Comparing the impacts of financial regulation in Australia and the United States using country-specific financial CGE models

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Abstract

Jurisdiction-specific differences exist in the implementation of the Basel III capital adequacy requirements. This paper highlights one reason inhomogeneous cross-country capital regulations may materialise, by illustrating how the impacts of regulatory change [in this case, a rise in bank capital adequacy ratios (CARs)] can be affected by jurisdiction-specific differences in the structure of the financial sector. To this end, we begin by summarising the development of a new financial computable general equilibrium (financial CGE) model of the U.S. called USAGE2F. We then illustrate how explicit recognition of financial stocks and flows can broaden the scope of CGE analyses to include the effects of changes in CARs of financial agents, e.g., the commercial banks. Finally, our results are compared to findings of a similar policy scenario in Australia, with differences in the results largely attributable to cross-country differences in financial structure.

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1 Introduction

The Basel Committee on Banking Supervision (BCBS) was established by the Group-of-ten (G-10) central bank Governors in 1974, following the failure of Bankhaus Herstatt in West Germany and the collapse of the Bretton-Woods system of monetary management several years earlier [Basel Committee on Banking Supervision (2016)]. Deliberations by the BCBS over several years culminated in the paper *International Convergence of Capital Measurement and Capital Standards* [Basle Committee on Banking Supervision (1988)]. This formed the foundation of the 1988 Basle (now Basel) Accord, which set out minimum capital requirements for banks and supervisory requirements for banking system regulators. While the BCBS cannot issue binding regulation, the 1988 Basel Accord was enforced by law in the G-10 in 1992 [Balthazar (2006)]. A 1998 review of the Basel Accord culminated in a revised capital framework, formally referred to as Basel II. Among several refinements and initiatives, Basel II extended the standardised minimum capital requirement rules in the Basel Accord in order to encourage sound banking practices [Basel Committee on Banking Supervision (2016)]. Unlike the unilateral enforcement of the 1988 Basel Accord, the recent Basel III regulations have been adopted "in spirit" by BCBS and non-BCBS member nations. Significant cross-country variation is therefore observed in the scope of regulatory adoption and the level of regulatory detail [Kara (2016)].

In this article, we use a new type of computable general equilibrium (CGE) model called a financial CGE model to determine whether differences in financial structure matter in understanding the country-specific macro-economic effects of bank capital regulation. Our analysis is motivated by several important distinctions that exist between two financial markets in particular: Australia and U.S. For example, in the U.S. various Government-Sponsored Enterprises (GSE's), e.g., Fannie Mae, act as market-makers by purchasing loans originated by commercial banks, e.g., Fannie Mae purchases home loans. These loans would otherwise persist as assets on the balance sheets of the U.S. commercial banks. In contrast, no Government-sponsored institutions such as Fannie Mae exist in Australia. Relative to their international counterparts, the asset-side of Australian commercial bank balance sheets are therefore dominated by housing loans, as was noted in Australia's recent Financial System Inquiry [Commonwealth of Australia (2014)].

To provide some context to this discussion, with regard to the exposure of U.S. commercial banks to residential property loans, the Board of Governors of The Federal Reserve System Statistical Release Z.1. (2015) shows that 28 per cent of outstanding U.S. home loan liabilities in 2013 were held as financial assets of the U.S. commercial banks. Almost double this proportion (46 per cent) were assets of U.S. GSE's. This contrasts with our findings for Australia[2], where in excess of 75 per cent of Australian household loans (both short- and long-term) were assets of Australian commercial banks at the end of 2013. In this article, we define cross-country differences in agent-specific capital structures and financial asset allocations such as those highlighted above as *structural differences*, and explore how these structural differences alter the macro impacts of changes in domestic bank capital adequacy ratios.

We model the capital adequacy ratio and its impact on the behaviour of commercial banks in the U.S. using a similar approach to the one adopted for the Australian economy by Giesecke et al. (2016). To this end, we develop a new financial CGE model of the U.S. economy called USAGE2F using the approach outlined by Dixon et al. (2015). As we shall describe in section 2, USAGE2F treats agent-specific supplies and demands for financial instruments in the U.S. endogenously by carrying equations that describe how various financial agents choose to finance their activities. For example, the ratio of debt to equity used by industries to finance domestic investment is endogenously determined in USAGE2F. This mix varies in response to changing relative rates of return and economic policies. Similarly, USAGE2F includes equations

[2] Data sourced from the ABS 5232.0 - Australian National Accounts: Finance and Wealth, September 2015. See http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5232.0Sep%202015?OpenDocument

describing how the composition of the asset side of each agent's balance sheet changes in response to movements in relative rates of return.

In section 3, we use the USAGE2F model to study the consequences of a 100 basis point rise in the capital adequacy ratio (CAR) of U.S. commercial banks. To facilitate our cross-country investigation, an Australian regulatory environment is imposed upon the U.S. commercial banks in USAGE2F, e.g., we impose Australian regulator-specified risk weights on U.S. commercial banks in USAGE2F. We then develop two business-as-usual (BAU) baselines for USAGE2F. In the first (BAU1), the risk weights are set at (Australian) business-as-usual levels while the capital adequacy ratio is exogenous and unchanged throughout the simulation. In the second baseline (BAU2), the capital adequacy ratio is increased by 100 basis points.

The consequences of the rise in the U.S. CAR are considered in section 3.3 by analysing the differences in outcomes for macroeconomic variables (e.g., real GDP, employment, consumption, investment) in BAU2 relative to BAU1. We then compare our findings with those in Giesecke et al. (2016) who also used a financial CGE model with a similar theoretical structure as USAGE2F to study the impact of an identical regulatory shock in Australia. With the regulatory framework adopted under BAU1 and BAU2 in USAGE2F identical to that used to study the macro impact of financial regulation in Australia by Giesecke et al. (2016), we compare our findings with those in Giesecke et al. (2016) for Australia and present the results of this comparison in section 3.4. We then explain the difference between the U.S. and Australian results for each variable in terms of two components: (1) differences in the real economies of each country; and (2) differences in the structure of each country's financial sector. As we discuss in section 3.5.1, we find that differences in financial structure explain the bulk of the difference in macroeconomic outcomes in the two models.

We present concluding discussions in section 4, whilst references, tables and figures are reported in sections 5, 6, and 7 respectively.

2 The USAGE2F financial computable general equilibrium (FCGE) model

We begin with a description of USAGE2F model. As we shall outline, the model is based on the identification of many agents and the optimising behaviour governing their actions. From this framework emerge a number of transmission mechanisms via which a change in commercial bank capital requirements can affect activity in the real economy, which we describe in section 2.2. Section 2.3 summarises how capital adequacy requirements are modelled in USAGE2F, while we include a brief discussion of the data sources used to construct the USAGE2F financial database in section 2.4.

2.1 Overview of the financial CGE model

While fully integrated, the USAGE2F model can nevertheless be broadly conceived as being comprised of two parts:

(i) A traditional CGE model describing the real-side of the economy; and

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

The real-side of USAGE2F is based on the USAGE 2.0 model. USAGE 2.0 is a dynamic CGE model of the U.S. economy based on the model of Dixon and Rimmer (2002). We provide below an overview of the real side of USAGE2F, and refer readers desiring more details of the model's real side to Dixon and Rimmer (2002).

The real side of USAGE2F is a disaggregated dynamic CGE model recognising 73 industries, 9 margin services, 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. Units of new industry-specific capital are formed as cost minimizing combinations of construction 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 U.S. commodity is inversely related to its foreign currency price, while consumer demands are modelled via a representative utility maximizing household. Physical capital accumulation is specified separately for each industry, and modelled 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. Purchases 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. As discussed, margin services, e.g., trade, transport, insurance and other margins, are also explicitly recognised as commodity flow facilitators.

Real-side CGE models with characteristics such as those described above are however largely silent on how a number of important transactions are financed. While a detailed exposition of the various financial asset/liability agent optimisation problems that form the basis of the financial module in USAGE2F (and the various linkages of this module to the real-side of the model) are beyond the scope of this article, we provide a short summary in what follows. For a detailed discussion of the FCGE model, we refer the reader to Dixon et al. (2015).

The financial part of the USAGE2F FCGE model recognises five financial instruments (see Table 1 for a short description) and eleven financial agents (see Table 2 for a description of each agent). Each financial agent is concerned with both the asset and the liability sides of its balance sheet. Hereafter, we refer to financial agents as "asset agents" in matters concerned with the asset sides of their balance 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 ϵ AA** (the set **AA** includes all 11 asset agents in the model, such as households, the commercial banks, etc.) of financial instrument **f ϵ INS** (the set **INS** includes all 5 financial instruments recognised in the model, such as equity, loans, bonds, etc.) issued by liability agent **s ϵ LA** (**LA** includes all 11 asset agents in the model, such as households, government, etc.);
2. $\boldsymbol{F}_{(s,f,d)}$ which describes the flow of net new holdings by asset agent **d ϵ AA**, of financial instrument **f ϵ INS**, issued by liability agent **s ϵ LA**;
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 ϵ INS**, issued by liability agent **s ϵ LA**, and held as an asset by agent **d ϵ AA**.

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 raise to finance their economic activity, 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 determine 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 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 (WACC) 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 to purchase 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 cost of financial capital for other financial agents.

2.2 *Monetary and regulatory transmission mechanisms in USAGE2F*

Mishkin (1995) outlines four channels via which financial policy shocks can affect the economy: the interest rate channel, the exchange rate channel, the asset price channel, and the credit channel. While these channels are not modelled explicitly within our FCGE model, they nevertheless emerge from the identification of the financial agents and instruments, optimising behaviour, and financial / real economy links discussed in Section 2.1. We describe each of these four channels and the role they play in an FCGE model in turn.

2.2.1 *The interest rate channel*

The *interest rate channel* describes the relationship between financial policy changes and real activity via the impact of interest rate movements on investment and other interest-sensitive expenditures [Mishkin (1995), p. 4]. This mechanism is present in our FCGE model because investors are assumed to undertake capital formation up to the point where the expected rate of return on new units of physical capital is equal to the weighted average cost of financial capital (WACC) that they issue to finance the activity [see Dixon et al. (2015), p. 17]. Because the WACC is potentially sensitive to changes in bank lending rates (and indeed, via changes in the cost of other forms of financial capital), the interest rate channel is a potentially relevant mechanism in understanding how a change in commercial bank capital requirements can affect real activity within the FCGE model.

2.2.2 *The exchange rate channel*

The *exchange rate channel* describes the capacity of monetary policy to influence real activity via interest rate induced movements in the exchange rate. Mishkin (1995), p. 5 summarizes the chain of causation thus:

$$i\uparrow \Rightarrow E\uparrow \Rightarrow NX\downarrow \Rightarrow Y\downarrow .$$

That is, a policy induced rise in interest rates ($i\uparrow$) encourages capital inflow and thus exchange rate appreciation ($E\uparrow$). The exchange rate appreciation damps net exports ($NX\downarrow$), and with it, real GDP ($Y\downarrow$). The exchange rate channel is an important short-run mechanism in the FCGE model, however we describe the sequence of transmission steps differently to Mishkin. While Mishkin's chain of causation emphasizes a demand-led connection between net exports and real GDP, our explanation emphasizes the neo-classical mechanism connecting employment (and thus output) to the real producer wage. That is, within the FCGE model, the chain of causation between a policy-induced rise in interest rates and real-side variables like GDP and net exports is:

$$i\uparrow \Rightarrow E\uparrow \Rightarrow P\downarrow \Rightarrow (W/P)\uparrow \Rightarrow L\downarrow \Rightarrow Y\downarrow \Rightarrow NX\downarrow .$$

Consistent with Mishkin, the first two steps in the chain link nominal appreciation with the rise in the interest rate. In the FCGE model, nominal appreciation causes a fall in the domestic price level ($P\downarrow$) due to a fall in the domestic price of traded goods. With the nominal wage sticky in the short-run, this causes the real producer wage to rise ($(W/P)\uparrow$), and hence the demand for labour to fall ($L\downarrow$). With employment lower, real GDP must fall ($Y\downarrow$). With stickiness in public consumption spending, real GNE is likely to fall by less than the fall in real GDP. Hence the balance of trade is likely to move towards deficit ($NX\downarrow$). Hence the FCGE model's exchange rate channel mechanism anticipates similar impacts on real-side variables as those outlined by Mishkin, but places more emphasis on the role of short-run wage stickiness in generating a temporary fall in employment via a rise in the real producer wage.

2.2.3 The asset price channel

Mishkin outlines two *asset price channel* effects: one via a Tobin's *q* mechanism, and the second via wealth effects on consumption. A mechanism like the first is present in the FCGE model. As Mishkin describes, monetary policy can affect the valuation of equities, and as such, affect investment via a Tobin *q* mechanism. Tobin's *q* is defined as the market price of firm equity divided by the replacement cost of firm physical capital. As Mishkin describes, when the value of *q* rises, investment should rise because firms can issue new equities at a price that is high relative to the construction cost of capital. Mishkin describes the Tobin *q* channel linking monetary policy with real activity via:

$$i \uparrow \Rightarrow P_e \downarrow \Rightarrow q \downarrow \Rightarrow I \downarrow \Rightarrow Y \downarrow .$$

At the beginning of this chain, a rise in interest rates reduces equity prices because the resulting fall in bond prices causes equity prices (P_e) to fall as investors switch from equities to bonds. This causes Tobin's *q* to fall, thereby reducing investment as firms find it relatively more attractive to purchase capital by acquiring the equities of existing firms rather than by constructing new physical capital. A similar mechanism operates within the FCGE model. In our model, a rise in interest rates, including a rise in bank lending rates induced by a rise in mandated bank capital, causes the cost of equity finance to rise because firms must offer competitive rates of return when issuing new equity finance. Hence, a tightening of industry credit conditions (whether via tight monetary policy or a mandated rise in bank capital) raises the WACC faced by industries, not only because it pushes up the cost of debt finance, but also because the portfolio-switching behaviour of asset agents forces issuers of new equity to offer higher rates of return on new equity. As discussed in Dixon et al. (2015), p. 17, with investors undertaking physical capital formation up to the point where the expected return on physical capital is equal to the WACC, a rise in the WACC will lower real investment in the FCGE model.

