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Jason Nassios,

James A. Giesecke,

Peter B. Dixon,

Maureen T. Rimmer

Centre of Policy Studies, Victoria University

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Jason Nassios, James A. Giesecke, Peter B. Dixon, Maureen T. Rimmer

Centre of Policy Studies

Victoria University, Melbourne Australia

Abstract

The proportion of employee wage income compulsorily allocated to superannuation is set to increase from 9.5% to 12% by July 2025. In this paper, we investigate the implications of an expanded superannuation system for the Australian commercial banking sector. This leads to a discussion of the structural implications of such a policy, particularly on the financing of Australian residential property. We find that an increase in the superannuation guarantee drives important short-run structural shifts within the Australia economy that persist in the long-run: namely, a reduction in Australia's foreign financing requirement, an increase in the ratio of debt-to-equity used to finance the residential housing stock and the private debt to income ratio, a shift in the capital structure of the commercial banks towards corporate bonds and away from bank deposits, and an expansion of the financial intermediaries, e.g., the commercial banks, the non-bank financial intermediaries, life insurers and the superannuation sector. In future work, we intend to explore the implications of these structural shifts within the corpus of research relating to macroeconomic stability.

Keywords: Financial CGE model; Superannuation

JEL Codes: C68, G11, G17, G21.

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1 Introduction

Authorised depository institutions (ADI's or commercial banks) play a unique role in any financial system in that they can accept cash deposits, which counterparties can readily convert at par and on demand into cash[1]. This role is facilitated by the central bank. Beyond the commercial banks, no other financial institution has the capacity to call upon central bank liquidity in order to meet the core obligation of a deposit liability. Relative to other financial intermediaries, e.g., non-bank financial intermediaries (NBFI's), commercial banks have grown in significance with regard to the size of Australia's financial system, particularly following a period of financial deregulation in the 1980's. As discussed by Ellis[1], much of the debate regarding the merits of deregulation suggested at the time that Australian commercial banks would find it more difficult to compete. Instead, they benefitted from the relaxation of interest rate controls and loan book size constraints, which improved their competitiveness and led to an expansion of their balance sheets. Concurrently, Commonwealth Government bonds begun being issued at tender and the exchange rate was floated. Competition was also improved, by allowing foreign banks (and new domestic banks) to enter the Australian financial system[2,3]. While commercial banks ultimately expanded (and therefore benefitted) due to these extensive reforms, NBFI's contracted due to increased competition. Some became commercial banks themselves, to leverage a direct relationship with the central bank[1]. Nevertheless, the benefits of deregulation for the commercial banks far outweighed the costs.

More recently, the role of superannuation in the monetary system has been raised in the recent Financial System Inquiry (FSI)[4] by the commercial banks. They fear that regulations and government policies are unfairly disadvantaging them relative to superannuation funds, particularly in competition for investable funds and investment opportunities.[1] To ameliorate these risks, submissions argue that higher deposit growth should be encouraged, that further development of a corporate bond market is required, and that the superannuation system should be encouraged to allocate more funds to deposits and fixed income products. As evidenced from these arguments, the commercial banks' are concerned by the impact an expanded superannuation sector will have on their supply of financial capital, e.g., cash deposits.

In this paper, we investigate the implications of an expanded superannuation system for the Australian commercial banking sector. In so doing, we build on previous work by Giesecke *et al.*[5], who focus explicitly upon the macroeconomic consequences of an expanded superannuation sector. Our analysis highlights several important structural implications of an expanded superannuation sector: (1) The commercial banks expand in the short-run, while long-run expansion is contingent on an elevated national savings rate; (2) The commercial bank capital structure is altered in both the short- and long-run, becoming less dependent on deposits and more dependent on corporate bond and equity finance; (3) Non-bank financial

[1] See for example the first FSI submission by Westpac[18], which argued that banks play a critical role in supporting the resilience of the financial system through economic cycles, and that the capacity to deliver this support rests on long-term relationships with customers. Westpac argued that this relationship is increasingly complicated by Government legislation, e.g., compulsory superannuation and tax treatment of income versus capital gains and domestic equity assets, which constrain the capacity of commercial banks to raise high-quality (and thus low risk) forms of finance, e.g., via household deposits. This is driving an expanding funding gap for the commercial banks, which has been funded of late via wholesale global credit markets.

intermediaries and life insurers benefit via an increase in supply of financial capital, which depresses their weighted average cost of capital (WACC) in the short- and long-run; (4) The economy-wide foreign financing requirement falls in both the short- and long-run; (5) The debt-to-equity ratio of the residential housing sector and the private-debt-to-income ratio both rise in the short- and long-run.

In what follows, we provide a short review of previous findings regarding the structural impacts of superannuation in section 1.1, before summarising the method we use herein in section 1.2.

1.1 Past Work

Recent analyses of the impact of an increase in the superannuation guarantee rate by The Allen Consulting Group[6] noted several macroeconomic impacts of a rise in the superannuation guarantee rate. Giesecke *et al.*[5] take this one step further, elucidating the impact on the weighted average costs of capital (WACC) for various capital creating agents, and linking these movements to the macroeconomic implications of the policy. Structural implications have hitherto remained largely unexplored, e.g., what are the implications of a rise in the superannuation guarantee for the capital structure of the residential housing sector? A report prepared for ASFA[7] touched on some structural implications. This report stated one consequence of an expanded superannuation sector being a reduction in the foreign financing requirements of the Australian economy.

1.2 Aim, method and summary of findings

Our aim in this paper is to understand the impact of the superannuation sector on the commercial banks and the structure of Australia's financial sector. To this end, we expand the relative size of the superannuation sector in Australia, by increasing the proportion of the national wage bill invested by households in superannuation assets by one percent. Our analysis makes use of the VU-Nat FCGE model of the Australian economy (Dixon *et al.*[8]). Two shocks are applied; firstly, we increase the proportion of the national wage bill allocated to superannuation by 1% (we refer to this as the *intermediation effect*), whilst the national savings rate is increased in line with the findings of Connolly[9] (which we refer to as the *savings effect*). As we shall discuss, the central bank plays a key role in offsetting some of the impacts of intermediation. We therefore present results for the intermediation effect under two closures: (1) passive monetary policy, where the central bank allows the cash rate to be determined by the demand for exchange settlements deposits by commercial banks; and (2) active monetary policy, where the central bank sets the cash rate based on a policy rule and manages monetary policy using open market operations. As we shall discuss, an increase in the national savings rate (or the savings effect herein) depresses the WACC of most agents in the economy. While we provide some clarity regarding the impact of the savings effect, our main focus is in understanding the intermediation effect in detail. Our intention is to contextualise the impacts of increased intermediation, and examine whether these impacts persist in the presence of the savings effect.

Our analysis considers both the short- and long-run implications. In the short-run, six main structural shifts are identified due to the intermediation effect.

(1) Increased intermediation of household savings drives a reduction in the supply of equity capital to both established (or non-reproducible) housing, and fringe urban housing/inner city apartment developments (referred to as reproducible housing). We also find that the demand for commercial bank loans rises. Financial intermediation therefore becomes more important for the purposes of funding the nation's housing stock, with *the debt-to-equity ratio of both the non-reproducible (NRH) and reproducible (RH) housing sectors rising* (see the dashed lines shown in Figure 1 and Figure 2 respectively). This is not offset by the savings effect (see the green bars in Figure 1 and Figure 2 respectively;
(2) The economy-wide level of private debt rises relative to income due to the intermediation effect. The savings effect reinforces this movement in the private-debt-to-income ratio, as shown in Figure 3;
(3) As shown in Figure 4, both the intermediation and savings effects act to reduce Australia's foreign financing requirements;
(4) With the demand for home loan finance elevated by a reduction in the supply of housing equity by households, and three quarters of housing loans supplied by the commercial banks in Australia, *the intermediation effect drives a short-run expansion of the commercial banks risk-weighted assets* (Figure 5). The savings effect reinforces this expansion in the short-run;
(5) Superannuation funds have a greater affinity for the financial liabilities issued by other financial intermediaries, such as the non-bank financial intermediaries and the life insurers, than Australian households do (Figure 6). The intermediation effect therefore increases the supply of financial capital to these agents, and both the NBFI's and life insurer's expand (see Figure 7 and Figure 8). This expansion is reinforced by the savings effect;
(6) Financial asset agents possess inhomogeneous preferences for the financial instruments issued by different financial liability agents in VU-Nat. Consequently, the intermediation effect drives a shift in the type of financial instruments asset agents use to supply financial capital to the commercial banks. This drives a subsequent shift in the capital structure of the commercial banks, which persists when we account for the savings effect.

In the long-run, several of these structural effects persist. To summarise:

1. We continue to observe elevated debt-to-equity ratios for both the NRH and RH agents due to intermediation, and this structural shift remains evident when we account for the long-run impact of the savings effect;
2. The private-debt-to-income ratio also remains elevated;
3. Australia's foreign financing requirement continues to be depressed relative to the baseline (where the superannuation guarantee rate remains at its current level);
4. The NBFI's and life insurance agents continue to expand due to both the intermediation and savings effects;
5. The capital structure of the commercial banks remains altered, with an increased reliance on corporate bond and equity financing, relative to bank deposits.

We observe one important difference between the short- and long-run implications of an expanded superannuation sector however; the commercial banks contract slightly due to increased intermediation in the long-run, however this is more-than-offset by a countervailing expansion caused by the savings effect. This in turn drives an overall long-run expansion of the commercial banks (Figure 5). We provide a more detailed discussion in section 3.1.7, where we study the long-run impacts of an expanded superannuation sector.

1.3 Outline

The outline of our paper is as follows. In section 2, we formally define the intermediation effect and the savings effect and discuss the design of our simulation. In section 2.1, we highlight how answers to questions regarding the impact of the intermediation effect can be determined via an analysis of a financial stock database of the Australian economy. The database we use is the VU-Nat Financial Stock database derived by Dixon *et al.*[8] using ABS data. This database maps out the ownership shares of Australian financial liabilities, e.g., commercial bank equity and deposits, across the various financial asset agents within the Australian economy, e.g., Australian households and superannuation funds. We subsequently provide an overview of the structure of the VU-Nat FCGE model in section 2.1.3, and turn to an investigation of the model output in section 3. We conclude with a summary of our key findings in section 4, and an agenda for future work in section 5. References and Figures are provided in sections 6 and 7.

2 Structural Impacts of a Rise in the Australian Superannuation Guarantee Rate on the Australian Economy

This section begins with an analysis of the financial database underlying the VU-Nat FCGE model of Australia, particularly with reference to the expected impact of a rise in the superannuation guarantee rate in Australia. As discussed in Giesecke *et al.*[5], this rise is simulated by increasing the proportion of household savings intermediated by the superannuation sector by an amount equal to one percentage point of the national wage bill, while simultaneously raising the household savings rate by an amount consistent with the findings of Connolly[9]. This allows us to consider the consequences of a rise in the superannuation contribution rate in terms of two effects:

1. **The intermediation effect**: the effects of a rise in the proportion of national savings that is intermediated by the superannuation sector rather than allocated across financial instruments by households directly.
2. **The savings effect**: the effects flowing from changes in the national savings rate caused by changes in the savings rates of those households which would have saved less if not for the influence of compulsory superannuation.

We assume commercial banks are constrained by capital adequacy and reserve requirements as per the approach by Giesecke *et al.*[10] and Nassios *et al.*[11], and use the VU-Nat FCGE model to simulate the impact of this policy reform. In the sections that follow, we consider some of the resulting structural changes. This is achieved via a series of decomposition diagrams, which distinguish the aggregate impact of both effects, from the intermediation effect and the savings effect in isolation. The decomposition diagrams are generated by undertaking four simulations:

(i) One in which only the savings rate rises (the "Savings effect");

(ii) One in which only the share of household savings flowing to superannuation rises, and the central bank (CB) does not undertake open market operations to stabilise the domestic cash rate (the "Intermediation effect (no CB)");[2]

(iii) One in which only the share of household savings flowing to superannuation rises, and the central bank sets the domestic cash rate according to a policy rule (the "Impact of the CB on the Int. effect");

(iv) One in which both the savings rate and the share of household savings flowing to superannuation rises (the "Aggregate effect").

Because the VU-Nat model is nonlinear in general, the decomposition of the aggregate effect into a savings and intermediation effect yields small residuals, which we also include in the decomposition plots for the reader's reference. As we shall show, the savings effect generally acts to reduce the weighted average cost of capital for all financial agents. In contrast, the intermediation effect drives some important structural changes, which persist when combined with the impact of the savings effect. We begin in section 2.1 by illustrating how some of these structural changes can be studied without VU-Nat, via an analysis of the model's financial stock database (Figure 6). This yields some key insights upon which we subsequently expand using the decomposition diagrams and VU-Nat model outputs in section 3. In section 2.2, we provide a short summary of the VU-Nat model's underpinnings and theory, which are pertinent to our current discussion. Some notes regarding our model closure are also included, in section 2.3.

2.1 The database shares

As discussed previously, the intermediation effect is defined as an increase in the share of the national wage bill that is allocated to superannuation (which currently makes up 26% of household financial assets in the VU-Nat financial stock database, as shown in Figure 6). In VU-Nat, the superannuation agent is compelled to expand the asset side of its balance sheet in line with an expansion of their aggregate financial liabilities to Australian households. In this section, we show how the VU-Nat database can be used to anticipate some of the resulting structural changes.

2.1.1 Expectation 1: The nominal exchange rate will shift

Ignoring for the moment changes in relative rates-of-return, the superannuation agent will tend to allocate each additional dollar of contributions as per the asset allocation shares shown in Figure 6. Our initial observation is that Australian superannuation funds invest a greater share of their aggregate financial assets offshore, when compared to Australian households (the respective ownership shares for foreign assets are 19% and 2.1%).

Expectation 1: In response to increased intermediation, we therefore expect an increase in gross financial capital outflows from Australia. Ceteris paribus, an increased financial capital outflow will lead to an improvement in Australia's net foreign asset position, driving the

[2] In simulation (ii), the domestic cash rate is therefore determined by equilibrium in the market for exchange settlement deposits. These deposits are assets of the commercial banks, and liabilities of the central bank. This simulation is included solely for the purpose of isolating the pure intermediation effect, from the impact of the central bank's policy response.

current account toward surplus. This movement in the current account will also have implications for the nominal exchange rate.

2.1.2 Expectation 2: Supply of capital to commercial banks will increase

The superannuation sector has a stronger affinity for Australian commercial bank liabilities than Australian households (with the bank ownership shares for each respective agent being 26% and 15%). However, in VU-Nat the decision by households on how much of their savings to allocate to superannuation sits *outside* their financial asset optimisation problem; that is, it is exogenously determined as a fixed proportion of the national wage bill. If we exclude the household allocation to superannuation from their aggregate financial assets, and once more consider their relative ownership of commercial bank liabilities compared to the superannuation agent (Figure 10), we see that it continues to hold that superannuation funds allocate a greater proportion of their assets to commercial bank liabilities, i.e., households invest a smaller proportion of both their aggregate financial assets (15%) and their non-superannuation assets (21%) with the commercial banks relative to superannuation funds (26%).

Expectation 2: The intermediation effect will increase the *aggregate* supply of financial capital to the commercial banks. This would reduce the WACC of the commercial banks if their capital structure remained unaltered and if demand for bank loans remained unchanged.

2.1.3 Expectation 3: Demand for commercial bank finance will increase

With regard to the demand for commercial bank finance, we also note from Figure 10 that households invest a much larger proportion of their non-superannuation savings in non-reproducible and reproducible housing equity (39% [NRH] and 10% [RH] respectively) compared to the superannuation agent. By autonomously increasing the asset allocation of Australian households to superannuation savings (and thereby reducing their allocation to non-superannuation assets), we expect the intermediation effect will reduce the capacity of households to equity finance their housing investment.

Expectation 3: We expect the intermediation effect will increase the demand for commercial bank loans to finance the residential housing stock. Ceteris paribus, this will lead to an expansion of commercial bank balance sheets and drive up their WACC. While the net outcome of expectations 2 and 3 on the commercial bank WACC is ambiguous, the commercial bank balance sheet will unambiguously expand.

2.1.4 Expectation 4: The supply of bond and equity finance to commercial banks will increase, at the expense of bank deposits

In addition to our observation that the aggregate supply of financial capital to the commercial banks will not be detrimentally impacted by increased intermediation, we also see that superannuation funds (who own 11.8% of outstanding commercial bank liabilities) prefer a different mix of commercial bank equity, bonds and deposits to Australian households (who own 28.0% of outstanding commercial bank liabilities). This is shown in Figure 9, where we present the commercial bank equity/bond/deposit ownership shares for households [column (3)] and superannuation funds (column (4)]. In column (1) of Figure 9, we summarise the capital structure of the commercial bank agent in the VU-Nat database,

i.e., the mix of equity/bonds/deposit finance they use to finance their activity, while in column (2) we include a breakdown of the foreign agent asset allocation shares for commercial bank equity/bonds/deposit liabilities. From Figure 9, we observe that households prefer to own more commercial bank deposits as financial assets than superannuation funds (87% of the overall asset allocation to commercial banks by households are deposits, versus 65% for superannuation funds), while superannuation funds allocate a larger proportion of their asset budget to commercial bank bonds (commercial bank bonds make up 10% of the superannuation funds commercial bank liability asset allocation, as opposed to no allocation for households) and equity (26% versus 13%) The commercial banks largest creditor, the foreign agent (who owns 32.6% of outstanding commercial bank liabilities), also prefers to hold much more commercial banks bonds and equity than deposits; we shall discuss the foreign agent in more detail in our exploration of the VU-Nat model output in section 3. In short, a reduction in the supply of financial capital by households and an increase in supply by the commercial banks other creditors, will (ceteris paribus) reduce the supply of deposit finance and increase the supply of corporate bonds and equity.

Expectation 4: The expansion in financial capital supply to the commercial banks is accompanied by a composition shift in the commercial banks capital, because the superannuation sector and Australian households do not own the same proportions of commercial bank equity/bonds/deposits as financial assets

2.1.5 Expectation 5: Supply of financial capital to other financial intermediaries will increase

From Figure 10, it is clear that superannuation funds also possess a greater affinity for the financial liabilities of financial intermediaries other than the commercial banks, relative to Australian households. In particular, superannuation funds hold a larger proportion of non-bank financial intermediary (NBFI) and life insurer financial liabilities as assets (17% and 15% of the superannuation sectors aggregate financial assets are financial liabilities of these respective agents), than what the Australian households do (4% and 2% respectively).

Expectation 5: The intermediation effect will drive an increase in the supply of financial capital to other financial intermediaries, which ceteris paribus will drive down the WACC of these intermediaries.

2.2 The VU-Nat financial computable general equilibrium (FCGE) model

In this section we provide a summary of the VU-Nat model used in the simulations described in section 2.1. For a detailed discussion of the financial part of the VU-Nat model, we refer the reader to Dixon *et al.*[8], Giesecke *et al.*[5] and Giesecke *et al.*[10]. As we shall describe, the FCGE model is based on identification of many financial agents and the optimising behaviour governing their actions.

2.2.1 Overview of the financial CGE model

While fully integrated, the VU-Nat model can nevertheless be broadly considered as being comprised of two parts:

(i) A traditional CGE model describing the real-side of the economy, based upon the MONASH CGE model of the Australian economy; and

(ii) A model of the interactions between financial agents and their links with the real side of the economy.

We expand on these two parts, and the important links between them, below.

As discussed, the real-side of the VU-Nat model is based upon the MONASH model. MONASH is a dynamic CGE model of the Australian economy. For a detailed description of the economic mechanisms in MONASH, we refer the reader to Dixon and Rimmer[12]. In what follows, we provide an overview of the real-side model for VU-Nat, which pertains to a description of the key features of the MONASH model.

MONASH is a disaggregated CGE model recognising many industries, capital creators, a representative household, government, and a foreign sector. Industries, investors and households are modelled as constrained optimizers. Each industry minimizes unit costs subject to given input prices and a constant-returns-to-scale (CRS) production function. Consumer demands are modelled via a representative utility maximizing household. Units of new industry-specific capital are formed as cost minimizing combinations of construction, machinery, engineering services, and other inputs relevant to physical capital formation. Imperfect substitutability between imported and domestic varieties of each commodity is modelled using the Armington constant-elasticity-of-substitution (CES) specification. Export demand for any given Australian commodity is inversely related to its foreign currency price. Physical capital accumulation is specified separately for each industry. An industry's capital stock at the start of year *t+1* is its capital at the start of year *t* plus its investment during year *t*, less depreciation. Industry-specific investment in year *t* is determined as a positive function of the expected rate of return on industry-specific capital.

Movements in relative prices reconcile the demand and supply sides of most commodity and factor markets through market clearing conditions. An important exception is the labour market, which is assumed to experience sticky wages in the short-run, but transition in the long-run to an environment of wage flexibility and a given natural rate of unemployment. Zero pure profit conditions in current production and capital formation determine basic prices (prices at the factory door) for domestically produced output. Purchaser prices differ from basic prices by the value of margin services and indirect taxes. In addition to indirect taxes, government revenue from direct taxes is identified, as are a variety of government outlays beyond public consumption spending (such as personal benefit payments and public investment). Together with variables describing foreign transfer payments, this provides sufficient detail for the identification of the government borrowing requirement, household disposable income, and household savings. Margin services, e.g., trade, transport, insurance and other margins, are also explicitly recognised as commodity flow facilitators between various agents, such as producers, importers, households, government, investors and foreign agents in export markets.

