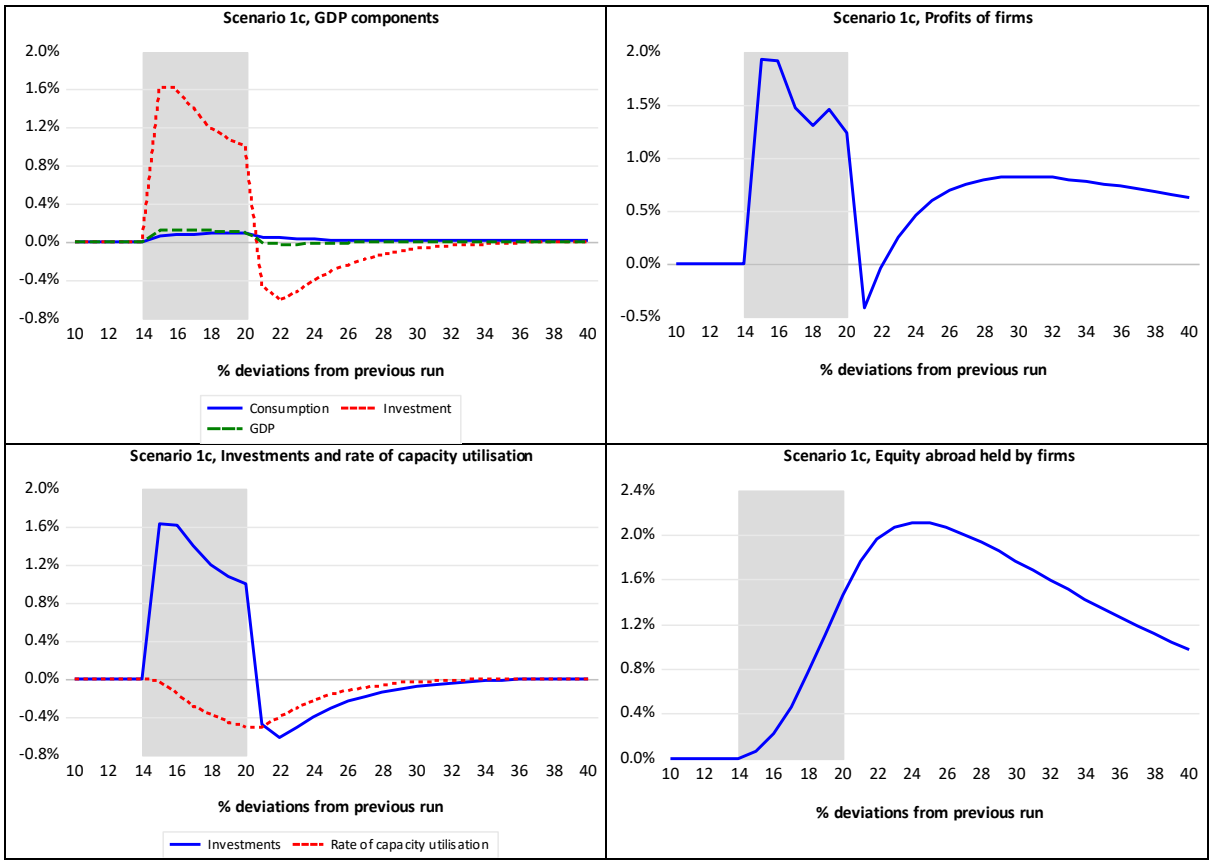
[29] The model implementation uses arithmetic growth rates and not log-based growth rate as presented in the appendix.

Scenario 1c: Additionally, a decrease in the interest rate of bank loans by firms (r_{lf}), also by 50 basis points.

As expected, the decreased interest rate on loans for firms has an immediate and positive impact on investment by firms as can be seen in the first panel of Figure 3. Contrary to the impact of the mortgage rate, a decrease in the interest rate of loans of firms has almost no effect on GDP since (net) investments are only a small share of GDP. One observes from the second panel that also profits increase due to decreased interest payments. These profits are partly (for about 56%) distributed to shareholders (abroad) and for the other part kept as retained profits by the firm.

After the shock, the interest rate has been reversed to its original value and the profits decrease first sharply but become positive quickly afterwards. This is explained by the decreased investments, and thus decreased costs after the shock has been reversed. During the shock, investments increase because of a lower interest rate and consequently the rate of capacity utilisation decreases as can be seen in the third panel of Figure 3. After the shock has been reversed, capacity is still relatively high and the rate of capital utilisation is low. Therefore, investments will be low for a longer period of time until the rate of capacity utilisation has been restored. Because the costs of lending have been reduced, firms are increasing their investments abroad (FDI) as is displayed in the last panel of Figure 3, see also equation (22) in the appendix. A decrease in the domestic interest rate on loans, therefore, increases investments abroad.

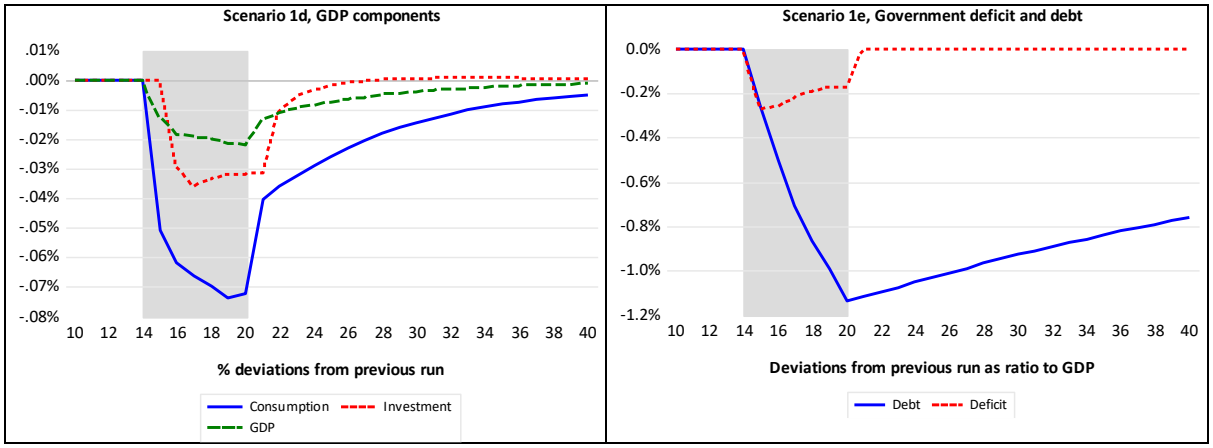
Figure 3. Scenario 1c, decrease in the interest rate on loans



Scenario 1d: Additionally, a decrease in the bond rate, also by 50 basis points.

A decrease of the interest rate received for holding government bonds decreases the income of bond holders, which are banks, pension funds, the central bank and the foreign sector, whereas the interest payments by the government also decrease. This leads to a decrease in both government deficit and debt relative to GDP as is shown in the second panel of Figure 4. The income of the pension funds decreases because of the decreased bonds rate, and therefore pension income by households decreases slightly. Compared to scenario 1c, this causes a small decrease in consumption with a relative deviation of less than 0.1%. Note that in the current version of the model all tax rates are exogenous, as well as government expenditures, implying that there is no direct positive feedback from the decreased debt and deficit relative to GDP to disposable income net of taxes.

Figure 4. Scenario 1d, decrease in the bond rate



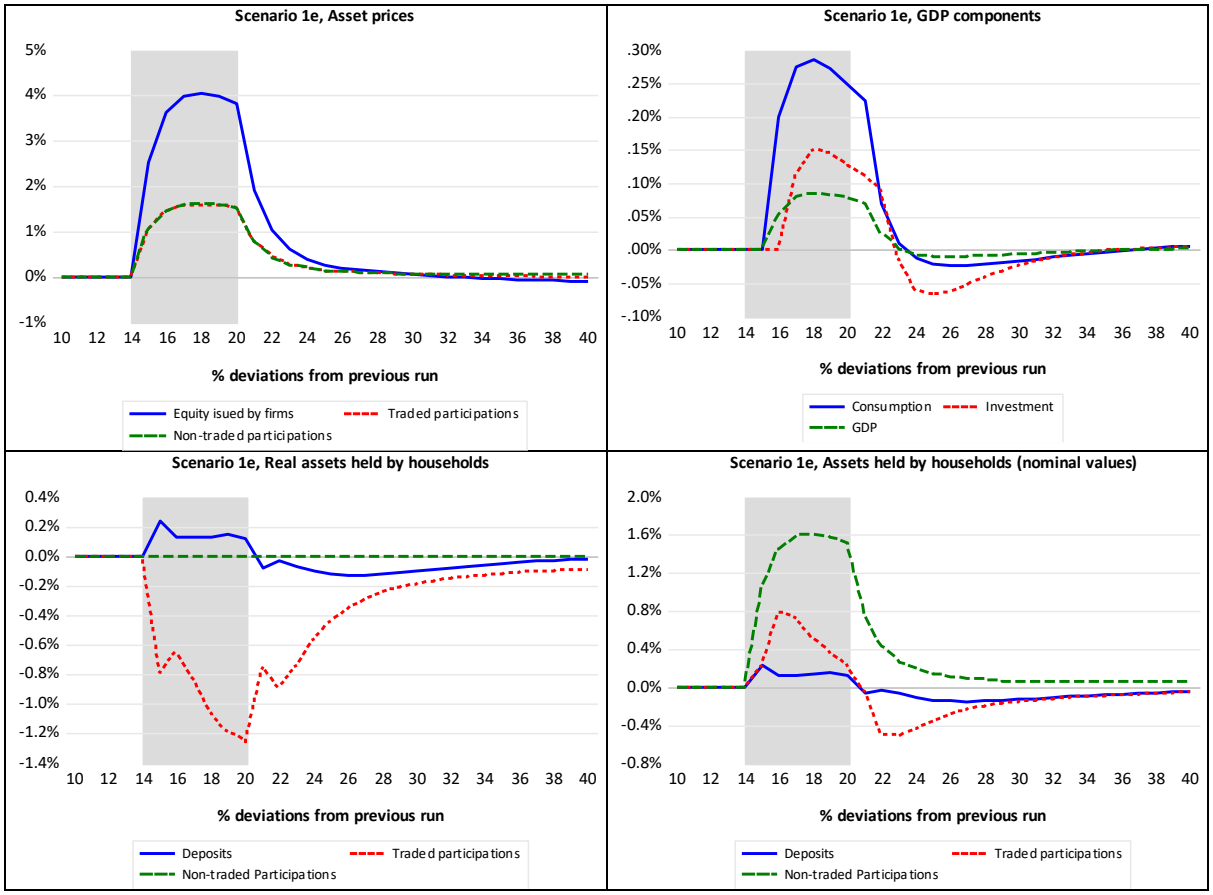
Scenario 1e: Additionally, a decrease in the central bank deposit rate relevant for the foreign sector, also by 50 basis points.

To investigate the effect of low interest rate on the prices of assets such as equity and participations, we also lower the interest rate of central bank deposits for the foreign sector. As is explained in the model description in the appendix, a decrease in the central bank rate changes the opportunity gains for the foreign sector and therefore the foreign sector will increase demand for equity, which leads to an increase in equity prices, and subsequently to increases in prices of participations by households, see equation (27) and footnote 32 in the appendix. Though non-traded participations are exogenous in the model, we also additionally assume in this scenario that the growth rate of non-traded asset prices is the same as for traded assets. Finally, because the model includes hysteresis in growth rates, we adjust the growth rate of prices of equity downward after the shock, so after 2020, in such a way that prices of equity return to about their original value afterwards.