The second asset price channel outlined by Mishkin relies on changes in equity values affecting household wealth, and with it, real consumption and real GDP. The FCGE model does not yet contain a direct link between household financial wealth and household consumption. This is a link we plan to explore in future work.

2.2.4 *The credit channel*

Mishkin identifies two broad credit channels: the *balance sheet channel* and the *bank lending channel*. The balance sheet channel rests on monetary and financial policy's capacity to affect lending behaviour via its impact on firm balance sheets and perceptions of lending risk. For example, Mishkin argues that a tightening of monetary policy can adversely affect the net worth of firms by lowering their equity prices. The fall in firm net worth can then adversely affect bank lending by raising bank perceptions of adverse selection and moral hazard risks.

The bank lending channel emphasizes the particular role that banks play as intermediaries for certain firms and sectors. As Kashyap and Stein (1994) note, summarising Bernanke and Blinder (1988), three conditions must hold for a model to possess a distinct lending channel for monetary policy transmission: (i) liability agents must view as imperfect substitutes financial capital raised by loans from banks and bonds sold to the general public; (ii) banks must view deposit finance and other forms of short-term finance as imperfect substitutes; and (iii) there must be a nominal rigidity that prevents monetary shocks from having no impact on the real economy. All three conditions hold in the FCGE model. Condition (i) ensures that borrowers cannot entirely offset a rise in the cost of bank funds by shifting to other sources of financial capital. Condition (ii) renders the cost of funds to commercial banks sensitive to changes in the costs of particular finance sources (like deposits), by ensuring that they cannot make costless switches between alternative funding sources. Condition (iii) ensures that changes in monetary policy are not immediately neutralized by costless price adjustment. These three conditions hold in the FCGE model, thus allowing a shock directed at commercial banks (like a rise in the capital adequacy ratio) to exert an influence on the cost of financial capital to agents reliant on bank finance (like the housing construction sector).

2.3 Modelling the capital adequacy ratio

2.3.1 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 $\mathbf{s \in LA}$ and $\mathbf{f \in INS}$ 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

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

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, while **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 $\mathbf{A1}_{(\mathbf{s,f,ComB})}$ for all $\mathbf{s} \in \mathbf{LA}$ and $\mathbf{f} \in \mathbf{INS}$ 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 $\mathbf{\Psi}$ is a positive parameter.

In equation (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, which costs 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 therefore influence the asset choices of the commercial banks.

2.3.2 Commercial bank liabilities and equity

For details on the modelling of the liability side of commercial bank balance sheets, we refer the reader to Dixon et al. (2015), particularly pp. 9-10, 12-13 and 17-19. Here, we draw out the key parts of the discussion in that paper that are relevant to the current simulation. We begin by reproducing the following four percentage change equations from Dixon et al. (2015):

$$\begin{aligned}&\mathrm{RABANK} \times \mathrm{prabank} = \\ &\sum_{s \in LA} \sum_{f \in FI} [\mathrm{RISKWGT}_{(s,f)} \times \mathrm{A1}_{(s,f,ComB)}] \times (\mathrm{priskwgt}_{(s,f)} + \mathrm{a1}_{(s,f,ComB)}),\end{aligned} \tag{7}$$

$$\mathrm{EQBANK} \times \mathrm{peqbank} = \sum_{d \in AA} \mathrm{A1}_{(ComB,Equity,d)} \times \mathrm{a1}_{(ComB,Equity,d)}, \tag{8}$$

$$\mathrm{pratio} = \mathrm{peqbank} - \mathrm{prabank}, \tag{9}$$

$$\begin{aligned}&\mathrm{BBNEQ}_{(ComB)} \times \mathrm{pbblneq}_{(ComB)} = \\ &\mathrm{BBL}_{(ComB)} \times \mathrm{pbbl}_{(ComB)} - \sum_{d \in AA} \mathrm{A1}_{(ComB,Equity,d)} \times \mathrm{a1}_{(ComB,Equity,d)},\end{aligned} \tag{10}$$

$$\mathrm{averorne}_{(ComB)} = \sum_{d \in AA} \sum_{f \in FINEQ} [\mathrm{A1}_{(ComB,f,d)} / \mathrm{BBNEQ}_{(ComB)}] \times \mathrm{rpow}_{(ComB,f,d)}, \tag{11}$$

$$\mathrm{a1d}_{(ComB,f)} = \mathrm{pbblneq}_{(ComB)} + \mathrm{TAU} \times [\mathrm{rpowd}_{(ComB,f)} - \mathrm{averorne}_{(ComB)}], \text{ where } (f \in \mathrm{FINEQ}). \tag{12}$$

For a definition of the variables in equations (7) – (12), we refer readers to Table 3.

Equation (7) calculates the percentage change in the risk-weighted value of end-of-year commercial bank assets. The risk weight on financial instrument **f ϵ INS** issued by liability agent **s ϵ LA** and held as an asset by banks is given by $\mathbf{RISKWGT_{(s,f)}}$, and we summarise the risk weights adopted in USAGE2F in Table 4. As discussed in section 1, these risk weights are identical to the values adopted by Giesecke et al. (2016) in the FCGE model of Australia. In choosing values for $\mathbf{RISKWGT_{(s,f)}}$ herein, we were guided by our desire to explore the impact of differences in the macroeconomic and financial structures of Australia and the U.S. Nevertheless, in constructing the USAGE2F financial database we have classified some securities not available to Australian investors in ways that reflect a conservative stance on the risk embedded within these securities by the U.S.-regulator. For example, GSE mortgage backed securities have been classed as Equity in USAGE2F, and we hence implicitly assign a risk weight of 3.0 to these securities. As outlined by Natter (2012), under U.S. Basel III regulations this is akin to an assumption that all GSE mortgages are backed by a pool of category 2 residential mortgages, with loan-to-value ratios of greater than 90 per cent.

Equation (8) calculates the percentage change in end-of-year bank equity as the share-weighted sum of the percentage changes in bank equity held by all asset agents. Equation (9) calculates the percentage change in the capital adequacy ratio, defined as the ratio of end-of-year bank equity to risk-weighted assets.

With equation (9) activated, in the sense that **pratio** is determined exogenously (thus enforcing a given ratio of equity to risk-weighted assets), we must allow for the non-equity component of bank financing to be determined outside of the standard liability optimisation mechanisms summarised in section 2 herein, and detailed in Section 3.8 of Dixon et al. (2015). This is provided by equations (10), (11) and (12). Equation (10) calculates the non-equity financing needs of commercial banks ($\mathbf{pbblneq_{(ComB)}}$) as the difference between total (equity-inclusive) bank financing needs ($\mathbf{pbbl_{(ComB)}}$) and that part of bank financing needs satisfied by equity. Equation (11) calculates the weighted-average value of the cost of non-equity finance to agent $\mathbf{s \in LA}$. Equation (12) establishes bank liability optimising behaviour over the issuance of non-equity financing instruments.

2.4 Constructing the USAGE2F financial database

As with all CGE models, an initial solution of the USAGE2F model is required. The real-side of the model adopts the USAGE 2.0 initial solution, which is calibrated using 2013 data.[3] The initial solution for the stock and flow data arrays $\boldsymbol{A}_{(s,f,d)}$ and $\boldsymbol{F}_{(s,f,d)}$ that underpin the financial module are derived using data from the Flow of Funds Accounts in the Board of Governors of The Federal Reserve System Statistical Release Z.1. (2015) (from henceforth we shall refer to this reference as FRSR0615). This statistical release lists the financial assets and liabilities of twenty-nine U.S. agents, together with a single agent representing the foreign investor (see Table 5 for a short description of each agent). In all, twenty-seven financial instruments (see Table 6) that represent high-level aggregates of several underlying financial instruments are used to describe the financial assets and liabilities of each of the twenty-nine U.S. financial agents, while the U.S. financial assets owned by foreign investors, and foreign financial liabilities owned by U.S. financial asset agents, are also summarised.

The USAGE2F stock and flow matrices are derived by mapping the FRSR0615 thirty agent/twenty-seven instrument data arrays to an eleven agent/five instrument description of the U.S. financial economy. The mapping of the FRSR0615 thirty financial asset/liability agents to the USAGE2F eleven agent description is summarised in, while the corresponding instrument mapping is reported in Table 8.

3 Simulations

3.1 Background

Recent work by Giesecke et al. (2015) examined the impact on Australia of a 100 basis point increase in the capital adequacy ratio. As discussed in section 1, in this article we adopt similar

[3] The principal data source for USAGE 2.0 is the U.S. Bureau of Economic Analysis (BEA) published Input-Output (I-O) data. From time-to-time, a lag arises between publication of the I-O data and the required base year simulation period for USAGE 2.0. In such cases, the model is updated using realized movements in real-side variables reported by the BEA, while baseline forecasts are prepared using data provided by the U.S. Energy Information Administration. Labor market data is sourced from the U.S. Bureau of Labor Statistics (BLS).

model specifications and use an equivalent shock to explore the impact of differences in macroeconomic and financial structure between the U.S. and Australia, and the implications of these differences on the macroeconomic impact of a rise in the capital adequacy ratio of commercial banks.

3.2 Closure

We make the following closure assumptions, in line with those in Giesecke et al. (2016):

i) 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) 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, according to a Taylor rule [Taylor (1993); Orphanides (2007)].

3.3 USAGE2F simulation results

The shock is a 100 basis point increase in the capital adequacy ratio of commercial banks (Figure 1).[4] This causes banks to adjust the composition of both the liability and asset sides of their balance sheets. On the liability side, the increase in the capital adequacy ratio causes commercial banks to increase issuance of equity instruments, and decrease their reliance on deposit and bond financing (Figure 2). On the asset side of bank balance sheets, the rise in the

[4] The simulation is performed using the GEMPACK software package [Harrison and Pearson (1996)].

capital adequacy ratio induces banks to reduce their holdings of risky assets. We see this in Figure 2 and Figure 3. In Figure 2, we see that the deviation in bank risk-weighted assets lies below the deviation in bank financial assets, signalling a fall in the share of bank assets represented by more risky instruments. Figure 3 provides more detail, showing the composition of bank assets shifting away from assets with comparatively high risk weights (such as foreign loans, loans to reproducible housing and industry, and foreign and industry equity), and towards those with lower risk weights (such as domestic government bonds).[6]

As already discussed, the rise in the capital adequacy ratio causes banks to raise additional equity finance, and reduce their use of deposit and loan finance (Figure 2). To attract asset agents to acquire the new equity, rates of return on bank equity must rise (Figure 4). Concurrently, commercial banks reduce their demand for loan and deposit finance, allowing them to secure loan and deposit financing at lower rates of return relative to baseline (Figure 4). Commercial banks source 64.9 per cent of their deposit finance from U.S. households[7], with these deposits making up 12.3 per cent of the financial assets of U.S. households. The fall in the rate of return on bank deposits induces households to rebalance their financial assets away from bank deposits. This rebalancing is highlighted in Figure 5, where we plot the change (in US$m) in financial capital flows from U.S. households to bank deposits (the change is negative, signalling a reduced allocation). As shown in Figure 5, the reduced allocation to bank deposits by the U.S. household is partially reinvested in U.S. commercial banks, via an increase in the household's allocation to commercial bank equity. A large proportion of the household's financial capital is however reinvested in NBFI equity, triggering an expansion of the NBFI sector (see Figure 2).

[6] As we shall discuss, in the long-run the commercial banks' balance sheet contracts (see the grey line in Figure 3). Ceteris paribus, the commercial banks allocation to financial assets with lower risk weights such as government bonds also therefore falls. This is shown in Figure 3, where the banks exposure to government bonds contracts in the long-run at a rate that is broadly in line with the contraction of the asset-side of their balance sheet.

[7] i.e. 35.1% of remaining bank deposit liabilities are held by industry, government and other financial agents.

Households also invest a large proportion of their reallocated savings in Industry equity (Figure 5). The additional equity capital supplied by households to Industry exceeds the reduction in loan and equity finance provision by the commercial banks, as shown in Figure 6. The aggregate supply of financial capital to Industry therefore increases (see the solid line in Figure 6), driving non-dwelling investment higher (Figure 7).

As discussed in section 1, a distinguishing feature of the U.S. financial market is the presence of U.S. Government Sponsored Entities (GSE's), e.g., the Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation (Freddie Mac). Both act as secondary market makers for U.S. mortgages.[8] In the USAGE2F financial database, the GSE's are subsumed within the NBFI sector, together with other non-bank financial intermediaries (see Table 5 for a description of these agents and Table 7 for the FRSR0615 agent to USAGE2F agent mapping). The NBFI agent in USAGE2F is therefore a significant owner of U.S. residential mortgages. For example, 67.7 per cent of U.S. reproducible housing loans are financial assets of the NBFI's in USAGE2F. This accounts for 42.5 per cent of the aggregate financing requirement of the reproducible housing sector. A smaller proportion of aggregate U.S. housing loan liabilities are financial assets of the banks (28.7 per cent).