Real-side CGE models with characteristics such as those described above have been used for many decades to answer diverse policy questions (Dixon and Rimmer[13]). They are however

silent on, or treat implicitly, the question of how a number of important transactions are financed. For example, how is investment spending financed? How does the cost of financial capital affect the decision to invest in physical capital? Who is financing the public sector borrowing requirement (PSBR)? How is the current account deficit financed? Who decides how household savings are allocated? An important role of the financial part of the FCGE model is to answer these and related questions.

The financial part of the VU-Nat model identifies 5 financial instruments and 11 financial agents.[3] Each financial agent is concerned with both the asset and the liability/equity sides of its balance sheet. Hereafter, we refer to financial agents as "asset agents" in matters concerned with the asset sides of their balances sheets, and as "liability agents" in matters concerned with the liability and equity sides of their balance sheets. The core of the FCGE model is three arrays and the equations describing how the values in these arrays change through time. The three arrays are:

1. $\boldsymbol{A}_{(s,f,d)}$, which describes the holdings by asset agent **d** (e.g. households, the banking sector) of financial instrument **f** (e.g. equity, loans, bonds) issued by liability agent **s** (e.g. households, government, industry);
2. $\boldsymbol{F}_{(s,f,d)}$ which describes the flow of net new holdings by asset agent **d**, of financial instrument **f**, issued by liability agent **s**;
3. $\boldsymbol{R}_{(s,f,d)}$ which describes the power of the rate of return (i.e. one plus the rate) on financial instrument **f**, issued by liability agent **s**, and held as an asset by agent **d**.

Financial agents are assumed to be constrained optimisers. Broadly, in their capacity as liability agents, financial agents are assumed to issue the mix of financial instruments that minimises the cost of servicing the total liabilities they require, subject to a constraint that prevents them moving to corner solutions in the issuance of particular financial instruments to particular asset agents. Similarly, in their capacity as asset agents, financial agents are assumed to hold the mix of financial instruments that maximises the return from their portfolio of financial assets, subject to a constraint that prevents them moving to corner solutions in the holding of particular financial instruments issued by particular liability agents. The solutions to these optimisation problems are a set of return-sensitive supply equations (governing the issuance of financial instruments by liability agents) and return-sensitive demand equations (governing the demand for financial instruments by asset agents). In general, the solution to these supply and demand equations determines rates of return across financial instruments ($\boldsymbol{R}$**(s,f,d)**).Results from the real-side of the FCGE model (while determined endogenously with the financial side) can be viewed as providing important constraints on the financial side of the model. Similarly, results for certain variables in the financial side of the FCGE model (while again, determined endogenously

[3] The financial instruments are: Cash, Deposits/loans, Bonds, Equity, Gold and SDRs. The financial agents are: Commercial banks, the Central Bank, Foreigners, Government, Households, Industries, NBFIs, Superannuation, Life insurance, Non-reproducible housing, Reproducible housing. We divide the housing sector into "reproducible" and "non-reproducible" housing in anticipation of future model applications, e.g., the simulation of property price bubbles. For non-reproducible housing (established inner-city dwellings) it is conceivable that asset prices can depart from construction costs. For reproducible housing (apartments, units, and houses outside the inner city) construction costs should anchor asset prices.

with the model's real side) exert an important influence on outcomes in the model's real-side. For example:

- the PSBR determines new liability issuance by government;
- gross fixed capital formation by industry determines new liability issuance by industry;
- household savings determines new asset acquisitions by households;
- the current account deficit determines new asset acquisitions by foreigners;
- pension fund contributions determine new liability issuance by the pension fund sector;
- changes in the weighted average cost of financial capital influences the desirability of undertaking gross fixed capital formation.

At the same time, linkages within the financial sector are modelled. For example, the commercial banking sector's roles as both a liability agent and as an asset agent are modelled, allowing detailed representation of the sector's activities in raising local and foreign deposit, bond and equity financing, and deploying the funds thus raised in the purchases of financial instruments such as loans to domestic industry for capital formation, and household mortgages for the purchase of new and existing dwellings. In this system, changes in prospects for one financial agent have consequences for the costs of funds to other agents.

2.2.2 Model Enhancements

As discussed in the Introduction, the version of VU-Nat applied herein is distinguished from the model applied by Giesecke *et al.*[5] in two ways:

1. Capital restrictions are imposed on the commercial banks, via an exogenous capital adequacy ratio (CAR) imposed upon them by the regulator. This enhancement is described in section 2.2.2.1.1;
2. Endogenous determination of the central bank cash rate on exchange settlement deposits, via a Taylor Rule. This enhancement is described in section 2.2.2.2.

2.2.2.1 Modelling the capital adequacy ratio

Modelling of the capital adequacy ratio requires us to depart, for commercial banks, from the default modelling of asset and liability optimization on the part of financial agents as described in Dixon *et al.*[8]. First, the theory describing bank decision making over asset ownership must recognise differences in capital requirements across risky assets. Second, we must activate theory that allows movements in the capital adequacy ratio to affect the amount of equity that banks hold on the liability side of their balance sheets. We expand below, following a similar approach to that in Giesecke *et al.*[5].

2.2.2.1.1 Asset demand by commercial banks

To model the effects of the capital adequacy ratio and risk weights on commercial bank behaviour, we begin by modifying the standard theory in the FCGE model governing decision making by asset agents. We assume that commercial banks (**ComB**) choose their end-of-year asset portfolio, $\mathbf{A1_{(s,f,ComB)}}$ for all **s** and **f** to maximize:

$$U(R_{(s,f,ComB)} \times A1_{(s,f,ComB)}, \text{ for all s and f}), \tag{1}$$

subject to

$$\sum_{s,f} A1_{(s,f,ComB)} = BB_{(ComB)}, \tag{2}$$

and

$$\sum_{d} A1_{(ComB,equity,d)} = MAX\left[\sum_{d} A1zero_{(ComB,equity,d)}, KAR \times \sum_{s,f} W_{(s,f,ComB)} \times A1_{(s,f,ComB)}\right], \tag{3}$$

where **KAR** is the capital adequacy ratio, $\mathbf{W_{(s,f,ComB)}}$ is the risk weight that the financial regulator assigns to $\mathbf{A1_{(s,f,ComB)}}$, $\mathbf{A1zero_{(ComB,equity,d)}}$ is the value of equity the commercial banks would have on issue in the absence of capital adequacy requirements, $\mathbf{BB_{(ComB)}}$ is the total value of commercial bank assets, and **U** is a constant elasticity of substitution function. We assume that the **KAR** constraint is binding so:

$$\sum_{d} A1_{(ComB,equity,d)} = KAR \times \sum_{s,f} W_{(s,f,ComB)} \times A1_{(s,f,ComB)} .$$

Equity liabilities are relatively expensive. Consequently, we approximate problem (1) through (3) as:

Choose $\mathbf{A1_{(s,f,ComB)}}$ for all **s** and **f** to maximize

$$U(NR_{(s,f,ComB)} \times A1_{(s,f,ComB)}, \text{ for all s and f}), \tag{4}$$

subject to

$$\sum_{s,f} A1_{(s,f,ComB)} = BB_{(ComB)}, \tag{5}$$

where

$$NR_{(s,f,ComB)} = R_{(s,f,ComB)} - \Psi \times KAR \times W_{(s,f,ComB)}, \tag{6}$$

and **Ψ** is a positive parameter.

In (6) we recognize that the commercial banks face a penalty when they expand their holding of asset (**s**,**f**,**ComB**). The penalty is that they have to increase expensive equity

liabilities. We model the penalty as proportional to the capital adequacy ratio times the risk weight. The factor of proportionality, **Ψ**, reflects the difference between the cost of equity finance to the commercial banks and the cost of other liabilities. For example, with **Ψ =** 0.08, and **KAR** = 0.1, the penalty for a risky asset with weight 1 (**W** = 1) would be 0.008 (80 basis points). This is because the acquisition of an additional $1 of the risky asset requires that the bank raise $0.1 of additional equity finance, costing 800 basis points more than non-equity finance. If the capital adequacy ratio were increased to 0.125 then the penalty for risky assets would increase to 0.01 (an increase of 20 basis points), whereas the penalty for a less risky asset (**W** = 0.1, say) would barely move, from 0.0008 to 0.001 (an increase of 2 basis points). By changing the capital adequacy ratio and/or the risk weights the regulator can influence the asset choices of the commercial banks. For further details on the modelling of the liability side of commercial bank balance sheets, we refer the reader to Dixon *et al.*[8], particularly pp. 9-10, 12-13 and 17-19.

2.2.2.2 The central bank policy rate and the Taylor rule

In section 2.2.1 we introduced the data arrays describing stocks of financial instruments ($\boldsymbol{A}_{(s,f,d)}$) and the rates of return on those stocks ($\boldsymbol{R}_{(s,f,d)}$). These data include two instruments relevant to the relationship between the central bank and commercial banks as it pertains to the operations of monetary policy within the FCGE model, namely:

1. $\boldsymbol{A}_{(CenB,DeposLoans,ComB)}$ and $\boldsymbol{R}_{(CenB,DeposLoans,ComB)}$, describing commercial bank holdings of clearing balances with the central bank, and the rate of return paid by the central bank on those balances.
2. $\boldsymbol{A}_{(ComB,DeposLoans,CenB)}$ and $\boldsymbol{R}_{(ComB,DeposLoans,CenB)}$, describing commercial bank borrowings of clearing balances from the central bank, and the rate of interest charged by the central bank on those balances.
3. $\boldsymbol{F}_{(Govt,Bonds,ComB)}$, describing purchases and sales of domestic government bonds by the central bank.

Consistent with the channel system operated by the Australian central bank (e.g. see Otto[14] and Woodford[15] and the approach in Giesecke *et al.*[5], we begin with the idea that both $\boldsymbol{R}_{(CenB,DeposLoans,Com)}$ and $\boldsymbol{R}_{(Com,DeposLoans,CenB)}$ are policy variables, with $\boldsymbol{R}_{(ComB,DeposLoans,CenB)} = \boldsymbol{R}_{(CenB,DeposLoans,ComB)} + 0.005$.[4] We assume that the central bank maintains a given supply of commercial bank exchange settlement balances ($\boldsymbol{A}_{(CenB,DeposLoans,ComB)}$) at the rate $\boldsymbol{R}_{(CenB,DeposLoans,ComB)}$ via open market operations in the domestic government bond market ($\boldsymbol{F}_{(Govt,Bonds,CenB)}$).[5]

[4] $\boldsymbol{R}_{(s,f,d)}$ is defined as the power of the rate of return (i.e. 1 plus the rate) earned by asset agent **d** on financial instrument **f** issued by liability agent **s**. Hence, if the deposit rate for settlement balances with the central bank is 3 per cent, then $\boldsymbol{R}_{(CB,DeposLoans,Banks)}$ = 1.03 and the power of the borrowing rate for settlement balances ($\boldsymbol{R}_{(Banks,DeposLoans,CB)}$) is 1.035.

[5] This is consistent, for example, with the channel system description in Woodford[19]. He describes a channel system as one in which the central bank supplies a given level of clearing balances at a given policy interest rate, in addition to standing ready to lend clearing balances at a fixed spread over the policy rate (Woodford[19:27]). This is also consistent with early descriptions of how the Reserve Bank affects changes in the policy rate. For example, Lowe[20:3]: "Monetary policy operates via the Bank influencing the interest rate paid on overnight funds (the "cash rate")…The Bank's influence over the cash rate comes from its ability to control

Under the closure described above, $\boldsymbol{R}_{(\mathbf{ComB,DeposLoans,CenB})}$ is exogenous, with $\boldsymbol{R}_{(\mathbf{CenB,DeposLoans,ComB})}$ formally endogenous but uniquely determined by the exogenous status of $\boldsymbol{R}_{(\mathbf{ComB,DeposLoans,CenB})}$ via the relationship $\boldsymbol{R}_{(\mathbf{ComB,DeposLoans,CenB})} = \boldsymbol{R}_{(\mathbf{CenB,DeposLoans,ComB})} + 0.005$. We endogenise $\boldsymbol{R}_{(\mathbf{ComB,DeposLoans,CenB})}$ by introducing a Taylor rule linking movements in the policy rate to deviations of inflation from target and the employment rate from the natural rate. As Orphanides[16] describes, Taylor rules are simple prescriptive policy rules describing how a central bank should adjust its policy interest rate in response to movements in inflation and economic activity. The "classic Taylor rule" proposed by Taylor[17] is:

$$r = (2 + p) + 0.5(p - 2) + 0.5y, \tag{7}$$

where ***r*** is the federal funds rate, ***p*** is the rate of inflation over the previous four quarters, "2" denotes an assumed natural real rate for the policy rate of 2 per cent per annum (in the first bracketed term) and a target inflation rate of 2 per cent per annum (in the second bracketed term), and ***y*** is an output gap measure calculated as the percent deviation of real GDP from potential (**Y***), i.e., y = 100 (Y-Y*) / Y*.

Within the FCGE model, we link movements in the policy interest rate to deviations in the price level from target and output from potential via the following adjustment process:

$$\left(\frac{R_{(\mathrm{CenB,DeposLoans,ComB}),t}}{R_{(\mathrm{CenB,DeposLoans,ComB}),t-1}}\right) = FR\left(\frac{P_t}{P_t^{(T)}}\right)^{\alpha}\left(\frac{ER_t}{ER_t^{(T)}}\right)^{(1-\alpha)}, \tag{8}$$

where $\boldsymbol{R}_{(\mathbf{CenB,DeposLoans,ComB}),t}$ and $\boldsymbol{R}_{(\mathbf{CenB,DeposLoans,ComB}),t\text{-}1}$ are the current and lagged powers of the interest rate offered by the central bank on settlement balances, $\boldsymbol{P}_t$ and $\boldsymbol{P}_t^{(T)}$ are the actual and target levels for the consumer price index in year ***t***, $\boldsymbol{ER}_t$ and $\boldsymbol{ER}_t^{(T)}$ are the actual and target levels of the employment rate, i.e., 1-UER_t, in year ***t***, ***FR*** is an exogenous shift variable, and **α** is a parameter (set at 0.5) governing the sensitivity of interest rate movements to deviations in prices and employment from target. Converting (14) to a percentage rate of change form, we have:

$$r_{(\mathrm{CenB,DeposLoans,ComB}),t} = r_{(\mathrm{CenB,DeposLoans,ComB}),t-1} + 0.5\left(p_t - p_t^{(T)}\right) + 0.5\left(er_t - er_t^{(T)}\right) + fr, \tag{9}$$

where $\boldsymbol{r}_{(\mathbf{CenB,DeposLoans,ComB}),t}$ and $\boldsymbol{r}_{(\mathbf{CenB,DeposLoans,ComB}),t\text{-}1}$ are the current and lagged percentage changes in the power of the interest rate offered by the central bank on settlement balances, $\boldsymbol{p}_t$ and $\boldsymbol{p}_t^{(T)}$ are the actual and target rates of consumer price inflation in year ***t***, $\boldsymbol{er}_t$ and $\boldsymbol{er}_t^{(T)}$ are the actual and target percentage changes in the employment rate, i.e., 1-uer_t, in year ***t***, and ***fr*** is a shift variable that is endogenous when the policy rule is inactive and exogenous (and typically unshocked) when the rule is activated.

2.3 Closure

We make the following closure assumptions:

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the availability of funds used to settle transactions between financial institutions. By undertaking open market operations, principally in government securities with less than one year to maturity, the Bank controls the availability of settlement funds and hence the interest rate paid on overnight deposits".

i) We assume that the nominal wage is sticky in the short-run, but sufficiently flexible over the medium term to ensure that the unemployment rate returns to its natural rate;

ii) We assume that real public consumption is unaffected by the movement in the capital adequacy ratio. That is, real public consumption follows its baseline path. We further assume that the ratio of public sector borrowing to GDP also follows its baseline path. The exogenous status of both public consumption and the PSBR / GDP ratio requires the flexible determination of at least one government revenue instrument. To this end, we endogenously determine a direct tax on household income;

iii) The policy interest rate in year *t* adjusts relative to its *t*-1 level in response to movements in the consumer price inflation rate away from target, and movements in the employment rate (an output gap measure) away from target [see equation (9)].

3 Analysing the VU-Nat Output

Guided by expectations 1 – 5 in section 2.1, in this section we study the output from VU-Nat. We simulated the impact of the policy reform using the approach outlined in section 2 over an 11-year time horizon. In sections 3.1.1 - 3.1.6, we focus explicitly upon the event-year impact of the policy shocks, while we give a summary of the long-run impact in section 3.1.7. As discussed in section 2, the intermediation effect is decomposed using two simulations:

(1) **Intermediation effect (no CB):** We increase the superannuation guarantee rate for an exogenous national savings rate, while the central bank is inactive, i.e., we deactivate equation (9) herein. The domestic cash rate is therefore determined by the demand for exchange settlement deposits by the commercial banks, i.e., if the commercial bank balance sheet expands, all else being equal, we would expect the cash rate to fall as the commercial banks attempt to expand exchange settlement deposits in an environment in which the central bank holds their supply fixed. The results will be depicted by *purple bars* in all decomposition diagrams presented herein;

(2) Intermediation effect (active monetary policy): We then activate the policy rule discussed in section 2.2.2.2 and summarised in equation (9), and explore the impacts of the central banks' response to the intermediation effect. These results will be presented as *blue bars* in the decomposition diagrams that follow.

The net impact of the intermediation effect (blue *plus* purple bars) will be given by dashed lines in all decomposition diagrams, while the savings effect will be exemplified by green bars. The aggregate impact (green *plus* blue *plus* purple bars) is given by the solid line. As we also show, the residual (orange bars) that arises due to our decomposition are very small.

3.1.1 The exchange rate and real-side impacts and the implications for foreign debt

3.1.1.1 Intermediation effect

Figure 11 plots the percentage deviation from baseline of the nominal exchange rate, due to both the intermediation and savings effects. In line with expectation 1, the nominal exchange rate depreciates in the event-year in response to the intermediation effect (dashed line). In what follows, we first consider the response due to intermediation under

passive monetary policy (purple bars), before turning our attention to the impact of the central bank (blue bars).

It is clear from the purple bars in Figure 11 that with equation (9) deactivated (and the central bank thus a passive agent) the nominal exchange rate depreciates. This:

1. Elevates the domestic price of imports and drives the domestic price level higher (see the purple bars in Figure 12);
2. Depresses the foreign-currency value of the foreign asset agents' Australian investments. Ignoring movements in domestic rates-of-return relative to foreign rates-of-return, this encourages the foreign investor to increase their foreign currency allocation to Australian investments, triggering a gross inflow of financial capital.

With regard to the implications of point 1 above, as discussed in section 2.3 our model closure assumes a sticky short-run nominal wage. With the nominal wage sticky in the year the superannuation guarantee rate is increased, nominal depreciation drives the real producer wage lower (Figure 13). With physical capital stocks sticky and a fall in the real producer wage, a rise in the superannuation guarantee rate increases event-year employment in the absence of central bank action (see purple bars in Figure 14).

With employment slightly elevated relative to baseline in the event-year, so too is real GDP (Figure 15). Real private consumption is also elevated for similar reasons (see Figure 16). With employment elevated relative to baseline, so too is the marginal product of capital. Together with an elevated real return on capital (which exceeds baseline by 0.32 percentage points), this drives aggregate real investment above baseline (Figure 17).

Real dwelling investment grows faster than real non-dwelling investment (see Figure 18 and Figure 19), because private consumption expands relative to baseline (Figure 16) and private consumption is housing-intensive. However, with real public consumption held at baseline (see the closure assumptions outlined in section 2.3), the event-year movement in real GNE lags the movement in real GDP (see the decomposition of the event-year movements in real GNE and real GDP in Figure 20). The balance of trade thus exhibits a small move towards surplus, causing the current account deficit to fall marginally (see Figure 4). Under a passive monetary policy, Australia's foreign financing requirement is thus reduced slightly in the event-year due to the intermediation effect.

By activating equation (9), we compel the central bank to tighten monetary policy in response to the rise in event-year inflation and employment depicted in Figure 12 and Figure 14). They achieve this by selling government bonds (thus elevating their rate of return via open market operations). Following the policy rule in equation (9), the domestic cash rate rises by 5.9 basis points relative to its level under passive monetary policy (see the purple and blue bars in Figure 21), which represents an aggregate rise relative to baseline of 0.3 basis points (as depicted by the dashed line in Figure 21). To put these figures in context, the most recent Reserve Bank adjustment in the cash rate was a reduction of 25 basis points.

