What impact do differences in financial structure have on the macro effects of bank capital requirements in the United States and Australia?

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Abstract

We investigate the influence of jurisdictional differences in financial structure on the economic consequences of bank capital regulation. We use two disaggregated financial computable general equilibrium models to compare the impacts of identical increases in bank capital adequacy ratios in the U.S. and Australia. In both models, this raises bank equity financing shares, and lowers banks' risk-weighted asset holdings. Thereafter however, differences in financial structure drive contrasting outcomes: in the U.S., average costs of capital fall, stimulating real investment, while we find the opposite outcome for Australia. We attribute this to differences in the structure of bank assets (U.S. banks hold more risk-free assets) and the importance of banks as intermediaries (bank finance is more important to capital formation in Australia). This may explain why capital regulations encompass non-banks in the U.S. but not Australia.

Declarations of interest: This research was supported by the Centre for International Finance and Regulation (project number E003) and Australian Research Council project DP140100476.

JEL classification: E17, E44, G21, C68

Keywords: Macro prudential policy; Capital adequacy ratio; financial structure; financial CGE model

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[2] We are grateful to A. Prof. Gordon Menzies for his feedback and suggestions on early drafts of this paper, and to Prof. Sushanta Mallick and three anonymous referees for their suggestions and comments. Thanks also to seminar participants at the Bank of England, University of California (Davis), San Francisco Federal Reserve Bank, US International Trade Commission, US Department of Commerce, Melbourne Economic Forum on Banking, the 2017 GTAP conference and National CGE workshop in Melbourne.

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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 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 regulators. While the BCBS cannot issue binding regulation, the 1988 Basel Accord was enforced by law across all members of the G-10 in 1992 [Balthazar (2006)].

Unlike the consistent adoption of the 1988 Basel Accord, the recent Basel III regulations have been adopted "in spirit" by BCBS and non-BCBS member nations. Cross-country variation is therefore observed in the scope of regulatory adoption, and the level of regulatory detail [Kara (2016)]. This has prompted researchers to investigate factors that might contribute to inhomogeneous regulatory frameworks across countries. Several authors, e.g., see Acharya (2003), Dell'Ariccia and Marquez (2006), and Barth *et al.* (2008), highlight disparate cross-country policies with regard to bank bailouts, dissimilarities in the importance banking regulators place on bank profits relative to financial stability, and differences in cross-country political and institutional structures, as key drivers of cross-country differences in regulatory frameworks.

This article adds to this body of research, by showing how differences in financial structure in the U.S. and Australia can drive differences in the macroeconomic response to tighter bank capital requirements. Our analysis is simulation-based: we use two financial computable general equilibrium (FCGE) models, one for each of the U.S. and Australia, to simulate the economy-wide effects of a 100 basis point rise in bank capital adequacy ratios (CARs) in each country.[5]

[5] The shocks we impose are equivalent to increasing the capital adequacy ratio from 9 per cent to 10 per cent, and are thus similar in magnitude to those studied by the BIS (2010a, 2010b). They are also smaller in magnitude than the 150 basis point increase in Australian bank capital requirements that are due to take effect in January 2020 [APRA (2017)].

In focusing our study on the U.S. and Australia, we attempt to control for some of the factors identified by Archaya (2003), Dell'Ariccia and Marquez (2006), and Barth *et al.* (2008) as key drivers of cross-country differences in regulation. As developed western democracies with independent financial regulators, similar institutional and political structures exist across the two countries. In response to the economic and financial stresses caused by the 2008 financial crisis, similar government guarantee schemes were introduced for wholesale funding and large bank deposits in the two countries [Schwartz (2010); Schwartz and Tan (2016)]. We also anticipate regulators across Australia and the U.S. place comparable weights on bank profit and financial stability. In this sense, the U.S. and Australia serve as appropriate controls for the factors identified by Archaya (2003), Dell'Ariccia and Marquez (2006), and Barth *et al.* (2008).

Importantly, despite these similarities, the capital structures and asset allocations of key financial agents in Australia and the U.S. differ in interesting ways. In the U.S., the task of intermediating between investors and borrowers has shifted over time from banks to securities markets, where borrowers and savers meet more directly, albeit with the assistance of non-bank intermediaries that help borrowers issue securities and then make markets in those securities [Kohn (2010)]. 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 remain as assets on the balance sheets of the U.S. commercial banks.

In contrast, commercial banks play a more traditional intermediary role in Australia's financial system. The asset-side of Australian commercial bank balance sheets are therefore dominated by housing loans, and these loans are financed in large part by household deposits, as was noted in Australia's recent Financial System Inquiry [Commonwealth of Australia (2014)]. To provide some context to this discussion, 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 by the U.S. commercial banks. Almost double this proportion (46 per cent) were assets of U.S. GSE's. This contrasts with Australia, 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 [Australia Bureau of Statistics (2015)].

Other structural differences are evident across the two countries. Over the 50 years preceding the financial crisis, the ratio of U.S. commercial bank excess-to-required reserves at the U.S. Federal Reserve, averaged less than 10 per cent [San Francisco Federal Reserve (2013)]. In response to the financial crisis however, the U.S. Federal Reserve was granted authority to pay interest on commercial bank reserve deposits [Board of Governors of The Federal Reserve System (2008)]. As noted by San Francisco Federal Reserve (2013), this caused the ratio of excess-to-required reserves to rise sharply to 150 per cent. A similar surge in the ratio of excess-to-required reserves did not occur in Australia, partly because the impact of the financial crisis was muted relative to the U.S., but also because the Reserve Bank of Australia has always paid interest on excess reserves. As we shall see, our models of the U.S. and Australian economies carry these important differences in financial structure. We find that commercial banks in the U.S. hold a large share of low-risk financial assets (such as deposits with the U.S. Federal Reserve and U.S. government bonds, which make up approximately 20% of their aggregate financial assets), particularly when compared to Australian commercial banks (which hold only 3.2% of their assets in comparable securities). In this article, we define differences between country- and agent-specific capital structures and financial asset allocations such as those highlighted here as *differences in financial structure*.

In order to analyse whether differences in financial structure can drive differences in the impact of tighter capital regulations across countries, we require a modelling framework that can carry a high degree of agent-specific and security-specific detail. Our article therefore adopts the approach described by Giesecke *et al.* (2017), who study the impact of a 100 basis point rise in CAR for Australia using a dynamic, single-country FCGE model. Giesecke *at al*. (2017) show that, while modest macroeconomic impacts arise in response to a rise in bank CARs in Australia, e.g., real investment falls by 0.025 per cent relative to baseline while real GDP falls 0.005 per cent relative to baseline 10 years after the rise in bank CARs, the shock also secures a shift in bank lending away from housing investment, a rise in household equity financing of home ownership, and a rise in equity and bond financing of non-residential capital formation.

Other modelling frameworks have been used to study the impacts of changes in bank capital regulation in the past. For example, Akram (2014) uses a macro econometric model to study the impact of a similar shock to bank CARs in Norway. More recently, Meeks (2017) uses a standard macroeconomic vector auto regression (VAR) under a set of restrictions to isolate the impacts of regulation-induced shocks to banking system capital in the U.K. The approach by Meeks (2017) relies on confidential regulatory data for the UK, which is lacking for the U.S. and Australia. Direct application of the approach described by Akram (2014) is frustrated by a lack of sufficient agent- and instrument-specific detail within the modelling framework.

In contrast, a defining characteristic of CGE models is agent- and sectoral-detail [Dixon and Rimmer (2016)]. Using publically-available data from the Board of Governors of The Federal Reserve System Statistical Release Z.1. (2015), we derive financial stock and flow matrices that describe the capital structures and asset allocations of eleven U.S. financial agents.[6] This detailed representation of the U.S. financial economy is then embedded within an FCGE model of the U.S. economy, called USAGE2F. Our emphasis on retaining structural detail is important when seeking to understand the role that differences in financial structure between the U.S. and Australia play in driving disparate country-specific responses to tighter bank capital regulation. This necessitates our choice of modelling framework.[7]

The structure of this article is as follows. In section 2, we describe the economic and financial mechanisms that underpin the FCGE model of the U.S. economy developed herein, USAGE2F. In section 3, we use USAGE2F to study the consequences of a 100 basis point rise in the capital adequacy ratio (CAR) of U.S. commercial banks. In so doing, we are cognisant that the

[6] The financial instruments are: cash, deposits/loans, bonds, equity, and gold and SDRs. The financial agents are: commercial banks, central bank, foreigners, government, households, industries, NBFIs, superannuation, life insurance, non-reproducible housing, and reproducible housing. Non-reproducible housing comprises established inner-city dwellings. Reproducible housing comprises apartments, units and houses outside the inner-city.

[7] Our decision of financial agent and instrument disaggregation is made to facilitate a direct comparison with previous work by Giesecke *et al.* (2017).

regulatory perimeter of U.S. capital requirements extend beyond the U.S. commercial banks, and to other U.S. financial agents, e.g., the non-bank systemically important financial institutions (SI-NBFIs). Nevertheless, the question we pose herein is very specific: namely, what are the impacts of a rise in U.S. commercial bank capital requirements, holding other regulatory parameters, e.g., capital restrictions that may be in place on other financial agents, and structural parameters in line with the baseline? We describe in detail the macroeconomic effects (e.g., on real GDP, employment, consumption, investment), and the implications for U.S. financial structure.