For this reason, the expansion of the NBFI sector (Figure 2) that results from a rise in the capital adequacy ratio of the commercial banks (Figure 5) has important implications for U.S. housing investment. As previously discussed, in response to a rise in their capital adequacy ratio the commercial banks reduce their risk-weighted asset exposure (as shown in Figure 3), which includes a reduction in their allocation to risky reproducible housing loans (Figure 2). This increases the rate of return on reproducible housing loans. As the rate of return on reproducible housing loans rise and the NBFI agent expands (due to the increase in equity

[8] The US Federal Housing Finance Authority (FHFA) oversees Fannie Mae and Freddie Mac; their purchase of US mortgages is regulated by maximum loan limit criteria set by the FHFA. A loan that conforms to the FHFA limits is called a conforming loan, and GSE's can subsequently purchase conforming loans that have been originated by a US commercial bank. This removes the conforming financial asset from the balance sheet of the commercial bank.

finance provision by households shown in Figure 5), an increase in the provision of NBFI-loan finance for reproducible housing materialises (see Figure 8). This partially offsets the reduction in loan finance provision by commercial banks (Figure 8). Concurrently, households increase their provision of equity finance to the housing sector as they rebalance their asset portfolio in response to the fall in bank deposit rates (Figure 5 and Figure 8). In conjunction with a small rise in the supply of equity finance by Industry (who, as discussed above, also expand due to an increase in equity finance from households (Figure 6)), the rise in supply of financial capital for housing investment by the NBFI sector and the household more than offsets the impact of a reduction in housing loan finance provision by the commercial banks. Financial capital flows to the housing sector therefore increase (see Figure 8), elevating housing investment relative to baseline (see Figure 7). With both components of aggregate investment slightly elevated relative to baseline, so too is aggregate investment (see Figure 7).

In part, this result arises from the large share (13.8%) of the financial assets of U.S. banks that are held as deposits at the U.S. Federal Reserve. If we also take account of U.S. government bonds held as financial assets by the U.S. banks (which comprise 6% of bank financial assets), we observe that for each additional dollar of liabilities raised by U.S. banks, approximately 80 cents are used to purchase financial assets that fund gross fixed capital formation (e.g., industry and reproducible housing loans) with the remaining 20 cents used to purchase government liabilities (central bank deposits and government bonds). In contrast, only 10% of the financial assets of NBFIs are liabilities of the U.S. government and central bank. Hence a greater share (approximately 90 cents in the dollar) of the new financial liabilities raised by NBFIs result in purchases of financial assets that fund investment.

With regard to the broader macroeconomic impacts of a rise in bank capital adequacy requirements, we begin by noting that the model recognises that the share of the NBFI sector's financing needs that are met by foreigners (16.9 per cent) exceeds that of commercial banks (7.5 per cent). As previously discussed, the rise in the bank capital adequacy ratio reduces the size of the banking sector (Figure 2), which is partly offset by an increase in the size of the NBFI sector (see Figure 2, Figure 6 and Figure 8). This is like an autonomous increase in the preference of the U.S. financial sector, taken as a whole, to seek finance from offshore. For a given current account deficit, this results in nominal appreciation (Figure 9).

As is clear from Figure 10, the balance sheets of the industry and reproducible housing sectors shift away from loan finance and towards equity finance. In the case of industry, bond finance also increases relative to baseline over the medium-to-long-term, however this increase falls short of the rise in equity liability issuance. This suggests a second avenue via which a rise in the capital adequacy ratio potentially promotes financial stability. Not only are commercial banks encouraged to finance a greater proportion of their operations by equity, but by raising the cost of bank debt finance, households are encouraged to finance a greater proportion of their stake in the reproducible housing sector via equity; similarly, industries finance a greater proportion of their gross fixed capital formation via equity and bonds.

Nominal appreciation has the effect of reducing the US$ price of imports. Together with a rise in real investment (which is relatively import-intensive), a small increase in U.S. import volumes materialises (Figure 9). With the economy-wide nominal wage given in the year the capital adequacy ratio is increased, nominal appreciation causes the domestic price level to fall relative to baseline. This is evident in Figure 11, where we include a plot of the nominal wage and the domestic price level. With the aggregate price of domestic production falling relative to baseline and the nominal wage remaining on baseline in the event-year, a corresponding positive deviation in the real producer wage occurs in the event-year. With physical capital stocks sticky and the real producer wage rising relative to baseline, event-year employment falls relative to baseline (Figure 11).

As discussed in section 3.2, the interest rate that the central bank offers on settlement balance deposits by commercial banks (and the rate the central bank charges commercial banks for settlement balance loans) are determined by a rule whereby the central bank policy rate responds to deviations in prices and unemployment from target. Via this rule, the fall in event-year employment, coupled with the fall in the private consumption deflator (see Figure 11), account for the initial negative deviation in the policy rate (see Figure 12). The changes in the policy rate reported in Figure 12 are small: a 0.44 basis point reduction in year 1, rising to a +0.8 basis point positive deviation by the end of the simulation period. This is close to the central bank simply maintaining its baseline path for the policy rate.

As the nominal wage responds to the reduced level of event-year employment, and the domestic capital stock adjusts to shifts in domestic investment, the employment rate adjusts in turn; by the end of the simulation period, the employment rate has returned to baseline, while the private consumption deflator remains slightly elevated. This latter observation accounts for the positive deviation in the policy rate relative to baseline at the end of the simulation period (see Figure 12). To put these numbers in context, the March 2017 U.S. Federal Reserve adjustment in the policy rate was a rise of 25 basis points. The deviation in the policy rate at the end of the period is 0.8 basis points. The positive deviation in the consumption price index at the end of the simulation period is approximately 0.004 per cent. This is akin to a realised inflation outcome of 2.004 per cent when the target is 2.0 per cent.

Figure 13 reports deviations in real GDP, employment, capital, and investment. As previously discussed, in the simulation's first year, the physical capital stock cannot change from baseline. However a small negative employment deviation generates a small negative GDP deviation in year 1. Thereafter, employment increases before gradually returning to baseline. However, the aforementioned positive deviation in real investment causes the aggregate capital stock to rise relative to baseline over the simulation (Figure 13). This causes a small positive deviation in GDP over the medium- to long-run, of the order of 0.002 per cent.

Figure 14 reports real GDP, real GNE, and the components of real GNE (private and public consumption spending, and investment). The aforementioned rise in real investment causes the real GNE deviation to lie above the real GDP deviation (Figure 14). This causes the balance of trade to move towards deficit. The resulting contraction in export volumes causes the terms of trade to rise relative to baseline (Figure 9). The rise in the terms of trade relative to baseline explains why the consumption deviation lies above the GDP deviation (Figure 14).

3.4 The macroeconomic impacts of financial structure differences: Comparing the impacts of financial regulation in Australia and the United States

Our description of the macroeconomic outcomes for the U.S. economy of a 100 basis point rise in the capital adequacy ratio of the U.S. commercial noted the importance of the structure of U.S. financial agent balance sheets. The rise in the CAR causes the relative return on commercial bank deposits to fall, as banks reduce their demand for deposit finance relative to equity finance. This causes U.S. households to reduce the share of bank deposits on the asset side of their balance sheets. A high share of the household assets are debt and equity instruments issued by Industry and NBFI. Hence these sectors benefit from the household's move out of bank deposits. This has a direct effect on non-housing investment, via an increase in the supply of financial capital to the industry agent. Housing investment also rises, because a large proportion of reproducible housing's financing needs in the U.S are met by NBFI's (42.5 per cent) and households (21.5 per cent). This causes a slight increase in the U.S. aggregate capital stock in the long-run, which generates a small positive deviation in GDP.

In recent work for Australia, Giesecke et al. (2016) simulated the impact of a 100 basis point rise in the CAR of Australian commercial banks using the VU-Nat FCGE model of the Australian economy. They found a small negative impact on real investment and real GDP. The theoretical structures of the Australian and U.S. financial CGE models are very similar.

However they differ in their parameterisations and structure. A question that naturally arises when comparing the Australian and U.S. results is whether the differences are caused by the financial structure of the respective economies, or matters related to the real-side of the economy (e.g., differences in primary factor substitution elasticities, export demand elasticities, or the sensitivity of investment to changes in rates of return). Because the cross-model financial regulatory environments are equivalent (and set according to Australian capital requirements), we are able to explore both avenues. Section 3.4.1 serves to outline our approach, while we present and describe our findings in section 3.5.1.

3.4.1 *Key structural differences between the United States and Australia*

We study four structural differences between Australia and the U.S. which could (in isolation or in combination) cause contrasting responses to a 100 basis point rise in the CAR.

3.4.2 *Real-side differences*

We began by isolating three differences in the parameterisation of the real sides of the Australian and U.S. FCGE models:

1. The sensitivity of movements in real investment to movements in rates of return are slightly higher in the U.S. model;
2. The primary factor input substitution elasticity for industries in the U.S. model are slightly more inelastic than their corresponding values in the Australian model;
3. As a model of a larger open economy, export demand elasticities in the U.S. model are lower than the corresponding values in the Australian model.

We explore the contribution of each of these differences to the paths generated for macroeconomic variables by the U.S. and Australian models in response to a 100 basis point rise in CAR in each model.

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3.4.3 Differences in financial structure

Differences in the financial structure of the two economies is a fourth possible contributor to differences in how the two economies respond to a 100 basis point increase in CAR.

We examine this by changing the structure of the USAGE2F financial database to more closely resemble the structure of the Australian financial economy, while maintaining values for aggregate stocks and flows. Put simply, we make the structure of the U.S. financial system look like the structure of the Australian system. For example, rather than 21.5 per cent and 12.4 per cent of household financial assets being invested in industry and NBFI equities respectively, we adjust these shares in the USAGE2F financial database to more closely resemble their Australian-equivalent values of 9.3 per cent and 2.5 per cent respectively. Adjustments like this are performed across the whole $\boldsymbol{A}_{(s,f,d)}$ array using a bi-proportional scaling algorithm.

The match is not exact, however; in the aforementioned example, the modified USAGE2F database shares are 12.4 per cent and 3.3 per cent respectively. Because we apply a similar scaling algorithm to both the stocks and flows arrays, i.e., $\boldsymbol{A}_{(s,f,d)}$ and $\boldsymbol{F}_{(s,f,d)}$ are scaled in similar ways, some relativities must be maintained within the USAGE2F financial database, e.g., the U.S. current account deficit (linked to the flow of financial capital to the foreign agent) in the USAGE2F financial database cannot be adjusted to match the corresponding value for Australia. Such an adjustment would disregard important linkages between the real-side CGE model and the financial theory, such as those discussed in section 2.1, which must be maintained. This places some limits on how far the structure of the U.S. financial sector can be adjusted to look like the Australian financial sector, although the differences are ultimately minor, as outlined here.

To describe some important differences between the USAGE2F shares and the Australian database shares, we use Figure 15 (U.S. model financial database) and Figure 16 (Australian model financial database), which summarises the proportion of each financial agent's liabilities that are owned by other financial agents. In preparing Figure 15 and Figure 16 we have condensed the financial instrument dimension to emphasise the structure of inter-agent dependencies. Some differences are immediately apparent; e.g in Figure 15 we observe that the U.S. reproducible housing sector obtains 18.0 per cent of its finance from banks, while Figure 16 shows that the Australian reproducible housing sector is majority (51.8 per cent) financed by commercial banks. This is also emphasised in Table 9, where we present a comparison of the U.S. and Australian financial database ownership shares for loans to reproducible housing and industry, as well as industry and NBFI equity.

In both the U.S. and Australia, the majority of the financing of reproducible housing is via loans (62.7 per cent in the U.S., 65.6 per cent in Australia). However, we see in Table 9 that in Australia the majority of these loans are on commercial bank balance sheets (75.8 per cent), with a comparatively small proportion being financial assets of Australian NBFI's (18.2 per cent). In looking at the U.S., we see the role of these agents largely reversed, with the NBFI agent providing 67.7 per cent of loans to reproducible housing, and commercial banks providing 28.7 per cent. The NBFI sector therefore plays a smaller role in funding housing investment in Australia relative to the U.S. This is also evident in a comparison of Figure 15 and Figure 16, which shows that 42.5 per cent of the liabilities of the U.S. reproducible housing sector are assets of the NBFI's, compared to 12.5 per cent in the Australia.

The simulation results presented in section 3.3 highlighted that U.S. households provide a large share of the NBFI agent's financing requirements, particularly via ownership of NBFI equity liabilities. As the CAR was increased and the return on commercial bank deposits fell, the household adjusted the composition of their asset portfolio away from bank deposits (comprising 12.3 per cent of U.S. household financial assets versus 13.3 per cent for Australian households) and towards other financial assets. In the U.S., this asset switching includes a sizeable reallocation towards industry and NBFI equity, which from Table 9 make up 21.5 per cent and 12.4 per cent of U.S. household financial assets respectively. The proportion of household ownership of industry and NBFI equity is also much smaller in Australia; 9.3 per cent of the household portfolio is allocated to industry equity, and 2.5 per cent is allocated to NBFI equity. These proportions represent 18.8 per cent and 11.8 per cent of the financing requirements of these two agents, respectively, compared to 39.5 per cent and 30.8 per cent in the U.S.

In contrast to the U.S., Australian industry is more reliant on both bank finance (23.6 per cent compared to 5.7 per cent, see Figure 15 and Figure 16) and foreign finance (33.5 per cent versus 19.8 per cent, see Figure 15 and Figure 16) but less reliant on NBFIs (8.4 per cent versus 16.4 per cent, see Figure 15 and Figure 16).

Relative to the U.S., Australian NBFIs are more dependent on commercial banks for financial capital. Australian banks own 22.7 per cent of the aggregate financial liabilities issued by NBFIs. This is almost double the share of U.S. NBFI liabilities owned by U.S. banks (11.7 per cent, see Figure 15 and Figure 16).

3.5 Methodology and Analysis

In this section, we study the impact of the structural differences between Australia and the U.S. and their relative importance in explaining differences between the simulation results reported for the U.S. in this paper, and the results for Australia reported in Giesecke et al. (2016). Our analysis focuses on a series of decomposition figures. The decomposition figures are created by running USAGE2F five times, with each model run subject to the same 100 basis point increase in the capital adequacy ratio of the commercial banks:

1. One simulation using the current USAGE2F specifications;
2. A second run, where we adjust the elasticity of investment with respect to movements in rates of return on capital in USAGE2F to match the VU-Nat model;

3. A third run, adjusting the primary-factor-substitution elasticity to the Australian model values;
4. A fourth run, where the USAGE2F financial database is adjusted following the process outlined in section 3.4.1;
5. A final run, where we adjust the export demand elasticities to match the Australian export demand elasticities.