The rate rise has two consequences:

1. With the rates-of-return on government bonds elevated by OMO's, other liability agents must increase the rates-of-return they offer on their own financial liabilities in order to attract financial capital. This drives up the WACC's of various domestic financial agents, such as the commercial banks (Figure 22);
2. With domestic rates-of-return elevated relative to the rate-of-return on foreign investments due to the cash rate movement, the nominal exchange appreciates slightly in the event-year (see the blue bar in Figure 11). When we consider the net impact of the intermediation effect (the dashed line in Figure 11), the nominal exchange rate exhibits a muted depreciation.

From a macroeconomic perspective, the rise in the cash rate also neutralises the event-year movements in price inflation and the real producer wage caused by intermediation under passive monetary policy (see the blue bars and dashed lines in Figure 12 and Figure 13). This drives a number of small short-run changes due to the intermediation effect, which we now describe. With the real producer wage broadly in line with the baseline, we observe a small fall in the employment level (see the dashed line in Figure 14). With employment slightly depressed from baseline, real dwelling and non-dwelling investment both contract marginally (see the dashed lines in Figure 18 and Figure 19). With non-dwelling investment depressed by the rise in the cash rate, the Industry agent reduces its demand for financial capital, allowing them to secure equity and bond financing at slightly lower rates-of-return. This reduces their WACC (see the blue bars in Figure 25). With both components of real investment depressed relative to baseline, aggregate real investment falls (Figure 17). Real GNE thus falls relative to real GDP in the event-year (see the white squares in Figure 20). This reinforces the event-year movement of the current account towards surplus that arose due to the intermediation effect under passive monetary policy (see the dashed line in Figure 4). Australia's foreign financing requirement is therefore further reduced by the central banks response to the intermediation effect.

3.1.1.2 Aggregate impact and the savings effect

The causes of event-year movements in Australia's foreign financing requirement due to the savings effect was discussed by Giesecke *et al.*[5]. We provide a brief summary of that description herein. Firstly, Australia's foreign financing requirement is reduced by the savings effect because: (i) private consumption falls in response to a rise in household savings (see the green bars in Figure 16); (ii) this damps real GNE relative to real GDP (Figure 20), which subsequently drives the balance of trade towards surplus and reduces the current account deficit (Figure 4).

The combined impact of the intermediation effect (see our discussion in section 3.1.1.1) and savings effects therefore act unambiguously to reduce Australia's foreign financing requirements. Our research supports assertions by ASFA[7] that a rise in the superannuation guarantee rate (that is, the combined savings and intermediation effects) reduces Australia's call on foreign capital in the short-run.

3.1.2 How does the supply of housing equity respond?

3.1.2.1 Intermediation effect

With equation (9) deactivated the intermediation effect triggers nominal depreciation of the exchange rate, which in turn causes domestic price inflation (see the purple bars Figure 11 and Figure 12) and elevated capital rentals (Figure 23). Equity prices rise, which in turn swells the asset budgets of the domestic financial asset agents in the model. We include a plot of the effect this price inflation has on the households' event-year financial asset budget in Figure 26 (see column 1). Under passive monetary policy, the growth in the households' event-year asset budget is clearly depicted. In the absence of significant movements in relative rates-of-return, this drives an expansion effect whereby households increase their allocation to the various financial liabilities they hold by a proportion that is in line with the growth in their overall financial asset budget. We observe the impact of this expansion in the households' asset budget on the event-year supply of equity finance to the NRH and RH agents in column 3 and column 6 of Figure 26. This finding contrasts with expectation 2 in section 2.1.3, where we outlined why the intermediation effect would reduce the supply of equity finance by households to the housing sector and increase the supply of financial capital to the commercial banks. In section 2.1.3, we did not to take price inflation and its impact on the asset budget of financial agents in the model into account. This effect is endogenously treated in VU-Nat, as demonstrated herein.

Our assertion that price inflation drives an increase in households' allocation to housing equity is further evident if we activate equation (9). As discussed in section 3.1.1.1, under this scenario the central bank responds to the elevated price and employment levels by raising the cash rate, which in turn neutralises the growth in the event-year rentals and drives the households' financial asset budget back toward baseline (see the dashed line in Figure 23 and the white squares in Figure 26). With the households' asset budget and capital rentals broadly in line with baseline, their allocation to housing equity falls due to the intermediation effect as expected (see the blue bars in column 3 and 6 in Figure 26). In line with expectation 3 from section 2.1.3, this drives a net reduction in the supply of equity to the housing sector, due to the intermediation effect; see the white squares in column 3 and 6 of Figure 26.

3.1.2.2 Aggregate impact and the savings effect

The reduction in the supply of equity capital to the housing sector due to intermediation is more than offset by the savings effect in the event-year; see the green bars in Figure 26. In the short-run, the aggregate impact of the rise in the superannuation guarantee rate drives the supply of equity finance to the housing sector higher (see the dark diamonds in Figure 26).

3.1.3 The impact of an expanded superannuation sector on the demand for debt finance by the housing sector

3.1.3.1 Intermediation effect

As discussed in section 3.1.2, with equation (9) deactivated the intermediation effect elevates short-run real dwelling investment and economy-wide equity valuations relative

to baseline. As discussed in section 3.1.2.1, the households' asset budget expands in turn. The value of the nation's housing stock also expands for similar reasons, with the value of both the RH and NRH housing stock expanding in line with the growth in the households' asset budget in the event-year (see columns 1, 2 and 5 of Figure 26). From column 3 and 6 of Figure 26, we also observe that while households increase their supply of equity finance to the housing sector, this increase in supply falls short of the expansion in the asset budget of all three agents because relative rates-of-return are not fixed in VU-Nat. The housing sector is therefore compelled to finance their expanded housing stock using a greater proportion of both equity and debt (see column 4 and 7 of Figure 26). Importantly, their use of debt finance grows relative to equity finance. This is clear from the purple bars in Figure 26, and also from plots of the debt-to-equity ratio of the RH and NRH agents in Figure 1 and Figure 2. However, with both employment and capital rentals elevated, the sticky short-run nominal wages and capital stocks unable to adjust to movements in short-run investment (see sections 2.3 and 3.1.1.1, and Figure 14 and Figure 23), private debt levels grow at a slower rate than income and the private-debt-to-income ratio falls, as evidenced by the purple bars in Figure 3.

Activating equation (9) curtails the supply of equity finance to the housing sector, as discussed in section 3.1.2.1, with the net impact of the intermediation effect drives the supply of equity finance to the housing sector down relative to baseline (see the white squares in Figure 26). The residential housing stock must however be financed. While the use of debt finance by the housing sector also falls in response to the increasing cash rate (see the blue bars in Figure 26), the net impact of the intermediation effect leaves short-run home loan demand slightly elevated relative to baseline (see the white squares in column 4 and 7 of Figure 26). This result is in line with expectation 3 in section 2.1.3, and drives the debt-to-equity ratio of the RNH and RH agents above baseline (see the dashed lines in Figure 1 and Figure 2). Furthermore, with employment and capital rentals broadly in line with baseline but housing debt elevated, and with nominal wages sticky in the short-run and the aggregate capital stock unable to adjust to changes in short-run investment (see section 2.3), the net impact of the intermediation effect causes income to fall relative to private debt (see Figure 3).

The NRH agent is more reliant on equity finance than debt finance (60% of aggregate financial liabilities of the NRH sector are equity owned by households), compared to the RH agent who is more reliant on debt as opposed to equity finance (32% of the aggregate financial liabilities of the RH sector are equities owned by households). The NRH sector is therefore more exposed to a fall in the supply of housing equity in the short-run. The net impact of the intermediation effect on the NRH sector demand for loan finance is therefore greater than the impact on the RH agent, whose demand remains broadly in line with the baseline (see the white squares in column 4 and 7 of Figure 26).

3.1.3.2 Aggregate impact and the savings effect

As shown by the green bars in the green bars in column 4 and 7 of Figure 26, the savings effect has a small positive impact on the use of debt by the housing sector. However, with short-run employment broadly in line with the baseline (Figure 14) and capital rentals slightly depressed (Figure 23), income levels fall and the private-debt-to-income ratio rises

in the short-run (see the green bars in Figure 3). This reinforces the net increase in the private-debt-to-income ratio caused by the intermediation effect in the short-run (see the green bars and the solid line in Figure 3).

As discussed is section 3.1.2.2, the reduced supply of equity capital to the housing sector due to intermediation is more than offset by the savings effect (see the black diamonds in column 3 and 6 of Figure 26), and this drives the debt-to-equity ratio of the housing sector down (see Figure 1 and Figure 2). From the solid lines in Figure 1 and Figure 2, it is clear that the aggregate short-run impact of a rise in the superannuation guarantee rate is however a rise in the debt-to-equity ratio of the housing sector. The intermediation effect therefore drives a significant shift towards debt financing of the housing stock, which is not offset by an increase in the national savings rate in the short-run.

3.1.4 What are the implications of a rise in the superannuation guarantee rate for the commercial banks?

3.1.4.1 Intermediation effect

As discussed in section 2.1.2 with reference to Figure 10, commercial banks benefit from increased intermediation by superannuation funds via a supply-side effect, i.e., superannuation funds have a greater propensity to invest in commercial bank liabilities than households. They also benefit from a short-run depreciation in the nominal exchange rate that arises with equation (9) deactivated (see the purple bars in Figure 11). Nominal depreciation triggers an increase in gross financial capital inflows. The commercial banks benefit from this stimulus, because foreign investors are their largest creditors (owning 32.6% of outstanding commercial bank financial liabilities). All else being equal, an increase in the supply of financial capital to the commercial banks depresses their WACC.

Figure 26 highlights that the commercial banks also benefit from an increase in the demand for housing loans, as discussed in section 3.1.3.1[6].

This demand-side effect places upward pressure on the WACC of the commercial banks, as they expand the liability side of their balance sheet to satiate the increased appetite for loan finance. As previously discussed, the supply of financial capital to the commercial banks also increases due to the intermediation effect under passive monetary policy. Figure 22 presents the realisation of both the supply- and demand-side impacts on the WACC of the commercial banks, with the two effects driving countervailing movements that leave the WACC largely unaffected. With the WACC of the commercial banks broadly in line with baseline, the WACC of the reproducible housing sector is also therefore largely unaffected by the intermediation effect under passive monetary policy (Figure 24).

Activating equation (9) and thus the central bank, the demand for commercial bank loans falls relative to the level observed under intermediation and passive monetary policy. We see this in Figure 26, which summarises the decomposition of the event-year movements in the households asset portfolio (column 1), the aggregate outstanding equity and loan liabilities for RH (column 2, which finance Australia's RH stock), the equity supplied by

[6] The Industry agent also expands their use of loan finance however we suppress a figure illustrating this for brevity

households for RH (column 3), the amount of loan finance used for RH (column 4), the aggregate outstanding equity and loan liabilities for NRH (column 5, which finance Australia's NRH stock), the equity supplied by households for NRH (column 6), and the amount of loan finance used for NRH (column 7). With regard to the fall in commercial bank loan demand, we refer the reader specifically to column 4 and 7 of Figure 26). The commercial banks risk-weighted asset base therefore contracts (Figure 5). Hence, commercial banks need to raise less financial capital to acquire this smaller pool of financial assets. That is, it leads to a contraction in commercial bank financial liabilities (Figure 27).

Considering the net impact of intermediation, we note from section 3.1.2.1 that the supply of equity by households to the housing sector falls in the event-year (see the white squares in column 3 and 6 of Figure 26). From section 3.1.3.1, this is offset by an increase in the use of debt finance (see the white squares in column 4 and 7 of Figure 26). This drives a small expansion in the asset- and liability-sides of the commercial banks' balance sheet in the event-year; see the Figure 5 and Figure 27.

3.1.4.2 Aggregate impact and the savings effect

As discussed in section 2 and shown in Figure 22, the WACC of the commercial banks falls in response to the savings effect. This drives an expansion in both their risk-weighted asset base and their financial liabilities; see Figure 5 and Figure 27. The commercial banks therefore expand in the short-run in response to both the intermediation and savings effects; see the solid lines in Figure 5 and Figure 27. This is in line with expectation 2 and 3 in section 2.1.2 and 2.1.3; an expansion in the supply of financial capital to the commercial banks, and an expansion in the demand for commercial bank loans, drives an expansion of the commercial banks.

3.1.5 Implications for the capital structure of commercial banks: A reduced reliance on bank deposit finance

3.1.5.1 Intermediation effect

In section 2.1.4 we discussed how households supply more deposit finance and less corporate bonds and equity to the commercial banks, relative to superannuation funds. In Figure 28, we observe the event-year realisation of these instrument-specific preferences with equation (9) deactivated (see the purple bars in Figure 28). The use of deposit finance relative to equity and bonds falls, while we observe a large increase in the use of corporate bond finance, and expansion in equity issuance. These findings are congruent with expectation 4, and indicate that the intermediation effect under passive monetary policy does drive a change in the commercial banks' capital structure.

The net impact of the intermediation effect on the commercial banks' capital structure is also shown in Figure 28 (see the white square markers). We observe that the impact of the central banks increase in the cash rate neutralises the aforementioned growth in commercial banks use of equity and deposit finance, while its use of bond finance remains slightly elevated relative to baseline (because the commercial bank still expands slightly due to intermediation under active monetary policy, see section 3.1.4.1). Because the commercial banks are constrained by capital adequacy requirements herein, their use of

equity finance moves in-line with the movement in their risk-weighted assets. In contrast, ignoring movements in relative rates-of-return and taste differences, their use of bond and deposit finance will generally grow and contract with their asset base (three quarters of which is comprised of NRH, RH and Industry loans). Therefore, if commercial banks de-risk their asset portfolio, e.g., for a given asset portfolio the banks increase NRH lending (which carries a risk weight of 0.35 in VU-Nat[7]) relative to Industry lending (which carries a relatively higher risk weight of 0.4 in VU-Nat) and RH lending (risk weight=0.5), their use of equity finance will ceteris paribus fall relative to deposit and bond finance. We observe such a shift in agent-specific lending in Figure 29, with Industry and RH loans falling relative to NRH loans in response to active monetary policy (see the blue bars in Figure 29). The use of equity finance by commercial banks (which falls by 0.269 percentage points relative to baseline) therefore falls relative to deposits and bonds (which are depressed by 0.225 and 0.227 percentage points relative to baseline respectively), as shown by the blue bars in Figure 28.

Despite no relative change in the use of deposit and equity finance due to intermediation, we do observe an increase in the use of bonds by the commercial banks in Figure 28. From Figure 9, we note that households do not hold commercial bank bonds, while superannuation funds do. The commercial bank therefore funds their expansion due to intermediation under active monetary policy (Figure 27) almost entirely by corporate bond issues. In line with expectation 3, we therefore observe a shift in the commercial banks' capital structure due to the intermediation effect, with an increase in the use of bond finance relative to both equity and deposits.

3.1.5.2 Aggregate impact and the savings effect

With non-dwelling investment elevated relative to dwelling investment due to the savings effect (see Figure 19 and Figure 18), the commercial banks increase lending to the Industry agent by more than the RH agent. Lending to both these agents is however elevated relative to the NRH-agent-lending, as shown in Figure 29. Once again, while the use of bond and deposit finance grow in proportion with one another (see Figure 28), the relative increase in lending to agents with higher risk-weights drives up the use of equity finance by the commercial banks. While the banks' capital structure therefore shifts once more due to the savings effect, it nevertheless remains altered relative to the baseline with an elevated preference for corporate bond and equity finance, relative to deposits.

3.1.6 What does an expanded superannuation sector mean for economy-wide financial intermediation?

3.1.6.1 Intermediation effect

Because superannuation funds have a stronger preference for NBFI and life insurance agent liabilities than households, the supply of financial capital to these agents increases due to intermediation under passive monetary policy. These agents can afford to reduce the return they offer on their various liabilities, as a result of this increase in financial capital supply, which depresses their WACC's relative to baseline (see Figure 30). In line

[7] For a discussion of the risk weights applied in VU-Nat, we refer the reader to Giesecke *et al.* [10]

with expectation 5, NBFI's and life insurers therefore expand due to the intermediation effect (see the purple bars in Figure 7 and Figure 8).

In line with the noted impact of active monetary policy on other financial intermediaries, the asset budget of the NBFI and life insurance agents contracts slightly while their WACC rises. As evidenced by the dashed lines in Figure 7 and Figure 8 however, the net impact of the intermediation effect drives a short-run expansion in the activity level of each agent. All four financial intermediaries (superannuation funds, commercial banks, NBFI's and life insurers) therefore expand due to the intermediation effect in the short-run.

3.1.6.2 Aggregate impact and the savings effect

In line with our discussions in section 2, the savings effect depresses the WACC of both the NBFI and life insurance agents in the event-year (see the green bars in Figure 30). This drives an expansion of the asset-side of their balance sheets (see Figure 7 and Figure 8). Therefore, the NBFI and life insurance agents each expand in response to the savings effect. The aggregate impact of a rise in the superannuation guarantee rate therefore drives an unambiguous expansion of both the NBFI and life insurance agents in the short-run. Coupled with the noted expansion of the commercial banks (see Figure 5 and Figure 27) and superannuation funds in the short-run, the economy's financial intermediaries expand in the short-run, in response to a rise in the superannuation guarantee rate.

3.1.7 Long-run analysis

In this section, we summarise the long-run impact of a rise in the superannuation guarantee rate using VU-Nat outputs.[8] In section 3.1.7.1, we focus on the intermediation effect and ignore the impact of the central bank, i.e., we focus on the purple bars that appear throughout the figures in section 7. We then summarise the impact of active monetary policy, and the long-run savings effect and aggregate impact, in sections 3.1.7.2 and 3.1.7.3.

3.1.7.1 Intermediation effect: Passive monetary policy

In the long-run, the intermediation effect under passive monetary policy continues to depress the nominal exchange rate and raise the domestic price level relative to baseline (see Figure 11 and Figure 12). With the domestic price level above baseline, capital rentals (Figure 23) and thus equity prices remain elevated, which continue to inflate the households asset budget (Figure 31) and the value of the housing stock (Figure 31[9]) relative to baseline. As discussed in section 3.1.2.1, this materialises as an increase in the supply of equity finance to the NRH and RH agents (see column 3 and 6 of Figure 31), which also remain elevated relative to baseline. The use of debt finance by the housing sector continues to exceed the baseline (see column 4 and 7 of Figure 31), because the increased supply of equity by households falls short of the level required to finance the inflated housing stock (see columns 1, 2 and 5 of Figure 31). This drives the debt-to-equity ratio of the NRH and RH agents above baseline in the long-run (see the purple bars in Figure 1 and Figure 2).

[8] Herein, we refer to the long-run as our final simulation year, denoted *Year 12* in our plots.
[9] The reproducible housing stock expands by a lesser amount, relative to the non-reproducible housing stock. This is because dwelling investment is depressed in the long-run; see Figure 18.

As discussed in section 3.1.1, employment was buoyed by a fall in the real producer wage in the short-run, with the rise in employment stimulating real investment via its effect on real rates of return on investment in the short-run. In contrast, the long-run is characterised by a depressed real producer wage relative to baseline (Figure 13) and return of employment to baseline (Figure 14). With long-run real investment below baseline (Figure 17), the aggregate capital stock also lies below baseline (Figure 33). This accounts for the fall in the real producer wage relative to baseline. The long-run impact on real dwelling investment is more pronounced than real non-dwelling investment (see Figure 18 and Figure 19), because approximately one-half of housing investment is financed using commercial bank loans. While the commercial banks' risk-weighted asset base and general activity level remain elevated in the long-run (Figure 5), their WACC continues to exceed its baseline level (Figure 22). This increased cost of securing financial capital is passed on to the RH agent, whose WACC rises (Figure 24) relative to the industry agent (Figure 25). The industry agent relies more on the foreigner (who is their largest creditor, funding one-third of their investment activity) to finance non-dwelling investment. These two effects therefore depress dwelling investment relative to non-dwelling investment. Nevertheless, with both investment and private consumption depressed relative to baseline, real GNE falls relative to real GDP in the long-run (Figure 35). As in the short-run, this shifts the balance of trade towards surplus, reducing the CAD (Figure 4).

The depressed level of employment and lower level of aggregate capital stock relative to baseline drive the long-run nominal wage and capital rental rate above baseline. Nevertheless, the growth in private debt (particularly debt accruing in order to fund housing, as shown in Figure 31) exceeds the growth in long-run income, driving the long-run private-debt-to-income ratio higher in response to intermediation under passive monetary policy (Figure 3).

The other general short-run trends we identified and discussed in sections 3.1.5 and 3.1.6 also persist in the long-run, with the rationale for these structural changes unaltered by the transition from the short- to the long-run. For brevity, we avoid restating the arguments presented in sections 3.1.5 and 3.1.6. To summarise, the supply of financial capital to the NBFI and Life Insurance agent's remains elevated in the long-run as a result of the intermediation effect, thus facilitating a long-run expansion in the asset budgets of these two agents (see Figure 7 and Figure 8). Additionally, commercial banks continue to utilise bond and equity liabilities more than bank deposits, in order to finance their financial asset acquisitions (Figure 32).