A decrease of the base rate will increase demand for equity and will therefore increase the prices of equity. This in turn also increases the prices of both traded and non-traded participations as is displayed in the first panel of Figure 5. The second panel shows that the increased prices have a positive effect on consumption and consequently also on GDP and on investment. Because of the increased prices, household net wealth increases though households will reshuffle their real assets away from participations to keep the nominal portfolio distribution in line with returns on deposits

and traded participations. (Note that the real value of non-traded participations is kept exogenous). However, given the changes in prices, the nominal value of non-traded assets increases the most, followed by traded assets and finally deposits as is displayed in the last panel of Figure 5.

Figure 5. Scenario 1e, decrease in interest rate for the foreign sector

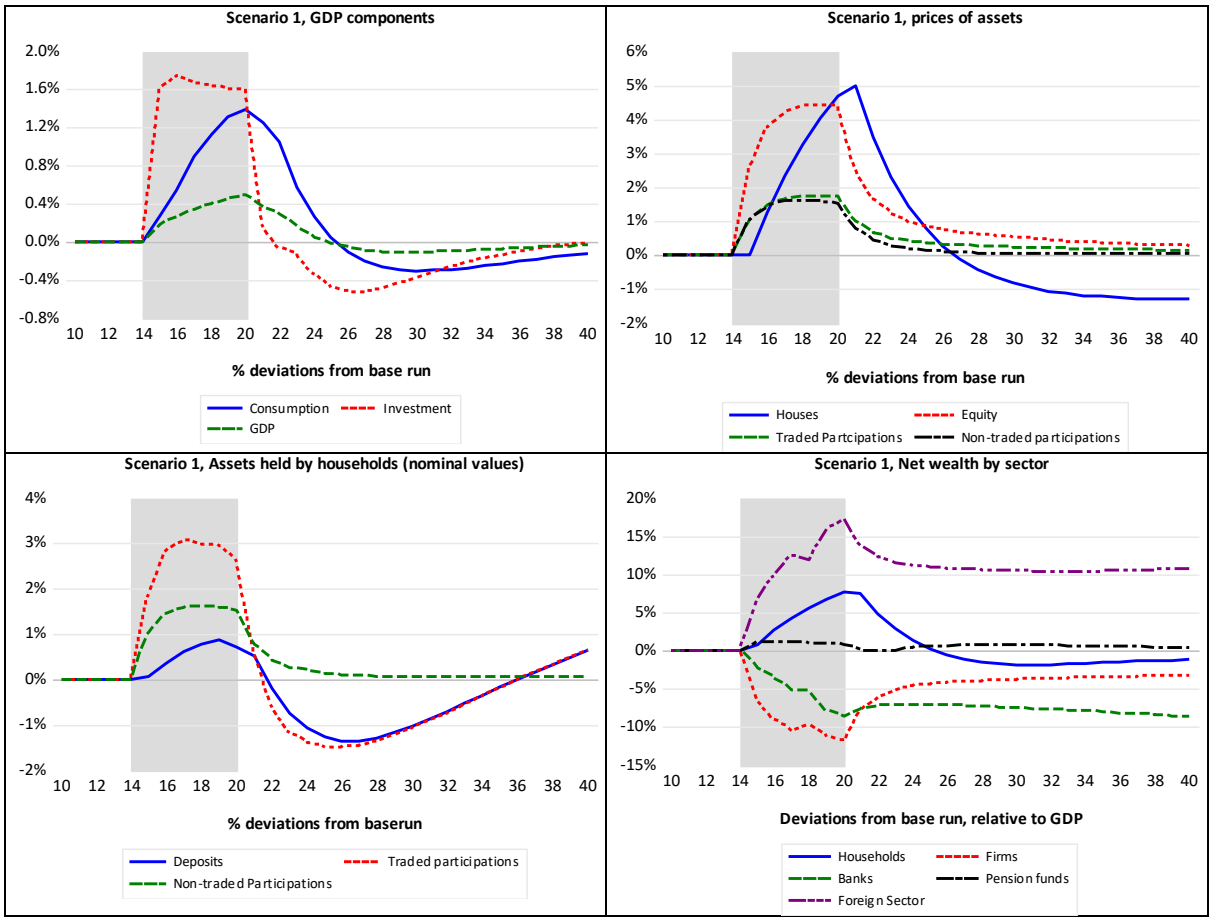


Scenarios 1a – 1e taken together.

If we take the outcomes of all five scenarios combined and compare these with the base run, we observe a strong and immediate increase in investment and a more sluggish but ultimately almost equal increase in consumption (First panel of Figure 6). GDP hardly increases since we keep exports and government expenditures exogenous.

The prices of all assets increase where prices of equity react immediately after a decrease in the interest rates and prices of houses increase ultimately to about the same relative deviation from the base run, but more sluggish, see the second panel in Figure 6. The third panel shows that households both increase their (financial) wealth and also shift their portfolio. The nominal value of traded participations increases the most, and this is caused by two effects: a shift within the portfolio and an increase in nominal wealth. The portfolio rebalancing is due to a decrease in the interest earnings relative to earnings on traded participations, and total wealth increases because of an increased price of traded participations. Finally, the last panel shows the development of the net wealth of several sectors (again, relative to the base run). For households, firms and pension funds this development follows the portfolio shifts. The persistence of the net wealth position of the foreign sector and of banks after the shock has been reversed is remarkable. This probably follows from shifts in the interest earnings and returns related to the shifts in the assets (and liability) distributions. Further research on the relationship between banks and the foreign sector is needed to better understand this aspect.

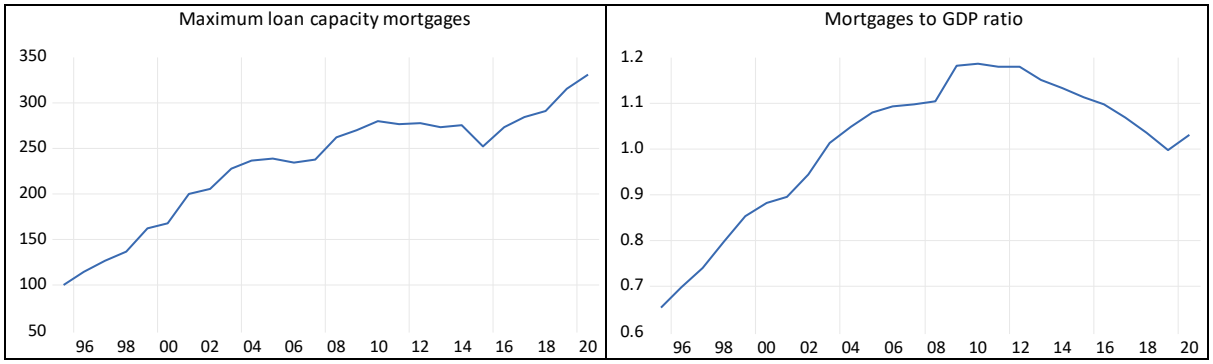
Figure 6. Scenario 1, altogether



5.2 Increasing risk behaviour by banks

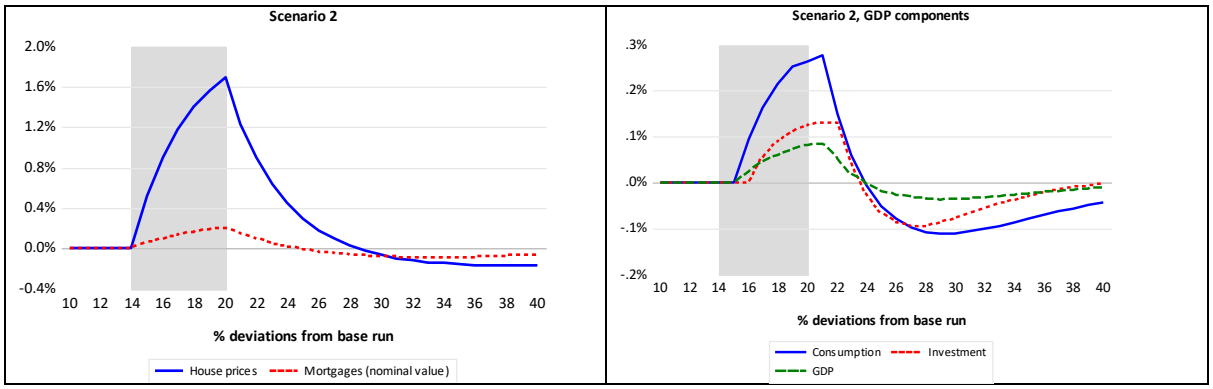
As mentioned in section 3 and as elaborated in the description of the model in appendix A, section A.1.1, the maximum loan-to-income ratio that is employed by banks to assess the affordability of households of receiving a mortgage has increased considerably in the Netherlands, cf the first panel in Figure 7. This has increased the total value of mortgages from about 65% of GDP in 1995 to about 120% of GDP in 2010, cf the second panel in Figure 7. Since then, the total value of mortgages relative to GDP has decreased. This increase in the mortgage loan-to-income capacity has increased demand for houses and thereby increased house prices.

Figure 7



In the model, we follow DNB(2021) in explaining house prices. Next to increases in real income, the interest rate and maximum loan-to-income ratio are important factors to determine the growth rate in house prices. A decrease in the mortgage rate already increases the demand for houses and thus the prices of houses, as we have demonstrated above. But next to this, a decrease in the mortgage rate seems also to increase the maximum loan-to-income ratio as displayed in Figure 7. To investigate the effect of changes in this maximum loan-to-income ratio, we simulate here an increase of that ratio by 5%. The first panel of Figure 8 shows that indeed the house prices rise, first only about 0.6% but they continue to rise given the sluggish adjustment of prices to increases in the maximum loan-to-income ratio. The nominal value of mortgages also increases, and households become more indebted because of the increased risk behaviour of banks, though the effect is modest.

Figure 8. Scenario 2, an increase in the loan-to-income ratio



As before, an increase in house prices leads to somewhat higher consumption, slightly higher GDP and slightly higher investments as is presented in the second panel of Figure 8.

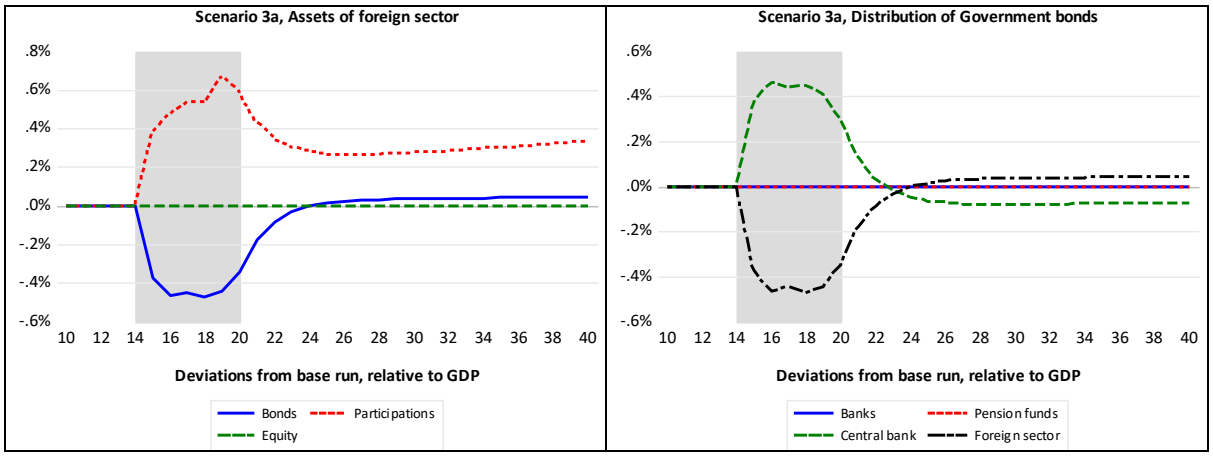
5.3 Quantitative Easing

In this scenario, we start from the base run and we give a shock by lowering the interest rate on government bonds by 50 basis points. Thereby we mimic the effects of QE as we explain in section A.6.2 of the Appendix. This scenario is comparable to the previous scenario where we decrease the interest rate on bonds, together with the other interest rates. Here we focus on the effect of QE.