Sections 4 and 5 are focused on attributing the striking differences we identify in key macroeconomic effects in the U.S., relative to the findings of an identical regulatory shock in Australia described by Giesecke *et al.* (2017). In section 4, we begin by identifying and summarising two main classes of differences between the U.S. and Australia that are reflected in our financial CGE models for each country: (1) differences in the real economies of each country; and (2) differences in the financial structure of each country. In section 5, we use decomposition analysis to determine the extent to which these differences account for the observed macroeconomic response variances across the two sets of results. As we show in section 5.1.1, differences in financial structure explain the bulk of the difference in macroeconomic outcomes. In contrast, parameter differences cannot explain the difference in the direction of our results, i.e., they do not explain why real investment rises in the U.S. and falls in Australia.

This finding has the potential to inform model selection in future econometric studies of cross-country differences in bank capital regulation, e.g., see Barth *et al.* (2008) and Kara (2016), in so much as we identify some of the key differences in financial structure between Australia and the U.S. that drive the contrasting country-specific results we observe. Future econometric studies might consider including the variables we identify as predictors, to assess their capacity to explain differences in cross-country capital regulation using standard model selection frameworks, e.g., the Akaike Information Criterion. We present concluding discussions in section 6.

2 The USAGE2F financial computable general equilibrium (FCGE) model

This section introduces the FCGE model developed and applied herein. We begin with a description of the model in section 2.1. The model is based on the identification of many agents and the optimising behaviour governing their actions, which is described in section 2.2. Section 2.3 summarises how capital requirements are modelled in USAGE2F.

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.[8] USAGE 2.0 is a dynamic CGE model of the U.S. economy based on the model of Dixon and Rimmer (2002).[9] In what follows, we provide 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

[8] 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. Labour market data is sourced from the U.S. Bureau of Labor Statistics (BLS).

[9] USAGE 2.0 and USAGE have been widely applied to study many economic policy questions. These include, but are not limited to, the impact of fiscal shocks [see Dixon *et al.* (2017a)]; labour market and immigration issues [see Dixon and Rimmer (2011) and Dixon *et al.* (2014)]; issues relating to trade [see Dixon *et al.* (2017b)]; and productivity shocks [see Dixon *et al.* (2017c) and Nassios and Giesecke (2018)].

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. Purchaser prices differ from basic prices by the value of margin services and indirect taxes. In addition to indirect taxes, government revenue from direct taxes is identified, as are a variety of government outlays beyond public consumption spending (such as personal benefit payments and public investment). Together with variables describing foreign transfer payments, this provides sufficient detail for the identification of the government borrowing requirement, household disposable income, and household savings. The 9 margin services facilitate flows of other commodities between producers, importers, households, government, investors and foreign agents in export markets.[10] For example, retail trade margins facilitate the flow of imported textiles to households, while pipelines facilitate the flow of oil and gas extraction industry output to petroleum refiners.

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

[10] We model wholesale and retail trade, rail and truck transport, pipelines, and international and domestic air and water transport as margin services in USAGE2F.

beyond the scope of this article, we provide a short summary in what follows. For a discussion of the FCGE model, we refer the reader to Giesecke *et al.* (2016, 2017).

The financial part of the USAGE2F FCGE model recognises five financial instruments (see Table 1 for a description of each instrument) and eleven financial agents (see Table 2 for a description of each agent).[11] 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. $A_{(s,f,d)}$, which describes the holdings by asset agent d ϵ AA (the set AA comprises all 11 asset agents in the model, such as households, the commercial banks, etc.) of financial instrument f ϵ INS (the set INS comprises all 5 financial instruments recognised in the model, such as equity, loans, bonds, etc.) issued by liability agent s ϵ LA (LA comprises all 11 liability agents in the model, such as households, government, etc.);

2. $F_{(s,f,d)}$ 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. $R_{(s,f,d)}$ 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

[11] The initial solution for the data arrays underpinning the financial module are from the Flow of Funds Accounts in the Board of Governors of The Federal Reserve System Statistical Release Z.1. (2015). This release lists the financial assets and liabilities of 29 U.S. agents, together with a single agent representing the foreign investor. In all, 27 financial instruments are used to describe the financial assets and liabilities of each of the 29 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. Herein, we map this 30 agent / 27 instrument data to an 11 agent / 5 instrument classification, thus establishing a concordance with the Australian financial database applied by Giesecke *et al.* (2017).

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 ($R_{(s,f,d)}$).

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 Modelling asset allocation and capital structure decisions

Various approaches exist to integrate real-side CGE models with a detailed theory of the financial sector, e.g., see Yeldan (1997), Giesecke *et al.* (2016, 2017) and Liu *et al.* (2015). Each implementation differs in the degree of financial agent disaggregation, and bespoke regulation, e.g., capital regulation, imposed on the financial agents they distinguish. In this section, we adopt a similar approach to Giesecke *et al.* (2016, 2017) and summarise the optimisation problems that govern the financial asset allocation decisions faced by the agents in USAGE2F.

To begin, we assume that domestic liability agent $s \in$ LA [subject to a need to raise a given amount of new financial capital [$NEWLIAB_{(s)}$] minimises a constant elasticity of transformation (CET) function in which the arguments are end-of-year liabilities weighted by the returns that must be paid on those liabilities. That is, we assume that liability agent s chooses $A1_{(s,f,d)}$ for all (f,d) to:

$$\text{Minimise:} \qquad CET\left(A1_{(s,f,d)} \cdot R_{(s,f,d)}, \forall\, f,d\right) \qquad \left(s \in LALF\right)$$

$$\text{subject to:} \qquad NEWLIAB_{(s)} = \sum_f \sum_d \left(A1_{(s,f,d)} - A0_{(s,f,d)} \cdot V_{(s,f,d)}\right)$$

where $R_{(s,f,d)}$ is as defined in section 2.1 and the set of liability agents are denoted LA. The domestic liability agents are LALF: {LALF = LA - FoR}, where FoR is the foreign liability agent. We also define:

$A0_{(s,f,d)}$ and $A1_{(s,f,d)}$	as the beginning- and end-of-year values of financial instrument $f \in$ INS issued by liability agent $s \in$ LA and held by asset agent $d \in$ AA;
$V_{(s,f,d)}$	is a revaluation term.

We assume that domestic asset agents $d \in$ AA choose the allocation of their end-of-year portfolio across domestic and foreign assets in order to maximise a constant elasticity of substitution

(CES) function in which the arguments are end-of-year asset holdings weighted by rates of return. That is, we assume that domestic asset agent *d* chooses $A1_{(s,f,d)}$ for all (*s*, *f*) to:

$$\text{Maximise} \qquad CES\left(A1_{(s,f,d)} \cdot R_{(s,f,d)}, \forall s, f\right) \qquad \left(d \in AALF\right)$$

$$\text{subject to:} \qquad NEWASSET_{(d)} = \sum_s \sum_f \left(A1_{(s,f,d)} - A0_{(s,f,d)} \cdot V_{(s,f,d)}\right)$$

where AALF: {AALF = AA - FoR} is the set of domestic asset agents[12] and $NEWASSET_{(d)}$ is the budget of asset agent $d \in$ AA for net new acquisitions of financial assets over the year[13]. The solutions to these optimisation problems, in percentage change form, are:

$$a1_{(s,f,d)} = liabilities_{(s)} - \tau_{(s)}\left(r_{(s,f,d)} - wacc_{(s)}\right), \quad \left(s \in LALF\right), \tag{1}$$

$$a1_{(s,f,d)} = assets_{(d)} + \sigma_{(d)}\left(r_{(s,f,d)} - averor_{(d)}\right), \quad \left(d \in AALF\right). \tag{2}$$

In equations (1) and (2), $a1_{(s,f,d)}$ and $r_{(s,f,d)}$ are the percentage rates of change in $A1_{(s,f,d)}$ and $R_{(s,f,d)}$ respectively, while $assets_{(d)}$ and $liabilities_{(s)}$ are the percentage changes in end-of-year assets and liabilities of agents *d* and *s* respectively. The variable $wacc_{(s)}$ is the percentage change in the weighted average cost of capital (WACC) for liability agent *s*, with $averor_{(d)}$ defined as the average rate of return received by asset agent *d* on its portfolio. The positive parameters $\tau_{(s)}$ and $\sigma_{(d)}$ govern the elasticity of a financial agent's capital structure and asset allocation weights (respectively) to movements in relative rates of return.

2.3 Modelling the capital adequacy ratio

2.3.1 Asset demand by commercial banks

We model the effects of the capital adequacy ratio and risk weights on bank behaviour using the approach by Giesecke *et al.* (2017). We assume that U.S. commercial banks (ComB) choose their end-of-year asset portfolio, $A1_{(s,f,ComB)}$ for all $s \in$ LA and $f \in$ INS to maximize:

[12] The foreign agent solves the same problem, but is concerned with the foreign currency value of its holdings.
[13] For example, for the household agent, NEWASSET is the value of household savings.

$$U(R_{(s,f,ComB)} \times A1_{(s,f,ComB)}, \text{ for all s and f}), \quad (3)$$

subject to

$$\sum_{s,f} A1_{(s,f,ComB)} = BB_{(ComB)}, \quad (4)$$

and

$$\sum_{d} A1_{(ComB,equity,d)} = \\ MAX\left[\sum_{d} A1zero_{(ComB,equity,d)}, KAR \times \sum_{s,f} W_{(s,f,ComB)} \times A1_{(s,f,ComB)}\right], \quad (5)$$

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

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

Equity liabilities are relatively expensive. Consequently, we approximate problem (3) - (5) as:

Choose $A1_{(s,f,ComB)}$ for all s ϵ LA and f ϵ INS to maximize:

$$U(NR_{(s,f,ComB)} \times A1_{(s,f,ComB)}, \text{ for all s and f}), \quad (6)$$

subject to:

$$\sum_{s,f} A1_{(s,f,ComB)} = BB_{(ComB)}, \quad (7)$$

where:

$$NR_{(s,f,ComB)} = R_{(s,f,ComB)} - \Psi \times KAR \times W_{(s,f,ComB)}, \quad (8)$$

and Ψ is a positive parameter.