We then study the impact of the deviations between the Australian and USAGE2F FCGE model results, as the four key structural differences are adjusted one-by-one from their standard USAGE2F specifications, to Australian specifications. A residual item is also included (labelled other factors"), which captures differences beyond the four structural differences outlined.

3.5.1 Decomposing the differences between Australia and the United States

In this section, we study the similarities and differences between the USAGE2F and VU-Nat FCGE model simulation results in Giesecke et al. (2016), when each model is used to study a 100 basis point increase in the commercial bank capital adequacy ratio.

While the magnitudes of the deviations from baseline differ slightly, some implications of the rise in the capital adequacy ratio are similar whether across the two countries. For example, as described for USAGE2F and shown in Figure 2, banks increase the issuance of equity and reduce their reliance on deposit and bond finance in both models. Also, both U.S. and Australian banks reduce their holding of risky assets, as shown in Figure 2 for the U.S., while also reducing the size of their financial asset portfolio. These movements have similar implications for the rate of return on bank equity, which rises in both Australia and the U.S., while the rates of return on bank deposits also fall in both countries. For brevity, we omit decomposition diagrams for these variables.

Figure 17 reports the deviations in real investment in the U.S. and Australian models, and explains the difference in terms of our four decomposition factors and a residual. Figure 17 can be read in the following way: the solid black line is the USAGE2F result for the deviation in U.S. real investment, while the dotted black line is the VU-Nat result for Australian real investment. The purple bar is the impact on the USAGE2F result (i.e., the solid black line) when we change the USAGE2F values for the elasticity of investment to rates of return to match the Australian values in VU-Nat. That is, the USAGE2F model with the Australian investment sensitivity yields a real investment result equal to the solid black line, plus the purple bars in Figure 17. As shown in Figure 17, the impact of the revised investment sensitivity is small, with real aggregate investment in the year of the shock adjusted upwards (and therefore further away from the VU-Nat result). The remaining solid bars represent the impact on the USAGE2F result as we progressively alter the primary factor substitution elasticity (red bars), financial database shares (green bars), export demand elasticities (orange bars) and other factors (blue bars). The sum of the decomposition bars accounts for the full gap between the USAGE2F and VU-Nat results.

As shown in Figure 17, the bulk of the deviation between the U.S. and Australian results for real investment is attributable to the financial database shares. This is because the database shares exert a strong influence on the relative movements across the two models of the WACCs of the reproducible housing and industry agents. WACC results for these agents are presented in Figure 18 and Figure 19. In USAGE2F, the WACC for each agent falls because the supply of financial capital to each agent increases (see the solid lines in Figure 6 and Figure 8). This in turn stimulates housing and non-housing investment (see Figure 7). As shown in Figure 18 and Figure 19, the impact of the financial database shares (green bars) on the WACC of each agent is large and positive, i.e., modifying the USAGE2F financial database shares to more closely match the Australian shares raises the WACC deviation for both agents, ceteris paribus. Again, relative to the other real side factors, the differences in financial shares account for much of the difference between the U.S. and Australian WACC results. Next, we use our analysis of the two respective financial databases and their ownership shares from section 3.4.3 to explain this result.

When the CAR is increased in the U.S., the WACC of the reproducible housing sector falls because of a rise in purchases of reproducible housing loans by the NBFI sector. As discussed in section 3.4.3, the NBFI sector finances 67.7 per cent of loans to reproducible housing in the U.S. In contrast, 28.7 per cent of reproducible housing loans are provided by the commercial banks that are subject to the rise in CAR. The NBFI sector can increase lending to reproducible housing, because as discussed in section 3.3, the household sectors demand for NBFI equities increases as they adjust the composition of their financial assets in response to the fall in the return on commercial bank deposits. With a large share of the household asset portfolio invested in NBFI equity (12.4 per cent, making up 30.8 per cent of aggregate NBFI liabilities), this increase in supply of equity is sufficient to cause an overall expansion in the supply of financial capital to the NBFI sector (see Figure 2).

As discussed in section 3.4.3, in Australia the roles of the NBFI and commercial bank agents are essentially reversed. The majority of reproducible housing loans are on the balance sheets of banks (75.8 per cent), with a smaller share being financial assets of NBFI's (18.2 per cent). Relative to the U.S., this constrains the reproducible housing agent's capacity to substitute towards NBFI-supplied capital when the cost of bank lending rises.

Additionally, as discussed in section 3.3, a large share (approximately 20 per cent) of the asset-side of U.S. commercial bank balance sheets are allocated to the purchase of low-risk Federal Reserve deposits and U.S. government bonds.   Relative to Australia, the asset portfolios of U.S. NBFIs also have a high weighting (approximately 10 per cent) to U.S. government bonds. In contrast, about 3.2 per cent of Australian commercial bank financial assets are central bank deposits and Australian government bonds. Similarly, Australian NBFIs place about 3.2 per cent of their aggregate financial assets in Australian government bonds. For each additional dollar of financial liabilities raised, Australian commercial banks and NBFI's therefore possess similar proclivities for risky lending. While still low relative to Australia, U.S. NBFIs possess stronger preferences for risky lending than U.S. commercial banks. Hence, as U.S. households reduce their allocation to bank deposits and shift towards NBFI equity, each $1 they shift represents an 80 cent reduction in bank lending to investment activities, but a 90 cent increase in NBFI lending to investment activities. This accounts for the fall in the the WACC of the U.S. industry and reproducible housing sectors. However, because the risky asset ownership shares of Australian NBFIs and commercial banks are similar, and the commercial banks allocate a larger share of their aggregate financial assets to the purchase of reproducible housing loans (23.0%) than Australian NBFIs (16%), a rise in CAR causes an increase in the WACC of the Australian reproducible housing agent (Figure 18).

Australian industry is also more dependent on commercial bank financing than their U.S. counterparts. As discussed in section 3.4.3, the proportion of aggregate industry financial liabilities owned by Australian commercial banks in Australia is 22.7 per cent, compared to 5.7 per cent in the U.S. (see Figure 15 and Figure 16). The capacity of Australian industry to substitute to other funding sources is therefore also constrained relative to their U.S. counterparts, however less so than the reproducible housing agent. This is because the commercial bank ownership share of Australian industry financial liabilities (22.7 per cent) is lower than the share for the reproducible housing sector (51.8 per cent).

In summary, differences in the ownership shares of industry and reproducible housing financial liabilities between financial agents in Australia and the U.S. alter the direction of the deviation in real investment from baseline when the capital adequacy ratio of commercial banks in each country are increased by 100 basis points.

With real investment falling in Australia and increasing in the U.S. relative to baseline, we expect movements in the physical capital stock between USAGE2F and the VU-Nat model to also differ. This difference is highlighted in Figure 20. With a large proportion of the difference in the real investment result from each model being caused by the financial database shares (see the green bars in Figure 17), we find that most of the deviation between the results for physical capital can be explained by the financial database shares.

The difference in the physical capital outcome for each model (Figure 20) accounts for the bulk of the difference in the GDP outcomes for the U.S. and Australia (Figure 22).[9] As expected, because this real GDP outcome is a result of a long-run fall (rise) in the physical capital stock of Australia (the U.S.), the deviation in long-run real GDP growth in response to the rise in commercial bank capital adequacy is also largely due to differences in the financial structure between the two countries (see the green bars in Figure 22).

The results presented establish the importance of cross-country differences in financial structure, particularly with regard to explaining cross-country differences in the macroeconomic implications of changes in financial regulation. Whereas in the U.S. we find that a rise in commercial bank capital requirements result in commercial bank loan provision for risky investment being substituted for NBFI finance and household-supplied equity, in Australia we find that an equivalent policy reform (under an identical regulatory framework) causes an overall reduction in lending activity. Jurisdiction-specific differences in financial structure may therefore provide some impetus for jurisdiction-specific capital regulation.

4 Conclusion

Following the widespread economic impact of the global financial crisis, a cornerstone principal of the Basel III capital framework released in December 2010 was a significant increase in the minimum capital requirements of commercial banks [Natter (2012)]. Along these lines, recent

[9] Differences in employment outcomes between the two models are small because wage adjustment returns the employment rate to close to its baseline level from about year 5 in both simulations.

work by Giesecke et al. (2016) explored the impact of a 100 basis point increase in the capital adequacy ratio of commercial banks in Australia. Giesecke et al. (2016) showed that such a rise in capital adequacy requirements have modest macroeconomic impacts in Australia, while securing a rise in tier-1 bank capital, a shift in bank lending away from residential housing investment, a rise in household equity financing of home ownership, and a rise in equity and bond financing of industry investment.

In this article, we have explored the impact of an equivalent shock to the capital adequacy ratio of U.S. commercial banks. This is achieved via the development of a financial CGE model of the U.S. economy, called USAGE2F. As in Giesecke et al. (2016), we find the macroeconomic impacts of a 100 basis point rise in the capital adequacy ratio of the commercial banks are small, but differ in important ways from the results in Giesecke et al. (2016) for Australia. Using decomposition diagrams, we identify the origin of these differences as lying largely in differences in the financial structure of the two economies. Relative to the contribution of financial structure, differences between the real sides of the two economies contribute relatively little to the gap in the measured outcomes of a rise in CAR.

Differences in financial structure therefore have the potential to cause inhomogeneous cross-country macroeconomic responses to identical financial regulation reforms. If regulators are aware of this, we would expect it to influence the cross-country details of bank regulations. Hence, future work along the lines of Barth et al. (2008) and Kara (2016), who explored some of the causes of cross-country differences in legislated capital regulations, might be advised to include predictors that capture cross-country differences in financial sector structure. These variables may, for example, include the share of commercial bank and non-bank financial intermediary financial assets invested in relatively safe or low risk-weight assets, such as deposits at the Federal Reserve/Reserve Bank of Australia and/or holdings of Government Bonds.

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6 Tables

Table 1: Financial Instruments, USAGE2F database

USAGE2F Handle Instrument	Description
Bonds	Interest-bearing securities that have varying terms to maturity, and can be backed or secured by physical assets.
DepLoans	Loans that may be secured by a physical asset.
Cash	Cash; can be either denominated in US$ or foreign currency
GoldSDRs	Gold (where a suitable financial counterparty exists) or Special Drawing Rights
Equity	Any claim that lies further along the risk-return spectrum when compared to Bonds.

Table 2: Financial Agents, USAGE2F Database

USAGE2F Handle Agents	Description
Hlds	The Household Agent
Inds	Nonfinancial industries, excluding housing
Govt	The Government Agent
CB	The Monetary Authority
Banks	Authorised Private Depository Institutions
LifeIns	Property, Casualty and Life Insurers
Retire	Retirement/Superannuation Funds
NBFI	Financial Institutions excluding the Banking Sector
Fgn	The Foreign Agent
RH	Reproducible Housing, being new apartments or property in new housing estates.
NRH	All Residential Property not classified as Reproducible.

Table 3: USAGE2F variables and their descriptions

USAGE2F Variable	Description
$BBL_{(ComB)}$	The level of total end-of-year commercial bank liabilities (including equity).
$BBNEQ_{(ComB)}$	The level of the equity-exclusive value of end-of-year commercial bank liabilities.
RABANK	The level of the value of end-of-year risk-weighted bank assets.
$RISKWGT_{(s,f)}$	The level of the risk weights attaching to financial instrument *f* issued by liability agent *s*.
$A1_{(s,f,d)}$	The level of end-of-year holdings by agent *d* of asset type *f* issued by agent *s*.
TAU	A parameter governing the sensitivity of the composition of commercial bank liabilities to changes in the relative costs of financial instruments issued to particular asset agents.
EQBANK	The value of bank equity.
prabank	The percentage change in risk-weighted bank assets.
$priskwgt_{(s,f)}$	The percentage change in the value of the risk weight attached to commercial bank holdings of financial instrument *f* issued by liability agent *s*.
$a1_{(s,f,d)}$	The percentage changes in end-of-year holdings by agent *d* of asset type *f* issued by agent *s*.
peqbank	The percentage change in end-of-year bank equity.
pratio	The percentage change in the capital adequacy ratio.
$pbblneq_{(ComB)}$	The percentage change in the equity-exclusive value of commercial bank liabilities.
$pbbl_{(ComB)}$	The percentage change in end-of-year (equity-inclusive) commercial bank liabilities.
$averorne_{(ComB)}$	The percentage change in the average rate of return on non-equity financial instruments issued by commercial banks as liability agents.
$rpow_{(ComB,f,d)}$	The percentage change in the power (1 plus the rate) of the rate of interest / return paid to asset agent *d* on financial instrument *f* issued by commercial banks as liability agents.
$a1d_{(ComB,f)}$	The percentage change in end-of-year non-equity liabilities ($f \in FINEQ$ i.e., deposits, loans, and bonds) issued by commercial banks

USAGE2F Variable	Description
	as liability agents.
$rpowd_{(s,f)}$	The percentage change in the power of the rate of interest paid by commercial banks on non-equity financing instrument *f*.