We split this scenario into two parts. First, we analyse the effect of portfolio rebalancing of all sectors that hold government bonds while ignoring the effect of the changing interest rate on income and expenditures. In the second phase, we also include the changes in income and expenditures due to a decrease in the interest rate in the analysis. As we will show below, this will change the picture dramatically.

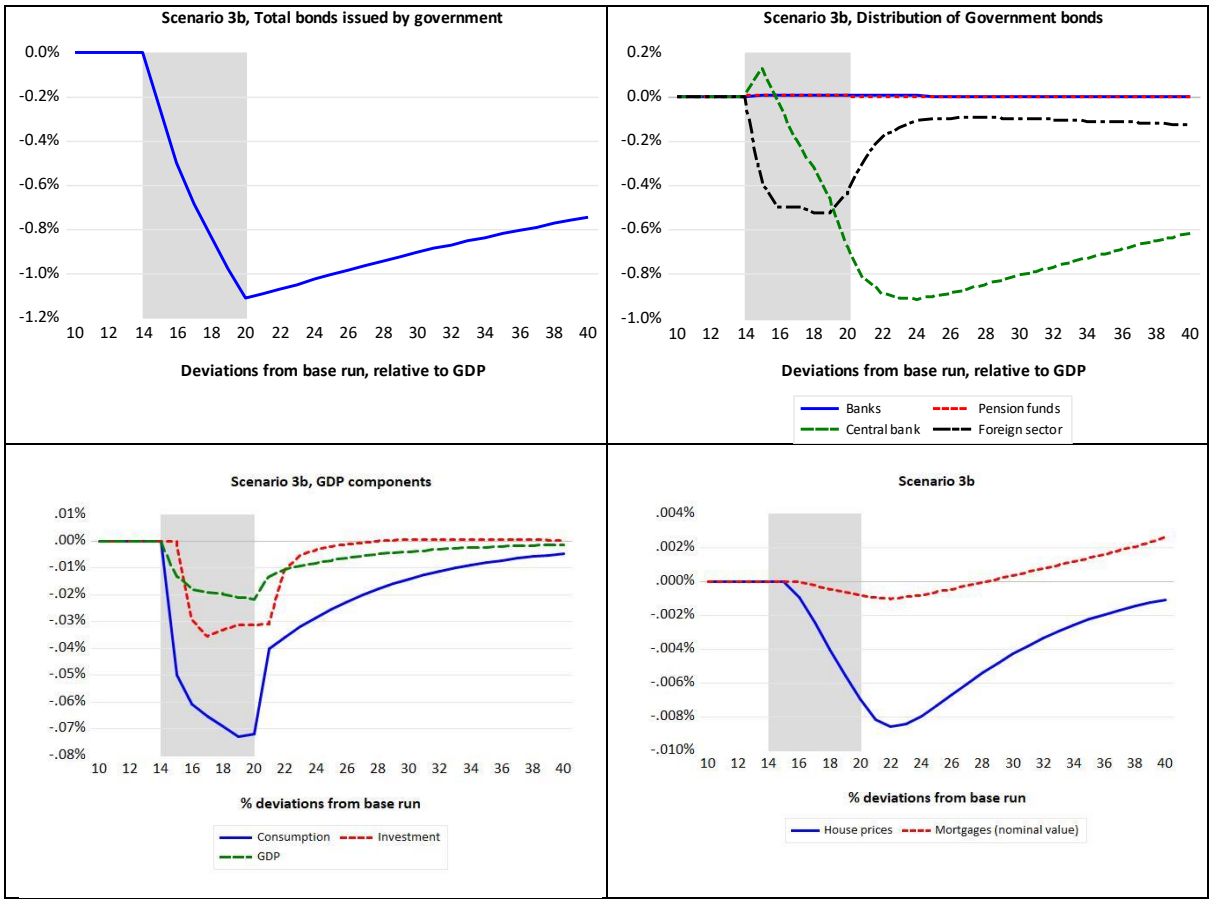
As the foreign sector had bonds in its portfolio, a decrease in the rate will cause a reshuffling of the portfolio away from bonds and towards participations. Pension funds and commercial banks do not change their portfolio because of the regulated market for pension funds whereas banks keep their position in government bonds relative to loans and mortgages. This causes the central bank to absorb the remaining bonds that are supplied by the government and not demanded by the other sectors. Hence, this scenario is in line with the development we observe from the actual data. The central bank increases its position in government bonds, and the foreign sector sells these bonds and places the net worth as participations at Dutch commercial banks. See the two panels in Figure 9.

Figure 9. Scenario 3a, Quantitative Easing, pure portfolio rebalancing effect



As the second step, we also include the effect of changing the interest rate on income and expenditures. This has two important implications for the government deficit. First, a decreased interest rate on government bonds decreases interest payments by the government and therefore decreases deficit and debt. Secondly, a shift of government bonds from the foreign sector to central banks also shifts the remunerations from the foreign sector towards the central bank. This increases the income and profits of the central bank which in turn are transferred to the government. This again implies a reduction of the government deficit and a reduction of government debt. The first panel of Figure 10 indeed shows that government debt as a percentage of GDP decreases by more than 1% in 2020. This has considerable effects on the portfolios of the foreign sector and of the central bank as is displayed in the second panel of Figure 10.

Figure 10. Scenario 3b, Quantitative Easing, including income and expenditure effect

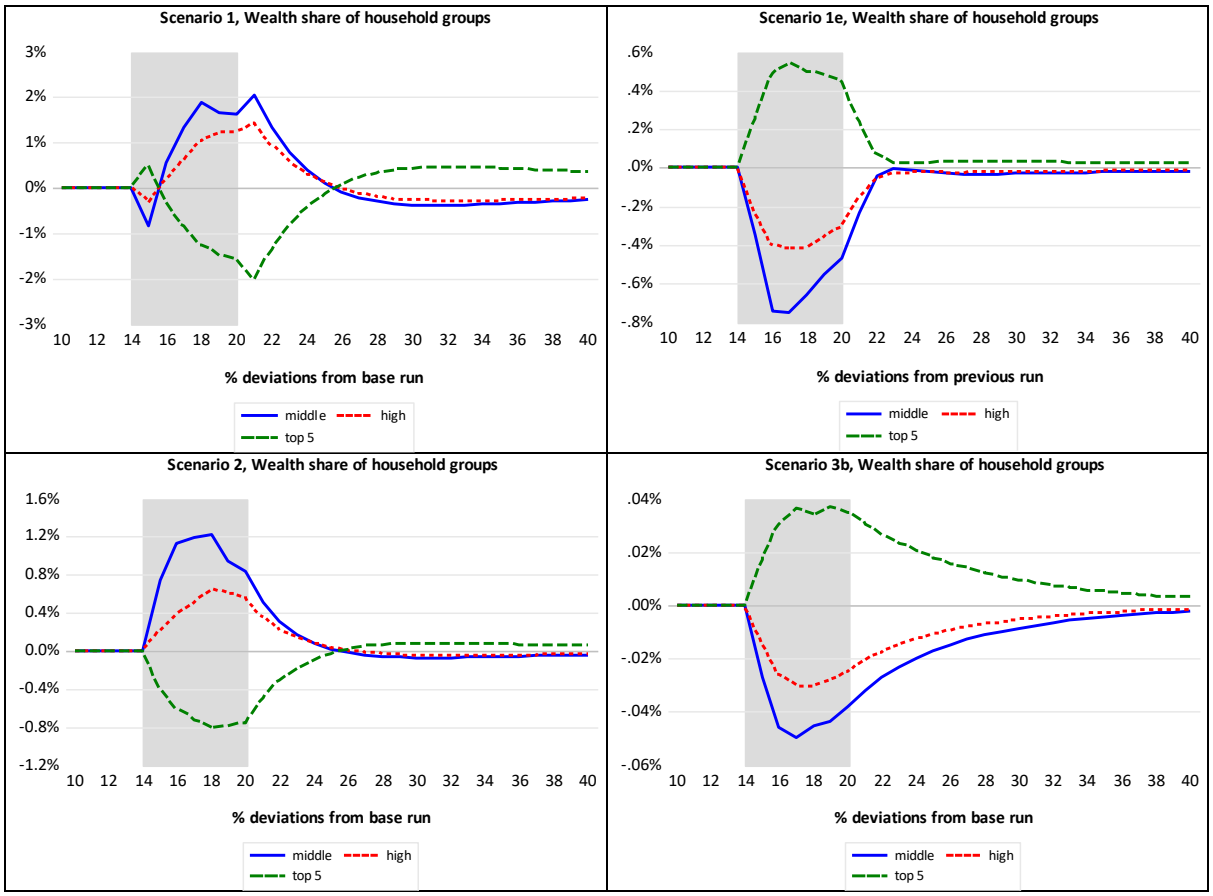


Since pension funds now receive less income from holding government bonds, their income reduces which implies that pension benefits slightly decrease. This has an effect on the income of households, which reduces consumption but also reduces the prices of houses. Note that both effects are very small as is shown in the third and fourth panels of Figure 10. In this simulation we keep the tax rates as well as the expenditures of the government exogenous, so a stimulus that would be possible because of decreased interest payments by the government by means of increased expenditures or decreased taxes is not considered. However, these simulations are consistent with the observation that the huge Quantitative Easing operations by the Dutch Central bank had no discernible impact on the real economy.

5.5 Impact on the wealth distribution

This final section shows how these developments have contributed to increased wealth inequality. The model does not distinguish between various households explicitly and therefore we make some assumptions regarding the wealth distribution of various assets. This is further elaborated in Appendix B. The households with low wealth have no houses or financial assets. The middle class has some net housing value and deposits, and the high-wealth group has additionally some traded participations in their portfolio, whereas the top 5 wealthiest households own all non-traded assets, some traded assets, some net housing wealth, and some deposits. This section describes how wealth positions change in the scenarios described above. As before, we compare to the base run and in all cases, we present relative changes In absolute terms these pictures might be different.

Figure 11. Effects on wealth distribution



In the abovementioned analysis of the first scenario, we showed several effects of decreasing interest rates on the economy whereby increased housing prices and increased equity prices play an important role. The first panel of Figure 11 shows that the top5 wealthy households initially gain in their relative wealth position but this gain is taken over quickly by the two middle groups. This can be well explained by investigating house and equity prices. We have shown that equity and participation prices increase quickly which leads to an immediate increase in the net wealth of the holders of these assets. As the top5 has a higher share of these assets in their portfolio, they gain the most. But quickly after the rising equity prices, also housing prices start to increase. Percentage-wise the two wealth groups in the middle have a larger share of houses in their portfolio such that indeed these two groups show a higher (relative) increase in their wealth shortly after the start of the shock. To further illustrate this effect, the second panel of Figure 11 shows the isolated effect of asset price changes on the wealth distribution, comparable to scenario 1e above. As expected this scenario shows an increase in the wealth of the top5.

The effects of the second scenario where the risk behaviour of banks is increased, resemble the effects of the first scenario as it affects the house owners most. Again, the two middle wealth groups own the largest share of houses and thus their net wealth position increases the most. The QE scenario where we decrease the interest on government bonds has a smaller impact on wealth positions. The top5 increases whereas all other classes see a decrease in their relative wealth position, though the changes are small.

In all cases, the low wealth group, which constitutes about 50 per cent of the households, does not obtain any wealth (by assumption). Further research is needed to explain the position of the low wealth group better, also taking into account its negative net wealth position observed in Figure 7 of section 3.