In equation (8) 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 CAR 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, for example) would barely move, from 0.0008 to 0.001 (an increase of 2 basis points). By changing the CAR 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 Giesecke *et al.* (2017). Here, we draw out the key parts of the discussion in that paper that are relevant to the current simulation. To begin, consider equations (9) – (14):

$$\begin{aligned}&\text{RABANK} \times \text{prabank} = \\ &\sum_{s\in LA}\sum_{f\in FI}[\text{RISKWGT}_{(\text{s,f})} \times \text{A1}_{(\text{s,f,ComB})}]\times(\text{priskwgt}_{(\text{s,f})} + \text{a1}_{(\text{s,f,ComB})}),\end{aligned} \tag{9}$$

$$\text{EQBANK} \times \text{peqbank} = \sum_{d\in AA} \text{A1}_{(\text{ComB,Equity,d})} \times \text{a1}_{(\text{ComB,Equity,d})}, \tag{10}$$

$$\text{pratio} = \text{peqbank} - \text{prabank}, \tag{11}$$

$$\begin{aligned}&\text{BBNEQ}_{(\text{ComB})} \times \text{pbblneq}_{(\text{ComB})} = \\ &\text{BBL}_{(\text{ComB})} \times \text{pbbl}_{(\text{ComB})} - \sum_{d\in AA} \text{A1}_{(\text{ComB,Equity,d})} \times \text{a1}_{(\text{ComB,Equity,d})},\end{aligned} \tag{12}$$

$$\text{averorne}_{(\text{ComB})} = \sum_{d\in AA}\sum_{f\in FINEQ}[\text{A1}_{(\text{ComB,f,d})} / \text{BBNEQ}_{(\text{ComB})}]\times \text{rpow}_{(\text{ComB,f,d})}, \tag{13}$$

$$a1d_{(ComB,f)} = pbblneq_{(ComB)} + TAU \times [rpowd_{(ComB,f)} - averorne_{(ComB)}], \text{ where } (f \in FINEQ). \quad (14)$$

For a definition of the variables in equations (9) – (14), we refer readers to Table 3.

Equation (9) calculates the percentage change in the risk-weighted value of end-of-year commercial bank assets. The risk weight on financial instrument $f \in$ INS issued by liability agent $s \in$ LA and held as an asset by banks is given by $RISKWGT_{(s,f)}$, and we summarise the risk weights adopted in USAGE2F in Table 4. In choosing values for $RISKWGT_{(s,f)}$ herein, we are guided by: (i) the comprehensive set of standardised risk weights for Australian depository institutions by APRA (2013); (ii) the simple risk weight approach (SRWA) for U.S. depository institutions described by the U.S. Department of Treasury (2012); and (iii) our desire to explore the impact of differences in the macroeconomic and financial structures of Australia and the U.S. Because APRA (2013) and The U.S. Department of Treasury (2012) offer similar guidance on asset risk weights, we parameterise RISKWGT according to the conventions adopted by Giesecke *et al.* (2017), who relies on APRA (2013).[14]

Equation (10) 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 (11) 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 (11) 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. This is provided by equations (12), (13) and (14). Equation (12) calculates the non-equity financing needs of commercial banks ($pbblneq_{(ComB)}$) as the difference between total (equity-inclusive) bank financing needs ($pbbl_{(ComB)}$) and that part of bank financing needs satisfied by equity. Equation (13) calculates the weighted-average value of the cost of non-

[14] 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.

equity finance to agent $s \in$ LA. Equation (14) establishes bank liability optimising behaviour over the issuance of non-equity financing instruments.

2.4 Closure and implementation method

We make the following closure assumptions, in line with those in Giesecke *et al.* (2017):

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 follows its baseline path. We further assume that the ratio of public sector borrowing to GDP follows its baseline path. The exogenous status of both public consumption and the PSBR/GDP ratio requires the flexible determination of a government revenue instrument. Hence, 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); Giesecke *et al.* (2017)].

Both the U.S. and Australian models are solved using the GEMPACK economic modelling software package [Harrison and Pearson (1996)].

3 Results

The shock is a 100 basis point increase in the CAR of commercial banks. On the liability side of the banks' balance sheet, the increase in the CAR causes banks to increase issuance of equity instruments [see equation (11)], and decrease their reliance on deposit and bond financing. This compositional shift is highlighted in Figure 1. Via equation (8) (where the bank capital adequacy ratio is defined as the variable *KAR*), the shock alters the relative net rates of return on bank financial assets. This in turn causes banks to adjust the composition of the asset side of their balance sheets. Specifically, the rise in CAR induces banks to reduce holdings of risky assets, which is clear in Figure 1 and Figure 2. In Figure 1, 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 2 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).[15]

As already discussed, the rise in the CAR causes banks to raise additional equity finance, and reduce their use of deposit and loan finance (Figure 1). To attract asset agents to acquire the new equity, rates of return on bank equity must rise (Figure 3). 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 3). In the USAGE2F financial database, commercial banks source 65 per cent of their deposit finance from U.S. households, with these deposits making up 12 per cent of the financial assets of U.S. households. The fall in the rate of return on bank deposits induces households (and other agents who hold bank deposits as financial assets) to rebalance their financial assets away from bank deposits. This rebalancing is highlighted in Figure 4, where we focus explicitly on the change (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 4, 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. However, a large proportion of the household's financial capital is reinvested in NBFI equity, triggering an expansion of the NBFI sector (see Figure 1).

Households also invest a large proportion of their reallocated financial assets in Industry equity (Figure 4). 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 5.

[15] As we shall discuss, in the long-run the commercial bank's balance sheet contracts (see the grey line in Figure 2). Ceteris paribus, the commercial bank's allocation to financial assets with lower risk weights such as government bonds also falls. This is shown in Figure 2, where the bank's 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 its balance sheet.

The aggregate supply of financial capital to Industry therefore increases (see the solid line in Figure 5), driving non-dwelling investment higher (Figure 6).

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. In the USAGE2F financial database, the GSE's are subsumed within the NBFI sector, together with other non-bank financial intermediaries. The NBFI agent in USAGE2F is therefore a significant owner of U.S. residential mortgages. For example, from Table 5 we see that 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. reproducible housing loan liabilities are financial assets of the banks (28.7 per cent, see Table 5).

For this reason, the expansion of the NBFI sector (Figure 1) that results from a rise in the CAR of the commercial banks (Figure 4) has important implications for U.S. housing investment. As previously discussed, in response to a rise in their CAR, the commercial banks reduce their risk-weighted asset exposure (as shown in Figure 2), which includes a reduction in their allocation to risky reproducible housing loans (Figure 1). 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 finance provision by households shown in Figure 4), the provision of NBFI-loan finance for reproducible housing rises (see Figure 7). This partially offsets the reduction in loan finance provision by commercial banks (Figure 7). 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 4 and Figure 7). 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 5]), 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 7), elevating housing investment relative to baseline (see Figure 6). With both components of aggregate investment slightly elevated relative to baseline, so too is aggregate investment (see Figure 6).

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 aggregate 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 physical capital formation.

With regard to the broader macroeconomic impacts of a rise in bank CAR, we begin by noting that the model recognises that the share of the NBFI sector's financing needs that are met by foreigners (17 per cent) exceeds that of commercial banks (7 per cent). As previously discussed, the rise in the bank CAR reduces the size of the banking sector (Figure 1), which is partly offset by an increase in the size of the NBFI sector (see Figure 1, Figure 5 and Figure 7). 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 appreciation of the nominal exchange rate (Figure 8).

As is clear from Figure 5 and Figure 7, the balance sheets of the industry and reproducible housing sectors (respectively) shift away from loan finance and towards equity finance. Because a rise in bank CARs raises the cost of bank debt finance, households 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 occurs (Figure 8). With the economy-wide nominal wage given in the year the capital adequacy ratio is increased (see section 2.4), nominal appreciation causes the domestic price level to fall relative to baseline. This is evident in Figure 9, 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 9).

As discussed in section 2.4, 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 9), account for the initial negative deviation in the policy rate (see Figure 10). The changes in the policy rate reported in Figure 10 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 capital stock adjusts to shifts in 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 10).[16]

[16] To put these outcomes 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 simulation 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 11 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 11). This causes a small positive deviation in GDP over the medium- to long-run, of the order of 0.002 per cent.

Figure 12 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 12). 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 8). The rise in the terms of trade relative to baseline explains why the consumption deviation lies above the GDP deviation (Figure 12).