Table 4: Risk weights on commercial bank assets

Parameter	Description	Value[(a)]
$RISKWGT_{(CB,f)}$ $(\forall\ f \in FI)$	Liabilities issued by the Central Bank.	0
$RISKWGT_{(Govt,f)}$ $(\forall\ f \in FI)$	Liabilities issued by the domestic government.	0
$RISKWGT_{(s,Cash)}$ $(\forall\ s \in LA)$	Cash.	0
$RISKWGT_{(s,Equity)}$ $(\forall\ s \in LA)$	Equity.	3.0
$RISKWGT_{(Foreigners,DeposLoans)}$	Loans to foreign agents.	0.4
$RISKWGT_{(Inds,DeposLoans)}$	Loans to domestic industry.	0.4
$RISKWGT_{(NonBankFinIn,DeposLoans)}$	Loans to non-bank financial intermediaries.	0.4
$RISKWGT_{(NRH,DeposLoans)}$	Loans to the non-reproducible housing sector.	0.35
$RISKWGT_{(RH,DeposLoans)}$	Loans to the reproducible housing sector.	0.5
$RISKWGT_{(NonBankFinIn,Bonds)}$	Bonds issued by non-bank financial institutions.	0.4
$RISKWGT_{(Foreigners,Bonds)}$	Foreign bonds.	0.4
(a) In choosing values for RISKWGT, we were guided by Giesecke et al. (2016). Independent evaluation of key risk weights for U.S. residential mortgages confirmed the weights summarised above for Australia as being suitable (see Natter (2012)), while the assumption of an equity-like risk on GSE securities is also conservative (see also Natter (2012)).		

Table 5: Summary list of FRSR062015 financial asset and liability agents

FRSR0615 Classification	FRSR0615 Numeric Classification	Description
Asset and Liability Agents		
HHoldsNFP	01	**Households and Not-for-Profit Organisations.** Derived largely as a residual item to the accounts, and therefore contains financial assets/liabilities of domestic hedge funds and private equity firms, as well as not-for-profit organisations.
NonFinCorp	103	**Nonfinancial Corporate Businesses.** No access to corporate equity markets to fund business activities, however does not trade in financial services.

FRSR0615 Classification	FRSR0615 Numeric Classification	Description
NonFinNoCorp	104	**Nonfinancial Noncorporate Businesses.** Small businesses that trade in similar goods and services to nonfinancial corporate businesses. All equity is owned by the households.
FedGov	106	**Federal Government.**
SLGov	107	**State and Local Government.**
FedReserve	109	**The Monetary Authority.**
PrivDeposIns	110	**Private Depository Institutions,** comprising U. S.-Chartered Depository Institutions, Foreign Banking Offices in the U. S., Banks in U. S.-Affiliated Areas and Credit Unions.
Insurers	115 + 116	**Insurers,** including Property-Casualty Insurance and Life Insurance Organisations.
DBFunds	118b + 119b + 120b	**Defined Benefit Superannuation Funds,** spanning the Private, Federal and State and Local Government superannuation sectors. The individual sectors can be disaggregated if required.
DCFunds	118c + 119c + 120c	**Defined Contribution Superannuation Funds,** spanning the Private, Federal and State and Local Government superannuation sectors.
MoneyMktMFds	121	**Money Market Mutual Funds.** Represent the set of domestic fund managers who operate in the Fixed Income space only; they do not trade in equity markets. Represented as a large unit trust, with the sum of financial assets matching the sum or liabilities on issue. A pure financial agent who is valued at market.
MutualFds	122	**Mutual Funds.** Represent the set of domestic fund managers who operate in both the Fixed Income and Equity space. Represented as a large unit trust, with the sum of financial assets matching the sum or liabilities on issue. A pure financial agent who is valued at market.
ETFs	123	**Exchange-Traded and Closed-Ended Funds**. The set of mutual funds who are closed to new business, together with the set of all Exchange Traded Fund managers, e.g., iShares, Vanguard, etc.
GSEs	124	**Government Sponsored Enterprises,** spanning Fannie Mae, Freddie Mac, Farmer Mac, Federal Home Loan Banks, the Farm Credit System, the Financing Corporation and the Resolution Funding Corporation.
GSEMortPools	125	**Pools of Mortgage-Backed Securities** created by the GSE's
ABSIssuers	126	**Asset-Backed security Issuers.** Issue short-dated commercial paper and corporate bonds backed by mortgages or loans over assets, e.g., home, commercial and farm loans, credit card or automobile debt, trade credits or other asset backed

FRSR0615 Classification	FRSR0615 Numeric Classification	Description
		securities.
FinanceComp	127	**Finance Companies**. Corporations that provide financing through the purchase of debt securities as financial assets, e.g., General Electric's GE Capital, General Motor's GMAC.
REITs	128	**Real Estate Investment Trusts**. Corporations who trade in real estate or real estate mortgages. Based on the Integrated Accounts data, we infer that no significant residential real estate is owned by REITs in the U.S., despite the FoF's data implying multifamily (apartment building) fixed investment being a component of annual REIT flow of funds.
Brokers	129	**Brokers and Dealers**. Market makers who facilitate the transfer of physical securities or financial risk. Hold significant proportions of security repurchase agreement as assets and also liabilities, along with various other financial instruments.
HoldingComp	130	**Holding Companies**. Companies that own the outstanding securities of other companies, and trade in no physical assets directly. Activities funded through the issue of debt securities and equity.
FundingCorp	131	**Funding Corporations**. Intermediaries that facilitate the funding of financial or real economy activities, e.g., financial bailouts or U. S. export funding. Large exposure to debt securities as a means of financing their own activities and facilitating those of other agents.
Foreigner	132	**The Rest of the World**. The foreign agent. FRSR0615 and FRSR0915 assume no nonfinancial U. S. assets are held by the foreigner.
ResidentRE	Artificial Agent	Sum of the total stock of US residential real estate, valued at market.

Table 6: FRSR0615 database financial and nonfinancial instruments

FRSR0615 Instruments	Description
ABSecurities	Broad aggregation of mortgage-, consumer- and trade-credit backed securities that we classed as **Asset-backed Securities**.
AutoLoan	Automotive Loans to Consumers.
Bonds	Corporate and Municipal Bonds.
CardDebt	Consumer Credit Card Debt.
Cash	Cash, consisting of time and savings deposits and foreign cash deposits.
ComPaper	Commercial Paper, representing money market securities with short terms to maturity (generally <1 year).
ComPropLoan	Commercial Property Loans.

FRSR0615 Instruments	Description
Currency	Currency
Equity	Corporate and Noncorporate equity.
FarmLoan	Farm Loans that excludes the Farm House.
FDIDebt	Foreign Direct Investment (either US Abroad or Foreigner in the US) in the form of Debt Finance.
FDIEquity	Foreign Direct Investment (either US Abroad or Foreigner in the US) in the form of Equity Finance.
HomeLoan	Home Loans.
LifePenRes	Reserves managed by Pension Funds and Life Insurers to meet future liabilities. Also includes unallocated insurance company contracts and pension fund contributions payable.
Loans	Loans that could not be classified into Consumer Credit, Mortgages or Trade Credits.
MultiFamLoan	Multi-family residential mortgages.
NMTreasuries	Nonmarketable Treasury Securities.
NoResidentRE	Non-residential buildings, including Hospitals and Schools.
OvrNghtLoan	Overnight Loans for Settlement of Exchange Balances.
Receivables	Spans Trade and Security Credit, Taxes Payable and Receivable, and transactions with subsidiaries (principally by Holding Companies).
Repurps	Repurchase agreements, which are essentially a loan from the asset agent to the liability agent where collateral in the form of a debt security is provided by the liability agent.
Reserves	Reserves, placed with either the World Bank or the Monetary Authority
RevRepurps	Reverse Repurchase Agreements, which are a loan to the asset agent from the liability agent, with the asset agent providing collateral in the form of a financial instrument to secure the loan.
SDR	Special Drawing Rights
StudentLoan	Student Loans.
TBills	Treasury short-duration bills of maturity less than 1 year.
Treasuries	Treasury Bonds.
USSavingsBnd	Retail US Government securities called US Savings Bonds; marketed and sold to Households, rather than the wholesale Treasury Bills and Securities.

Table 7: Mapping USAGE2F database agents to the FRSR0615 agents

FRSR0615 Agents	USAGE2F Database Agents
HHoldsNFP	Hlds
NonFinCorp	Inds
NonFinNoCorp	Inds
FedGov	Govt
SLGov	Govt
FedReserve	CB
PrivDeposIns	Banks
Insurers	LifeIns
DBFunds	Retire
DCFunds	Retire
MoneyMktMFds	NBFI
MutualFds	NBFI
ETFs	NBFI
GSEs	NBFI
GSEMortPools	NBFI
ABSIssuers	NBFI
FinanceComp	NBFI
REITs	NBFI
Brokers	NBFI
HoldingComp	NBFI
FundingCorp	NBFI
Foreigner	Fgn
ResidentRE	*One-third* to RH *Two-thirds* to NRH

Table 8: Mapping FRSR0615 instruments to the USAGE2F database instruments

FRSR0615 Instruments	USAGE2F Instrument
ABSecurities	Equity
AutoLoan	**Not utilised**
Bonds	Bonds
CardDebt	**Not utilised**
Cash (Deposits)	DepLoans

FRSR0615 Instruments	USAGE2F Instrument
ComPaper	Bonds
Commodities	GoldSDRs
ComPropLoan	**Not utilised**
Currency	Cash
Equity	Equity
FarmLoan	**Not utilised**
FDIDebt	DepLoans
FDIEquity	Equity
HomeLoan	DepLoans
LifePenRes	Equity
Loans	For Households: **Not utilised** All other agents: DepLoans
MultiFamLoan	DepLoans
NMTreasuries	Bonds
OvrNghtLoan	DepLoans
Receivables	Equity
Repurps	DepLoans
Reserves	DepLoans
ResidentRE	Netted against **HomeLoan** and **MultiFamLoan**, then allocated to Equity
RevRepurps	DepLoans
SDR	GoldSDRs
StudentLoan	From Government: DepLoans All others: **Not utilised**
TBills	Bonds
Treasuries	Bonds
USSavingsBnd	Bonds

Table 9: Selected USAGE2F Financial Database shares compared to their Australian Financial Database counterparts

USAGE2F Financial Database Shares vs Australian Financial Database Shares Initial ownership share by instrument and counterparty	Bank	CB	Fgn	Govt.	Hlds	Inds	NBFI	Ret.	Life Ins	NRH	RH
Reproducible Housing Loans											
USAGE2F (U.S.)	28.7	0.0	0.0	2.1	0.6	0.4	67.7	0.1	0.5	0.0	0.0
VU-Nat (Australia)	75.8	0.0	2.3	2.5	0.0	0.3	18.2	0.8	0.0	0.0	0.0
Difference (Aus – U.S.)	***47.1***	***0.0***	***2.3***	***0.5***	***0.6***	***0.1***	***49.5***	***0.7***	***0.5***	***0.0***	***0.0***
Industry Loans											
USAGE2F (U.S.)	50.7	0.0	17.0	4.0	0.6	0.0	27.1	0.0	0.7	0.0	0.0
VU-Nat (Australia)	65.5	0.0	16.6	8.5	3.1	0.0	5.9	0.0	0.5	0.0	0.0
Difference (Aus – U.S.)	***14.8***	***0.0***	***0.4***	***4.5***	***2.5***	***0.0***	***21.2***	***0.0***	***0.2***	***0.0***	***0.0***
Industry Equity											
USAGE2F (U.S.)	0.2	0.0	18.9	1.4	50.9	0.0	13.9	10.8	4.0	0.0	0.0
VU-Nat (Australia)	1.1	0.0	37.9	1.3	32.0	0.0	10.0	16.8	0.9	0.0	0.0
Difference (Aus – U.S.)	***1.0***	***0.0***	***19.1***	***0.2***	***18.9***	***0.0***	***3.9***	***6.0***	***3.1***	***0.0***	***0.0***
NBFI Equity											
USAGE2F (U.S.)	0.7	0.1	9.5	1.8	54.1	7.4	0.0	23.2	3.3	0.0	0.0
VU-Nat (Australia)	3.3	0.0	11.9	4.8	19.1	6.1	0.0	28.9	25.8	0.0	0.0
Difference (Aus – U.S.)	***2.6***	***0.1***	***2.5***	***2.9***	***35.0***	***1.3***	***0.0***	***5.7***	***22.6***	***0.0***	***0.0***

7 Figures

Figure 1: Capital adequacy ratio of the commercial banks, basis point change relative to baseline

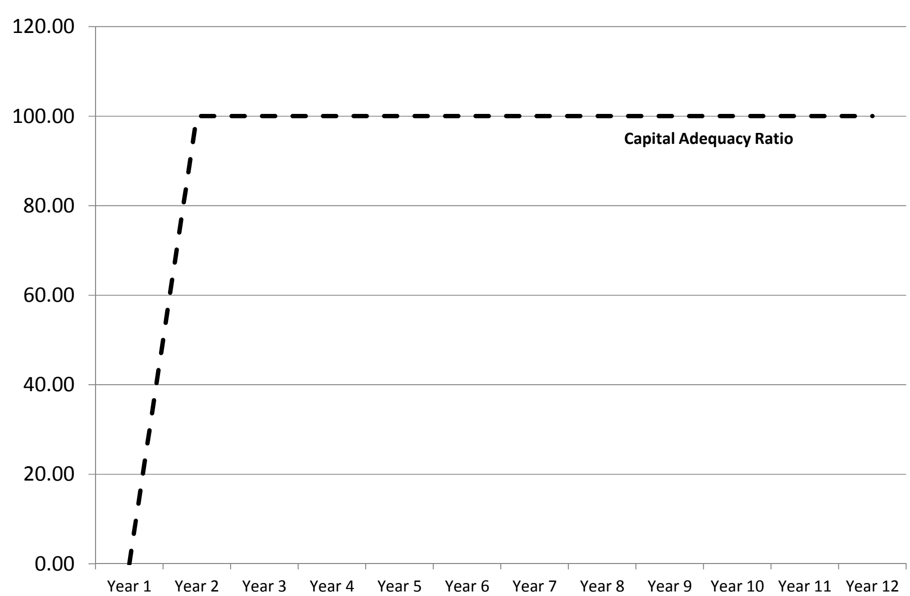

Figure 2: Bank liabilities by instrument and risk-weighted assets, and aggregate Bank and NBFI financial assets and liabilities, percentage deviation from baseline