Next to that, increases in house prices will lead to a decrease in wealth inequality amongst the top 50 per cent of the households (owning houses) – cf the outcomes of scenarios 1 and 2.[30] But an increase in assets prices will lead to an increasing wealth inequality amongst the top50 per cent – cf the outcomes of scenarios 1e and 3b. This last scenario also shows that Quantitative Easing induced wealth inequality in the Netherlands.

[30] This is consistent with other findings in the literature – see van der Geest et al (2022) and Moatsos et al (2022) for further references.

6. Conclusions

The increased financialisation of the economy, together with deregulation and globalisation, has led to a strong decrease of productive investment and hence domestic economic growth through two channels. First, household savings were progressively absorbed by increased house prices and pension portfolios held abroad, while firm savings were diverted through share buy-backs and speculative investments abroad. Second, credit creation in the financial sector eased the re-routing of household and firm savings and created additional problems of increased volatility and higher risks to the financial system. These developments were accompanied by an increasing wealth inequality.

In line with our previous research we argue that these phenomena can be captured very well by a stock flow consistent model in the tradition of Godley and Lavoie, which we estimate and simulate for the Netherlands. From simulations with our model we show that both housing price bubbles and asset price bubbles occur due to low interest rates and riskier bank behaviour, induced by a central bank policy of Quantitative Easing. The intended aim of this central bank policy – enhancing economic growth – is not reached, because the monetary stimulus is absorbed by the financial sector.

We also show how these policies affect wealth inequality. First, we observe that the low-wealth group, which constitutes about 50 per cent of the households, does not obtain any wealth. While increasing house prices lead to a decrease in wealth inequality amongst the top 50 per cent of households, increasing asset prices lead to an increase. We demonstrate that therefore a presumably unintended consequence of Quantitative Easing in the Netherlands is an increase in wealth inequality.

Although we analyse the impact of the various policies on wealth inequality, we have not yet integrated the impact of wealth inequality on the economy. Apart from the social impacts, which are very important but hard to include in our model, there are also economic impacts that could be included in a follow-up version of the model. For instance the impact of wealth inequality on household decisions with respect to consumption and investment in financial assets and houses. But also the consequences of taxation decisions of government, reducing the heavy bias of the current tax system on labour income. And the consequence of a reform of the pension system which is currently being discussed in the Netherlands. We leave these aspects for further research.

Finally, the model estimations and within-sample simulations focus on the period until and including 2019 and we do not include the impact of the Covid-19 crisis, nor the impact of the war in Ukraine such as high inflation. Though the effects of the Covid-19 crisis are present and visible in the data, see section 3 above, further analysis is needed to fully capture the effects of these crises in the model and the simulations.

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Appendix A A detailed description of the model

In this appendix, we present a detailed overview of the model used in our analysis. Many elements have already been presented in MMS (2015, 2016). However, new elements are the extension of the financial sector with a pension system with large foreign investments and the elaboration of the banking sector, including the operations of the Central Bank. Both elements contribute considerably to a proper understanding of the impact of globalisation and financialisation on the Dutch economy. We present the model subsequently for households, firms, government, the foreign sector, the pension funds and the banking sector, including the central bank. For each sector a balance sheet is presented and at the end of this appendix, we present the overall balance sheet for the economy, the social accounting matrix and a table summarising the accumulation of savings and the way these are invested.

A.1 *Households*

The introduction of pension wealth as an extension to our earlier models has important consequences for consumption and savings behaviour of households, as we discuss below. Pension wealth of households consists of the claims on pension funds.

Each year the pension fund pays out benefits PF_b to households and receives contributions PF_c. However, in the analysis we focus on the net contributions by households only, i.e. $PF_c - PF_b$. These contributions constitute part of the claims by households on pension funds. The other part of the claims follows from discounted future obligations. As we elaborate in section 1.5 below, this inclusion of future obligations motivates us to distinguish between a real value of pension claims C_{pf}, and its implicit price p'_{pf}. That is, $p'_{pf}C_{pf}$ represents the nominal value of claims, valued at an implicit price p'_{pf}. These claims do not affect the wealth effect on consumption, although they affect savings behaviour as we discuss below.

A.1.1 *Wealth of households*

The composition of housing wealth is summarised in the balance sheet in Table 1. Household wealth consists of financial wealth, pension wealth and housing wealth, net of mortgages. Financial wealth consists of deposits M_h and participations held at banks. The latter consist of traded assets $pa.A_h$ and non-traded assets *Ant* – we will use this distinction when discussing the wealth distribution, as we

Table 1 Balance sheet of the household sector

ASSETS		**LIABILITIES**	
Bank deposits	M_h	Mortgages	*MO*
Traded participations	$pa.A_h$		
Non trade assets	*Ant*		
Pension claims	$p'_{cf}.C_{pf}$		
Houses	$p_h.HS$		
		Total (net worth)	V_h

elaborate below.[31] Pension wealth consists of the claims on pension funds $p'_{pf}C_{pf}$ and is discussed in section 4.5 below. Finally, we assume that with respect to the portfolio of wealth, housing wealth is determined separately from financial wealth.

The distribution of financial wealth over bank deposits and participations follow a Tobin type of portfolio model, although we assume the non-traded assets to be exogenous. This implies that household financial wealth VN_h, net of housing minus mortgages and net of claims on pension funds:

$$VN_h = V_h - (p_h.HS - MO) - p'_{cf}.C_{pf} = M_h + pa.A_h + Ant \quad (1)$$

is distributed over financial assets as follows, with Ant being exogenous:

$$M_h /(VN_h - Ant) = 0.59 + 0.64.r^e_M - 0.22.(r^e_{Ah} + g^e_{pa/p}) + 0.02.trend2000\text{-}8 \quad (2)$$

$$p_a.A_h = VN_h - M_h - Ant \quad (3)$$

The variables r^e_{Ah} and r^e_M are the expected real returns for participations and deposits, respectively, and $g^e_{pa/p}$ is the expected growth rate of the real asset price. The return on deposits is the real interest rate, whereas the return on participations is the real interest rate including price changes of participations. The price of participations p_a grows in line with the endogenously determined price of firm equity, p_{efa} – cf equation (27);[32] the price of non-traded equity p_{ant} is exogenous. All interest rates are determined by an exogenous mark-up on r_{mcb}. The return on participations r_{Ah} is exogenous. Expected values of variables follow an adaptive expectations mechanism:

$$X^e = X_{-1} + 0.5.(X_{-1}^e - X_{-1}) \quad (4)$$

Where we set ξ equal to 0.5. A simple estimation of equation (2) for the Netherlands shows that all variables have the expected signs. Note that equation (2) also includes a trend term for the period 2000 - 2008, an element that we clearly identify in the data. For out-of-sample simulations, we set this trend term to zero.

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 DNB (2020) argued, banks have been increasing their maximum loan-to-income ratio max_{LTI} systematically over time. They then claim that this is the main reason to explain the increase in house prices. Essentially, DNB uses the following equation to explain the growth in house prices, which is a variant of the equation used by Madsen (2012):

$$\Delta lnp_h = -0.002 + 0.75.\Delta lnp_{h,-1} - 0.12.[\Delta lnr_{MO} - \Delta lnmax_{LTI}] + 0.15.\Delta\, ln\left(\frac{Y}{p}\right)^e \quad (5)$$

Where r_{MO} is the mortgage rate and $(Y/p)^e$ is expected real GDP.

We assume with respect to the demand by households for mortgages *MO* that demand for mortgages is a proportion of the housing value, although the impact of price changes may differ from the impact

[31] Due to the unreliable nature of the data on non-traded assets, we do not distinguish between prices and quantities here – hence only the nominal value is considered.
[32] We use the equation $gp_a = 0.38.\ gp_{efa}$.

of the real value of houses. Moreover, we introduce a trend term, to control for the sharp increase in house prices over the estimation period. Hence:

$$\Delta MO = 4744 + (2.52 - 0.12.trend).\ p_h.\ \Delta HS + 0.11.HS.\Delta p_h \quad (6)$$

Simple estimation of equations (5) and (6) yields the expected results. We assume *HS* to grow at an exogenous rate.

Finally, the increase in housing net of depreciation represents the net investment of households as presented in the national accounts. It should be included in the production of firms, which appears in the capital balance of the social accounting matrix – see Table 7B below.

A.1.2 *Consumption and savings*

Household income consists of wages W, household profits F_h, returns to financial assets, $r_M.M_h + r_a.(pa.A_h + Ant)$, and net benefits, $PF_c - PF_b$, received from pension funds plus attributed pension income $Y_{pf,HH}$:

$$Y_h = W + F_h + PF_c - PF_b + Y_{pf,HH} + r_M.M_{h,-1} + r_a.(p_{a,-1}.A_{h,-1} + Ant_{-1}) \quad (7)$$

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

$$Td = \tau_h.(Y_h - \tau_{MO}.r_{MO}.MO_{-1}) \quad (8)$$

where τ_h is the tax rate on income and τ_{MO} is the tax reduction on interest payments.[33]

The disposable income of households is defined by deducting taxes paid by households Td, net contributions to the pension fund and interest payments on mortgages from household income Y_h:

$$Y_{hd} = Y_h - Td - r_{MO}.MO_{-1} - [PF_c - PF_b] \quad (9)$$

We assume that households' consumption depends on disposable income and the opening stock of net financial wealth VN_h (excluding mortgages) and net housing wealth VNH_h.[34] Simple estimation for the Netherlands yielded the expected effect for the following relation:

$$C/p = 73577 + 0.43.\ (Y_h - Td - [PF_c - PF_b])/p + 0.13.VN_{h-1}/p_{-1} + 0.07.\ VNH_{h-1}/p_{-1} \quad (10)$$

Net household savings are defined as the disposable income of households *Yhd* minus consumption C and depreciation $\delta_h.HS_{-1}$:[35]

$$S_h = Y_{hd} - C - \delta_h.p_{h,-1}HS_{-1} \quad (11)$$

or

$$S_h = W + F_h + r_M.M_{h,-1} + ra.(p_{a,-1}.A_{h,-1} + Ant_{-1}) + Y_{pf,HH} - C - Td - r_{MO}.MO_{-1} - \delta_h.p_{h,-1}HS_{-1} + [PF_c - PF_b] \quad (12)$$

[33] The tax rate τ_h varies between 0.9 and 0.14, and is o.11 on average. The tax rate τ_{MO} is set at 0.5.
[34] Here we exclude pension claims from household wealth, since they do not affect consumption – see also CPB (2010).
[35] The depreciation rate δ_h equals 0.04.

The net savings in equation (12) follow by substituting equation (7) in (11). The resulting equation illustrates that savings consist of a voluntary part – the right-hand side of (12) without the term between brackets – and net contributions to the pension fund. The latter constitute the compulsory part of net savings, since pension contributions are mandatory and cannot be used for consumption. This is a relevant distinction since recently in the Netherlands aggregate savings were positive, while voluntary savings were negative as we discussed above.

Finally, the change in household wealth V_h follows from:

$$\Delta V_h = S_h + A_{h,-1}.\Delta pa + HS_{-1}.\Delta p_h + C_{pf,-1}.\Delta p'_{cf} \quad (13)$$

The second and third terms on the right-hand side follow from valuation changes in financial assets and houses, respectively. Moreover, since claims to pension funds are included in the household wealth, we should take their valuation changes also into account – see the last term on the right-hand side of equation (12).

A.2 *Firms*

A.2.1 *Wealth of firms*

The assets of firms consist of capital stock ($p_k.K$) and financial assets ($pe_{af}.E_{af}$) following from direct investments abroad. Liabilities consist of loans at banks (L) and equity issued abroad ($pe_{fa}.E_{fa}$), following from foreign direct investments in the Netherlands. This constitutes the balance sheet of firms presented in Table 2. The net worth of firms is V_f.