4 Comparing the impacts of a rise in CAR in the U.S. and Australia

As we described in section 2, the theoretical structures of the Australian FCGE model discussed in Giesecke *et al.* (2017), and U.S. FCGE model developed herein, are very similar. However, they differ in their parameterisations and in the financial structure of the two economies that are reflected in the respective model databases. Are the differences in macro effects, e.g., the change in sign of investment and GDP outcomes across the two countries, caused by differences in financial structure, or matters related to the real-side of the two economies? The remainder of this section is concerned with summarising the key real-side parameters we consider herein, as well as the many differences in financial structure that exist between the two economies.

4.1.1 Differences in the real economy

We begin 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 on capital 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 smaller in magnitude than the corresponding values in the Australian model.

We explore the impact of each of these differences to the paths generated for macroeconomic variables in the U.S. and Australia, in response to identical 100 basis point rises in bank CARs.

4.1.2 Differences in financial structure

Differences in the financial structure of the two economies are 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 stock and flow data arrays ($A_{(s,f,d)}$ and $F_{(s,f,d)}$) to more closely resemble the structure of the Australian financial economy, while maintaining values for aggregate U.S. 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 (see Table 5) 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 $A_{(s,f,d)}$ and $F_{(s,f,d)}$ arrays using a bi-proportional scaling algorithm.

As we will demonstrate in this section, U.S. banks play a much smaller role in financing the financial liabilities raised by other U.S. financial agents. In modifying the U.S. financial database to more resemble the underlying structure of the Australian financial system, we therefore increase the importance of banks as financial intermediaries. To describe some important differences in financial structure that are reflected in the USAGE2F shares and the Australian database shares, we use Table 6 (U.S. model financial database) and Table 7 (Australian model financial database), which summarise the proportion of each financial agent's liabilities that are owned by other financial agents. In preparing Table 6 and Table 7, we have condensed the financial instrument dimension to emphasise the structure of inter-agent dependencies. Some differences are immediately apparent; in Table 6 we observe that the U.S. reproducible housing sector obtains 18 per cent of its finance from banks, while Table 7 shows that the Australian reproducible housing sector is majority (52 per cent) financed by commercial banks. This is also emphasised in Table 5, where we expand the instrument dimension and present a comparison of the U.S. and Australian financial database ownership shares for loans to reproducible housing and industry, as well as the supply of equity finance to industry and NBFI's.

In both the U.S. and Australia, the debt-to-equity ratios of the reproducible housing sectors are similar. However, we see in Table 5 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 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 larger role in funding housing investment in the U.S. relative to Australia. This is also evident in a comparison of Table 6 and Table 7, which shows that 42 per cent of the liabilities of the U.S. reproducible housing sector are assets of the NBFI's, compared to 12 per cent in the Australia.

In describing the USAGE2F simulation in section 3, we highlight 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 in the U.S., and the return on bank deposits in the U.S. fell, U.S. households adjust the composition of their asset portfolios 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. This asset switching includes a sizeable reallocation towards direct investment in industry and NBFI equity. In the U.S., households own 41 per cent and 35 per cent of industry and NBFI financial liabilities, respectively. The proportion of Australian industry and NBFI liabilities owned directly by Australian households is much smaller (20 per cent and 12 percent, respectively).

Who finances Australian industry? Once again, Australian banks play an important role in facilitating the provision of non-residential finance, owning 24 of overall Australian industry liabilities as financial assets (see and Table 7). The corresponding share in the U.S. is 6 per cent (see Table 6). Direct foreign investment also plays a more significant role in Australia: 33 percent of Australian industry liabilities are foreign-owned, whereas in the U.S., the share is 20 per cent (see Table 6 and Table 7).

The bank intermediation channel also plays a larger role in financing the activity of Australian NBFI's, relative to their U.S. counterparts. Australian banks own 23 per cent of the aggregate financial liabilities issued by NBFIs (Table 7). This is almost double the share of U.S. NBFI liabilities owned by U.S. banks (12 per cent, see Table 6).

5 Cross-model attribution analysis

In this section, we study the degree to which the factors discussed in section 4 are responsible for the dissimilarities we observe between Australian and U.S. macro responses to a rise in bank CARs. Our analysis focuses on a series of decomposition figures. These figures are created by running USAGE2F five times, with each model run subject to the same 100 basis point increase in the CAR 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 of Australia;

3. A third run, adjusting the primary-factor-substitution elasticity to the Australian model values;

4. A fourth run, where we adjust the export demand elasticities to match the Australian export demand elasticities;

5. A final run, where the USAGE2F financial database is adjusted following the process outlined in section 4.1.2.

We then study 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.

5.1.1 The response to a rise in CAR in Australia and the U.S.: similarities and differences

While the magnitudes of the deviations from baseline differ slightly, some of the implications of a rise in the bank CAR for the U.S. are similar to those described by Giesecke *et al.* (2017) for Australia. For example, as described for USAGE2F and shown in Figure 1, banks accommodate the higher CARs in three ways: (1) they issue more equity; (2) they contract slightly; and, (3) they reduce their exposure to assets with higher risk weights.

However, the implications of these responses for key macro effects, for example the response of real investment, differ in sign: U.S., real investment rises despite a smaller banking industry, while in Giesecke *et al.* (2017), Australian real investment falls. Figure 13 reports the deviation in real investment from baseline forecast that is caused by an equivalent 100 basis point rise in bank CARs in the U.S. and Australia. The figure explains the difference in terms of the four decomposition factors described in section 4, and a residual. Figure 13 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 from Giesecke *et al.* (2017). The grey 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 on capital, to match the corresponding 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 grey bars in Figure 13. As shown in Figure 13, 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 bars represent the impact on the USAGE2F result as we progressively alter the primary factor substitution elasticity (black bars), export demand elasticities (wave pattern bars), financial database shares (dotted bars), and our residual item (vertical dashed bars). This residual captures the impact of the other real-side differences between the two economies. The sum of the decomposition bars accounts for the full gap between the USAGE2F results for the U.S., and the VU-Nat results in Giesecke *et al.* (2017).

As shown in Figure 13, the bulk of the deviation between the U.S. and Australian results for real investment is attributable to financial structure. This is because the financial database shares exert a strong influence on the relative movements across the two models of the weighted cost of capital (WACC) of the reproducible housing and industry agents. Decomposition diagrams for each agents' WACC results are presented in Figure 14 and Figure 15, and are to be interpreted in an identical way to Figure 13. In USAGE2F, the WACC for each agent falls because the supply of financial capital to each agent increases (see the solid lines in Figure 5 and Figure 7). This in turn stimulates housing and non-housing investment (see Figure 6). As shown in Figure 14 and Figure 15, the impact of the financial database shares (dotted bars) on the WACC of each agent is large and positive, i.e., modifying the USAGE2F financial database shares to look more like the Australian shares increases the WACC for both agents, ceteris paribus. Again, relative to the other real-side factors, the differences in financial structure 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 4.1.2 to explain this.

When the CAR is increased in the U.S., the WACC of the reproducible housing sector falls because of a rise in lending to reproducible housing by the NBFI sector. As discussed in section 4.1.2, the NBFI sector is the key provider of loan finance to reproducible housing in the U.S. The U.S. NBFI sector can increase lending to reproducible housing, because as discussed in section 3, demand by the household sector (and other sectors who hold bank deposits as assets) for NBFI liabilities increases, because the composition of their financial assets changes when the return on commercial bank deposits falls. With a large share of the household asset portfolio invested in

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 1).

As discussed in section 4.1.2, banks play a more traditional intermediary role in the Australian financial system.[17] The majority of reproducible housing loans are on the balance sheets of Australian banks (75.8 per cent), with a smaller share being financial assets of Australian 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. By changing U.S. financial structure to mirror that in Australia, we impose similar constraints on the capacity of the U.S. housing sector to substitute one form of finance for another. This damps U.S. investment.

An additional factor, which was discussed in both the introduction and section 3, is that 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 U.S. Federal Reserve deposits and U.S. government bonds. While the asset portfolios of U.S. NBFIs also have a high weighting (approximately 10 per cent) to U.S. government bonds (particularly compared to their Australian counterparts, as we will discuss), this share is much lower than the U.S. commercial banks. In Australia, about 3.2 per cent of 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.[18] 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 finance capital formation, but a 90 cent increase in NBFI lending to capital formation activities. This also accounts for the fall in the WACC of the U.S. industry and reproducible housing sectors. Because

[17] Put another way, our findings support the notion that the bank-lending channel described by Bernanke and Blinder (1988) and summarised by Kashyap and Stein (1994), plays a smaller role in the U.S. financial system than the Australian financial system.
[18] By risky lending, we refer to their appetite for financial assets other than Federal Reserve/RBA reserve deposits, or government bonds.

the risky asset ownership shares of Australian NBFIs and commercial banks are similar, and commercial banks allocate a larger share of their aggregate financial assets to the purchase of reproducible housing loans (23%) than NBFIs (16%), a rise in CAR causes an increase in the WACC of the Australian reproducible housing agent (Figure 14).[19]

In summary, when we raise bank CAR in both models, differences in the ownership shares of industry and reproducible housing financial liabilities across financial agents in Australia and the U.S. alter the direction of the deviation in the weighted costs of capital. This drives real investment deviations of similar magnitudes across the two economies, but of different directions. With real investment falling in Australia but increasing in the U.S. relative to baseline, we expect movements in physical capital stocks in the Australian and U.S. models to also differ. This difference is highlighted in Figure 16. With a large proportion of the difference in the real investment result from each model being caused by differences in financial structure in the U.S. and Australia (see the dotted bars in Figure 13), we find that most of the deviation between the results for physical capital can also be explained by the financial database shares.