3.1.7.2 Intermediation effect: The impact of active monetary policy and net impact

Despite long-run employment being slightly below baseline due to the intermediation effect under passive monetary policy (see the purple bars in Figure 14), with the price level rising relative to baseline (Figure 12) so too does the cash rate (see the blue bars in Figure 21). To quantify this rise, the central bank increases the long-run cash rate by 29.7 basis points relative to its level under passive monetary policy in order to keep the price level close to its baseline level.

As in the short-run, an elevated long-run cash rate drives nominal appreciation, which neutralises the long-run deviation in the nominal exchange rate discussed in section 3.1.7.1. Long-run CPI also falls as a result of the rise in the cash rate, thus neutralising the inflation-stimulating impact of nominal depreciation caused by intermediation under a passive monetary policy (see the blue bars and dashed line in Figure 12). With the price level in line with baseline, the rise in rentals noted in section 3.1.7.1 is also muted (Figure 23). Equity prices therefore also contract, reversing the long-run growth in the asset budget of the household (Figure 31). With the household's asset budget depressed relative to baseline in the long-run, so too is their provision of equity financing to the RH and NRH agents. Reproducible and non-reproducible housing stock valuations also fall, as shown in Figure 31, with the reduction in the supply of equity finance by the households exceeding the fall in housing stock valuations. For this reason, while the demand for housing loans by the RH and NRH also fall in the long-run (Figure 31), the use of debt-relative to equity financing by each agent expands slightly under active monetary policy (see the blue bars in Figure 1 and Figure 2). As we shall discuss, real dwelling investment is slightly depressed relative to non-dwelling investment (see Figure 18 and Figure 19), because private consumption is both below baseline and housing-intensive. Consequently, the long-run value of the reproducible housing stock falls slightly relative to the value of the non-reproducible housing stock, as shown in Figure 31. ***The net impact of the intermediation effect therefore drives a long-run rise in the debt-to-equity ratio of the reproducible and non-reproducible housing agents.***

With the demand for housing loans depressed by the rise in the cash rate, we also observe a long-run contraction in the commercial banks' risk weighted assets (see the blue bars in Figure 5). This contraction dominates the expansion due to intermediation under passive monetary policy that we identified in section 3.1.7.1. ***Consequently, the commercial banks experience a small contraction in the long-run in response to the intermediation effect, which arises due to the contractionary pressure placed upon their balance sheet by an increase in the domestic cash rate.***

The contraction in the commercial banks risk-weighted assets drives a corresponding contraction in the liability-side of their balance sheet (Figure 27). As in the short-run, the use of deposit and bond finance contract in proportion with the overall contraction in the size of the commercial banks' balance sheet (Figure 32), while the use of equity finance contracts in line with the reduction in the banks risk weighted asset base. The demand for housing loans by the RH agent (which carry a risk weight of 0.5) also falls by a greater amount than the demand for loans by the NRH agent (which carries a risk weight of 0.35); see Figure 31. As was the case in the short-run, the rise in the cash rate therefore reduces the size of the commercial banks' risk-weighted asset portfolio relative to the overall balance sheet. Because the commercial banks are constrained by capital adequacy requirements, this means that the use of equity finance must fall relative to the use of bond and deposit finance in the long-run (Figure 32). Nevertheless, the commercial banks continue to use an elevated level of bond finance in the long-run, relative to equity and deposit finance. ***The net long-run impact of intermediation on the commercial banks' capital structure is therefore very similar to our findings in the short-run; namely, the use of bond finance rises relative to the use of deposits and equity.***

With the demand for financial capital depressed by the elevated long-run cash rate, the non-bank financial intermediaries and life insurers also experience a contraction in their level of economic activity. This is evident from the blue bars in Figure 7 and Figure 8. This contraction is however insufficient to offset the expansion observed in response to intermediation under passive monetary policy. ***The intermediation effect therefore drives an overall expansion of the non-bank financial intermediaries and the life insurance agents in the long-run.***

With employment broadly in line with the baseline (see the dashed line in Figure 14) and the capital stock slightly below baseline (see the dashed line in Figure 33), real GDP and real private consumption are both slightly below baseline in the long-run (see the dashed lines in Figure 15 and Figure 16). Because private consumption is housing-intensive, real dwelling investment is depressed slightly relative to non-dwelling investment (see the dashed lines in Figure 18 and Figure 19). With real investment and real private consumption depressed relative to baseline, real GNE falls relative to real GDP (see Figure 35). As in the short-run, the balance of trade and the CAD both move towards surplus, as demonstrated by the blue bars and the dashed line in Figure 4. ***Australia's foreign financing requirement therefore experiences an unambiguous long-run reduction under the intermediation effect.***

In the long-run, the terms of trade is slightly depressed relative to baseline; see Figure 34. This drives household income down slightly relative to baseline. Nevertheless, the intermediation effect drives a reduction in the capacity to fund the nation's housing stock using household equity, and the use of loan finance rises (see the net impact of intermediation in Figure 31). Commercial banks also increase their reliance on corporate bond finance (see Figure 32). ***The net impact of the intermediation effect therefore drives income lower relative to private debt in the long-run, as evidence by the rise in the long-run private-debt-to-income ratio (see the blue bars in Figure 3).***

3.1.7.3 Aggregate impact and the savings effect

As discussed in section 2, the savings effect drives a general rise in the provision of financial capital which has the effect of lowering economy-wide weighted average costs of financial capital. In sections 3.1.1 - 3.1.6, we established that this assertion holds true in the short-run. For brevity, we omit a similarly lengthy analysis of the long-run impact of the savings effect herein, and provide a summary of the key long-run consequences of an increase in the national savings rate. This allows us to determine whether the savings effect reinforces, damps, or counteracts the key structural shifts caused by the intermediation effect in the long-run, which we summarised in section 3.1.7.2.

1. The foreign financing requirement is also reduced by the savings effect in the long-run. This is because real private consumption falls in the long-run, in response to a rise in household savings. This depresses long-run real GNE relative to real GDP (Figure 35), driving the current account deficit towards surplus (Figure 4). ***This reinforces the corresponding reduction in foreign financing that arises due to the intermediation effect, as shown by the solid line in Figure 4***.

2. The supply of equity finance by households to the RH and NRH agents also expands, because their savings rate (and therefore their asset budget) has increased (see the green bars in Figure 31). The savings effect therefore depresses the debt-to-equity ratio of the RH and NRH agents, as shown in Figure 1 and Figure 2. ***While this partially offsets the rise in these ratios caused by the intermediation effect, we continue to observe elevated debt-to-equity ratios for the RH and NRH agents in the long-run.***
3. While private debt levels rise strongly above baseline as the commercial banks increase their use of debt finance (Figure 32) and reproducible housing loans also expand (Figure 31), income rises only marginally. The savings effect therefore reinforces the long-run rise in private-debt-to-income caused by the intermediation effect. ***Consequently, we observe a rise in the long-run private-debt-to-income ratio in response to the rise in the superannuation guarantee rate.***
4. Because the demand for housing loan finance expands in response to the savings effect (see point 2 above and Figure 31), and the economy-wide supply of financial capital is elevated by the increased savings rate, the commercial banks expand in the long-run in response to the savings effect (see the green bars in Figure 5 and Figure 27). This more-than-offsets the small contraction due to the intermediation effect (see the solid line in Figure 5 and Figure 27). ***The commercial banks therefore expand in the long-run, in response to a rise in the superannuation guarantee rate. This is driven by the savings effect.***
5. Because the proportion of commercial bank loans to reproducible housing rises relative to non-reproducible housing in the long-run (see Figure 31) and reproducible housing loans carry a higher risk-weight (0.5 versus 0.35), the commercial banks risk-weighted assets expand by a larger percentage relative to baseline than the asset-side of their balance sheet. Their use of equity finance therefore expands, relative to deposit and bond financing (see the green bars in Figure 32). The use of deposits also expands because the households' savings rate rises and bank deposits are a key financial asset of households (see Figure 6 and Figure 9). This expansion falls short of the expansion in the use of equity finance however, for the reasons discussed. The capital structure of the commercial banks therefore shifts in response to the savings effect, with a greater reliance on equity finance relative to deposits and bonds. ***The aggregate impact of a rise in the superannuation guarantee rate therefore drives an expansion of the commercial banks, which is funded using a greater proportion of bond and equity liabilities in the long-run, relative to bank deposits.***
6. With the supply of financial capital elevated due to the increased savings rate, the WACC of the non-bank financial intermediaries and the life insurers remains depressed in the long-run, which reinforces their expansion due to intermediation (see Figure 7 and Figure 8). ***The non-bank financial intermediaries therefore expand in the long-run, in response to a rise in the superannuation guarantee rate***.

4 Summary and Key Findings

We have explored the structural implications of a rise in the superannuation guarantee rate in Australia. This rise was decomposed into two parts: (1) The intermediation effect, modelled as an increase in the share of Australian household savings invested in superannuation; and (2) The savings effect, which was predicated upon the work by Connolly[9] and modelled as a rise in the national savings rate. Some of the implications the intermediation effect were first considered by analysing the VU-Nat financial stock database. This analysis yielded several expectations: firstly, we identified that the commercial banks might experience a short-run benefit from an increase in the size of Australia's superannuation sector via an increase in the supply of financial capital, and secondly, we conjectured that commercial banks might also benefit via an increase in the demand for loan finance from the residential housing sector. Because households do not hold commercial bank bonds whereas superannuation funds do, we also suspected that the commercial banks' capital structure may be altered by a rise in the superannuation guarantee rate. Exchange rate effects were also anticipated, because of differences in the proclivity for superannuation funds and Australian households to hold offshore financial assets. Superannuation funds also tend to invest a greater share of their asset portfolio in financial liabilities issued by other financial intermediaries, such as the non-bank financial intermediaries and life insurers. A rise in the superannuation guarantee rate was therefore expected to drive a reduction in the weighted average cost of capital faced by these agents.

Many of these responses materialised as expected. For example, commercial banks benefit from an increase in the superannuation guarantee rate in the short-run because the demand for commercial bank loans rises, and their supply of financial capital increases. The commercial banks therefore expand in the short-run, while in the long-run their expansion is contingent upon an increase in national savings rate.

We also elucidate the intermediation-induced impact on the capital structures of both the reproducible and non-reproducible housing sectors; namely, an increase in debt relative to equity financing. This effect is shown to persist when we also account for the savings effect. As a result, we determine that the debt-to-equity ratio of the residential housing sector is likely to rise in response to an increase in the superannuation guarantee rate. In turn, the private debt-to-income ratio is also likely to rise in the short- and long-run, and we show that this structural shift is reinforced by the savings effect. Finally, we found some evidence that both the intermediation and savings effects act to reduce Australia's foreign financing requirements.

5 Further Work

In future work, we intend to extend our analysis in two directions. Firstly, our aim is to consider the implications of the structural shifts identified herein for macroeconomic growth and stability. Second, we hope to explore the impact of the superannuation sector on two other financial intermediaries identified in the model in more detail: the non-bank financial intermediaries and the life insurance sector. Part of this work will involve refining our treatment of the regulatory framework that relates to these two financial intermediaries, e.g., regulator-

imposed Life and General Insurance Capital (LAGIC) requirements influence the asset purchase behaviour of life insurers. [10]

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7 Figures

Figure 1: Debt-to-equity ratio for non-reproducible housing, basis point deviation from baseline

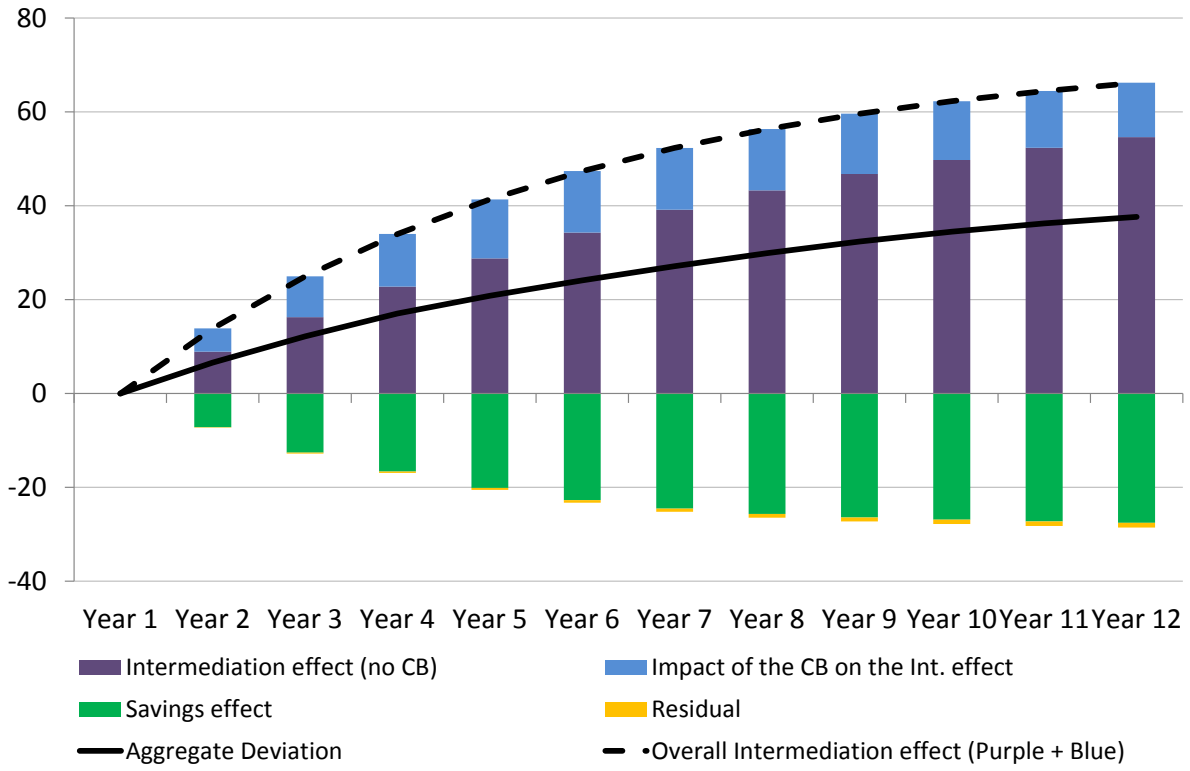

Figure 2: Debt-to-equity ratio for reproducible housing, basis point deviation from baseline

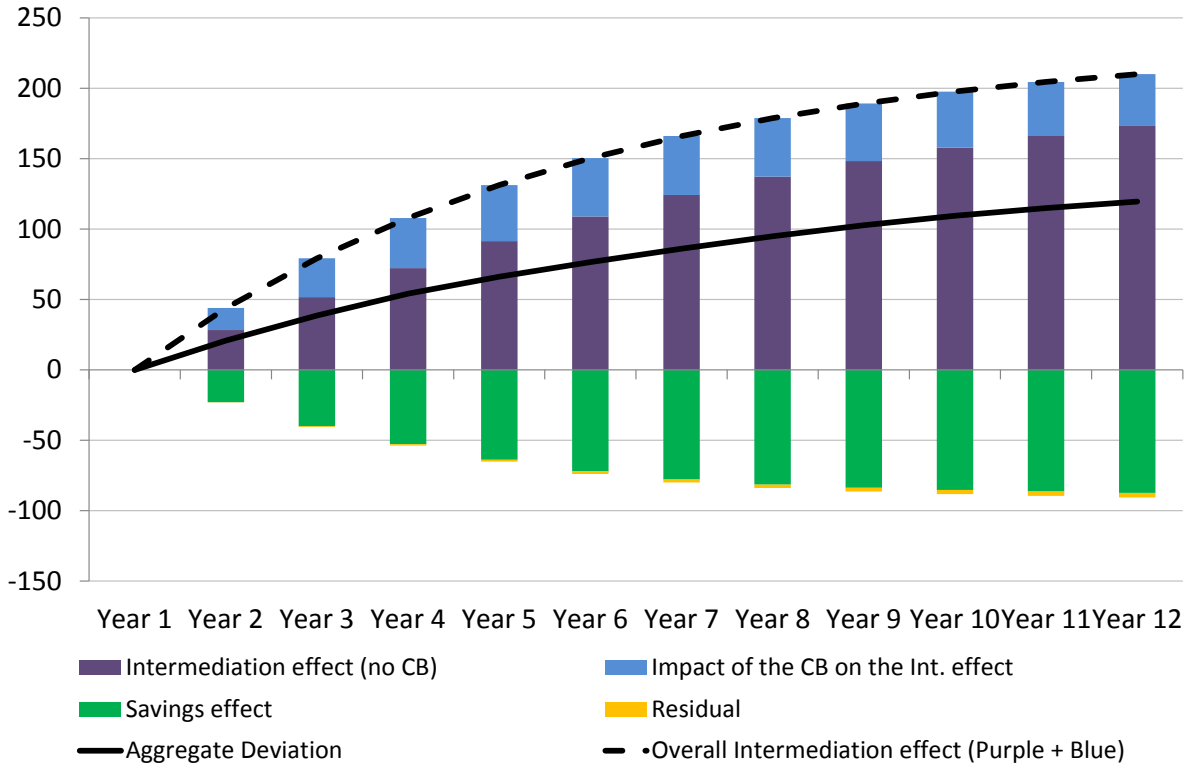

Figure 3: Private debt to income, percentage deviation from baseline

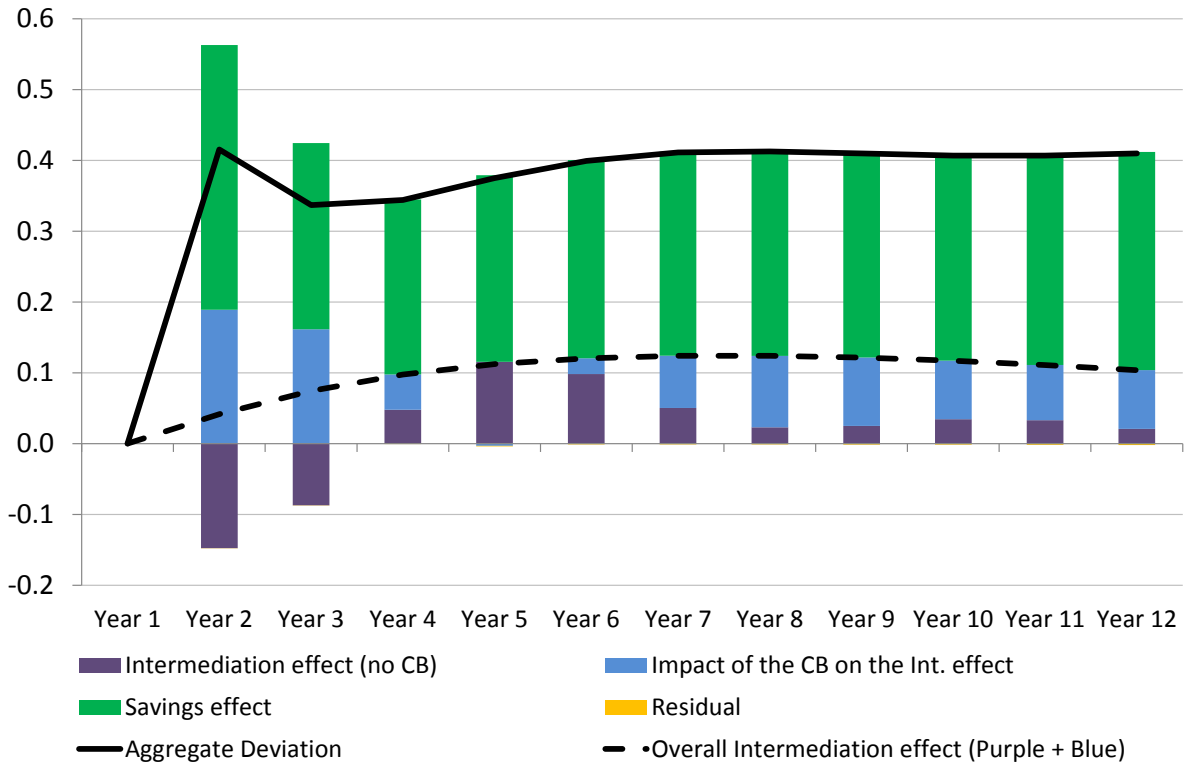

Figure 4: Change in the ratio of the CAD-to-GDP from baseline

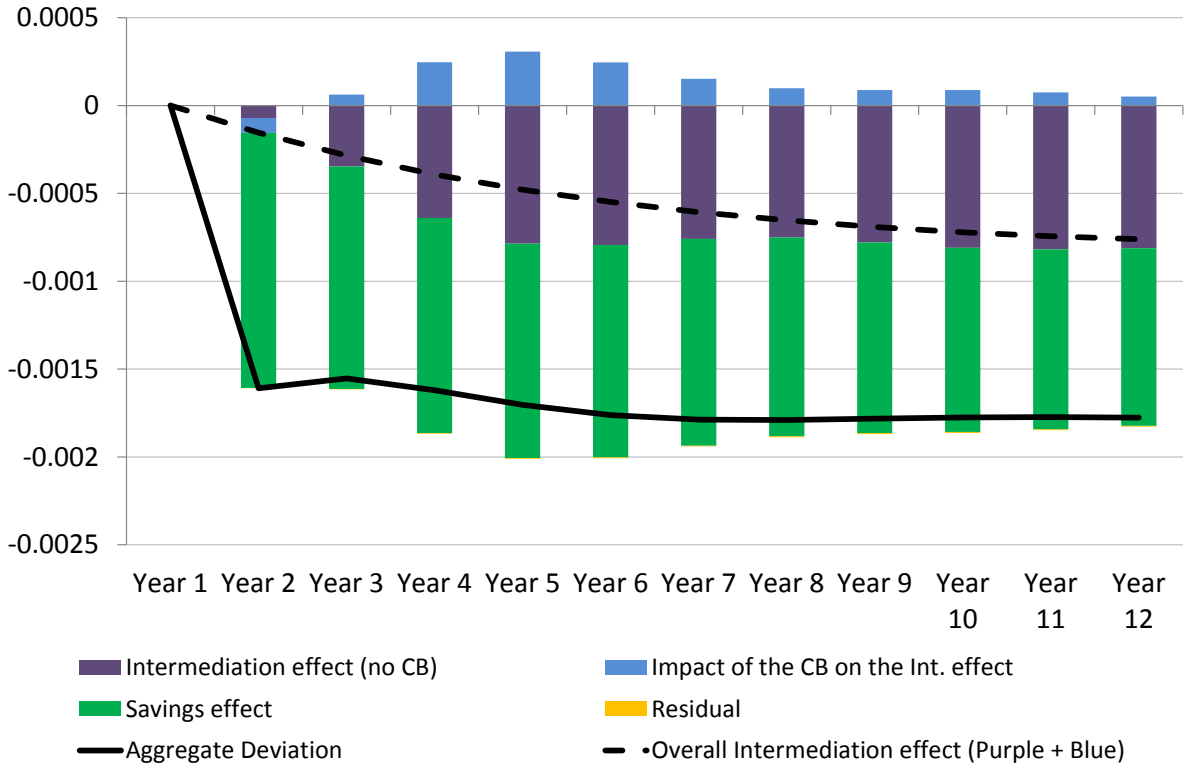

Figure 5: Commercial bank risk-weighted assets, percentage deviation from baseline