Table 2 Balance sheet of firms

ASSETS		**LIABILITIES**	
Capital	$p_k.K$	Loans	L
Equity acquired	$pe_{af}.E_{af}$	Equity issued	$pe_{fa}.E_{fa}$
		Total (net worth)	V_f

A.2.2 *Firm behaviour and wage and price formation*

Retained earnings follow from profits. Profits from production F_f result by deducting the wage bill W, indirect taxes $T_i = \tau_i.Y$, and other gross operating surpluses from nominal GDP (Y). The other surpluses are household profits F_h and depreciation of government D_g, which constitutes the operating surplus of government for statistical reasons. Hence:

$$F_f = Y - W - T_i - F_h - D_g \quad (14)$$

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.[37] Hence:

$$p.(1 - \tau_i) = [1 + m].w.a \tag{15}$$

Given the labour-output ratio, employment N follows from $N = a.(Y/p)$, where (Y/p) represents real output. The wage bill then follows from:

$$W = w.N \tag{16}$$

Nominal wages are exogenous.[38]

When calculating total income of firms Y_f, we should include the returns F_{af} on foreign assets $pe_{af}.E_{af}$, next to profits from production F_f. Hence:

$$Y_f = F_f + F_{af} = F_f + r_{eaf}.\ pe_{af,-1}.E_{af,-1} \tag{17}$$

The price on foreign assets pe_{af} is exogenous, its returns are determined r_{eaf} endogenously – as follows from equation (22).

Direct taxes on firms are proportional to its total income (gross profits):

$$Td_f = \tau_f.F_f \tag{18}$$

Net profits F_{fn} then are defined as total income of firms minus taxes Td_f, interest payments on loans $r_L.L$ and depreciation $p_k.\delta_k.K$:

$$F_{fn} = Y_f - Td_f - r_L.L_{-1} - p_{k,-1}.\delta_k.K_{-1} \tag{19}$$

The tax rate on gross profits τ_f and depreciation rate δ_k are exogenous.[39] The price of capital p_k is equal to the output price p. The interest on loans is set by a spread on the base rate, $r_L = r_{mcb} + spread_L$.

A fixed proportion $(1 - \varphi_1)$ of the net profits is kept as retained earnings, FU, and the remaining part is paid out as dividend payments.[40] Hence:

$$r_{efa}.\ pe_{fa,-1}.E_{fa,-1} = \varphi_1.\ F_{fn} \qquad \text{when } (F_{fn} > 0) \text{ and zero otherwise} \tag{20}$$

and retained earnings are given by:

$$F_{f,ret} = F_{fn} - r_{efa}.\ pe_{fa,-1}.E_{fa,-1} \tag{21}$$

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[36] Hein (2012) 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. We take the mark-up from the data. It varies between 0.6 and 0.7, with 0.64 on average. The tax rate τ_i is 0.1 on average and varies between 0.09 and 0.11 in the data.

[37] Labour productivity is 0.92 on average. It increases over time from 0.79 until 0.99.

[38] 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.

[39] The tax rate τ_f varies between 0.02 and 0.11, and is 0.06 on average. The depreciation rate δ_k fluctuates around 0.08.

[40] We set $\varphi_1 = 0.44$. In Meijers, Muysken and Sleijpen (2016) we used a portfolio approach, relating φ_1 to the relative rates of return.

Both returns r_{efa} and prices pe_{fa} are determined endogenously as follows from equations (20) and (27), respectively.

The retained earnings $F_{f,ret}$ also constitute firm's savings S_f. They are invested in both the capital stock and used to buy foreign assets, which we define here as equity abroad bought by firms $pe_{af}.E_{af}$. The choice between both is determined by a portfolio model with $shareE_{af} = pe_{af}.E_{af}/(pe_{af}.E_{af}+ p_k.K)$:

$$shareE_{af} = 0.44 + 0.49.shareE_{af,-1} – 1.91.r_{ff} +1.55.r_{faf} \quad (22)$$

where $r_{ff} = F_f/(pe_{af}.E_{af}+ p_k.K)$ and $r_{faf} = F_{af}/(pe_{af}.E_{af}+ p_k.K)$.

A.2.3 *Investment behaviour*

From simple estimation on Dutch data, we find that investment is determined by two variables – see also Burgess et al (2016). First by the utilization rate, u, with normal utilization defined at u^*:[41]

$$u = (Y/p)/(\kappa.K) \quad (23)$$

and second by the interest rate r_L. We then find for the growth of the capital stock:[42]

$$g_K = 0.02 + 0.28. (u_{-1} – u^*) – 0.41.r_{L,-1} \quad (24)$$

Equation (24) then constitutes the investment equation.

A.2.4 *Closing the model*

Financial needs by firms Fin_f is determined by investments in physical capital plus investments in equity abroad minus retained profits. Hence:

$$Fin_f = pe_{af}.\Delta E_{af} + p_k.\Delta K – F_{f,ret} \quad (25)$$

These needs are financed by loans and by issuing equity abroad, where firms employ a portfolio approach to decide on the distribution of both with $shareL = L/(L + pe_{fa}.E_{fa})$:

$$shareL = 0.09 + 0.54.ShareL_{-1} + 0.72.r_{efa} – 0.93.r_L \quad (26)$$

Moreover, firms set the price pe_{fa} according to:

$$gp_{efa} = 0.42. gp_{efa,-1} – 5.67. \Delta r_{mcb} + 0.66.r_{efa} \quad (27)$$

where r_{efa} denotes the returns on foreign direct investment by the foreign sector. That is, the higher the returns for the foreign sector and the lower the returns from interest-paying assets held domestically by the foreign sector, here proxied by the central bank deposit rate, the higher the price they are willing to pay for foreign direct investment.

Thus after borrowing L from banks, firms finance the remaining part of Fin_f by issuing equity $pe_{fa}.\Delta E_{fa}$ against an endogenous price pe_{fa}. The foreign sector is assumed to absorb this demand for equity.

[41] The normal utilisation rate u* = 0.8 and the capital-output ratio κ varies between 0.94 and 1.16, with 1.06 on average.

[42] The leverage ratio and Tobins' q, used in Hein (2012), have no significant impact.

Finally, retained earnings $F_{f,ret}$, which constitute firms' savings S_f, contribute to the wealth of firms. Next valuation changes should also be considered. Hence holds:

$$\Delta V_f = S_f + (\Delta pe_{fa}).E_{fa} - (\Delta pe_{af}).E_{af} + (\Delta p_k).K \quad (28)$$

A.3 *Government*

Traditionally government is treated in a very simple way in SFC models. We follow that tradition but as a new feature, we introduce the government capital stock and allow for government investment in our analysis.[43] We first discuss the wealth composition of the government and then turn to government behaviour.

A.3.1 *Wealth of government*

Government supplies bills to the various sectors of the economy Accumulated government debt therefore equals $pb.B = pb.B_{CB} + pb.B_{PF} + pb.B_B + pb.B_a$, which constitutes also the financial liabilities of the government. Next to that, government capital $p_k.K_g$ appears as an asset. The corresponding balance sheet is presented in Table 3.

Table 3 Balance sheet of the government sector

ASSETS		**LIABILITIES**	
Government capital	$p_k.K_g$	Government bonds	$pb.B_{cb}$
			$pb.B_b$
			$pb.B_{pf}$
			$pb.B_a$
		Total (net worth)	V_g

A.3.2 *Government behaviour*

The income of the government, Y_g, consists of taxes T, profits from the Central Bank F_{cbg} and its gross operating surplus D_g. Taxes consist of Value added taxes T_i, profit taxes T_f and income taxes T_d, with $T = T_i + T_d + T_f$. The taxes are proportional to the relevant tax base with fixed rates. We discuss profits from the Central Bank below in section 1.6.1. The depreciation of the government capital stock is a fixed proportion of the government capital stock – following national account conventions it is included as the gross operating surplus of the government. Government income therefore is:

$$Y_g = T + F_{cbg} + D_g \quad (29)$$

Government outlays consist of government expenditures G and the interest paid on government bonds $r_B.B$. Government outlays G are exogenous. The interest rate paid on government bonds r_B is set as a spread on the base rate, $r_B = r_{mcb} + spread_B$.

[43] Allowing for a productive use of this investment is left for further research.

The budget balance, together with profits from the Central Bank F_{cbg} minus interest paid on government bonds $r_B.pb.B$, and minus consumption of fixed capital D_g constitute net government savings S_g:

$$S_g = T - p.G + F_{cbg} - r_B.pb.B - D_g \tag{30}$$

These savings, which usually are negative, correspond to the change in the amount of bills supplied to the various sectors of the economy minus government investment:

$$pb.\Delta B + pk.\Delta Kg = - S_g \tag{31}$$

A.4 *The foreign sector*

The foreign sector is very important for the Dutch economy. Imports and exports are important components of GDP – this implies that economic growth and fluctuations are highly dependent on the development of world trade. Moreover, the financialisation of the Dutch economy is strongly interwoven with globalisation and the openness of the Dutch economy. We elaborate on both points below. First, we present foreign wealth. Then we discuss the trade balance. Finally, we discuss the accumulation of net foreign wealth and its composition.

A.4.1 *Foreign wealth*

Since foreigners hold bills issued by the government ($pb.B_a$), bank participations ($pa_{ba}.A_{ba}$) and equity ($pe_{fa}.E_{fa}$) issued by (domestic) firms, 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, $pe_{af}.E_{af}$ and $pe_{apf}.E_{apf}$, respectively, participations provided by banks $pa_{ab}.A_{ab}$, and foreign reserves held by the Central Bank R. The balance sheet of the foreign sector is given in Table 4.

Table 4 Balance sheet of the foreign sector

ASSETS		**LIABILITIES**	
Foreign Equity	$pe_{fa}.E_{fa}$	Foreign Equity firms	$pe_{af}.E_{af}$
Bills	$pb.B_a$	For. equity Pension Funds	$pe_{apf}.E_{apf}$
Participations banks	$pa_{ba}.A_{ba}$	Part. Banks	$pa_{ab}.A_{ab}$
		Foreign Reserves	R
		Total (net worth)	V_a

1.4.2 *Imports, exports and the trade balance*

The real side of 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 imports IM to be proportional to GDP with a fraction im.[44] Exports X are exogenous. Hence the trade balance is given by:

$$TB = X - IM = X - im.Y \tag{32}$$

[44] The fraction *im* varies between 0.51 and 0.75, it is 0.61 on average.

Below we discuss foreign wealth and its composition.

A.4.3 *The accumulation of net foreign debt abroad*

The trade balance is part of the current account *CA* together with net primary income and net secondary income. We ignore the latter in our model and net primary income consists of returns received on participations from domestic banks, $ra_{ab}.pa_{ab-1}.A_{ab-1}$, and as well as dividends paid to domestic firms and pension funds on their foreign investment, $r_{af}.pe_{af-1}.E_{af-1}$ and $r_{apf}.pe_{apf-1}.E_{apf-1}$ respectively, plus interest payments on reserves held by the central bank ($r_r.R_{-1}$),[45] minus interest paid for deposits held at domestic banks and government bonds, $r_{aba}.pa_{aba,-1}.A_{ba,-1}$ and $r_b.pb_{-1}.B_{a,-1}$ respectively, and dividends paid by domestic firms $r_{fa}.pe_{fa,-1}.E_{fa,-1}$. Therefore we find:

$$CA = TB + ra_{ab}.pa_{ab,-1}.A_{ab,-1} + r_{af}.\ pe_{af,-1}.E_{af,-1} + r_{apf}.\ pe_{apf,-1}.E_{apf,-1} + r_r.R_{-1} - r_{b,-1}.pb_{-1}B_{a,-1} - r_{aba}.pa_{ba,-1}.A_{ba,-1} - r_{fa}.pe_{fa,-1}.E_{fa,-1} \quad (33)$$

The current account equals minus foreign savings, since income of the foreign sector Y_a equals:

$$Y_a = r_{b,-1}.pb_{-1}.B_{a,-1} + r_{aba}.pa_{ba,-1}.A_{ba,-1} + r_{fa}.pe_{fa}.E_{fa,-1} \quad (34)$$

Savings then follow from:

$$S_a = Y_a - TB - r_{aab}.pa_{ab,-1}.A_{ab,-1} + r_{af}.\ pe_{af,-1}.E_{af,-1} + r_{apf}.\ pe_{apf,-1}.E_{apf,-1} = -CA \quad (35)$$

These savings deplete the desired foreign reserves *R* held by the domestic Central Bank:

$$\Delta R = pb.\Delta B_a + pa_{ba}\Delta A_{ba} + pe_{fa}.\Delta E_{fa} - pa_{ab}\Delta A_{ab} - pe_{af}.\Delta E_{af} - pe_a.\Delta E_{apf} - S_a \quad (36)$$

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.