The difference in the physical capital outcome for each model (Figure 16) accounts for the bulk of the difference in the long-run real GDP outcomes for the U.S. and Australia (Figure 17). 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 dotted bars in Figure 17).

5.1.2 Summary of findings and policy implications

The results presented establish the potential importance of differences in financial structure between countries, particularly with regard to explaining differences in the macroeconomic implications of otherwise identical changes in regulation. Jurisdiction-specific differences in

[19] Australian industry is also more dependent on commercial bank financing than their U.S. counterparts, and similar arguments to those presented here can be made to explain the results in Figure 15. For brevity, we do not repeat this rationale here.

financial structure may therefore provide some impetus for jurisdiction-specific differences in capital regulation, to ensure that the macroeconomic outcomes desired by regulators are secured when capital requirements are changed. Our work therefore contributes both to the literature on the drivers of cross-country differences in capital regulation, e.g., see Acharya (2003), Dell'Ariccia and Marquez (2006) and Barth *et al.* (2008), and to a growing literature on the impact financial structure has on the effects of economic policies and shocks, e.g., see Wang *et al.* (2016).

In our decomposition analysis, we go beyond studying whether financial structure differences are the sole contributing factor driving differences in Australian and U.S. simulation results, by performing a parameter sensitivity analysis. The parameters we alter are the commodity-specific export demand elasticities, industry-specific labour/capital substitution elasticities, and the industry-specific investment elasticities. As we show in our decomposition charts, when these parameters are altered in the U.S. model (independently of changes in financial structure) to match the corresponding Australian parameter values, the impact on the U.S. results are small. They do not explain, for example, why real investment rises in the U.S. and falls in Australia.[20]

With regard to the policy implications of our findings, a consequence of increasing the capital requirements of U.S. banks in USAGE2F is expansion of the non-bank financial intermediary sector. Is concentration of loan and finance provision within a sector whose capital requirements are now less stringent than the U.S. banking sector, likely to improve U.S. macroeconomic stability? If the answer to this question is no, then a natural policy implication of the findings we have presented is that a broader regulatory perimeter may be necessary. Interestingly, the Dodd-Frank Wall Street Reform and Consumer Protection Act (DFA) provides a mandate for the U.S. Federal Reserve Board to declare some NBFIs as non-bank systemically important financial institutions (NB-SIFI's). These NB-SIFI's are prudentially regulated, in a similar way to the U.S. depository institutions. As highlighted by the Reserve Bank of Australia (2019), no such prudential regulation is imposed on Australian non-bank financial intermediaries. In our analysis, we

[20] This parameter sensitivity analysis also establishes that, if in altering financial structure we also alter model parametrisation, i.e., U.S. parameter estimates converge to the Australian parameter specifications, the impact of these changes on our U.S. simulation results are expected to be small.

highlight the strength of the bank lending channel (measured by the size of the commercial banking sector relative to the size of the non-bank financial intermediary sector), and the relative appetite for risky lending by the banks and NBFIs, as two important elements of financial structure that can be used to gauge whether country-specific, tailored capital requirements may be desirable.

6 Conclusion

Following the widespread economic impact of the global financial crisis, a cornerstone principal of the Basel III framework released in 2010 was a significant increase in the minimum capital requirements of commercial banks [Basel Committee On Banking Supervision (2011)]. Along these lines, recent work by Giesecke *et al.* (2017) explored the impact of a 100 basis point increase in the capital adequacy ratio of commercial banks in Australia, showing that such a rise in capital adequacy requirements has a modest macroeconomic impact, while securing a rise in tier-1 bank capital, a shift in bank lending away from residential investment, and a rise in household equity financing of home ownership.

In this article, we have explored the impact of an equivalent shock to the capital adequacy ratio of U.S. commercial banks. Our shock is therefore very specific: we do not alter the capital requirements of other U.S. financial agents. This is achieved via the development of a financial CGE model of the U.S. economy, USAGE2F. Like Giesecke *et al.* (2017), we find the macroeconomic impacts of a 100 basis point rise in the CAR of the commercial banks are small, but differ in important ways from results 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 between countries therefore have the potential to cause inhomogeneous macroeconomic responses to identical changes in capital regulations. If regulators are aware of this, we would expect it to influence differences in the details of financial sector regulation across countries. We suspect U.S. regulators are indeed cognisant of the factors discussed herein, because jurisdiction-specific differences do exist between the Australian and

U.S. capital regulations. In the U.S., non-bank systemically important financial institutions are subject to strict prudential regulatory standards and supervision by the Federal Reserve Board (FRB), i.e., they are regulated like commercial banks. This would have the effect of damping, or reversing entirely, the kind of stimulus we observe herein when we simulate a 100 basis point rise in bank capital adequacy ratios in the U.S. using USAGE2F. An interesting direction for future research would be to confirm this result.

Future work along the lines of Barth *et al.* (2008) and Kara (2016), which explored some of the causes of cross-country differences in legislated capital regulations, might also consider including predictors that capture cross-country differences in financial sector structure in their econometric analyses. Based on our findings, suitable variables include the share of commercial bank and non-bank financial intermediary aggregate financial assets that are invested in relatively safe or low risk-weight assets, e.g., deposits with the central bank and/or holdings of government bonds. The validity of such models can then be tested using standard econometric model validation procedures.

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Tables

Table 1: Financial instruments, USAGE2F database

Instrument	Description
Bonds	Interest-bearing securities of varying terms to maturity.
DepLoans	Loans that may be secured by a physical asset.
Cash	Cash; can be either denominated in US$ or foreign currency
GoldSDRs	Gold or Special Drawing Rights
Equity	Any claim that lies further along the risk-return spectrum relative to Bonds.

Notes: This table summarises and describes the financial instruments we distinguish in USAGE2F and VU-Nat.

Table 2: Financial agents, USAGE2F database

Agent	Description
HLD	The representative household
IND	Nonfinancial industries, excluding housing
GOV	The representative government, i.e., the local, state and federal governments
CB	The U.S. federal reserve
BNK	Authorised private depository institutions
LFE	Property, casualty and life Insurers
RET	Retirement/superannuation funds
NBFI	Financial institutions excluding the banking sector
FGN	Non-domestic investors
RH	Reproducible housing, being new apartments or property in new housing estates.
NRH	All residential property not classified as reproducible.

Notes: This table summarises and describes the financial agents we distinguish in USAGE2F and VU-Nat.

Table 3: Variables defined to model bank capital adequacy in 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.

Variable	Description
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 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*.

Notes: This table describes the variables required to model bank capital requirements in the FCGE model. See section 2.3 for the equation system.

Table 4: Risk weights on commercial bank assets.

Parameter	Description	Value
$RISKWGT_{(CB,f)}$ $(\forall\ f \in FI)$	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

Notes: This table summarises the risk weights we assign to various financial assets owned by U.S. and Australian commercial banks. In choosing values for RISKWGT, we rely on Giesecke et al. (2017).

Table 5: Selected instrument-specific USAGE2F and VU-Nat financial database shares.

	BNK	CB	FGN	GOV	HLD	IND	NBFI	RET	LFE	NRH	RH

RH Loans											
(1) USAGE2F (U.S.)	28.7	0.0	0.0	2.1	0.5	0.4	67.7	0.1	0.5	0.0	0.0
(2) Australian model	75.8	0.0	2.3	2.6	0.0	0.3	18.2	0.8	0.0	0.0	0.0
(a) Difference [(2) – (1)]	***47.1***	***0.0***	***2.3***	***0.5***	***-0.6***	***-0.1***	***-49.5***	***0.7***	***-0.5***	***0.0***	***0.0***
IND Loans											
(3) USAGE2F (U.S.)	50.7	0.0	16.9	4.0	0.6	0.0	27.1	0.0	0.7	0.0	0.0
(4) Australian model	65.5	0.0	16.5	8.5	3.1	0.0	5.9	0.0	0.5	0.0	0.0
(b) Difference [(4) – (3)]	***14.8***	***0.0***	***-0.4***	***4.5***	***2.5***	***0.0***	***-21.2***	***0.0***	***-0.2***	***0.0***	***0.0***
IND Equity											
(5) USAGE2F (U.S.)	0.2	0.0	18.8	1.4	50.9	0.0	13.9	10.8	4.0	0.0	0.0
(6) Australian model	1.1	0.0	37.9	1.3	32.0	0.0	10.0	16.8	0.9	0.0	0.0
(c) Difference [(6) – (5)]	***0.9***	***0.0***	***19.1***	***-0.1***	***-18.9***	***0.0***	***-3.9***	***6.0***	***-3.1***	***0.0***	***0.0***
NBFI Equity											
(7) USAGE2F (U.S.)	0.7	0.1	9.5	1.7	54.1	7.4	0.0	23.2	3.3	0.0	0.0
(8) Australian model	3.3	0.0	12.0	4.8	19.1	6.1	0.0	28.9	25.8	0.0	0.0
(d) Difference [(8) – (7)]	***2.6***	***-0.1***	***2.5***	***3.1***	***-35.0***	***-1.3***	***0.0***	***5.7***	***22.5***	***0.0***	***0.0***

Notes: Herein, we do not summarise the full set of USAGE2F and VU-Nat financial database portfolio weights. Instead, we present some weights that are important in describing our results. Table 5 is to be read in conjunction with Table 6 and Table 7. Whereas Table 6 and Table 7 describe the capital structure of all financial liability agents in USAGE2F and VU-Nat (respectively) by condensing instrument detail, Table 5 unpacks some instrument-specific detail for three liability agents in the model: RH, IND and NBFI. All USAGE2F and VU-Nat database shares in rows (1) – (8) in Table 5 sum to 1, while differences [rows (a) – (d)] sum to zero.