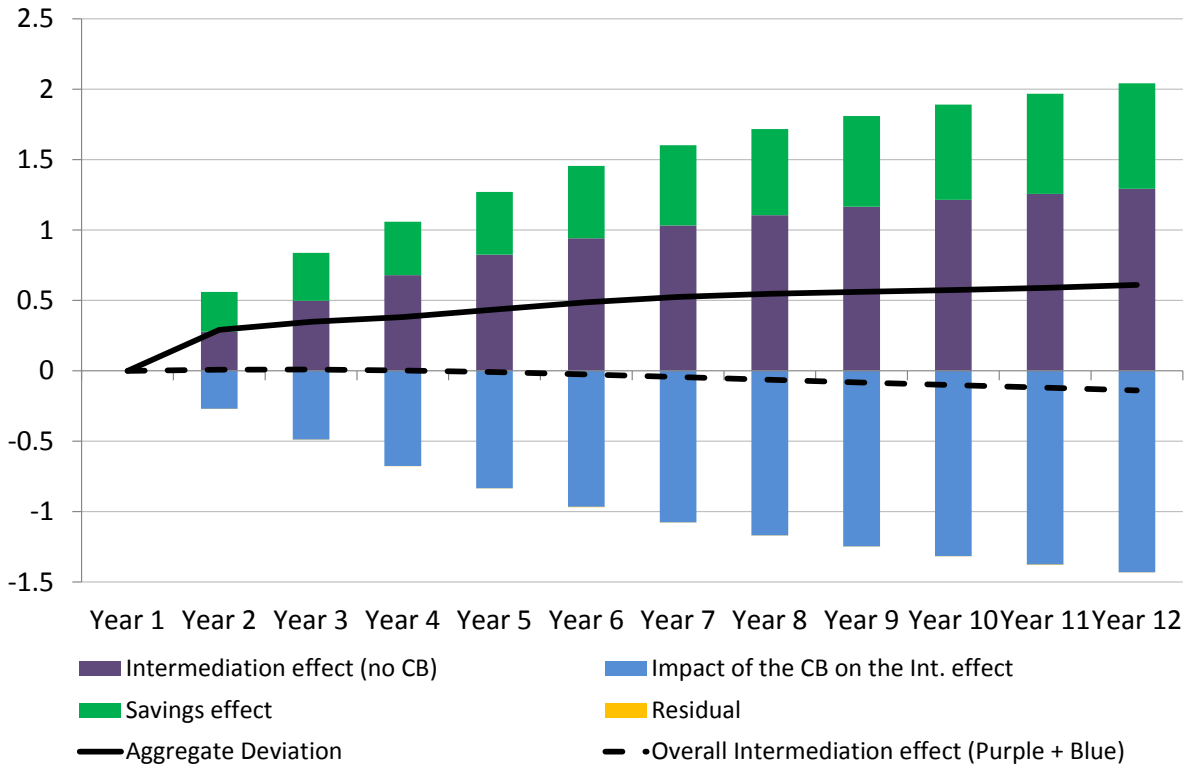

Figure 6: Financial asset ownership shares by asset agent, VU-Nat financial database

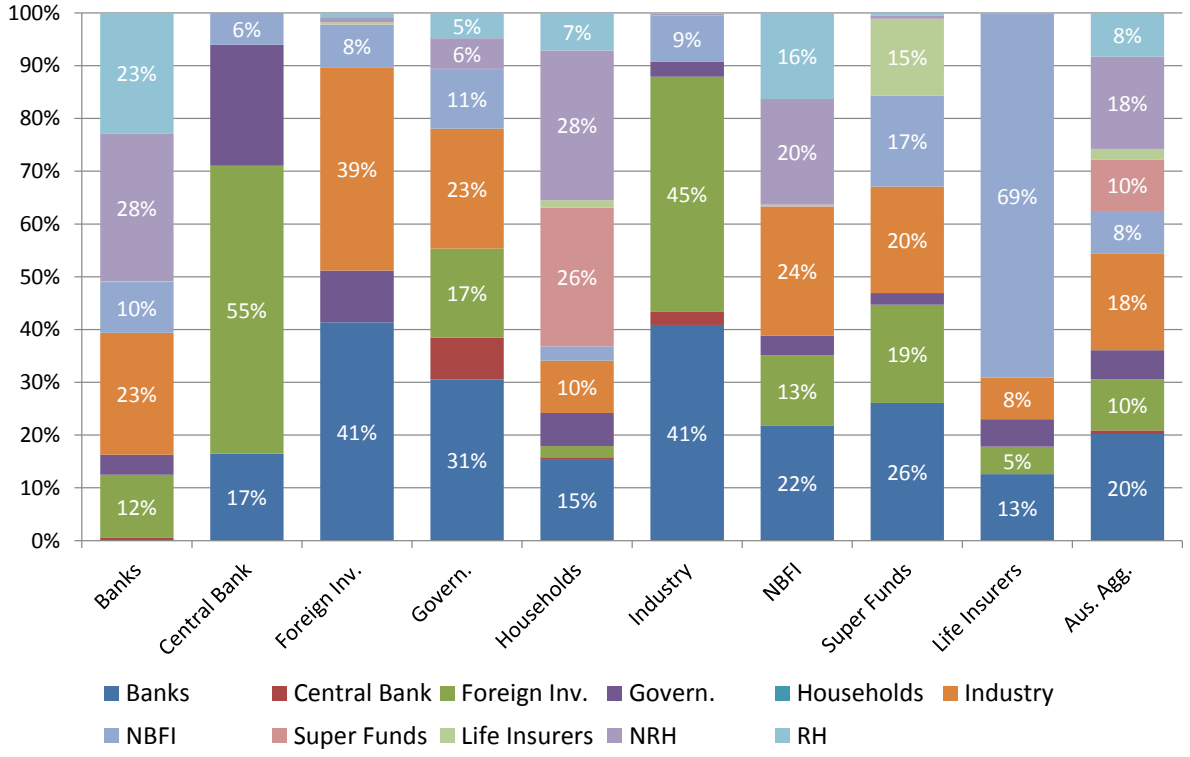

Figure 7: Asset budget for non-bank financial intermediaries, percentage deviation from baseline

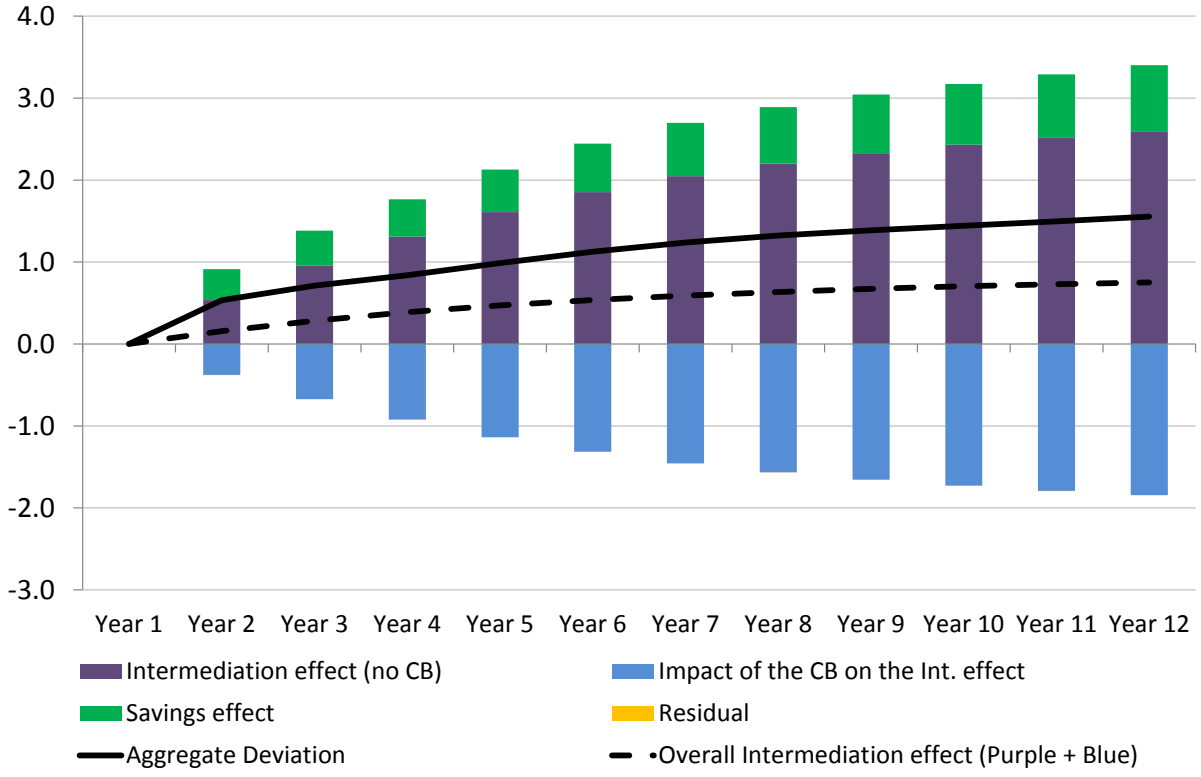

Figure 8: Asset budget for life insurers, percentage deviation from baseline

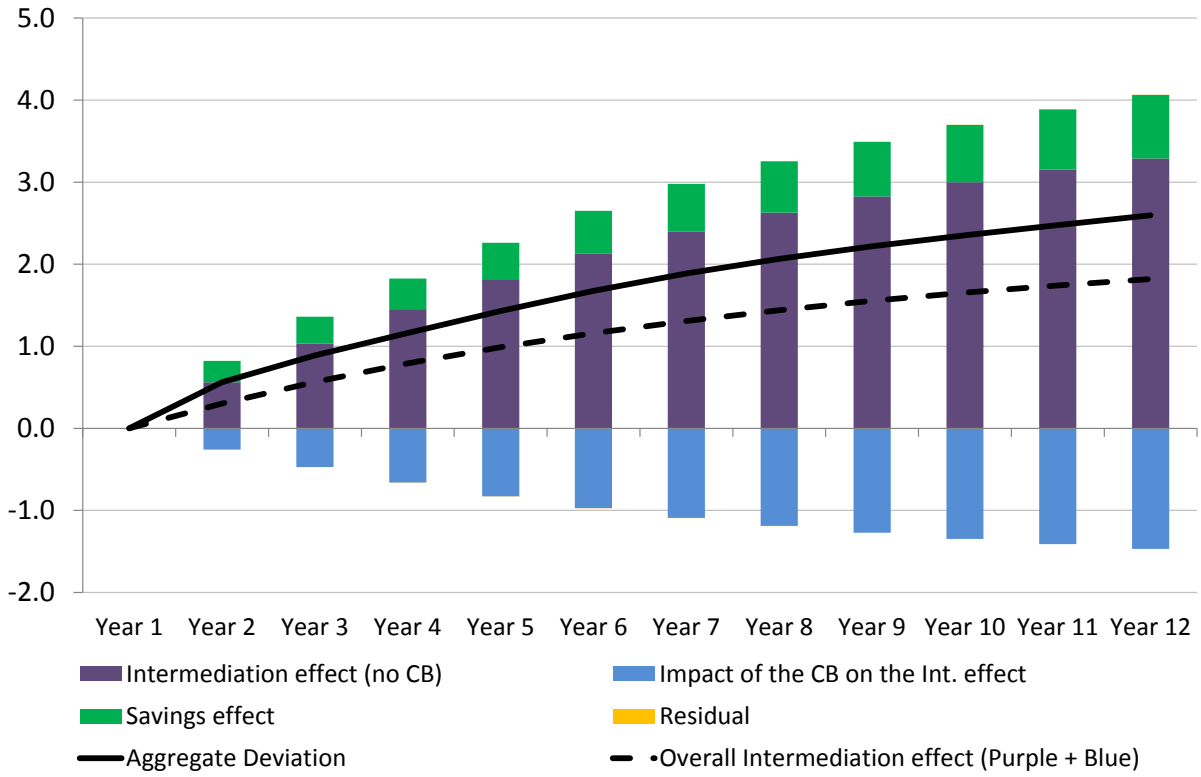

Figure 9: Instrument breakdown by agent for the key financial capital suppliers to the commercial banks

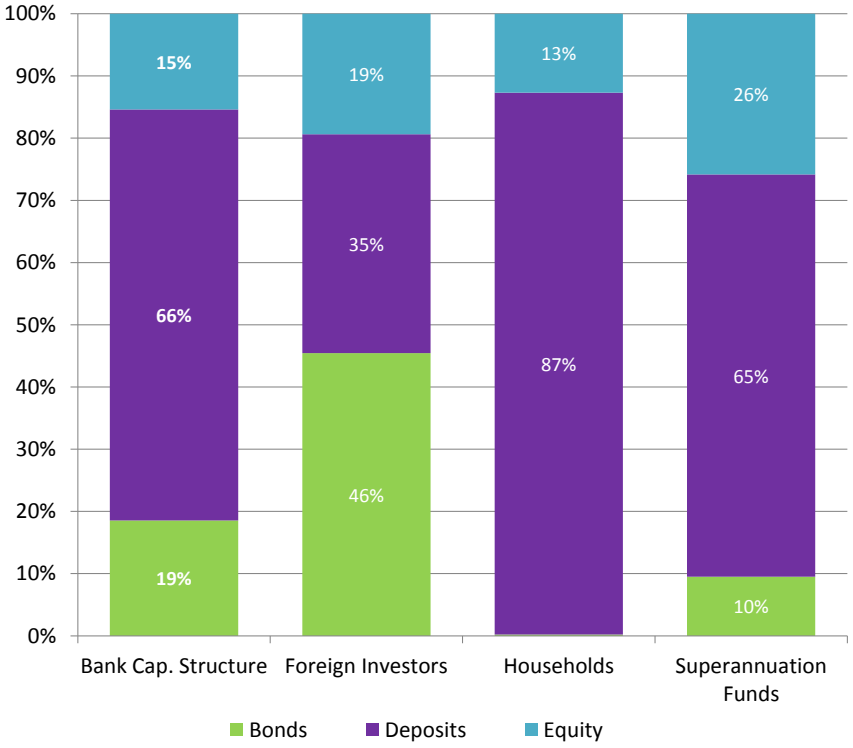

Figure 10: Financial asset ownership shares by asset agent, VU-Nat financial database