Considering the liabilities of the foreign sector, equity held by pension funds $pe_a.E_{aPF}$ follows from the portfolio choice by pension funds – see section 1.5 below. On the other hand, foreign equity held by domestic firms $pe_{af}.E_{af}$ follows from firm behaviour as discussed in section 1.2 above. This leaves the determination of foreign bank participations $pa_{ab}.A_{ab}$ and reserves *R*. We assume a semi portfolio model to determine both. First the ratio $pa_{ab}.A_{ab}$ $/(\ pe_{af}.E_{af} + pe_{apf}.E_{apf})$ is considered exogenous, in the sample period it follows the actual data, and in the simulation period it is a constant. Second, with respect to reserves we suppose that the $shareR = R/(\ pe_{af}.E_{af} + pe_{apf}.E_{apf})$ is determined by:

$$shareR = 0.01 + 0.54.ShareR_{-1} + 0.12.r_{afpf} - 0.27.r_r \quad (37)$$

where r_{afpf} is the return on $(\ pe_{af}.E_{af} + pe_{apf}.E_{apf})$.

On the assets side the foreign sector absorbs all equity that is demanded by domestic firms as to finance their investments and we assume that the remaining assets, B_a and A_{ba}, are distributed according to a portfolio model. That is, bonds issued by government B_a are a fraction Ω of the remaining assets, where *TA* represents total assets. In line with portfolio analysis, this fraction

[45] We ignore interest payments on reserves held by the central bank.

depends negatively on the real rate of return on domestic bank assets held by the foreign sector rr_{aba}, and positively on the real interest rate of bonds rr_B:

$$\Omega = 0.05 + 0.05.d08 + 0.53.\ \Omega_{-1} - 0.04.rr_{aba} + 0.31.rr_B \qquad with \qquad pb.B_a = \Omega.(TA - pe_{fa}.E_{fa}) \tag{38}$$

Then A_{ba} follows from:

$$A_{ba} = (TA - pe_{fa}.E_{fa} - pb.B_a)/pa_{ba} \tag{39}$$

Equation (38) determines the demand amount for domestic government bonds B_a held by the foreign sector. As we discuss in section A.6.1 below, under QE operations by the domestic National Central Bank the amount for domestic government bonds held by the foreign sector B_a decreases due to a decrease in the real interest rate for bonds. This is compensated by an increase in bank participations A_{ba} held by the foreign sector.

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

$$\Delta V_a = S_a + (\Delta pb).B_{a,-1} + (\Delta pe_{fa}).E_{fa,-1} + (\Delta pa_{ba}).A_{ba,-1} - (\Delta p_{eaf}).E_{af,-1} - (\Delta p_{eapf}).E_{apf,-1} - (\Delta pa_{ab}).A_{ab,-1} \tag{40}$$

With respect to asset prices and asset returns we explicitly allow for different developments of prices pe_{fa} and returns r_{fa} on equity held by foreign parties in the domestic country, compared to the prices pe_{af} and returns on r_a equity held by domestic parties abroad. However, these are all exogenous.

A.5 *Pension Funds*

The Netherlands has a funded pension system according to which wage earners are obliged to contribute to their pension fund by paying a premium, p_{pf}, based on their wage.[46] When retiring, the pensioners receive a pension benefit. Till recently we used to have a traditional defined benefit system, which implied that pensioners receive a benefit which is a fraction, b_{pf}, of their (mean) wage with pension benefits and accruals being increased based on price or wage developments. However, this defined benefit system has been under discussion recently and the fraction has been decreased, as we explain below.

A.5.1 *Background*

To understand the pension system, we distinguish between the working age population, N^Y, and the retired population, N^O. The working age population contributes each year $p_{pf}.W$, and the pensioners receive each year $b_{pf}.\ W.\ N^O/\ N^Y$. or, from the view of the pension fund: Each year the pension fund pays out $PF_b = b_{pf}.\ W.\ N^O/\ N^Y$ and receives $PF_c = p_{pf}.\ W$ from the workers. However, since contributions and benefits are transfer payments, they do not constitute part of income of pension funds in the national accounting system. The income Y_{pf} of the pension funds equals the return on its assets $i_{ass,pf}.Ass_{pf}$:[47]

$$Y_{pf} = i_{ass,pf}.Ass_{pf} \tag{41}$$

[46] We ignore here for simplicity that employers are in practice paying (a substantial) part of the premium.
[47] We elaborate on these returns below – cf. equation (53).

This income then is spent on net benefits, $PF_b - PF_c$, and savings S_{pf} remain. Hence pension fund savings are given by:

$$S_{pf} = Y_{pf} - (PF_b - PF_c) = (PF_c - PF_b) + i_{ass,pf}.Ass_{pf} \quad (42)$$

Therefore, in the national accounting system only the net contributions by households are included, i.e. $PF_c - PF_b$. These contributions constitute part of the claims by households on pension funds. The other part of the claims follows from discounted future obligations. This distinction of claim components motivates us to distinguish between a real value of pension claims, C_{pf}, and its implicit price, p'_{pf}. That is, $p'_{pf}C_{pf}$ represents the nominal value of claims, valued at an implicit price p'_{pf}.

A.5.2 *The value of claims on the pension fund*

The discounted future obligations follow from the notion that in a funded pension system the contributions by the workers increase their claims on the pension fund. If the number of working years is T^y, each young worker accumulates on average an amount $\sum_{t=0}^{T^y}(1+r^y)^t.p_{pf}W$ which is available to pay out for the pension at the beginning of his or her retirement;[48] r^y represents the real interest rate during the period of accumulating the pension. The liabilities of the pension fund with respect to this person then are on average $\sum_{t=0}^{T^o} b_{pf}W/(1+r_{pf})^t$ at the beginning of retirement; T^o is the average number of retirement years and r_{pf} represents the real interest rate which should be used to discount the future claims of the worker and retired person. However, the future is uncertain, for instance due to longevity T^o, which has increased beyond expectations, and the interest rate has decreased beyond expectations, which affects r_{pf}. Thus, the nominal value of claims can be represented by:[49]

$$p'_{pf}C_{pf} = b_{pf}WB.\frac{N^o}{N^y}\sum_{t=0}^{T^o}\frac{1}{(1+r_{pf})^t} \quad (43)$$

The discount rate r_{pf} is set as a spread on the base rate, $r_{pf} = r_{mcb} + spread_{pf}$.

Changes in claims of households $\Delta p'_{pf}C_{pf}$ are equal to the net transfer from household to pension funds $(PF_c - PF_b)$, plus the change in discounted future obligations reflected in a change in the implicit price. We then find:

$$\Delta p'_{pf}C_{pf} = (PF_c - PF_b) + C_{pf,-1}\Delta p'_{pf} \quad (44)$$

and the change in the implicit price is equal to:

[48] The use of the word "average" refers to the notion of risk-sharing between plan members.

[49] This is a very rough approximation, since the claim of the existing old pensioners is about half of the liabilities indicated here (remember T^o is the average number of years of retirement). The other part of the liabilities consists of future claims built up by the young till now – for simplicity we assume that to equal the other half of the liabilities here. This short cut is taken because we want to focus on the impact of a decrease in the interest rate r^o and an increase in the ratio N^O/N^Y. The qualitative impact of these variables on $p'_{pf}C_{pf}$ will not change in an extended specification of equation (43). For the moment we multiply the right-hand side of equation (43) by a factor 1.5.

$$\frac{\Delta p'_{pf}}{p'_{pf,-1}} = \frac{\Delta p'_{pf} C_{pf} - (P_{fc} - P_{fb})}{p'_{pf,-1} C_{pf,-1}} \quad (45)$$

It is important to notice that an (unexpected) increase in longevity and/or a decrease in the interest rate, without changes in net contributions, will lead to an increase implicit price since future claims will increase – see equation (43).

A.5.3 *The composition of assets and liabilities*

Savings minus net contributions by households are used for asset accumulation. From equation (42) then follows:

$$pb.\Delta B_{pf} + pa.\Delta A_{pf} + pe_{apf}.\Delta E_{apf} = r_b.pb_{-1}.B_{pf,-1} + r_{apf}.pa_{-1}.A_{pf,-1} + re_{apf}.pe_{apf,-1}.E_{apf,-1} \quad (53)$$

when we recognize that pension funds invest in government bonds B_{pf}, participations in investment banks A_{pf}, and equity abroad E_{apf}. The respective prices are pb, pa and pe_{apf}, and the corresponding returns are r_b, r_a and re_{apf}. The right-hand side of equation (53) constitutes the returns on assets of pension funds in equation (42).

Therefore, the balance sheet of the pension fund has the structure as presented in Table 5. The change in net-worth V_{pf} is given by:[50]

$$\Delta V_{pf} = S_{pf} - C_{pf,-1}.\Delta p'_{pf} + A_{pf,-1}.\Delta pa + E_{apf,-1}.\Delta pe_{apf} \quad (54)$$

The last two elements of equation (54) follow from valuation changes of financial assets. Since the pension funds adjust benefits and contributions to obtain balance between assets and liabilities, the net-worth of pension funds is very small.[51]

Table 5 Balance sheet of the pension funds

ASSETS		**LIABILITIES**	
Bills	$pb.B_{pf}$	Outstanding claims	$p'_{pf} C_{pf}$
Participations	$pa.A_{pf}$		
Equities	$pe_{apf}.E_{apf}$		
		Total (net worth)	V_{pf}

The composition of financial assets follows from a Tobin type portfolio model. This implies that wealth net of liabilities:

$$VN_{pf} = V_{pf} + p'_{pf}.C_{pf} = B_{pf} + pa.A_{pf} + pe_{apf}.E_{apf} \quad (55)$$

[50] This follows from $\Delta V_{pf} = S_{pf} - (PF_b - PF_c) + A_{pf,-1}.\Delta pa_{pf} + E_{apf,-1}.\Delta pe_{apf} + p'_{pf}\ \Delta C_{pf}$

[51] However, in our model the rates of benefits and contributions, b_{pf} and p_{pf}, respectively are exogenous. In an earlier version of our model we used endogenous rates (Meijers and Muysken, 2016).

is distributed over financial assets. For simplicity, we assume an exogenous assets distribution.[52]

The above items constitute the balance sheet of the pension funds, presented in Table 5. One should realise that when presenting the balance sheet this way, claims to pension funds $p'_{pf}.C_{pf}$ are included in the pension fund wealth V_{pf}.

A.6 *The banking sector and the Central Bank*

We describe both sectors, starting with the central bank.

A.6.1 *The Central Bank*

Next to holding foreign reserves R, the Central Bank holds bills issued by the government B_{CB} and advances provided to banks A_{CB}, which include Target2 balances. Its liabilities are deposits held by banks M_{CB}. 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. The resulting balance sheet is presented in Table 6A.