Table 6: Capital structure by liability agent (%), USAGE2F model financial database

Liab agent \ Asset agent	BNK	CB	FGN	GOV	HLD	RET	IND	LFE	NBFI	NRH	RH	*Tot*
Commercial banks (BNK)	-	1	7	3	52	2	10	1	24	-	-	*100*
Central Bank (CB)	55	-	17	4	9	-	8	1	6	-	-	*100*
Foreign Investor (FGN)	6	-	-	3	19	8	29	9	26	-	-	*100*
Government (GOV)	3	9	28	-	13	27	5	4	12	-	-	*100*
Households (HLD)	-	-	-	-	-	-	-	-	-	-	-	*-*
Retirement / superannuation funds (RET)	-	-	-	-	100	-	-	-	-	-	-	*100*
Industries (IND)	6	-	20	2	41	9	-	6	16	-	-	*100*
Life insurers (LFE)	2	-	5	-	70	11	7	-	4	-	-	*100*
Non-bank financial intermediaries (NBFI)	12	4	17	4	35	16	4	8	-	-	-	*100*
Non-reproducible housing (NRH)	11	-	-	6	35	-	21	-	26	-	-	*100*
Reproducible housing (RH)	18	-	-	5	21	-	13	-	42	-	-	*100*

Notes: Share of each liability agent (rows) owned by the listed asset agents (columns) in USAGE2F. For example, 52% of commercial bank (row 1) liabilities in USAGE2F are assets of U.S. households (column 5).

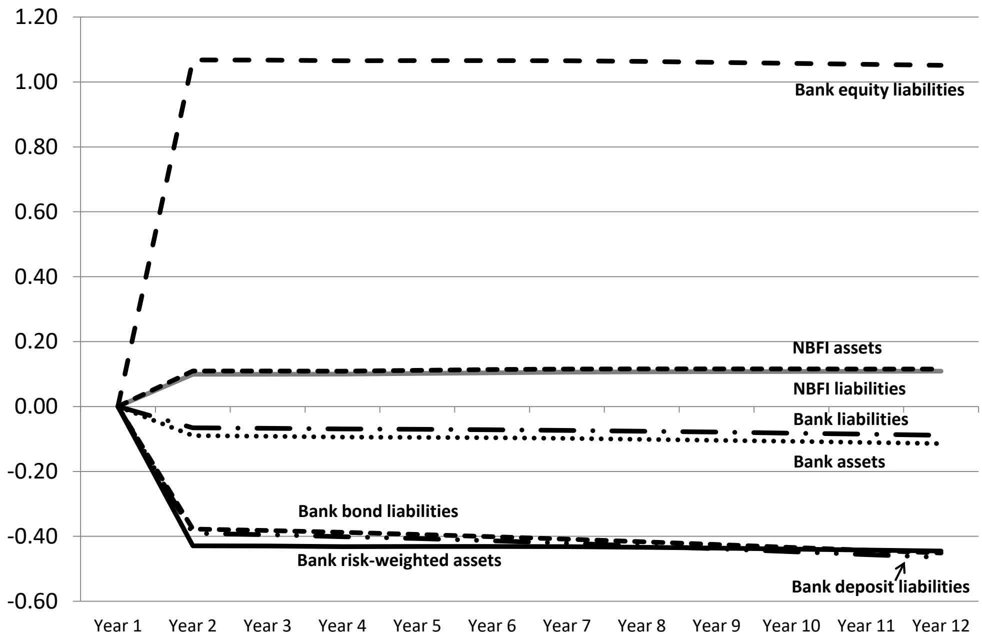
Table 7: Capital structure by liability agent (%), VU-Nat model financial database

Liab agent \ Asset agent	BNK	CB	FGN	GOV	HLD	RET	IND	LFE	NBFI	NRH	RH	*Tot*
Commercial banks (BNK)	-	1	33	5	28	12	14	1	7	-	-	*100*
Central Bank (CB)	13	-	-	35	26	-	26	-	-	-	-	*100*
Foreign Investor (FGN)	23	4	-	5	8	18	33	1	9	-	-	*100*
Government (GOV)	13	3	28	-	43	4	4	2	4	-	-	*100*
Households (HLD)	-	-	-	-	-	-	-	-	-	-	-	-
Retirement / superannuation funds (RET)	-	-	-	-	100	-	-	-	-	-	-	*100*
Industries (IND)	24	-	33	4	20	10	-	1	8	-	-	*100*
Life insurers (LFE)	1	-	4	-	27	68	-	-	1	-	-	*100*
Non-bank financial intermediaries (NBFI)	23	1	16	4	12	20	8	16	-	-	-	*100*
Non-reproducible housing (NRH)	30	-	1	1	60	-	-	-	7	-	-	*100*
Reproducible housing (RH)	52	-	2	2	32	1	-	-	12	-	-	*100*

Notes: Share of each liability agents (rows) owned by the listed asset agents (columns) in VU-Nat. For example, 28% of commercial bank (row 1) liabilities in VU-Nat are assets of Australian households (column 5).

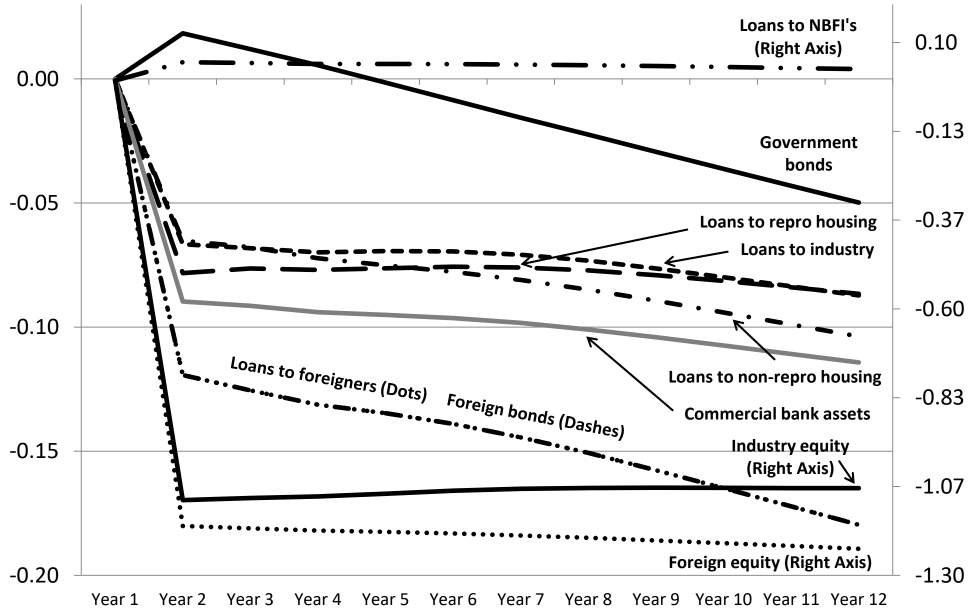
Figures

Figure 1: Bank liabilities by instrument and risk-weighted assets, and aggregate Bank and NBFI financial assets and liabilities, percentage deviation from baseline



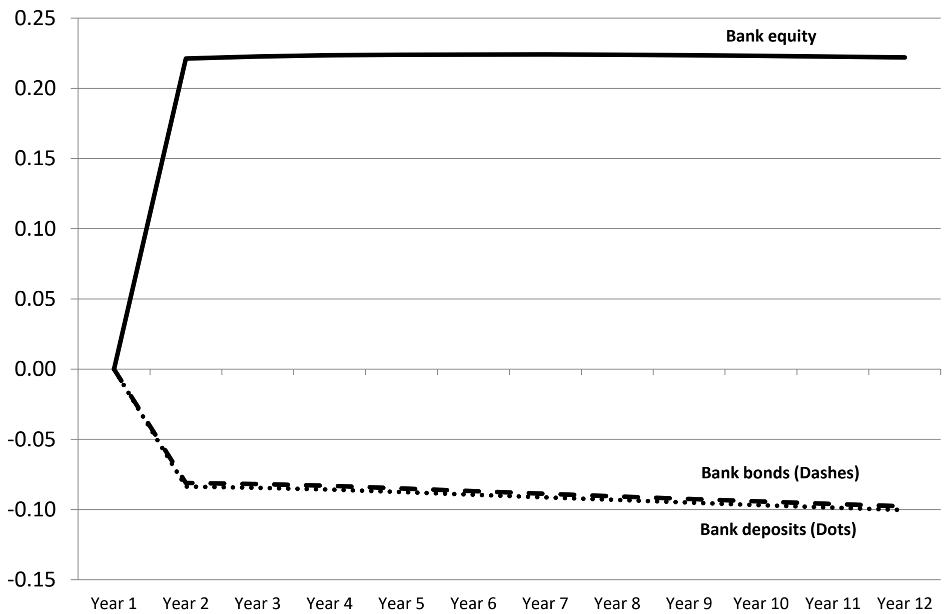
Notes: Summary of the percentage change in size of the financial asset portfolios of U.S. commercial bank and non-bank financial intermediaries, when the U.S. commercial bank capital adequacy ratio is increased by 100 basis points. For the banks, we also unpack the financial instrument dimension in their capital structure (for equity, bonds and deposits), which emphasises the increase in use of equity finance, and reduction in the use of bond and deposit finance.