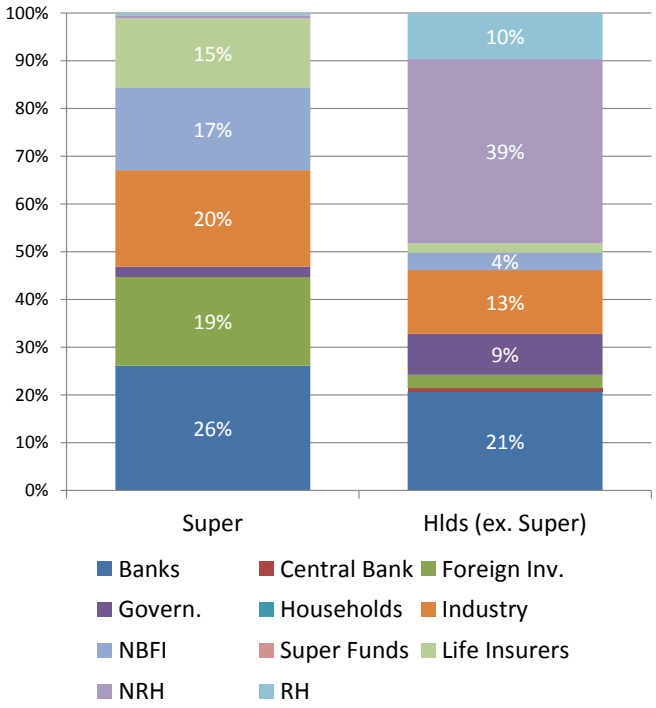

Figure 11: Nominal exchange rate, percentage deviation from baseline

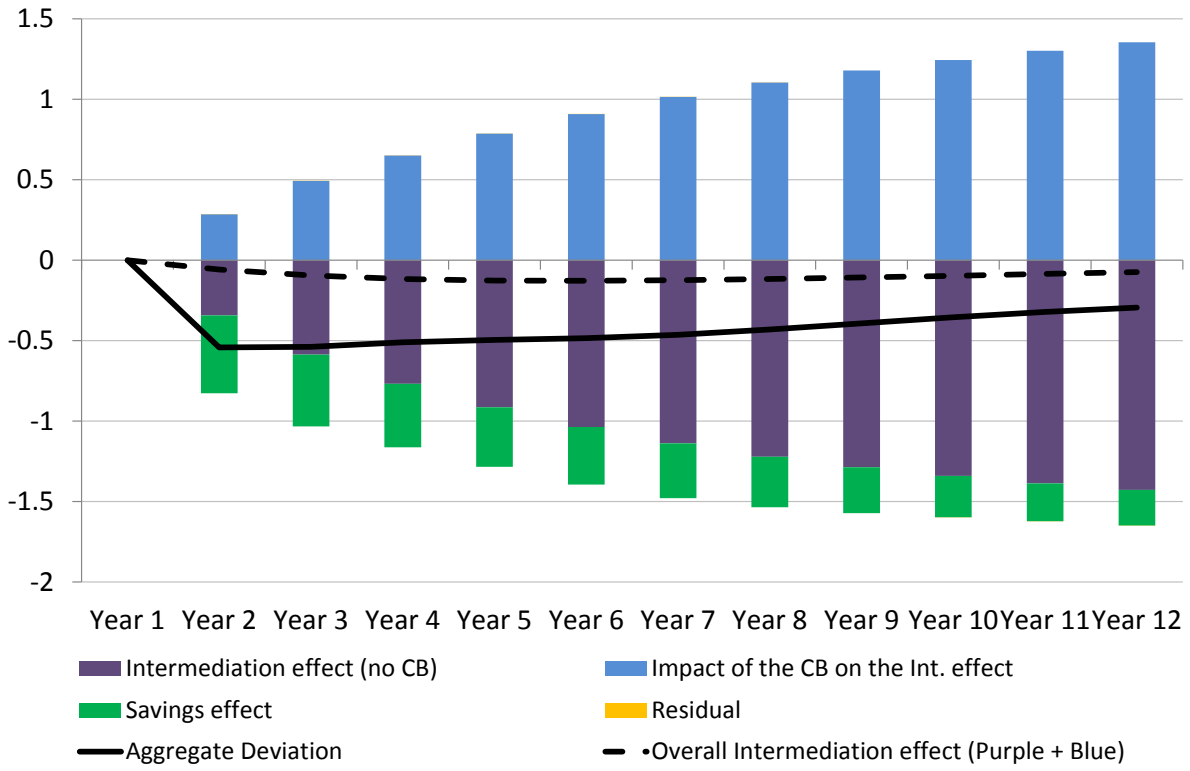

Figure 12: Private consumption deflator, percentage deviation from baseline

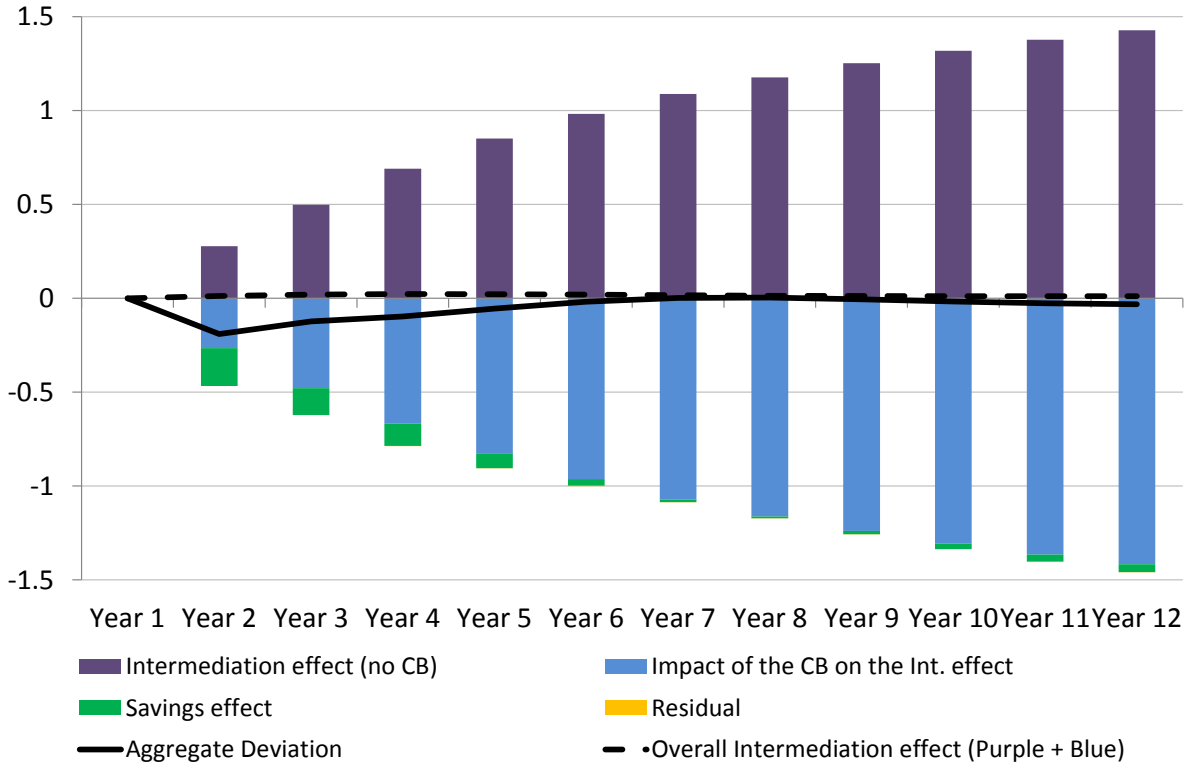

Figure 13: Real producer wage, percentage deviation from baseline

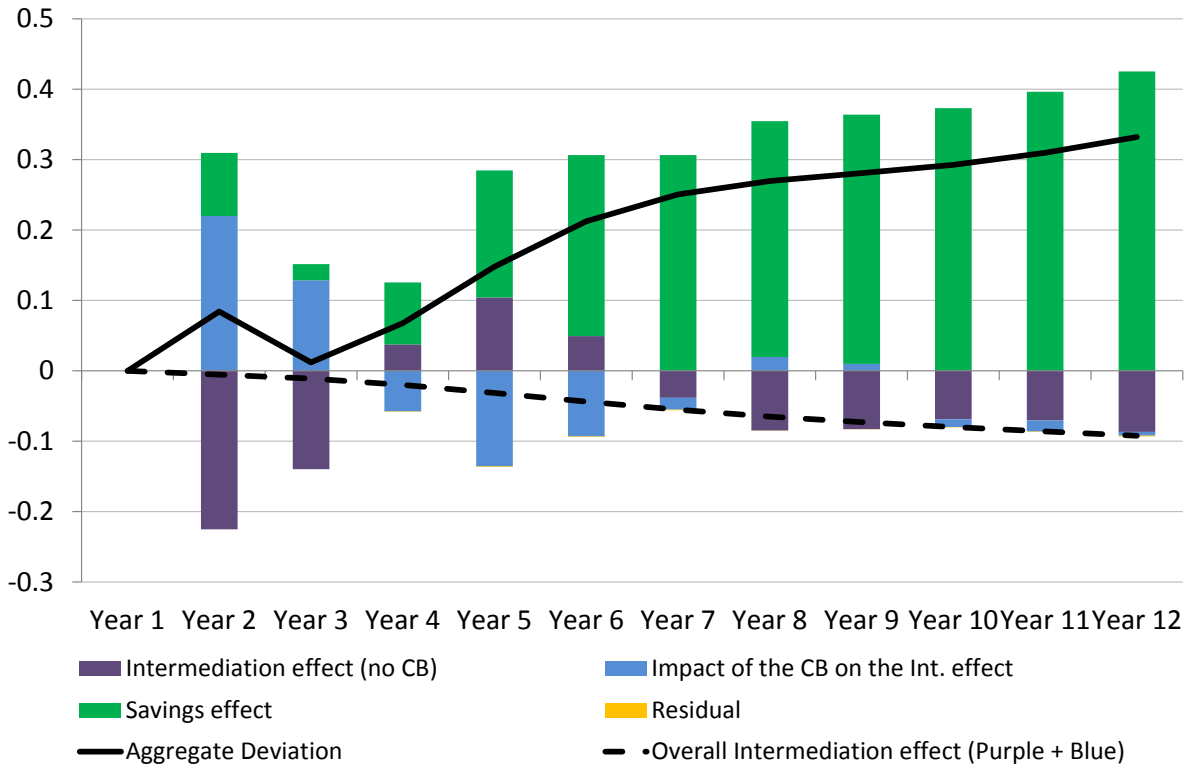

Figure 14: Employment, percentage deviation from baseline

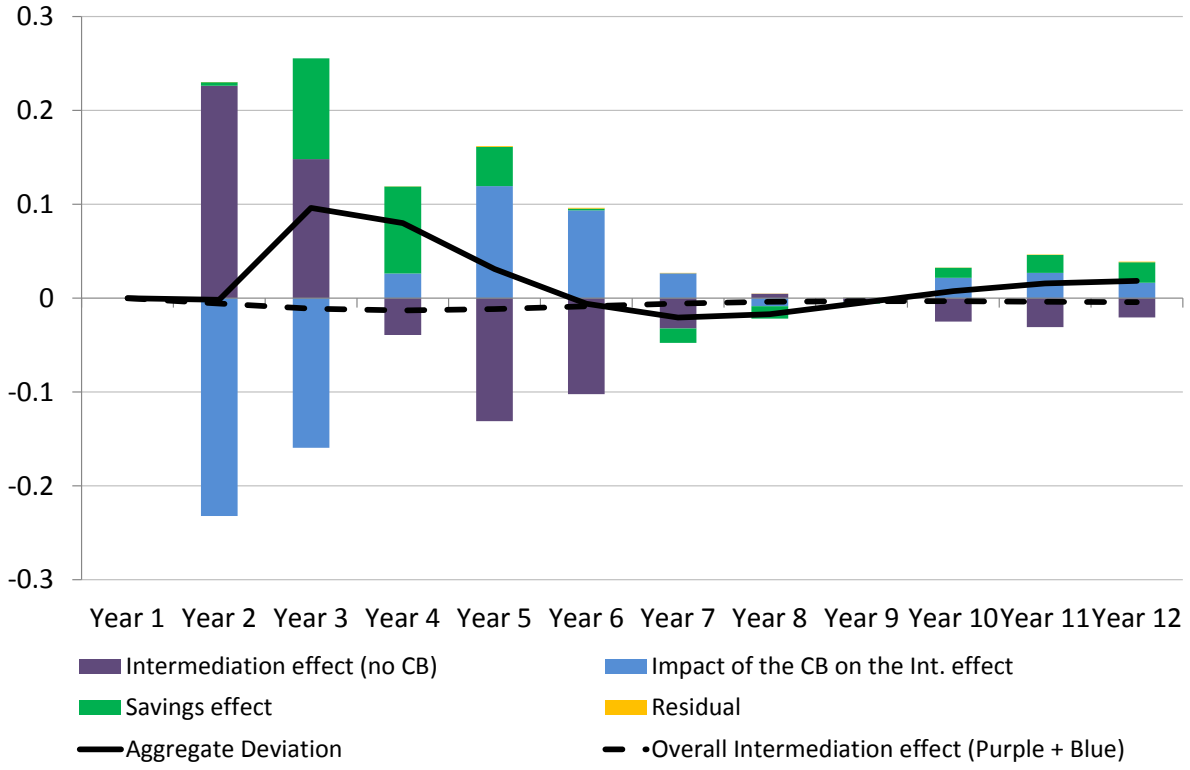

Figure 15: Real GDP, percentage deviation from baseline

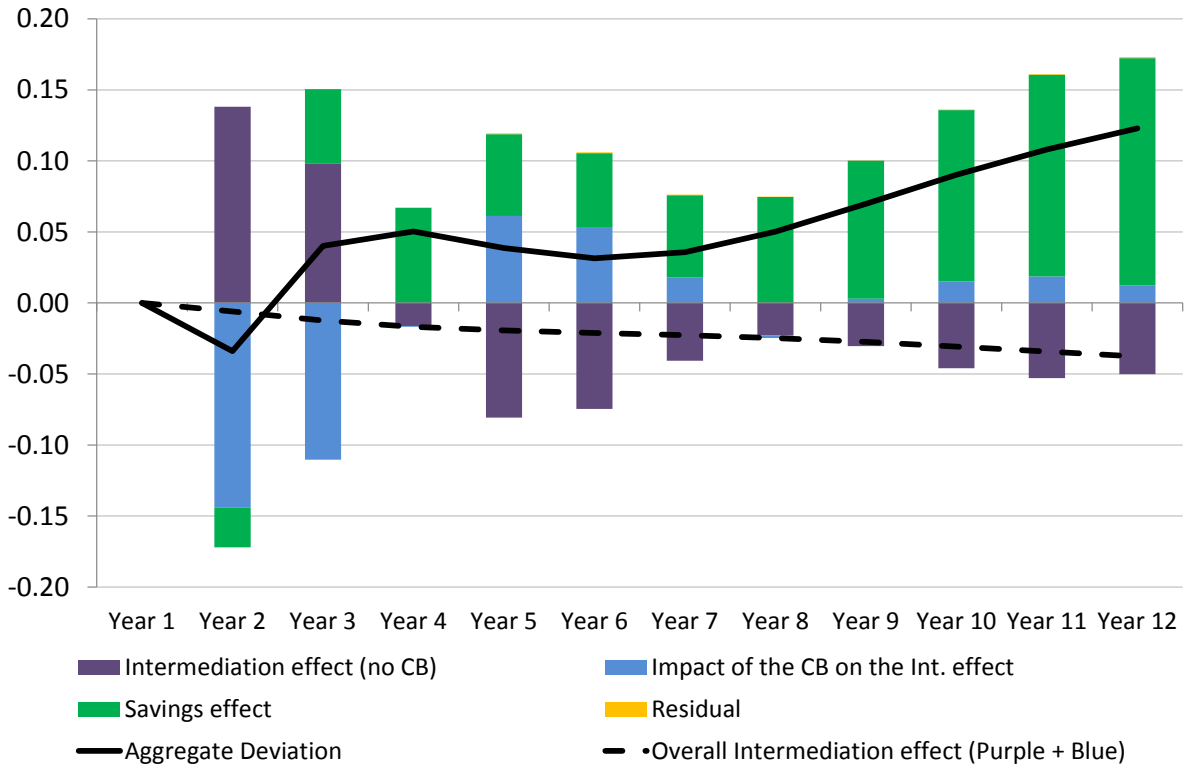

Figure 16: Real private consumption, percentage deviation from baseline

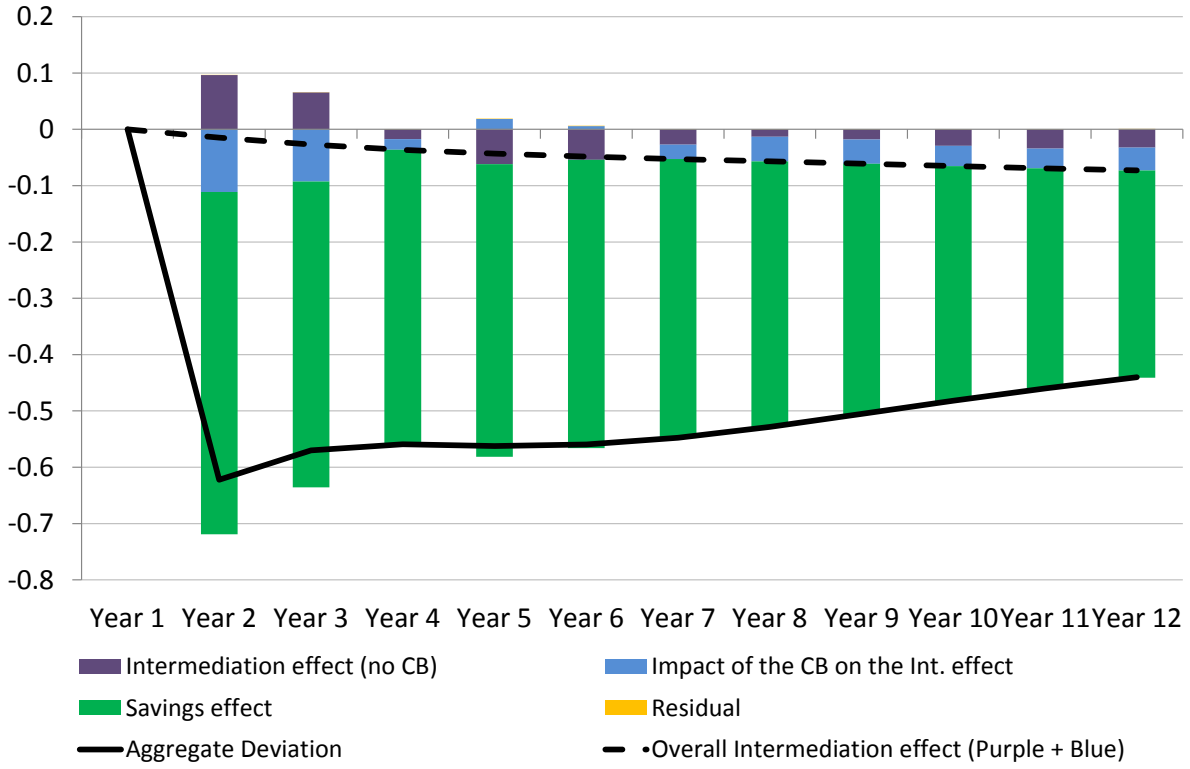

Figure 17: Real investment, percentage deviation from baseline

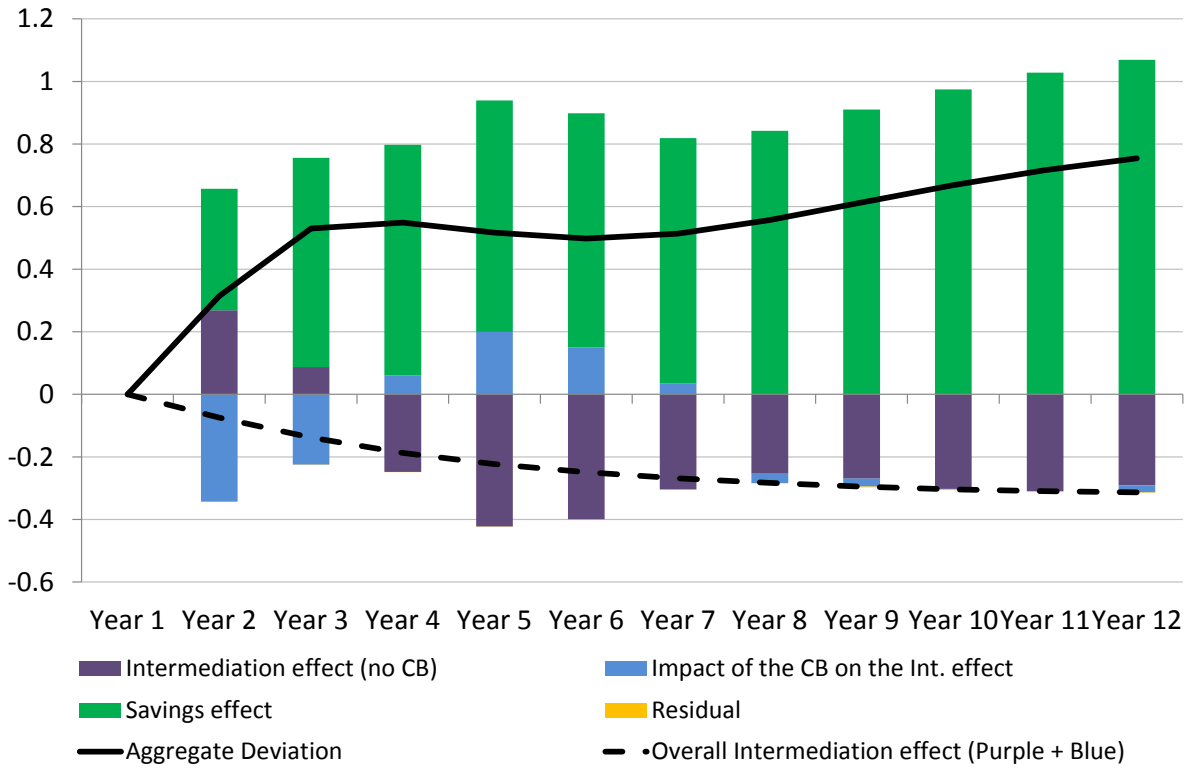

Figure 18: Dwelling investment, percentage deviation from baseline

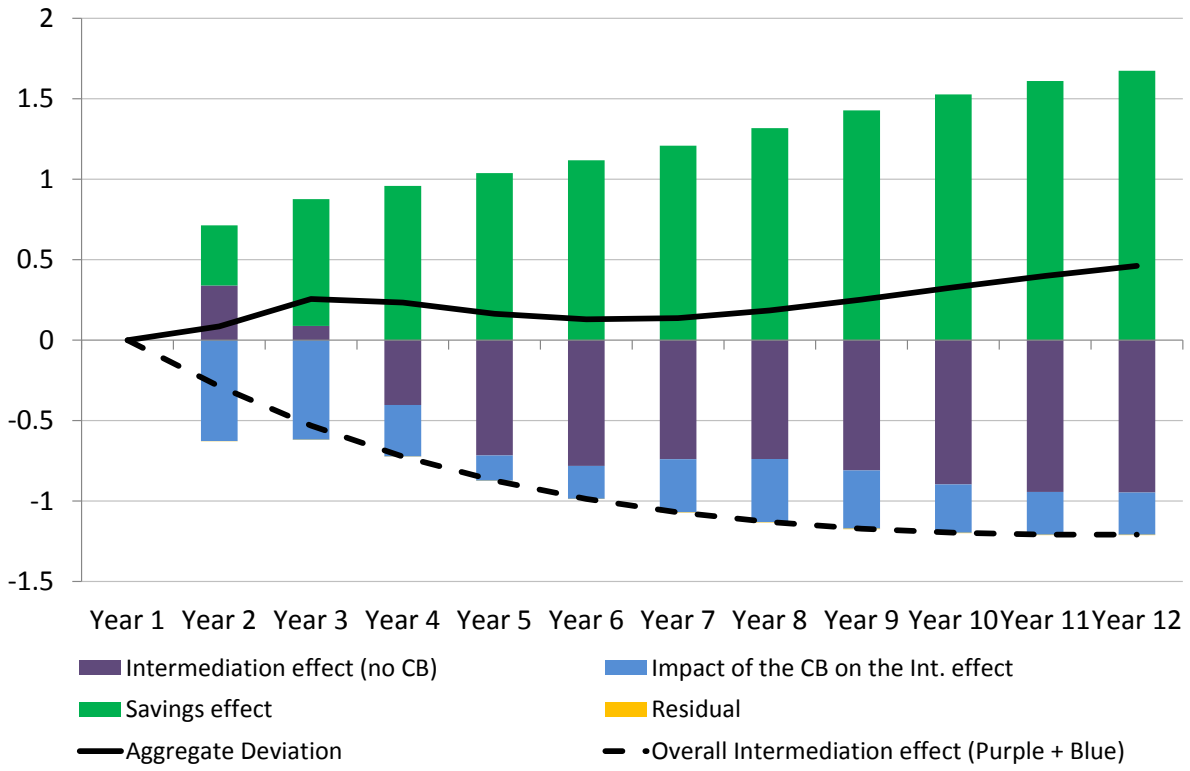

Figure 19: Non-dwelling investment, percentage deviation from baseline

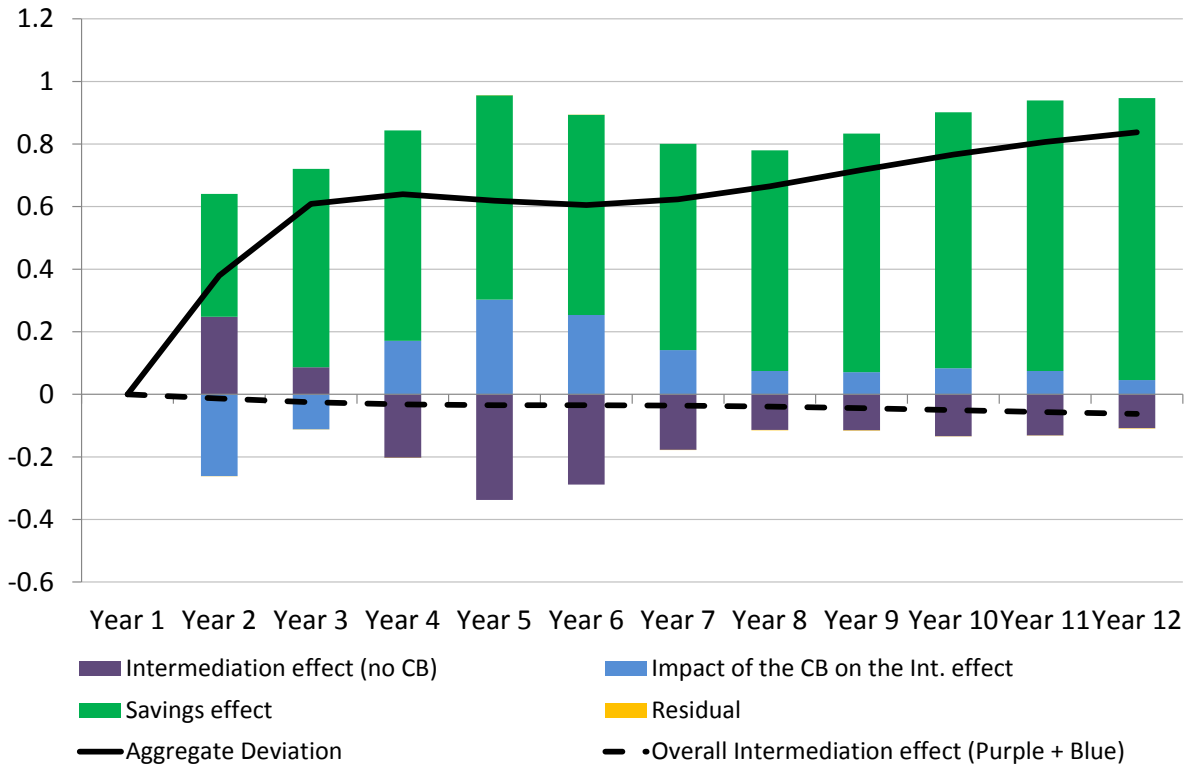

Figure 20: Event-year movement in real GNE and real GDP, percentage deviation from baseline