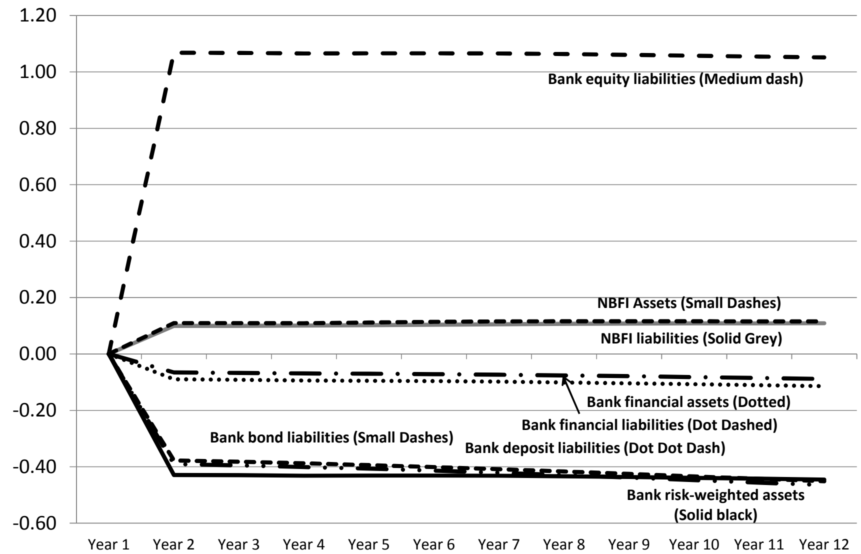

Figure 3: Major asset holdings of the commercial banks, percentage deviation from baseline

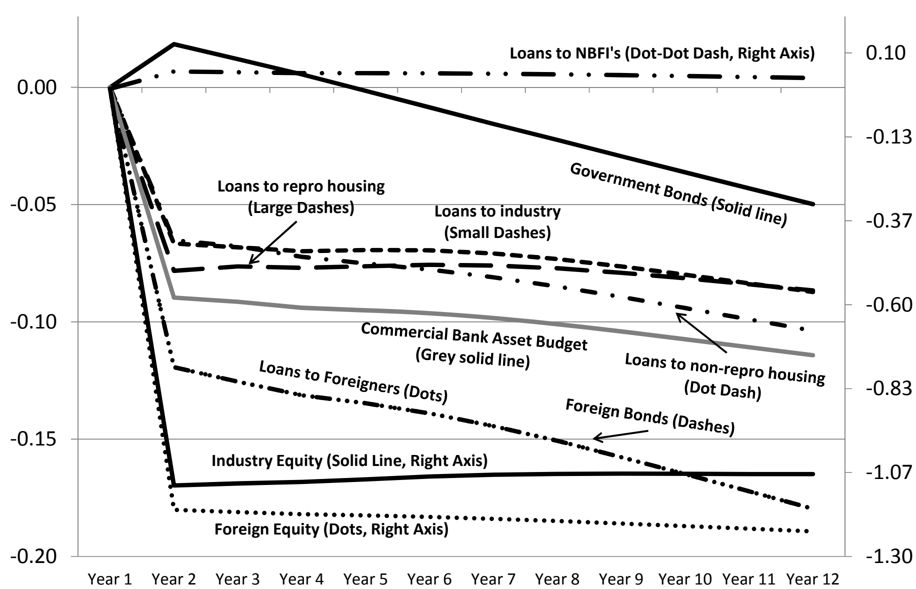

Figure 4: Rates of return (powers thereof) on various financial instruments, percentage deviation from baseline

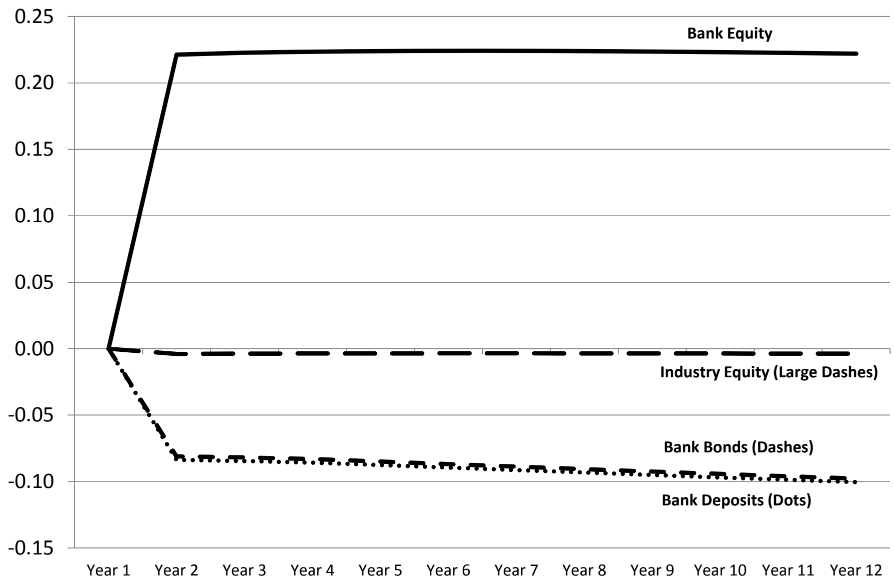

Figure 5: Cumulative flows of financial capital to financial asset acquisition by the U.S. Household, deviation from baseline in US$m

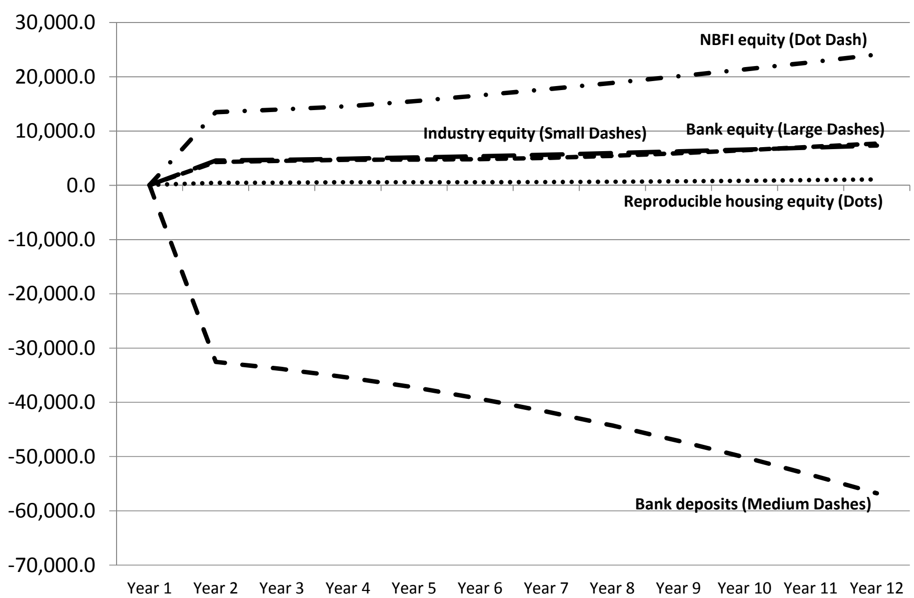

Figure 6: Cumulative flows of financial capital supplied to the Industry agent, deviation from baseline in US$m

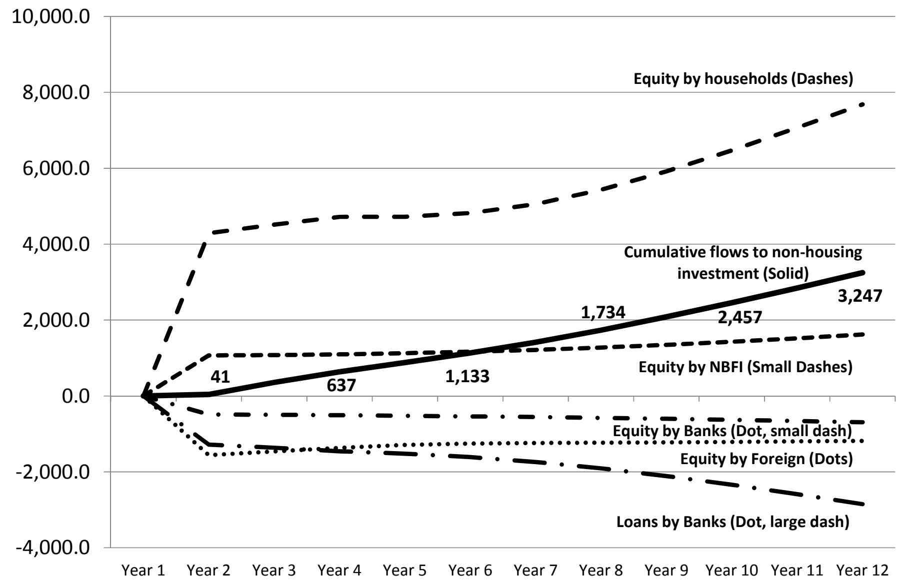

Figure 7: Housing and non-housing investment, and economy-wide real investment, percentage change from baseline

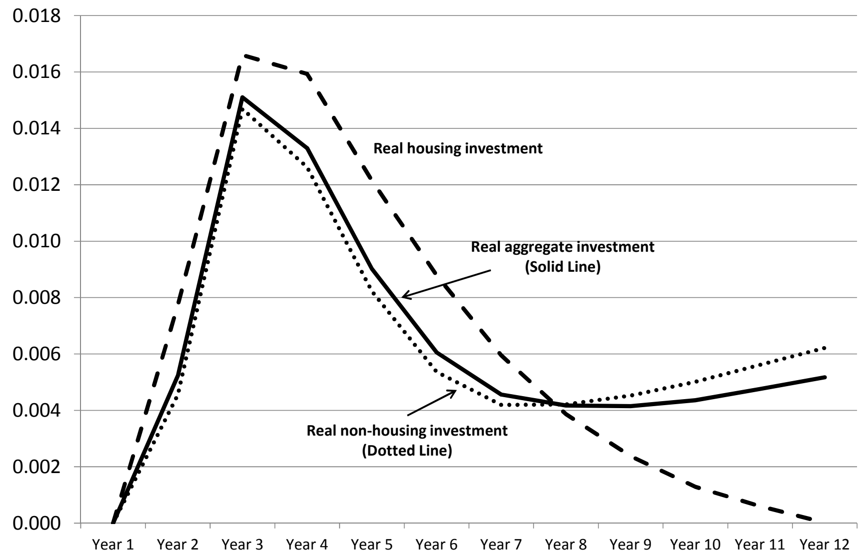

Figure 8: Cumulative flows of financial capital supplied to the reproducible housing agent, deviation from baseline in US$m

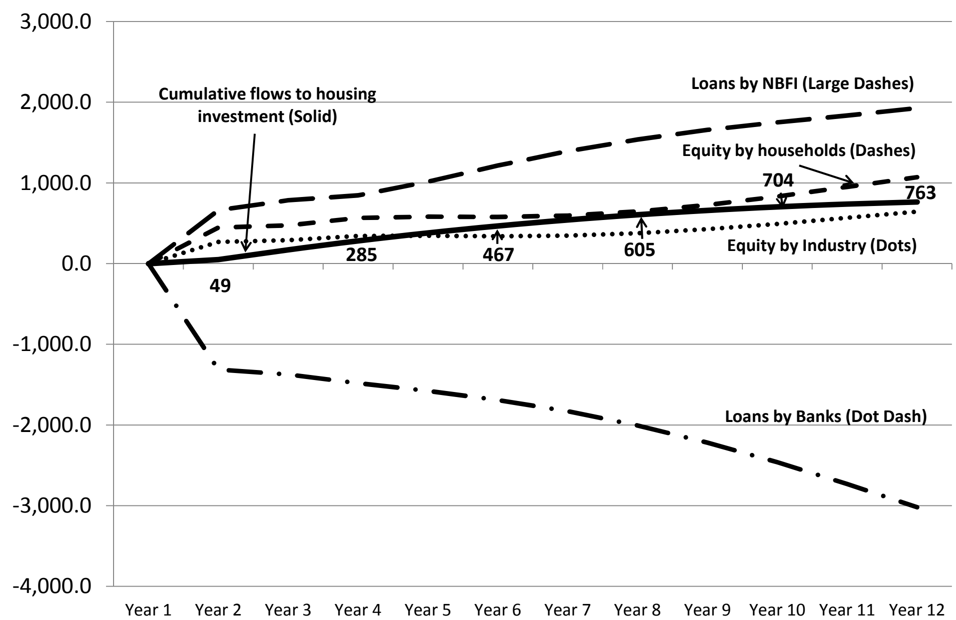

Figure 9: Nominal exchange rate ($Fgn/$US), export volumes, import volumes and the terms of trade, percentage deviation from baseline

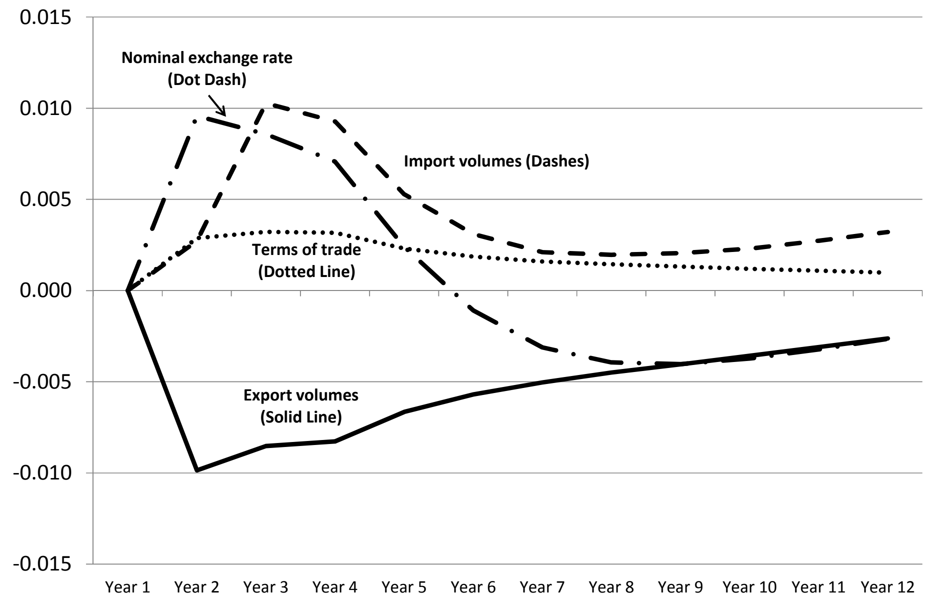

Figure 10: Equity and debt of Industry and reproducible housing agents, percentage deviation from baseline