Figure 2: Major asset holdings of the commercial banks, percentage deviation from baseline



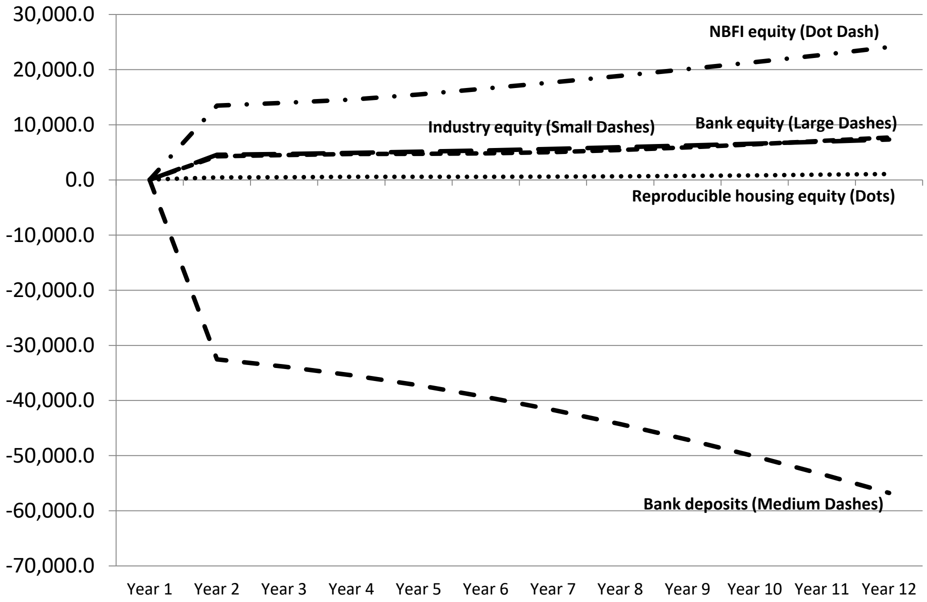
Notes: Summary of the change in the instrument- and agent-specific financial asset portfolio of the U.S. commercial banks when we raise the U.S. commercial bank CAR by 100 basis points. This shows a shift away from assets with relatively high risk-weights such as foreign equity (risk weight =3.0 from Table 4), and toward less risky assets such as government bonds (risk weight =0 from Table 4).

Figure 3: Rates of return (powers thereof) on various financial instruments, percentage deviation from baseline



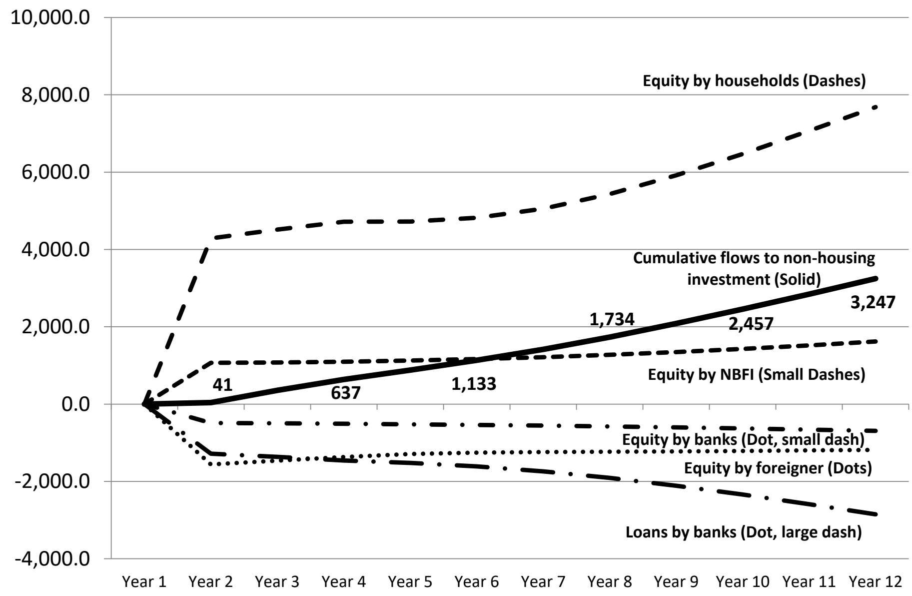
Notes: Summary of the change in rate of return U.S. commercial banks offer on the instrument-specific liabilities they use to finance their activity, when the U.S. commercial bank CAR is increased by 100 basis points. To elicit investors to purchase more equity in order to accommodate the higher capital requirements, rates of return on equity rise, while reduced reliance on bonds and deposits drive down their respective rates of return.

Figure 4: Cumulative flows of financial capital to financial asset acquisition by the U.S. Household, deviation from baseline in US$m



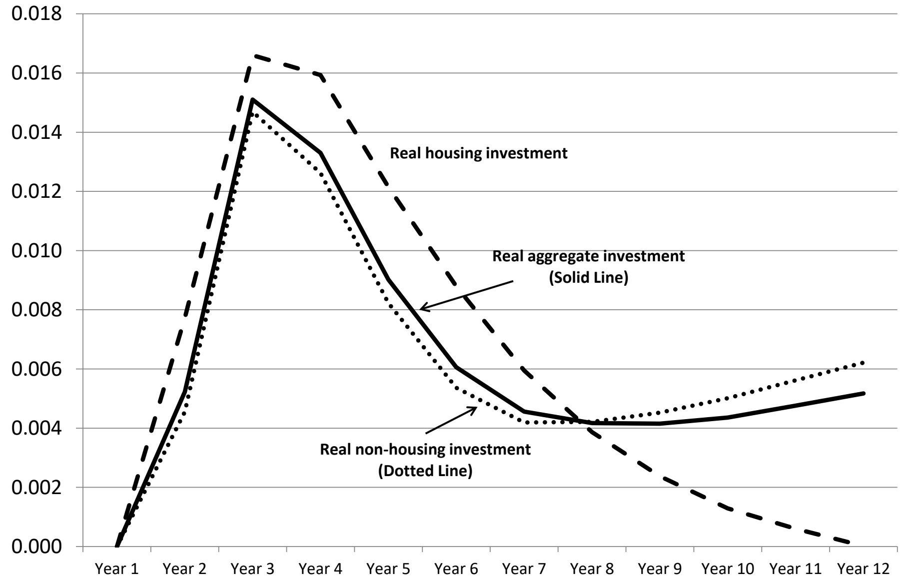
Notes: Summary of the change in capital flows by U.S. households when the U.S. commercial bank CAR is increased by 100 basis points. It is clear from this figure that U.S. households respond to lower rates of return on commercial bank deposits by tilting their financial asset portfolio away from bank deposits, and toward equity issued by the banks, non-bank financial intermediaries and industry.

Figure 5: Cumulative flows of financial capital supplied to the Industry agent, deviation from baseline in US$m



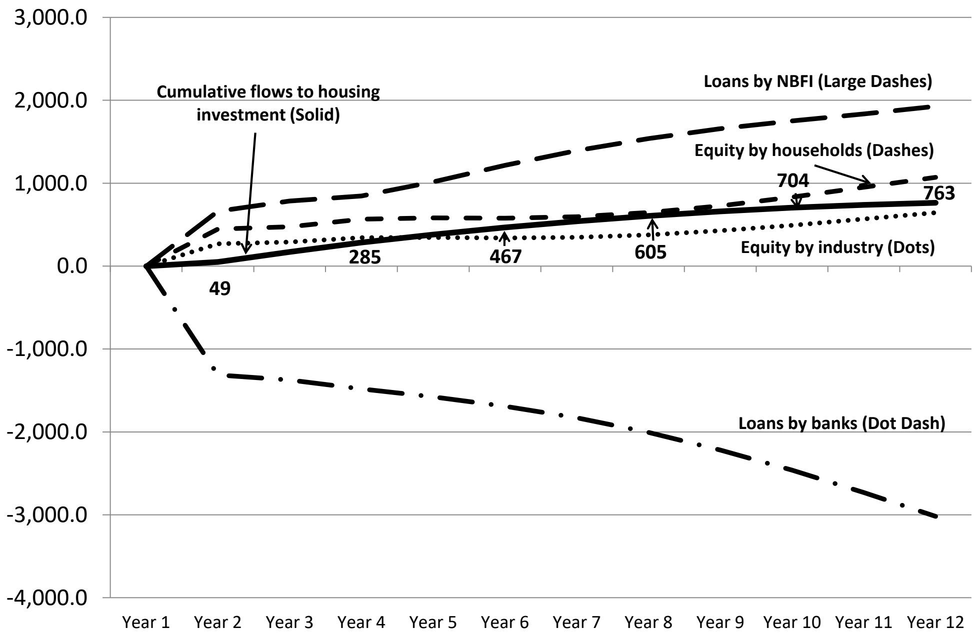
Notes: Summary of the change in capital flows to U.S. industry when the U.S. commercial bank CAR is increased by 100 basis points. It is clear from this figure that while loan finance from commercial banks contract, this is more-than-offset in dollar terms by increased supply of equity finance from U.S. households.