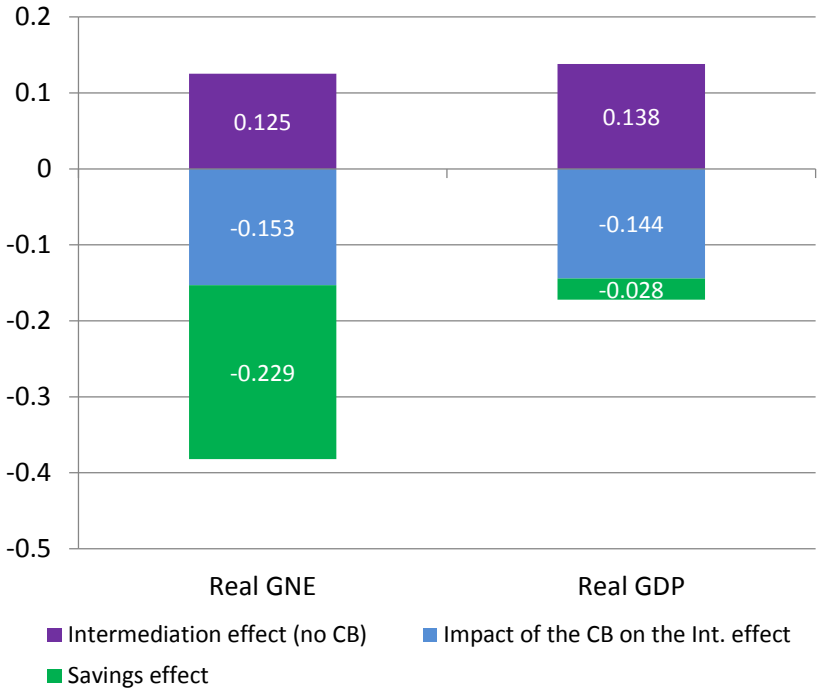

Figure 21: Domestic cash rate, basis point deviation from baseline

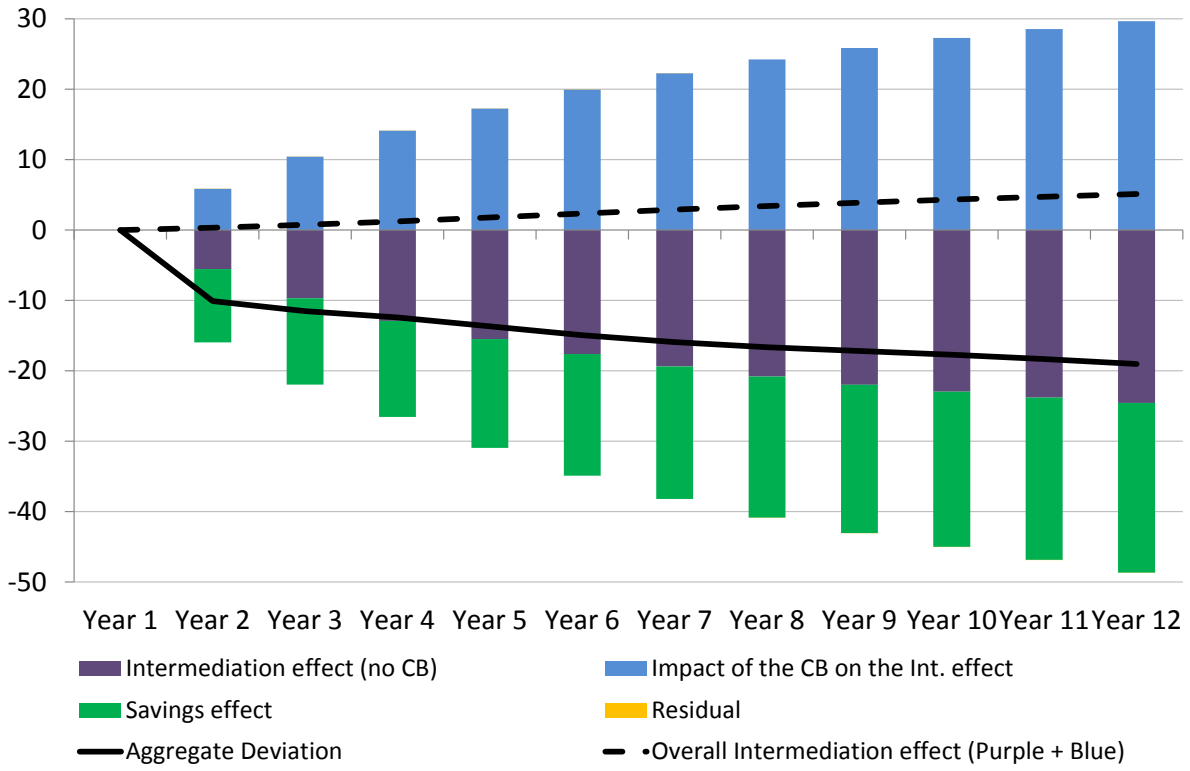

Figure 22: WACC for commercial banks, basis point deviation from baseline

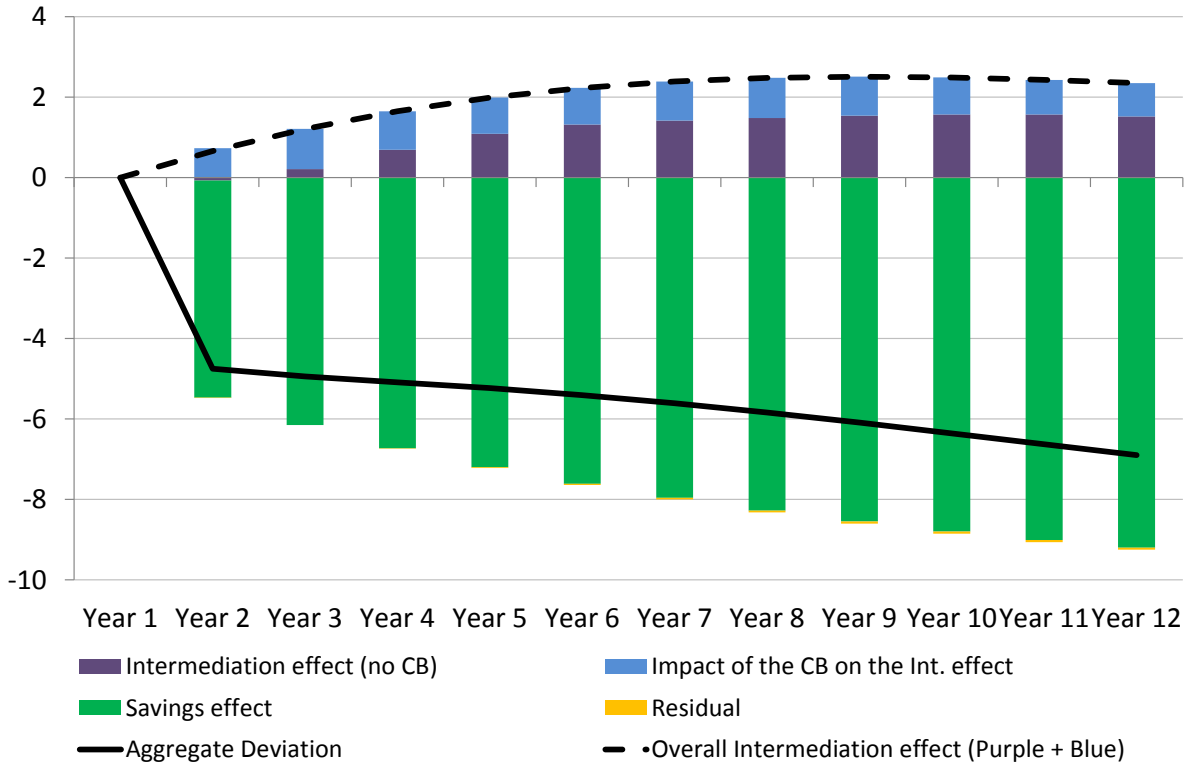

Figure 23: Average capital rental, percentage deviation from baseline

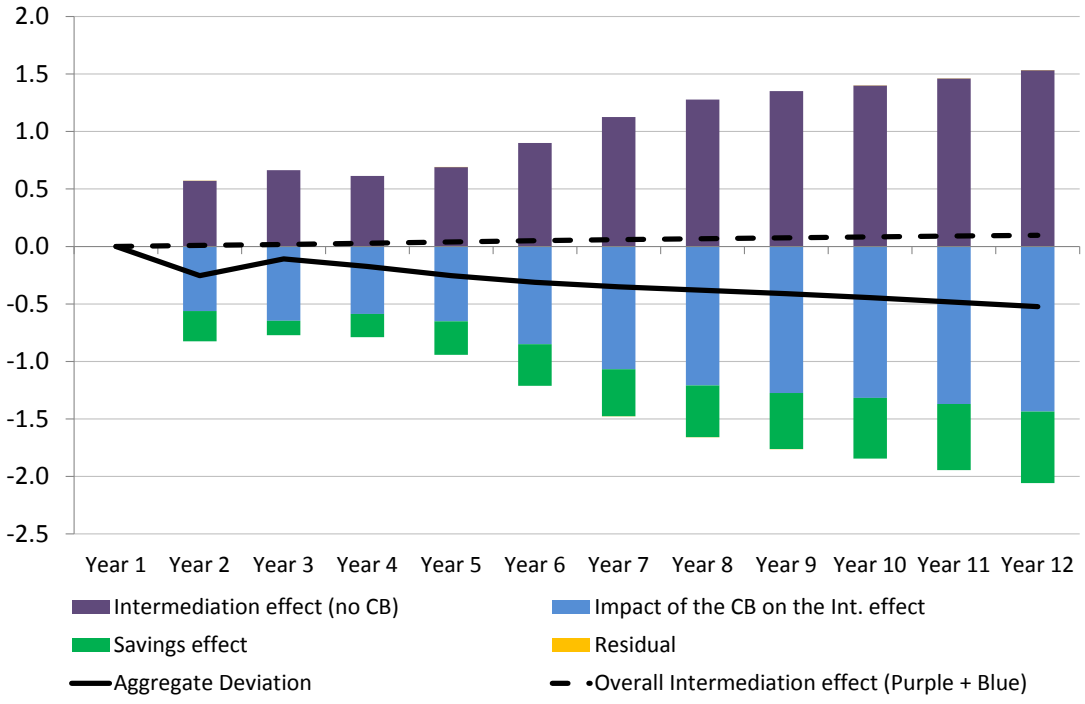

Figure 24: WACC for reproducible housing, basis point deviation from baseline

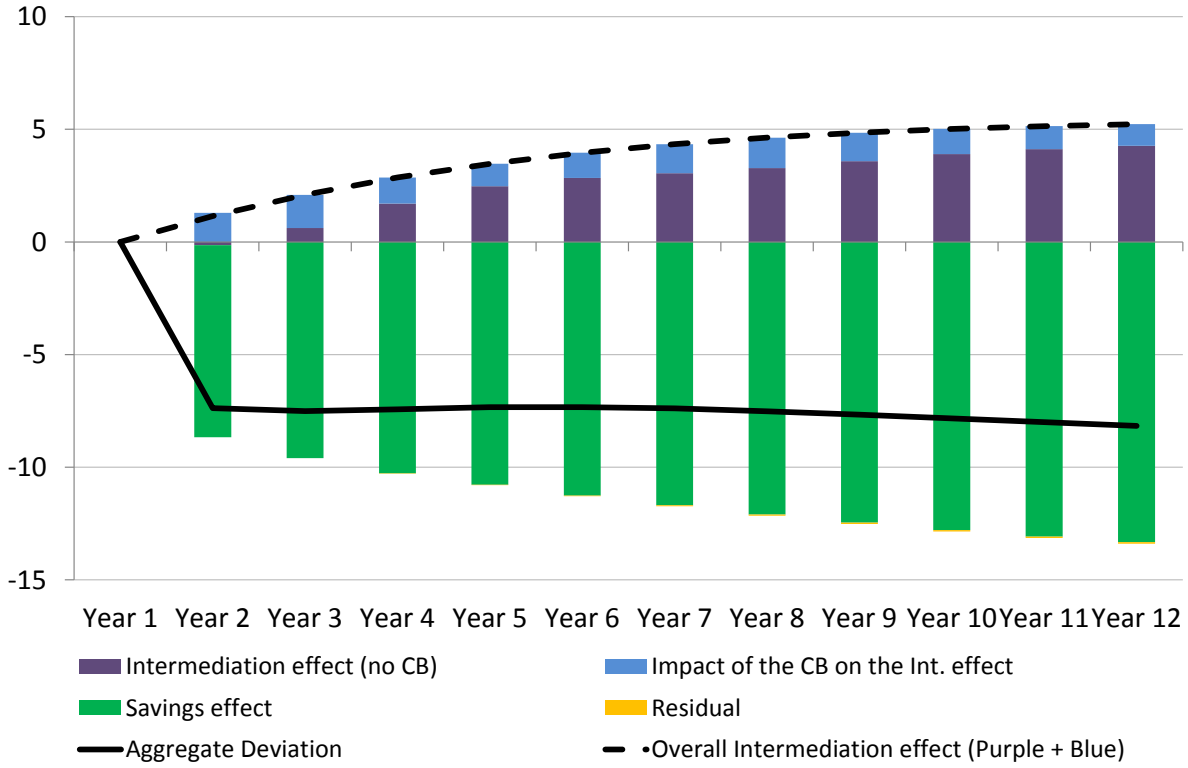

Figure 25: WACC for industry agent, basis point deviation from baseline

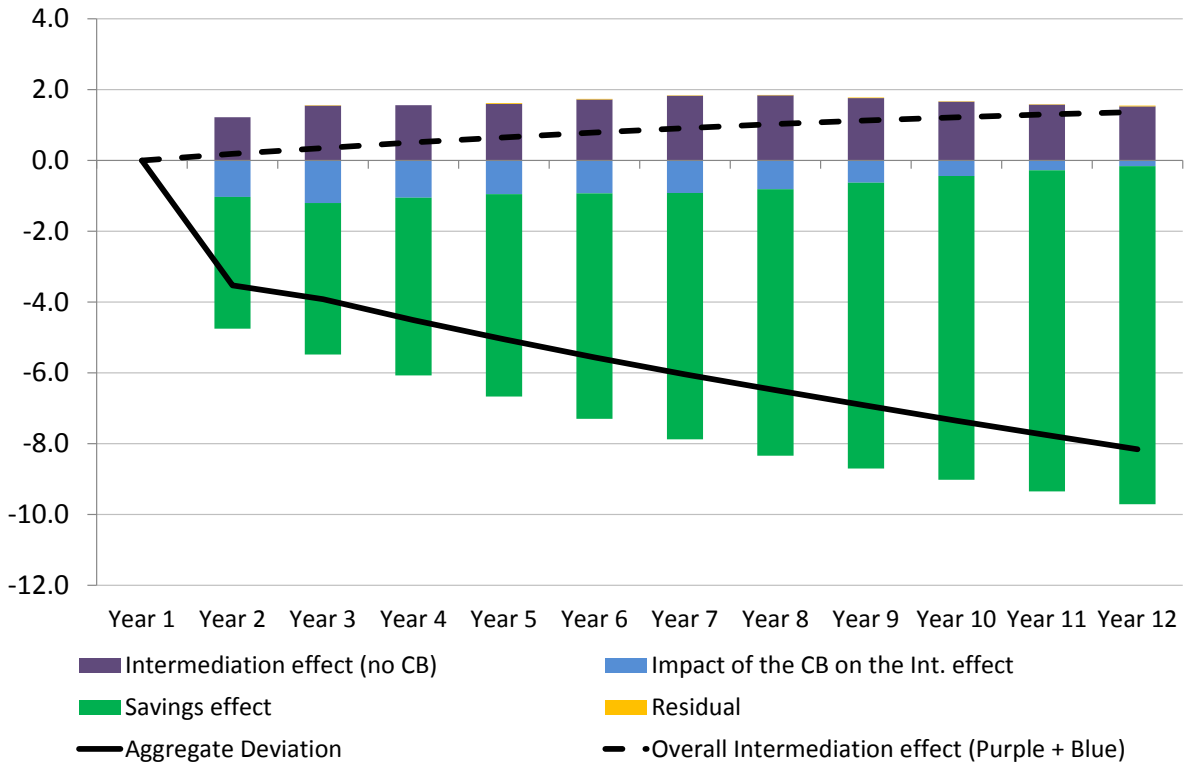

Figure 26: The event-year movement of various financial asset and liability portfolios and levels, percentage deviation from baseline

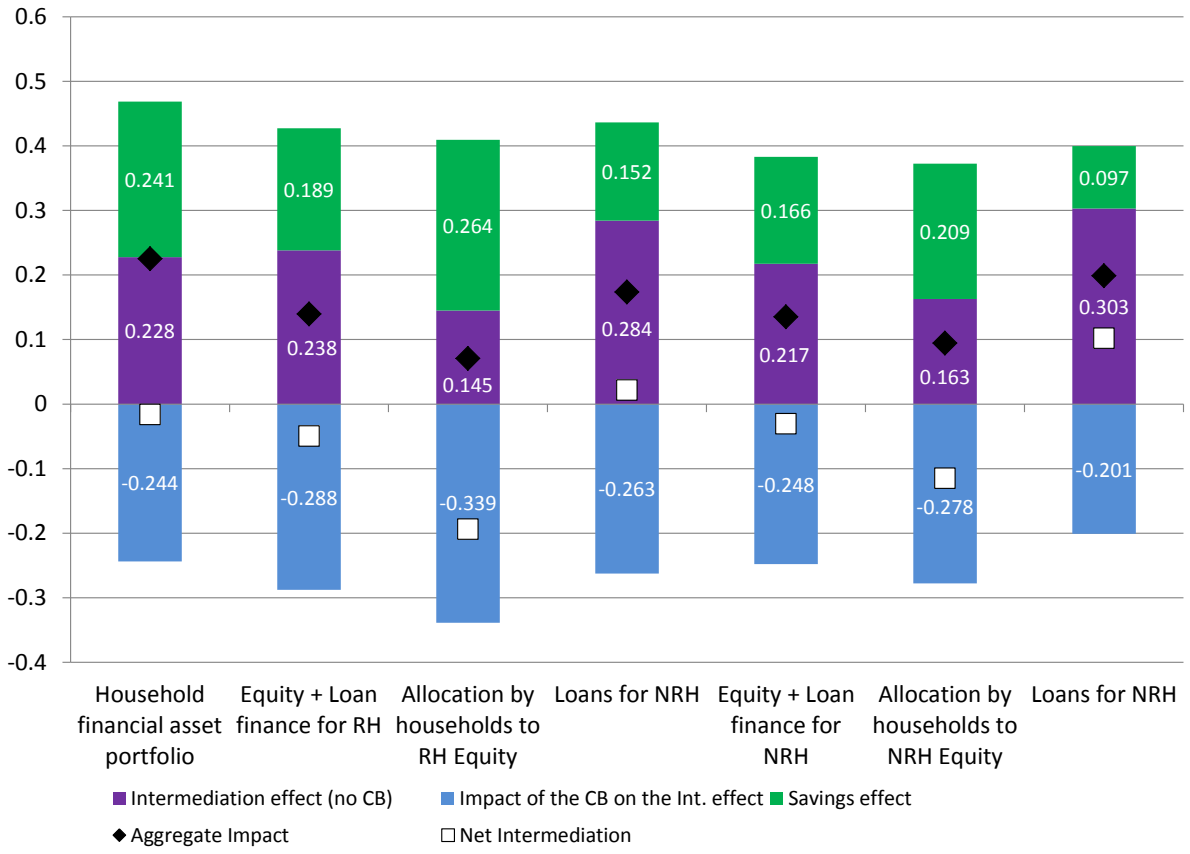

Figure 27: Commercial bank financial liabilities, percentage deviation from baseline