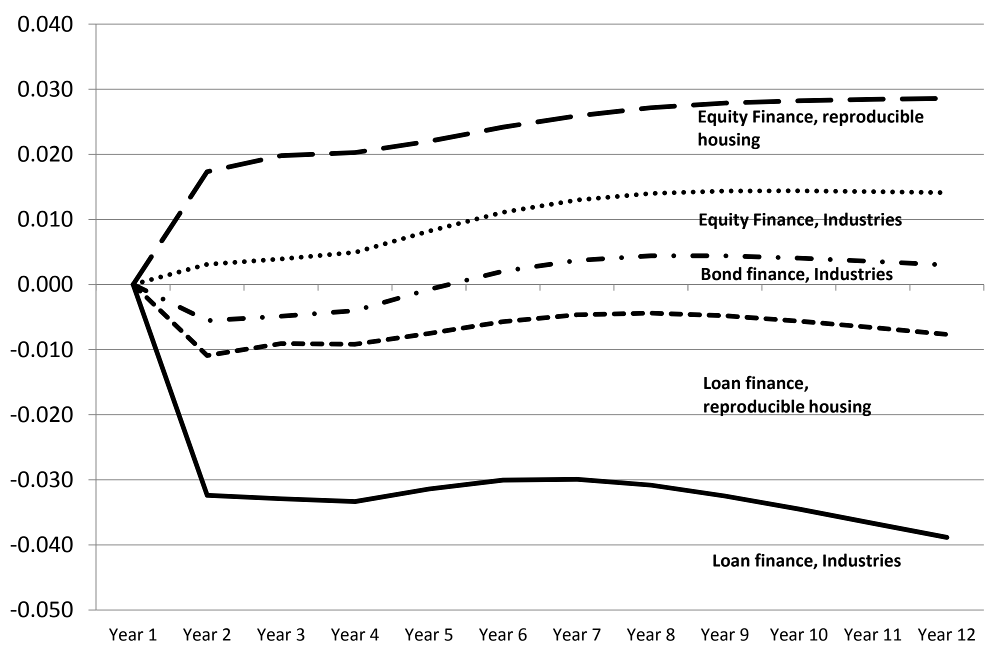

Figure 11: Average producer price level, the nominal wage, average consumer price level and employment, percentage deviation from baseline

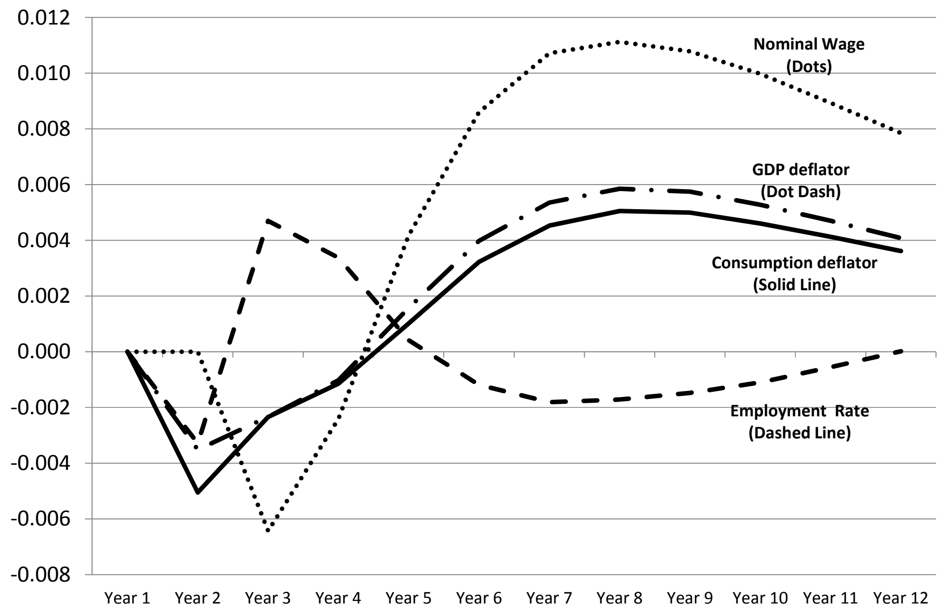

Figure 12: Movement in the central bank deposit and lending rate for settlement balances, basis point deviation from baseline

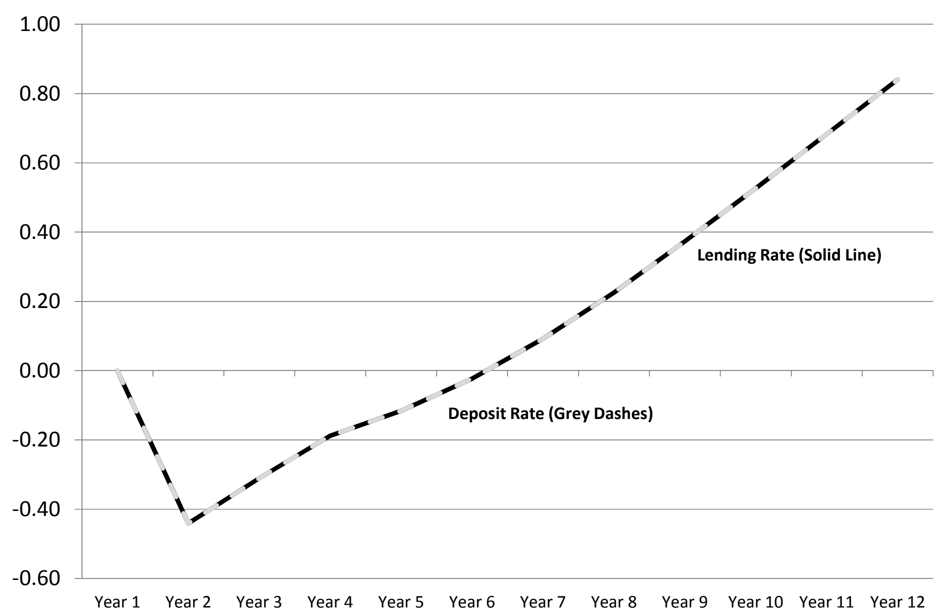

Figure 13: Real GDP, employment, capital stock and real investment, percentage deviation from baseline

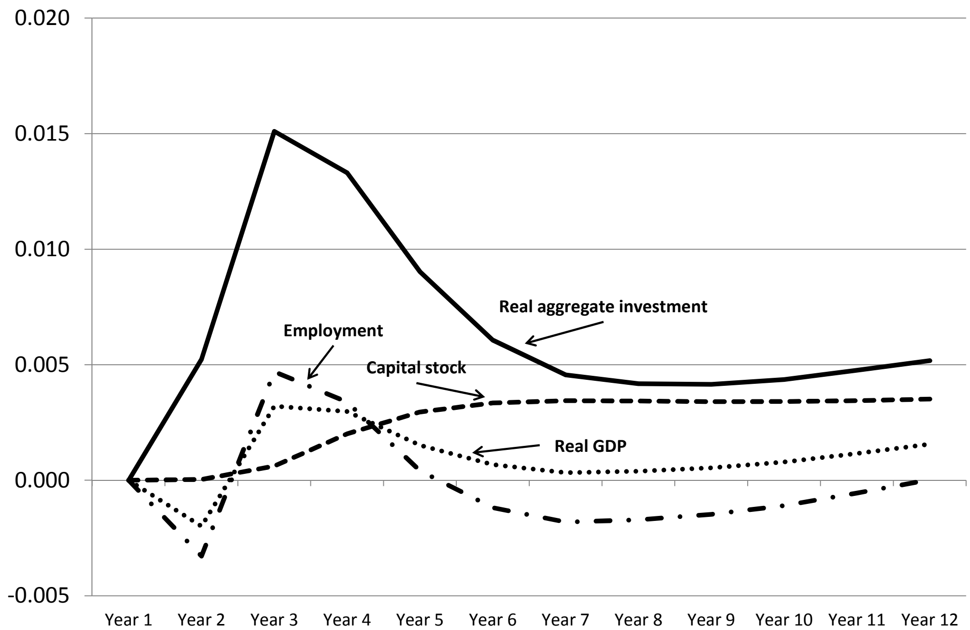

Figure 14: Real GDP, real GNE and the components of real GNE, percentage deviation from baseline

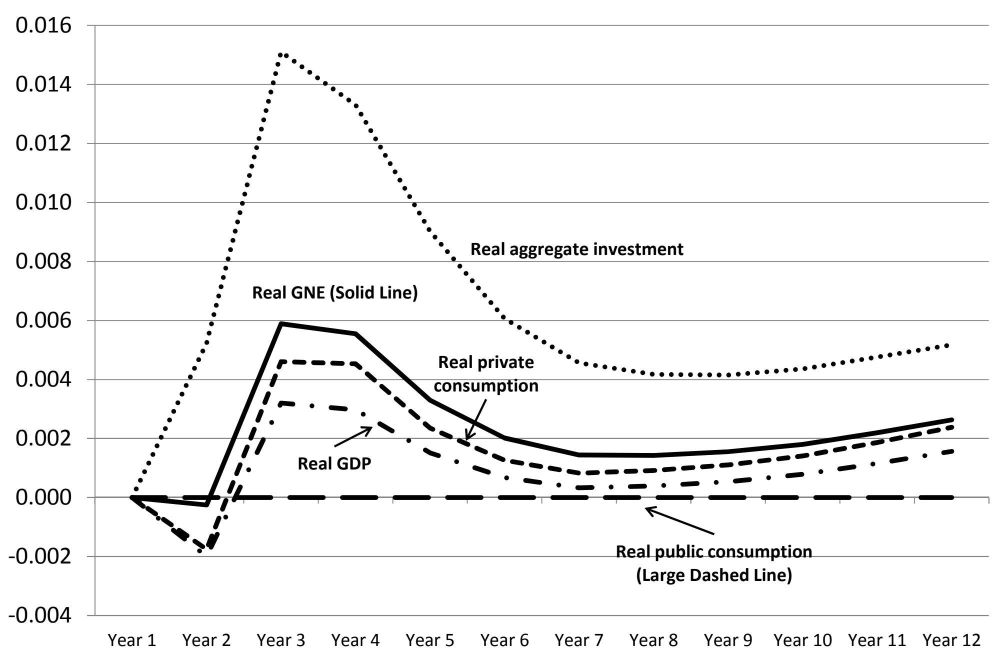

Figure 15: Financial liabilities in USAGE2F by asset agent ownership shares

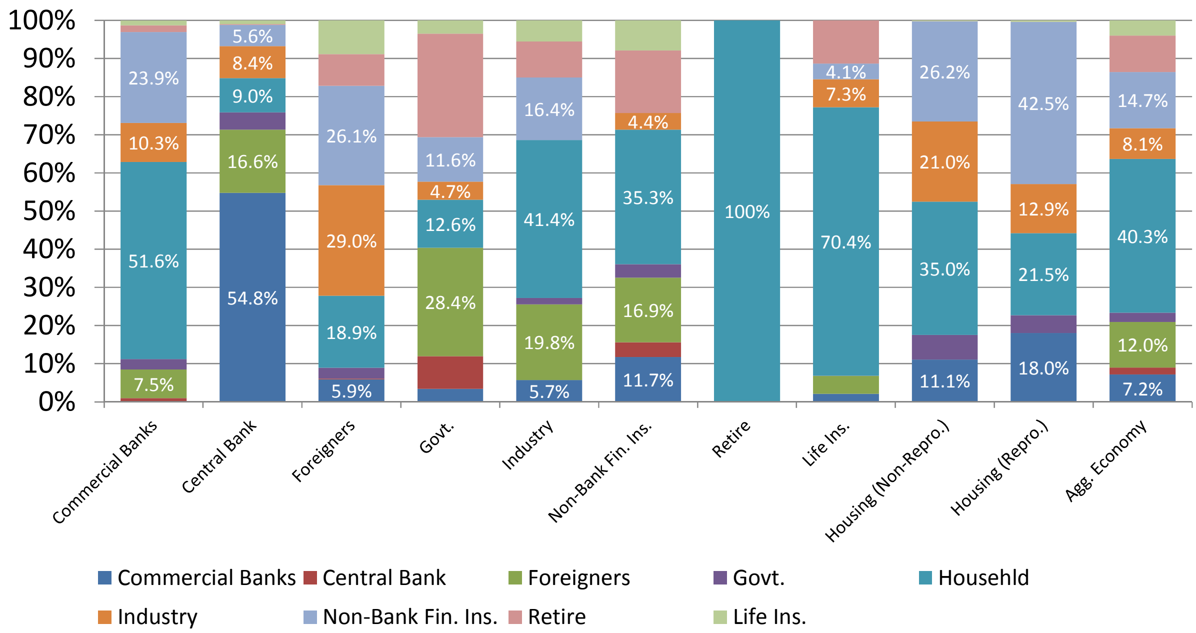

Figure 16: Financial liabilities in the VU-Nat model of Australia by asset agent ownership shares