Table 6A Balance sheet of the Central Bank

ASSETS		**LIABILITIES**	
Advances	Av	Central bank deposits	Mcb
Bills	$pb.B_{CB}$		
Foreign reserves	R		
		Total (net worth)	0

The Central Bank provides as much bills as demanded by the government. That is B_{CB} bonds are held by the Central Bank, such that holds:

$$pb.B_{CB} = pb.(B - B_{PF} - B_B - B_a) \quad (59)$$

Where B is the amount of bonds issued by government. However, the situation is different under QE operations, as we discuss below.

Deposits to banks are provided to satisfy the banks' need, while advances are exogenous.

We discussed the foreign reserves in equation (36a) above.

The revenues of the Central Bank are given by:

$$Fcbg = r_r.R_{-1} + r_b.\ pb_{-1}.Bcb_{-1} + r_{av}.\ Av_{-1} - r_{mcb}.M_{cb,-1} \quad (61)$$

Here r_r is the (nominal) rate on central bank reserves, r_b is the rate on government bills set by the Central Bank, r_{av} is the interest rate on advances and r_{mcb} is the interest rate on deposits. These interest

[52] In an earlier version of our model we used a portfolio model (Meijers and Muysken, 2016).

rates are set exogenous in real terms, i_r, i_B, i_A and i_M, respectively. The nominal rates then take expected inflation into account.

A.6.2 *Quantitative Easing operations*

As we discussed above, in normal times the Central Bank provides as much bills as demanded by government – see equation (59). To understand the situation better we should realise that the interest rate is found endogenously at a rate r_B. Hence does hold:

$$B_{cb} = B - B_{pf}(r_b) - B_b - B_a(r_b) \qquad (59')$$

where B is the amount of bonds issued by government and bank bonds are determined independent of the interest rate – see equation (67) below.

When Quantitative Easing takes place, the Central Bank wants to obtain an additional amount of B_{QE} bonds. Compared to the initial situation then should hold:

$$B'_{cb} = B_{cb} + B_{QE} = B - B_{pf}(r'_b) - B_b - B_a(r'_b) \qquad (59'')$$

and r'_b is the new interest rate in equilibrium. We will find that almost all bonds obtained through QE, B_{QE}, will be held abroad. The reason is that the foreign sector sells all bonds demanded by the Central Bank – the banks and pension funds do not want to sell their bonds, as we discussed under the stylised facts. The latter implies that domestic demand for bonds is interest inelastic, while foreign demand – where deposits are perfect substitutes for bonds – is interest elastic.

A.6.3 *The Banking Sector (MFIs)*

In our analysis banks finance their assets not only by holding deposits and participations from households, M_h , $pa.A_h$ and Ant respectively, but also to a considerable extent by borrowing from pension funds and the foreign sector. The latter is done by issuing participations $pa_{ba}.A_{ba}$ to foreign holders and $pa.A_{pf}$ to pension funds, where the latter mainly invest abroad. Finally banks also borrow advances Av from the Central Bank.

Table 6B Balance sheet of the banking sector

ASSETS		**LIABILITIES**	
Central bank deposits	M_{cb}	Advances	Av
Bonds	$pb.Bb_b$	Bank deposits	M_h
Loans to firms	L_f	Part. HH traded	$pa.A_h$
Mortgages	MO	Part. HH non-traded	$pa_{nt}.Ant$
Participations foreign	$pa_{ab}.A_{ab}$	Participations PF	$pa.A_{pf}$
		Participations foreign	$pa_{ba}.A_{ba}$
		Total (net worth)	V_b

The main assets held by the bank are loans L_f provided to firms, mortgages MO issued to households and participations $pa_{ab}.A_{ab}$ bought from the foreign sector. Next to that banks also hold government

bonds $pb.B_b$ and deposits M_{cb} held at the Central bank. The corresponding balance sheet is presented in Table 6B.

In the current version of the model, we keep the returns of assets as exogenous which implies that bank profits can be non-zero. Income of banks is:

$$Yb = r_{cb}.M_{cb,-1} + r_b.pb_{-1}.B_{b,-1} + r_L.\ Lf_{,-1} + r_{MO}.\ MO_{-1} + r_{aab}.\ pa_{ab,-1}.A_{ab,-1} \quad (62)$$

Bank savings before taxes then are given by:

$$S'_b = Y_b - r_{av}.\ Av_{-1} - r_{mh}.\ M_{h,-1} - r_{aba}.\ pa_{ba,-1}.A_{ba,-1} - r_{ah}.\ pa_{-1}.A_{h,-1} - r_{ah}.\ pant_{-1}.Ant_{-1} - r_{apf}.\ pa_{-1}.A_{pf,-1} \quad (63)$$

If these savings are positive, banks pay a tax ($T_b = \tau_b.S'_b$) such that net savings are equal to:

$$S_b = S'_b - T_b \quad (64)$$

Finally, for simplicity bonds are assumed to be held as a constant fraction of outstanding loans and mortgages:[53]

$$Bb = \Psi.(L_f + MO)/pb \quad (65)$$

Turning to the liabilities side we assume that the demand for deposits M_h by households and from abroad is fully accommodated by banks. With respect to participations we also assume that the demand by households and pension funds is fully accommodated by banks.[54]

Bank participations issued by the foreign sector and held by banks ($pa_{ab}.A_{ab}$) is assumed to be a fraction of total equity issued by the foreign sector:[55]

$$A_{ab} = \varsigma(pe_{af}.E_{af} + pe_{apf}.E_{apf})/pa_{ab} \quad (66)$$

The demand for participations issued by banks and held by the foreign sector ($pa_{ba}.A_{ba}$) are described above at the foreign sector and banks are assumed to accommodate this demand. M_{cb} closes the balance sheet.

[53] The fraction Ψ decreases from 0.22 to 0.06 over time, with 0.10 on average.
[54] A further refinement of the model is to introduce here also endogenous prices for participations. We leave this for later.
[55] The fraction ς fluctuates between 0.43 and 1.06, with 0.72 on average.

A.7 Summary tables

The stocks and flows of the model are summarised in Tables 7A – 7C. In Table 7A the balance sheet of each sector is presented, showing how all financial assets of one sector correspond to the financial liabilities of another sector. The physical assets, houses and capital constitute total wealth.

The social accounting matrix is presented in Table 7B, indicating the financial flows in the model and the interactions between the various sectors.

Finally, Table 7C summarises how for each sector savings are formed in each sector and how these savings are invested in either financial or physical assets. Below the table it is summarised how valuation changes contribute to wealth accumulation.

Table 7A Balance sheet

		Households	*Firms*	*Banks*	*Pension funds*	*Central bank*	*Government*	*Foreign*	*Total*
Central bank	*Deposits*			M_{cb}		$-M_{cb}$			
	Advances			-Av		Av			
Bank deposits		M_h		$-M_h$					
Loans			$-L_f$	L_f					
Bills	*Domestic*			$p_b.B_b$	$p_b.B_{pf}$	$p_b.B_{cb}$	$-p_b.(B_b+B_{pf}+B_{cb})$		
	Abroad						$-p_b.B_a$	$p_b.B_a$	
Capital			pk.K				$pk.K_g$		$pk.(K+K_g)$
Participations	*Traded*	$pa.A_h$		$-pa.A_h-pa.A_{pf}$	$pa.A_{pf}$				
	Abroad			$pa_{ab}.A_{ab}-pa_{ba}.A_{ba}$				$-pa_{ab}.A_{ab}+pa_{ba}.A_{ba}$	
	Non-Traded	$pa_{nt}.Ant$		$-pa_{nt}.Ant$					
Equities	*Firms/banks*		$-pe_{fa}.E_{fa}$					$pe_{fa}.E_{fa}$	
	Abroad		$pe_{af}.E_{af}$		$pe_{apf}.E_{apf}$			$-pe_{af}.E_{af}$ $-pe_{apf}.E_{apf}$	
Mortgages		-MO		MO					
Houses		ph.HS							ph.HS
Claims/Liabilities		$p_{cpf}.Cpf$			$-p_{cfp}.Cpf$				
Foreign Reserves						R		-R	
Miscellaneous		Xa_h	Xa_f	Xa_b	Xa_{pf}	Xa_{cb}	Xa_g	Xa_a	0
Total net worth		Vh	Vf	Vb	Vpf	Vcb	Vg	Va	Vt

Table 7b. Social Accounting Matrix

	Production	*Households*	*Firms*	*Banks*	*Pension funds*	*Central Bank*	*Government*	*Capital Account*	*Foreign*	*Correction*	*Total*
Production		C					G	If+Ih+Ig	Ex-Im		Y
Households	W+Fh			$r_{mh}.M_{h-1}$+ $r_{ah}.pa_{-1}.A_{h-1}$+ $r_{ah}.pa_{nt-1}.Ant_{-1}$	$Pens_{hh}$					$Ycorr_h$	Yh
Firms	Ff								Fa_f	$Ycorr_f$	Yf
Banks	Fb	$r_{mo}.MO_{-1}$	$r_{lf}.Lf_{-1}$			$r_{mcb}.Mcb_{-1}$	$r_b.pb_{-1}.B_{b-1}$		$r_{aab}.pa_{b-1}.A_{ab-1}$	$Ycorr_b$	Yb
Pension funds		Pfc-Pfb		$r_{apf}.pa_{-1}.A_{pf-1}$			$r_b.\ pb_{-1}.B_{pf-1}$		Fa_{pf}	$Ycorr_{pf}$	Ypf
Central Bank	Fcb			$r_{av}.Av_{-1}$			$r_b.\ pb_{-1}.B_{cb-1}$		$r_r.R_{-1}$	$Ycorr_{cb}$	Ycb
Government	$Ti+F_g$	T_d	T_f	T_b		Fcbg				$Ycorr_g$	Yg
Consumption of fixed capital		D_h	D_f				D_g				D_{tot}
Capital account		S_h	S_f	S_b	S_{pf}	S_{cb}	S_g		S_a	0	S_{tot}
Foreign sector			Ff_a	$r_{aba}.pa_{ba-1}.A_{ba-1}$			$r_b.\ pb_{-1}.B_{a-1}$			$Ycorr_a$	Ya
Total	Y	Yh	Yf	Yb	Ypf	Ycb	Yg	If+Ih+Ig	Ya	0	