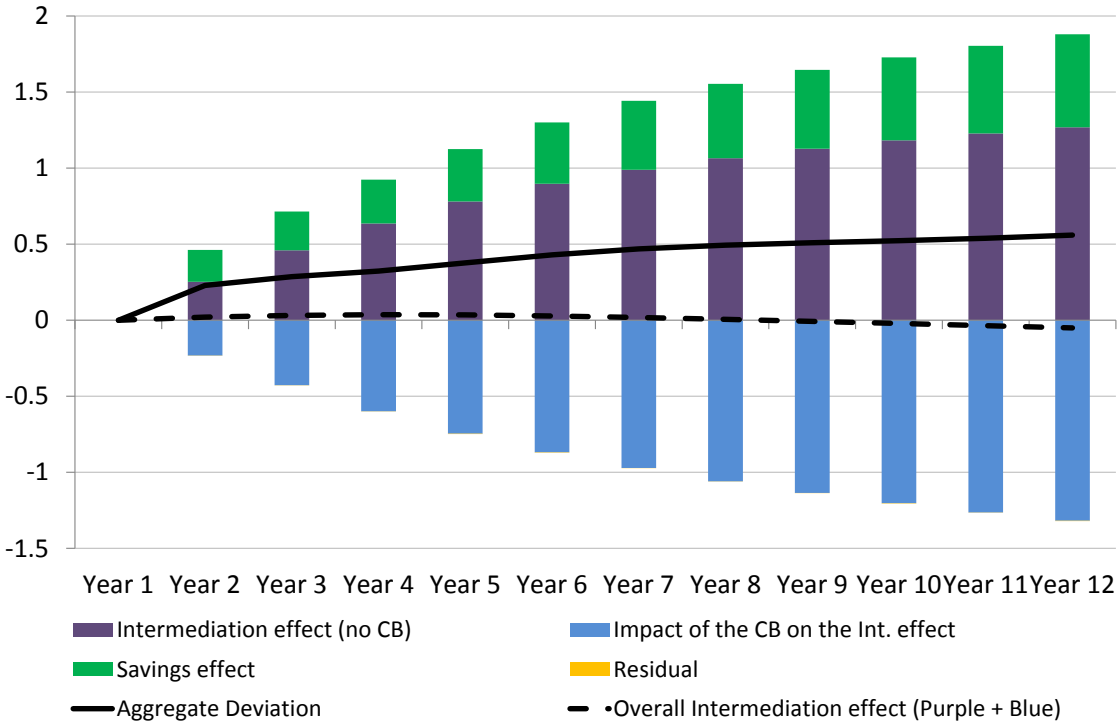

Figure 28: Event-year movement in commercial bank financial liabilities by instrument, percentage deviation from baseline

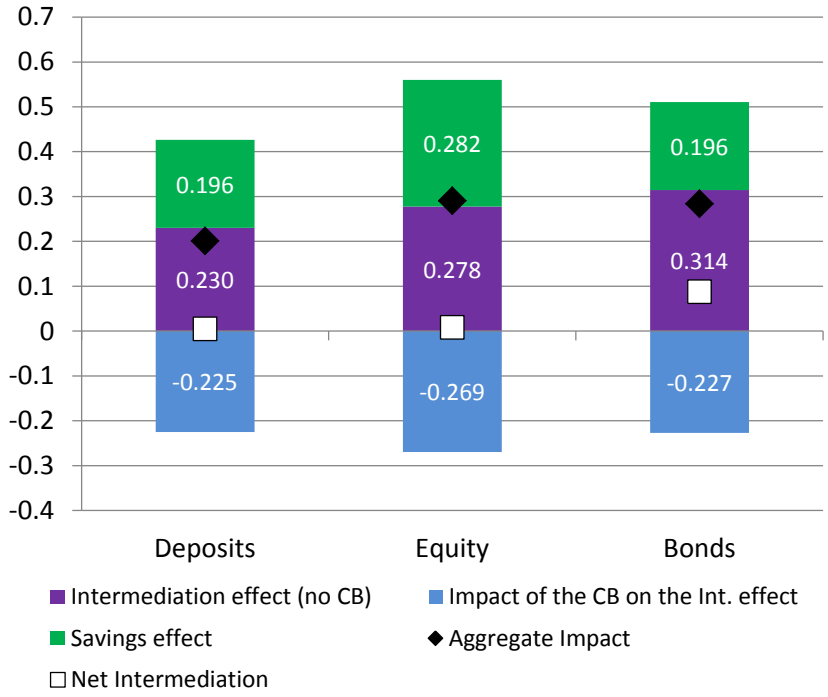

Figure 29: Event-year changes in agent-specific lending by commercial banks, percentage deviation from baseline

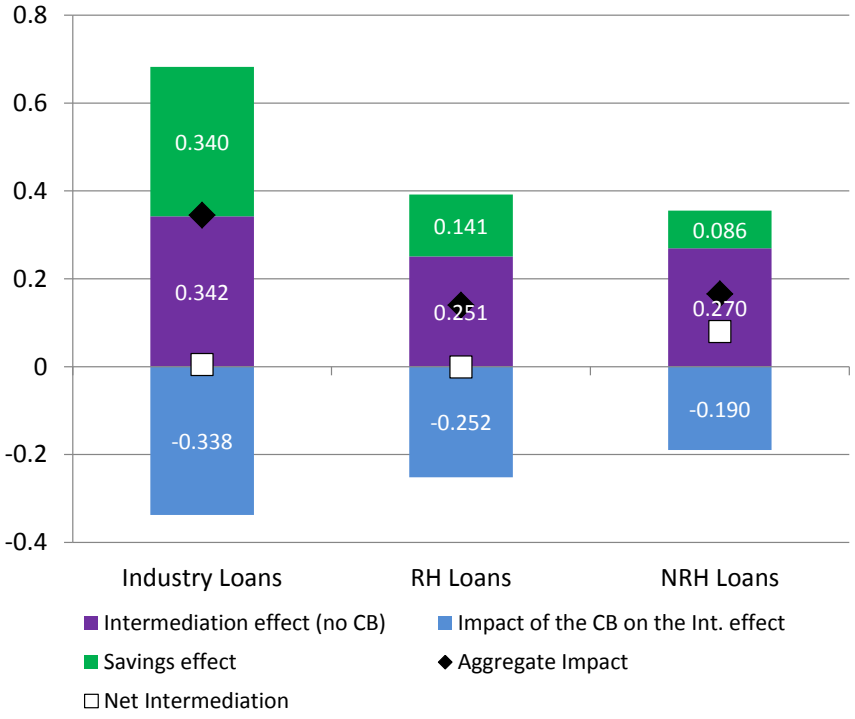

Figure 30: Event-year movement in the WACC of other financial intermediaries, basis point deviation from baseline

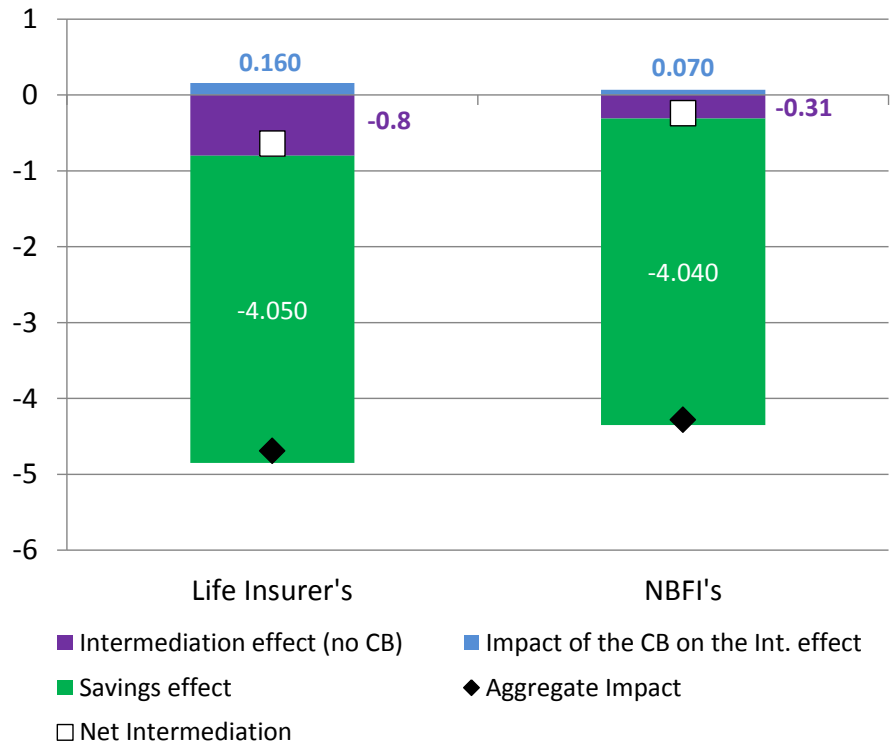

Figure 31: The long-run movement of various financial asset and liability portfolios and levels, percentage deviation from baseline

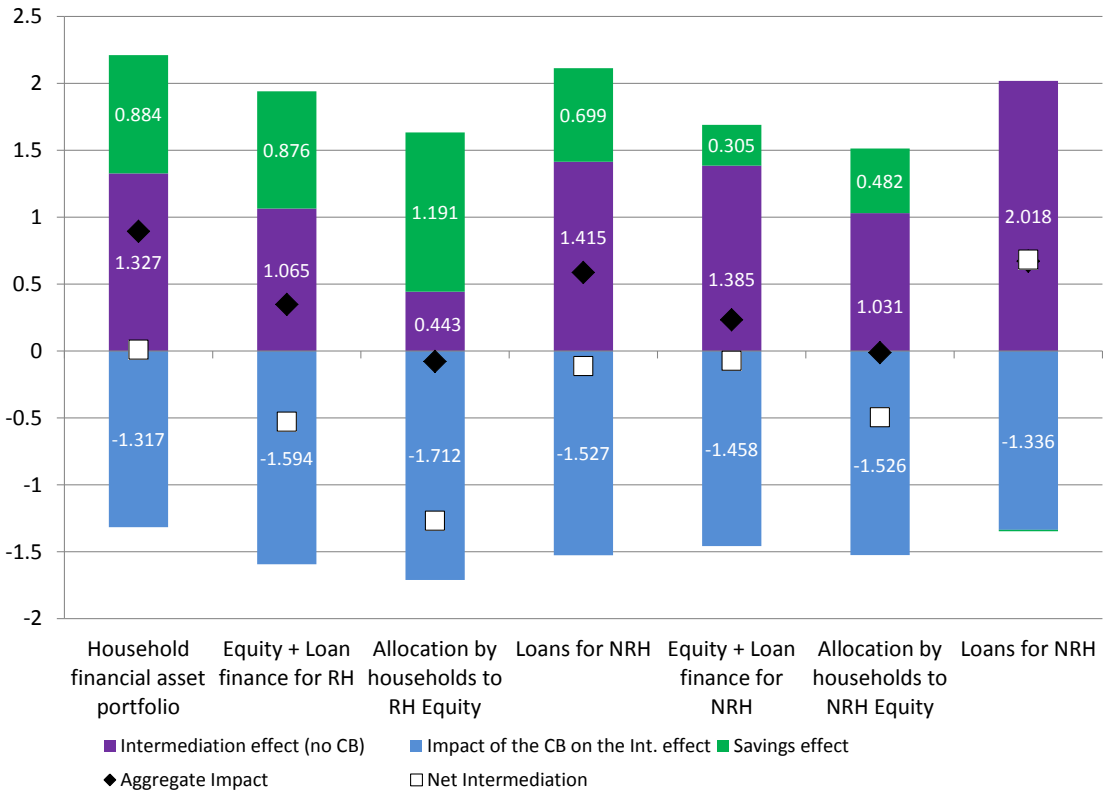

Figure 32: Long-run movement in commercial bank financial liabilities by instrument, percentage deviation from baseline

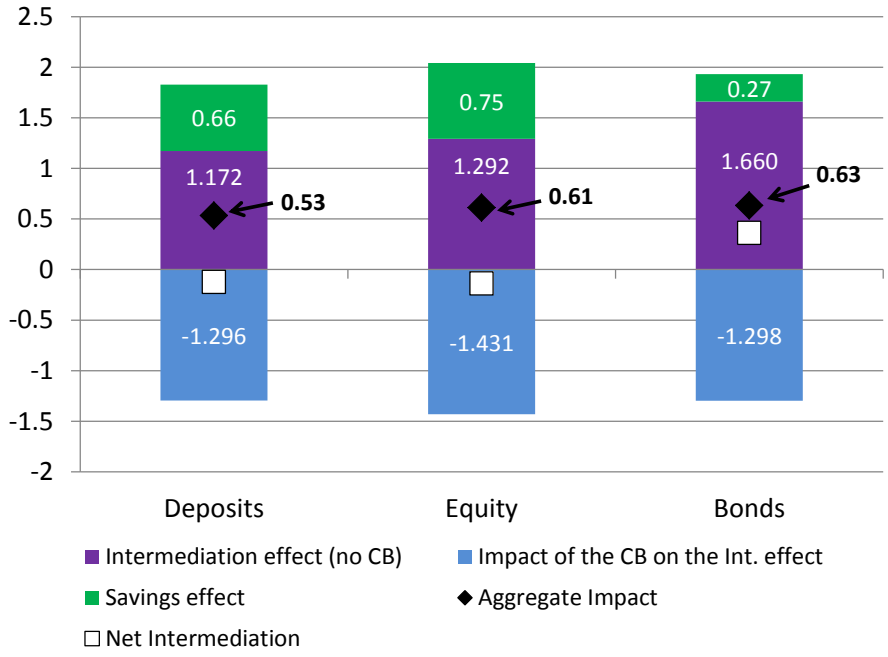

Figure 33: Aggregate capital stock (rental weights), percentage deviation from baseline

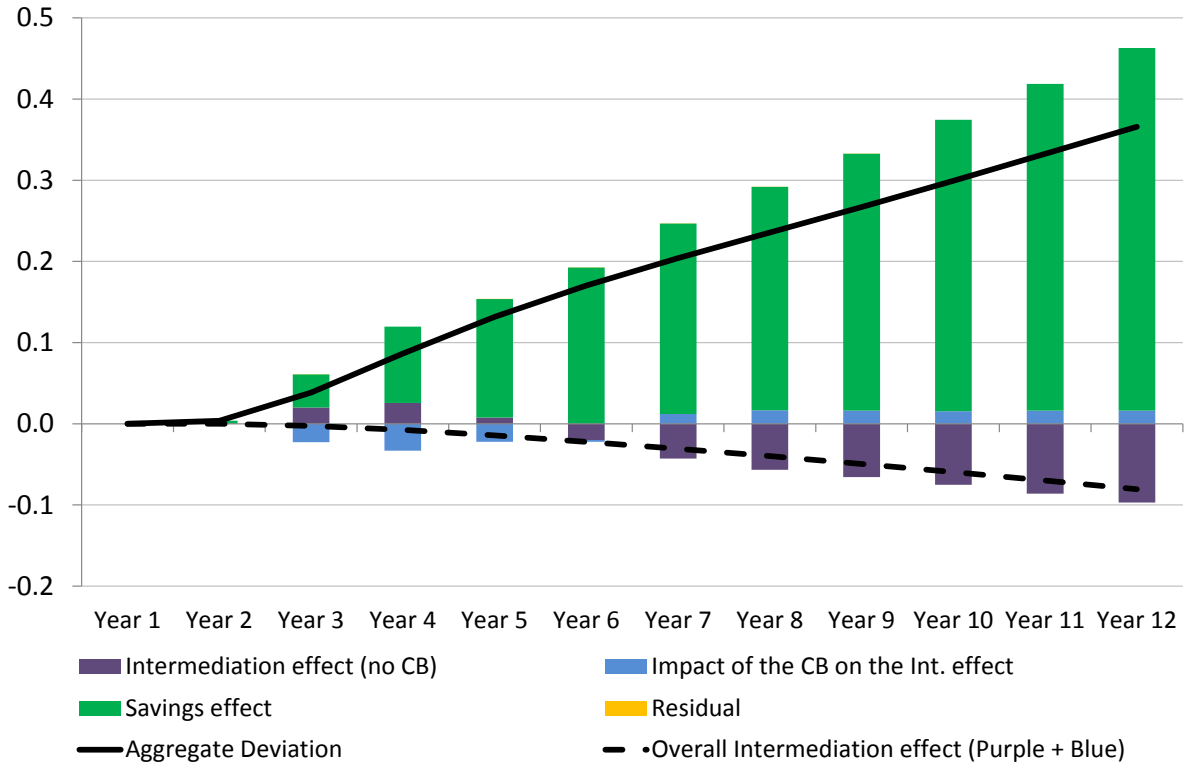

Figure 34: The terms of trade, percentage deviation from baseline

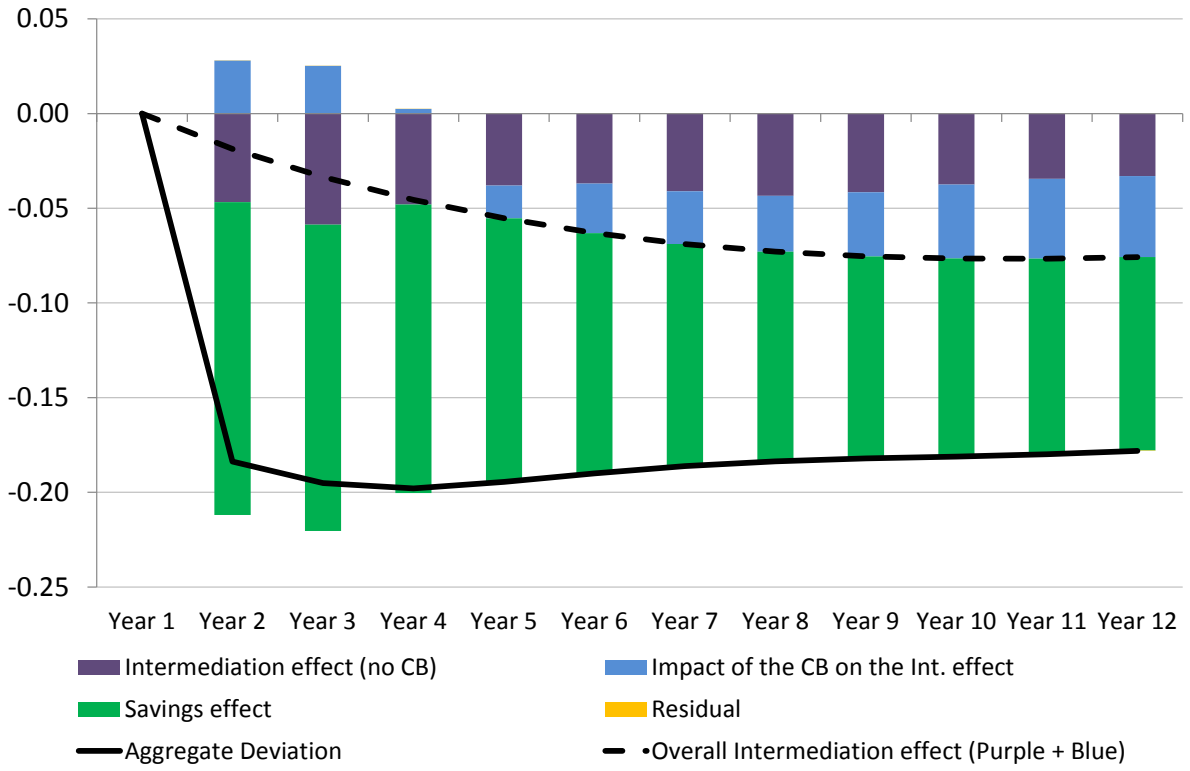

Figure 35: Long-run movement in real GNE and real GDP, percentage deviation from baseline