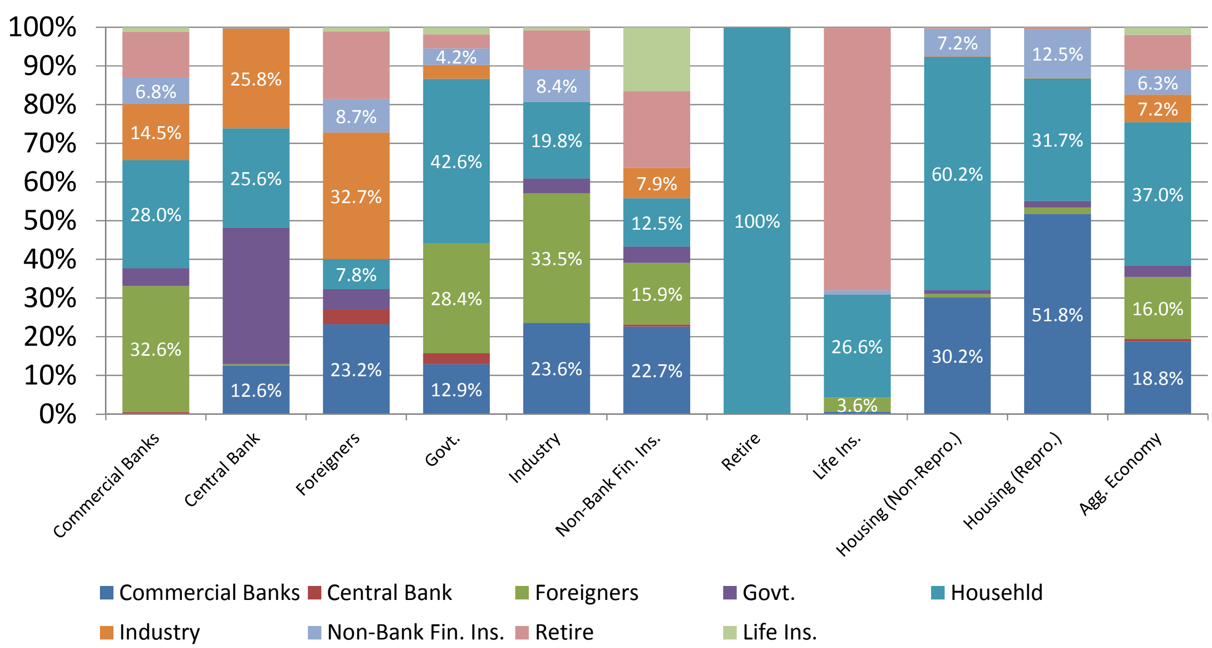

Figure 17: Decomposition of the differences in the percentage deviation from baseline of the real investment outcome in USAGE2F and VU-Nat

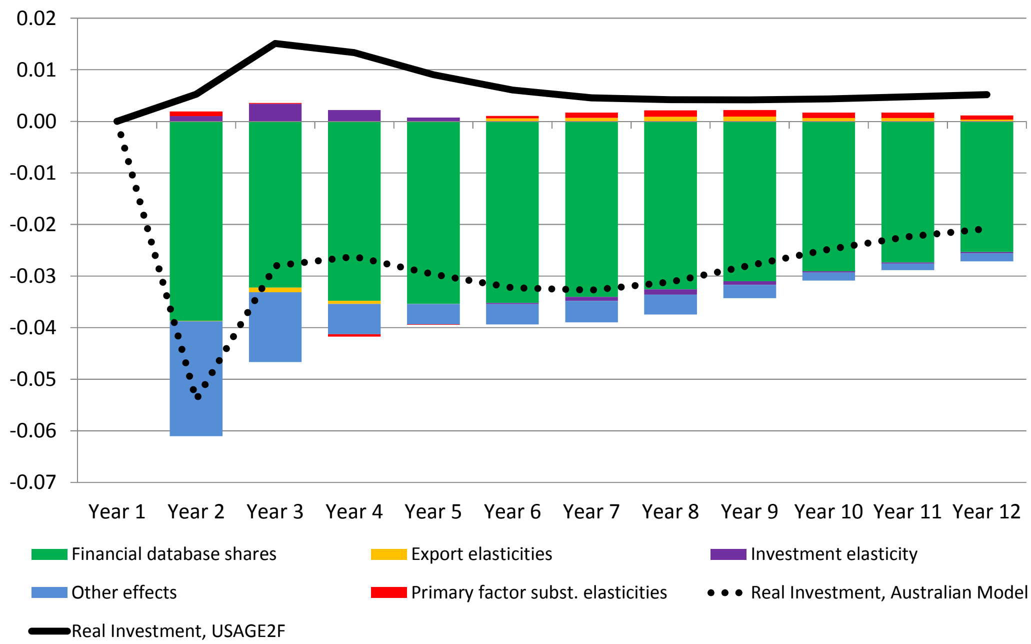

Figure 18: Decomposition of the differences in the basis point deviation from baseline of the WACC of the reproducible housing agent in USAGE2F and VU-Nat

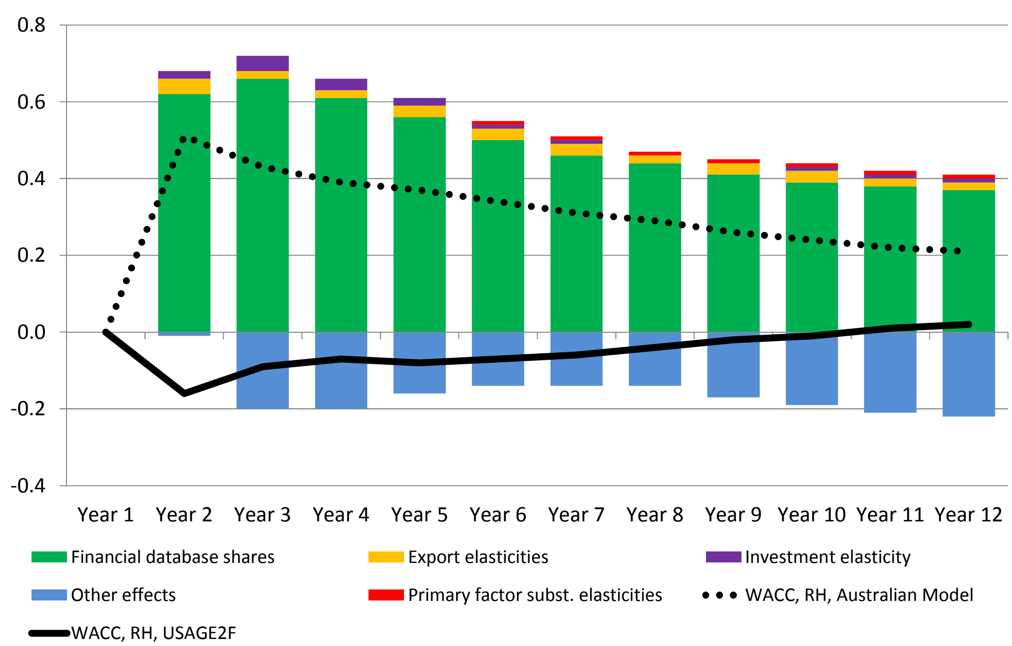

Figure 19: Decomposition of the differences in the basis point deviation from baseline of the WACC of the industry agent in USAGE2F and VU-Nat

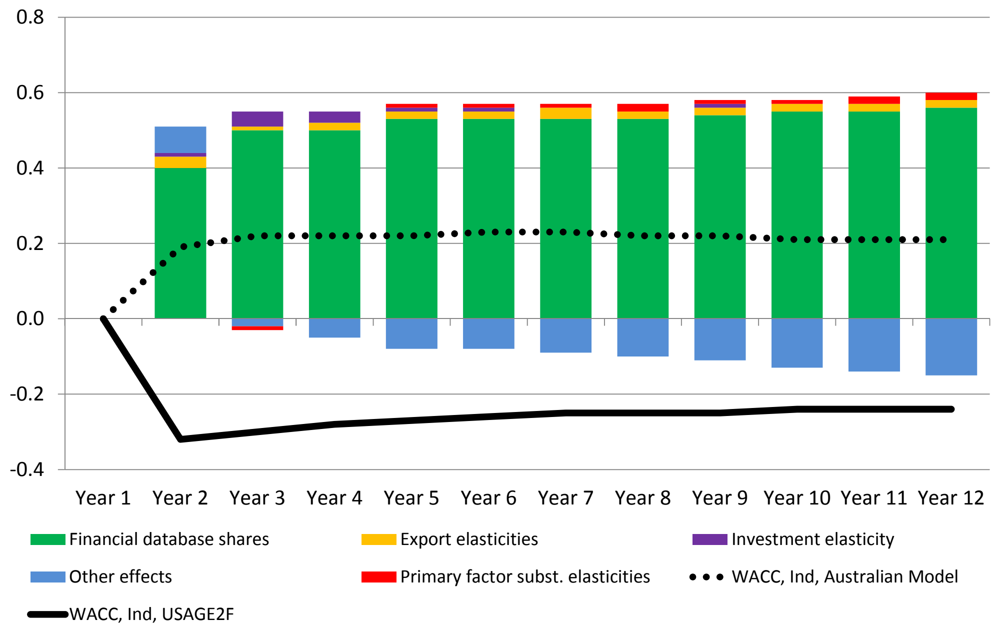

Figure 20: Decomposition of the differences in the percentage deviation from baseline of the aggregate capital stock in USAGE2F and VU-Nat

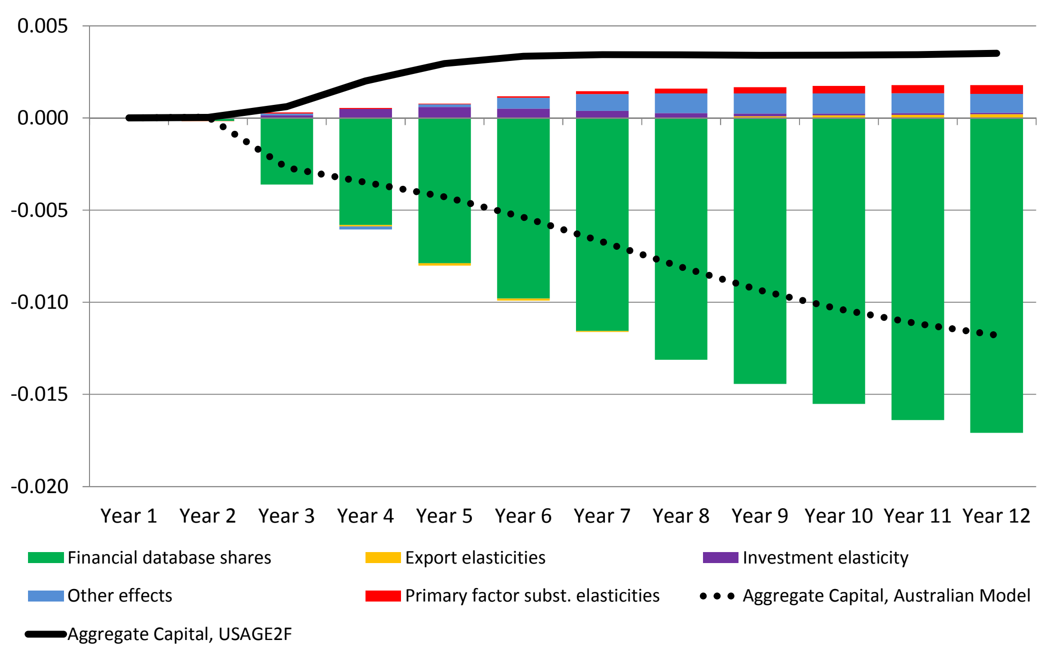

Figure 21: Decomposition of the differences in the percentage deviation from baseline of the employment outcome in USAGE2F and VU-Nat

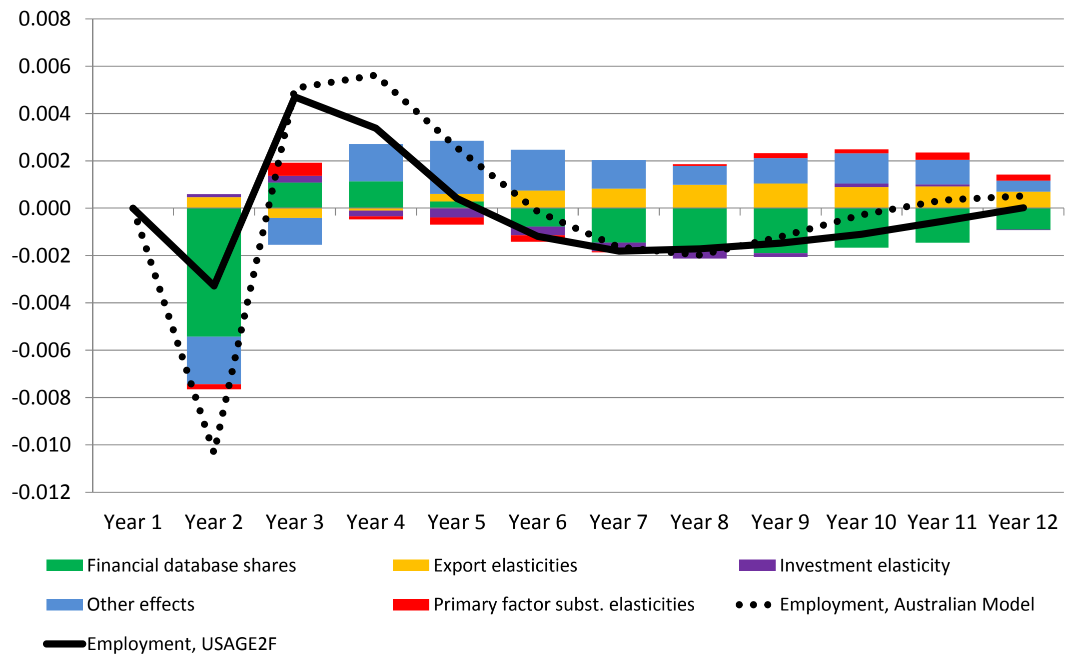

Figure 22: Decomposition of the differences in the percentage deviation from baseline of the real GDP outcome in USAGE2F and VU-Nat