Table 7c Accumulation and investment of savings

	Households	*Firms*	*Banks*	*Pension funds*	*Central Bank*	*Gov.*	*Foreign*	*Total*
Consumption	- C	C+G				-G		0
Gross Investment		IF+IH+IG						IF+IH+IG
Net exports		(X – IM)					-(X – IM)	0
Wages	W	-W						0
GOS	Fh	-Fh-Fb-Fcb-D_g	Fb		Fcb	D_g		0
Taxes	$-T_d$	$-T_f$ $-T_i$	$-T_b$			T		0
PF Contrib./Benefits	Ypf_h			$-Ypf_h$				0
Interest Deposits	$r_{mh}M_{h-1}$		$r_{mcb}.M_{cb-1}$ - $r_{mh}.M_{h-1}$		- $r_{mcb}M_{cb-1}$			0
Interest Loans/Advances		$-r_{lf}.Lf_{-1}$	$r_{lf}.Lf_{-1}$-$r_{av}.Av_{-1}$		$+r_{av}.Av_{-1}$			0
Interest Bills			$r_b.pb_{-1}.B_{b-1}$	$r_b.\ pb_{-1}.B_{pf-1}$	$r_b.\ pb_{-1}.B_{cb-1}$	$-r_b.\ pb_{-1}.B_{-1}$	$r_b.\ pb_{-1}.B_{a-1}$	0
Interest Participations	$r_{ah.}pa_{-1}.A_{h-1}$+ $r_{ah.}pa_{nt-1.}A_{nt-1}$		$-pa_{-1}.(r_{ah}.A_{h-1}+r_{apf}.A_{pf-1})-r_{ah.}pa_{nt-1.}A_{nt-1}$ $+r_{aab}.pa_{ab-1}.A_{ab-1}-r_{aba}.pa_{ba-1}.A_{ba-1}$	$r_{apf}.pa_{-1}.A_{pf-1}$			$r_{aba}.pa_{ba-1}.A_{ba-1}$ - $r_{aab}.pa_{ab-1}.A_{ab-1}$	0
Interest Mortgages	$-r_{mo}.MO_{-1}$		$r_{mo}.MO_{-1}$					0
Interest Reserves					$r_r.R_{-1}$		$-r_r.R_{-1}$	0
Dividends		Fa_f $-Ff_a$		Fa_{pf}	-Fcbg	Fcbg	Ff_a-Fa_f-Fa_{pf}	0
Cons of fixed capital	$-D_h$	$-D_f$				$-D_g$		$-D_{tot}$
Correction	$Ycorr_h$	$Ycorr_f$	$Ycorr_b$	$Ycorr_{pf}$	$Ycorr_{cb}$	$Ycorr_g$	$Ycorr_a$	0
Net Savings	S_h	S_f	S_b	S_{pf}	0	S_g	S_a	S_{tot}
Savings, correction	$Scorr_{ph}$+$Scorr_h$	$Scorr_f$	$Scorr_b$	$Scorr_{pf}$	$Scorr_{cb}$	$Scorr_g$	$Scorr_a$	$Scorr_{ph}$
ΔDeposits	ΔM_h		ΔM_{cb}-ΔM_h		- ΔM_{cb}			0
ΔLoans/Advances		-ΔLf	ΔLf -ΔAv		ΔAv			0
ΔBills			$pb\Delta B_b$	$pb\Delta B_{pf}$	$pb\Delta B_{cb}$	-pbΔB	$pb\Delta B_a$	0
ΔParticipations	$pa\Delta A_h$+ΔAnt		$-pa\Delta A_h$-$pa\Delta A_{pf}$-$pa_{ba}\Delta A_{ba}$ $+pa_{ab}\Delta A_{ab}$-ΔAnt	$pa\Delta A_{pf}$			$pa_{ba}\Delta A_{ba}$-$pa_{ab}\Delta A_{ab}$	0
ΔMortgages	-ΔMO		ΔMO					0
ΔEquity		$p_{eaf}\Delta E_{af}$ - $p_{efa}\Delta E_{fa}$		$p_{eapf}\Delta E_{apf}$			$p_{efa}\Delta E_{fa}$-$p_{eaf}\Delta E_{af}$- $p_{eapf}\Delta E_{apf}$	0
ΔClaims	$p_{cpf}\Delta Cpf$			- p_{cpf} ΔCpf				0
ΔReserves					+ΔR		-ΔR	0
ΔCapital	phΔHS	pkΔK				$pk\Delta K_g$		pk(ΔK+ΔK_g)+ phΔHS
ΔMiscellaneous	ΔXa_h	ΔXaf	ΔXa_b	ΔXa_{pf}	ΔXa_{cb}	ΔXa_g	ΔXa_a	0

All stocks are defined as end-of-year stocks. This implies that an income-flow based on that stock is defined as $flow_t = stock_{t-1} . rate_t$

Further:

$B = B_b+B_{pf}+B_{cb}+B_a$ (Government bonds)

$T = T_d + T_f + T_i + T_b$ (Taxes)

$Scorrtot = Scorr_h+Scorr_f+Scorr_b+Scorr_{pf}+Scorr_{cb}+Scorr_g+Scorr_a = 0$

If includes changes in inventories

Wealth Accumulation:

$\Delta Vh = S_h + \Delta ph.HS_{-1} + \Delta pa.A_{h,-1} + \Delta pa_{nt}.Ant_{-1} + \Delta pcpf.\ Cpf_{-1} + Scorr_h + Scorr_{ph}$

$\Delta Vf = S_f + \Delta p_{eaf}.E_{af,-1} - \Delta p_{efa}.E_{fa,-1} + \Delta pk.K_{-1} + Scorr_f$

$\Delta Vb = S_b + \Delta pb.B_{b,-1} + \Delta pa_{ab}.A_{ab,-1} - \Delta pa.A_{h,-1} - \Delta pa.A_{pf-1} - \Delta pa_{ba}.A_{ba-1} - \Delta pa_{nt}.Ant_{-1} + Scorr_b$

$\Delta Vpf = S_{pf} + \Delta pb.B_{pf-1} + \Delta p_{eapf}.E_{apf-1} + \Delta pa.A_{pf-1} - \Delta pcpf.\ Cpf_{-1} + Scorr_{pf}$

$\Delta Vcb = \Delta pb.B_{cb-1} + Scorr_{cb}$

$\Delta Vg = S_g - \Delta pb.B_{-1} + \Delta pk.K_{g-1} + Scorr_g$

$\Delta Va = S_a + \Delta pb.B_{a,-1} + \Delta pe_{fa}.E_{fa,-1} + \Delta pa_{ba}.A_{ba,-1} - \Delta p_{eaf}.E_{af,-1} - \Delta p_{eapf}.E_{apf,-1} - \Delta pa_{ab}.A_{ab,-1} + Scorr_a$

$\Delta V = S_{tot} + \Delta pk.K_{-1} + \Delta ph.HS_{-1} + \Delta pk.K_{g,-1} + Scorr_{ph}$

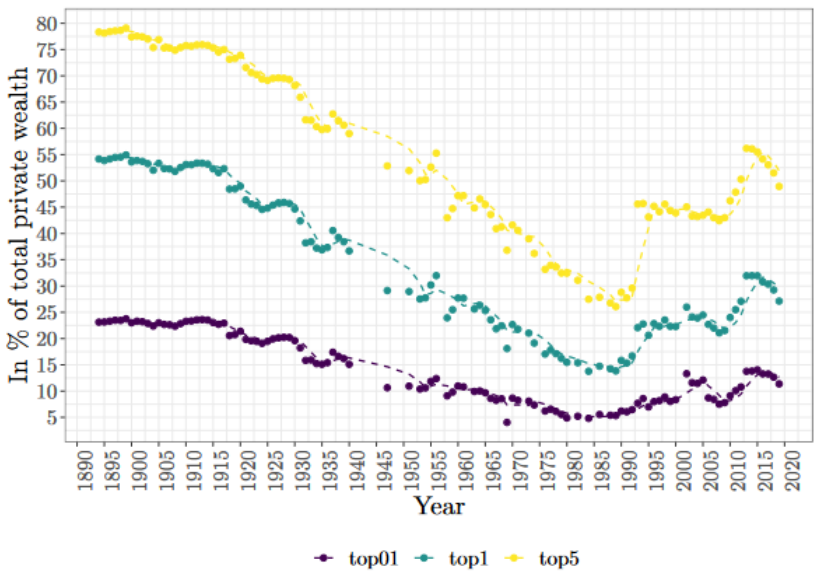
Appendix B Inequality in households

As mentioned in section 3.1.2, the wealth distribution over household deciles can be identified from the CBS data for the period 2006 – 2020. We distinguish between 4 groups of households: (1) low wealth, (2) middle wealth, (3) high wealth and (4) top5. These groups refers to the bottom 50% of households in the wealth distribution for low, the next 30% for middle, the next 15% for high, and the highest 5% for top5. In Figure 7 in section 3 above we observe how the wealth distribution developed in the Netherlands for the period 2006 – 2020.

A time series on the evolution of wealth inequality is provided by Moatsos et al (2022, Figure 5) which we reproduce in Figure B1. We used the data for our model to identify wealth inequality over time measured by the top 5 per cent of wealth owners – see Figure 1 in section 3 above.

Figure B1

Figure 5: Evolution of Top Wealth Shares, 1894–2019



Unfortunately, detailed data on the wealth distribution over households are only available from 2006 onwards – see Figure 7 in section 3 above. In addition, data on the distribution of the wealth components per category are only available from 2015 onwards for quintiles. For that reason, we have to calibrate the components of household wealth in Figure 3 in section 3 above for the period 2006 – 2020 in order to mimic the wealth distribution as presented in Figure 7 in section 3 above. Moreover, our calibration should also reproduce the top5 distribution for the period 1995 – 2020. We summarise the relevant assumptions in Table B1.

Consistent with the findings of van der Geest et al (2022, section 2.3.3), we assume that the low wealth category has no wealth and all other categories own houses and hold deposits. Next to that, the top5 owns all non-traded assets by and only the top5 and high hold participations (traded assets) – these assumptions are in line with the CBS data.[56] With respect to housing wealth net of mortgages we

[56] After 2015 the top 20% owns over 90 per cent of the risky assets according to CBS.

assume that the top5 category owns 25% of total net wealth, the high wealth category owns 45% and the middle wealth category owns 35% – these assumptions are also in line with the CBS data.[57]

Table B1

	Share in wealth categories		
	Top5	High	Middle
Net housing value	0.25	0.45	0.35
Deposits	0.4*top5	shdh	1-0.4*top5-shdh
Participations	shp5	1 – shp5	
Non traded assets	1		

We assume that the top5 holds 40% times the top5-wealth share in deposits and the remaining in participations. The resulting wealth share in participations of the top5 (*shp5* in Table B1) increases from around 35 per cent of total participations prior to 2007 to above 80 per cent in 2019 – see Figure B2. We also show in Figure B2 how this share closely follows the development of the real price of participations – suggesting that in particular the top5 did profit from the price increase of participations.

Figure B2

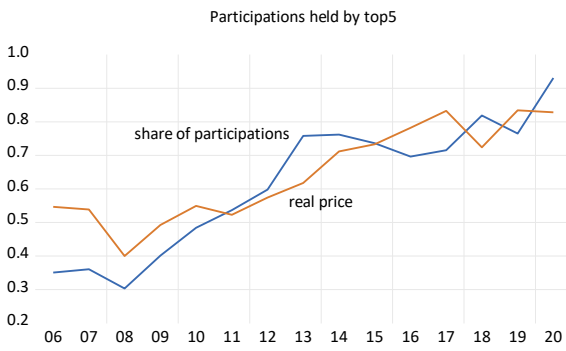
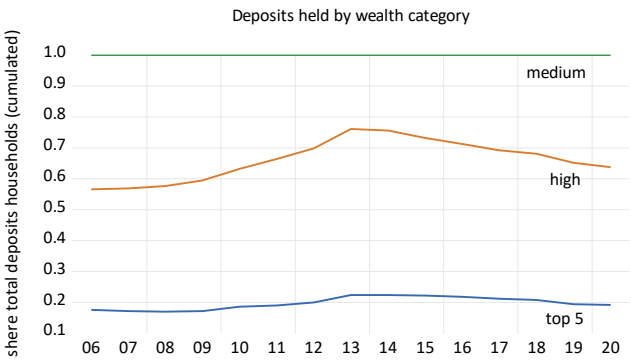


Figure B3



The high wealth category owns the remaining participations. Together with the assumption that the high own 45% of net housing wealth this implies that the share in total deposits of households they own (*shdh* in Table B1) increases from below 40 per cent in 2006 to almost 55 per cent in 2013-14 and then declines to 45 per cent in 2019 – see Figure B3.[58]

The medium category holds the remaining deposits, together with 35 per cent of net housing wealth. From Figure B3 one might think that the share of deposits held by medium decreases until 2013-14 and then increases again, but that is implied by the assumption that low has no wealth. As one observes from Figure 1 of section 3 above net wealth of low was negative, with a negative peak in 2013-14. This explains the suggestion of the negative hump-shaped development over time in deposits held by medium in Figure B3. Correcting for the negative impact of low, a relatively constant share of 40 per cent seems a reasonable assumption for medium.

[57] After 2015 the top 20% owns over 60 per cent of the net housing value according to CBS.
[58] After 2015 the top 20% owns almost 60 per cent of the deposits according to CBS.

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