Figure 6: Housing and non-housing investment, and economy-wide real investment, percentage change from baseline



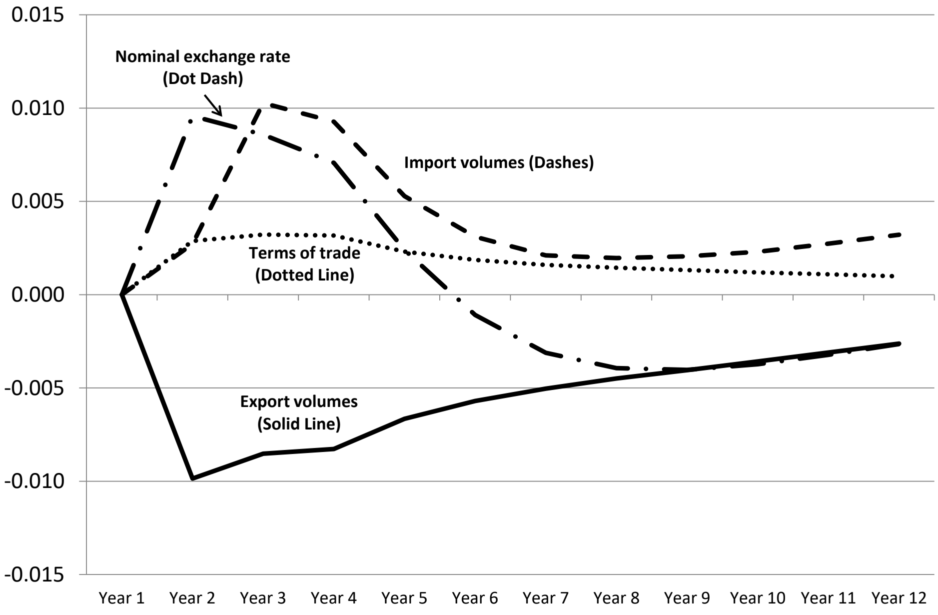
Notes: Summary of the change in real investment across the housing (dashed line) and non-housing (dotted line) sectors in the U.S., when the U.S. commercial bank CAR is increased by 100 basis points. Aggregate investment (solid line) in the long-run remains above baseline because non-housing investment by Industry is stimulated.

Figure 7: Cumulative flows of financial capital supplied to the reproducible housing agent, deviation from baseline in US$m



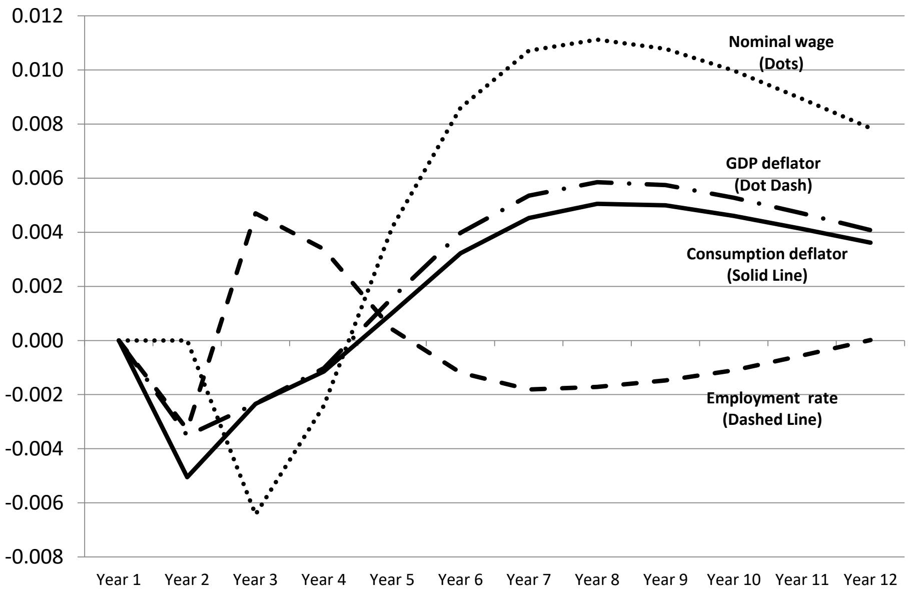
Notes: Summary of the change in capital flows to U.S. reproducible housing when the U.S. commercial bank CAR is increased by 100 basis points. It is clear from this figure that while loan finance from commercial banks contract, this is more-than-offset in dollar terms by increased supply of equity finance from U.S. households, and loan finance from non-bank financial intermediaries.

Figure 8: Nominal exchange rate ($Fgn/$US), export volumes, import volumes and the terms of trade, percentage deviation from baseline



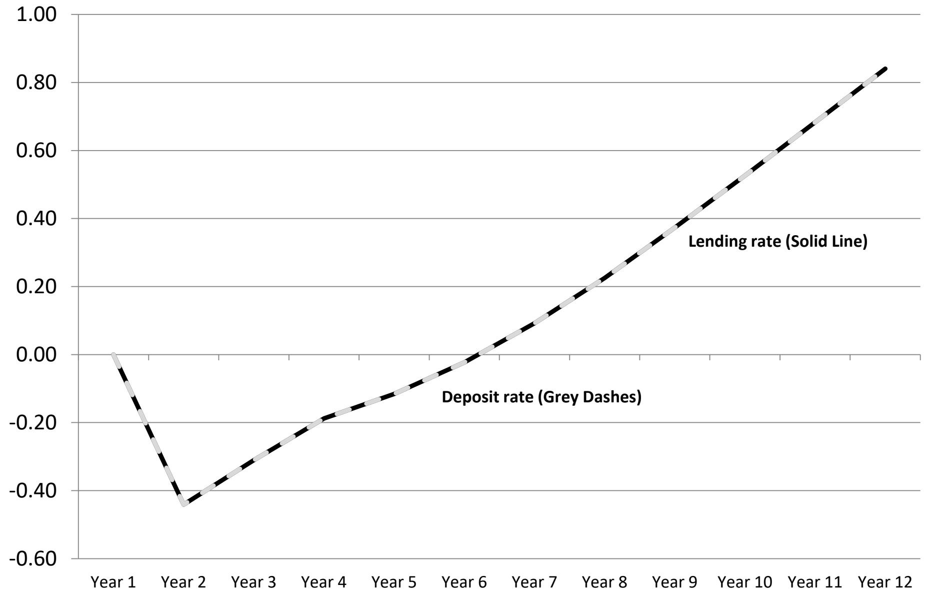
Notes: Summary of the change in export and import volumes, as well as the U.S. terms of trade and nominal exchange rate, when the U.S. commercial bank CAR is increased by 100 basis points. As described in section 3, the nominal exchange rate appreciates in the short-run in response to the policy, because of differences in the foreign financing requirement of the U.S. commercial banks and non-bank financial intermediaries.

Figure 9: Average producer price level, the nominal wage, average consumer price level and employment, percentage deviation from baseline



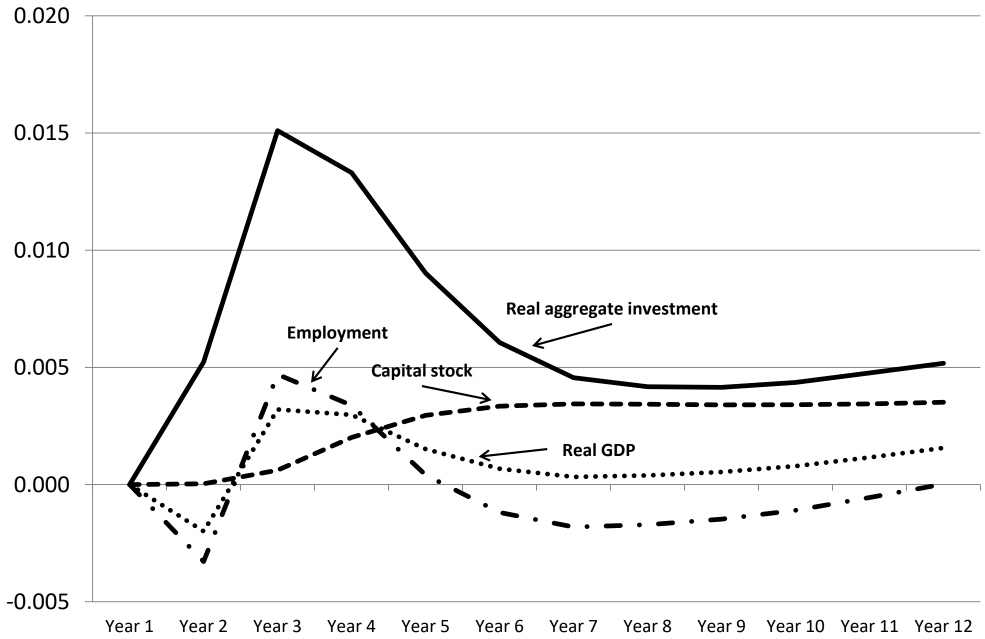
Notes: Summary of the change in aggregate employment (dashes), the economy-wide nominal wage rate (dots), and divisia indices of the producer (dot dashes) and consumer (solid) price levels, when the U.S. commercial bank CAR is increased by 100 basis points. The nominal wage is sticky in the short-run, while the GDP deflator falls. This in turn increases the real producer wage, driving employment down.

Figure 10: Movement in the central bank deposit and lending rate for settlement balances, basis point deviation from baseline



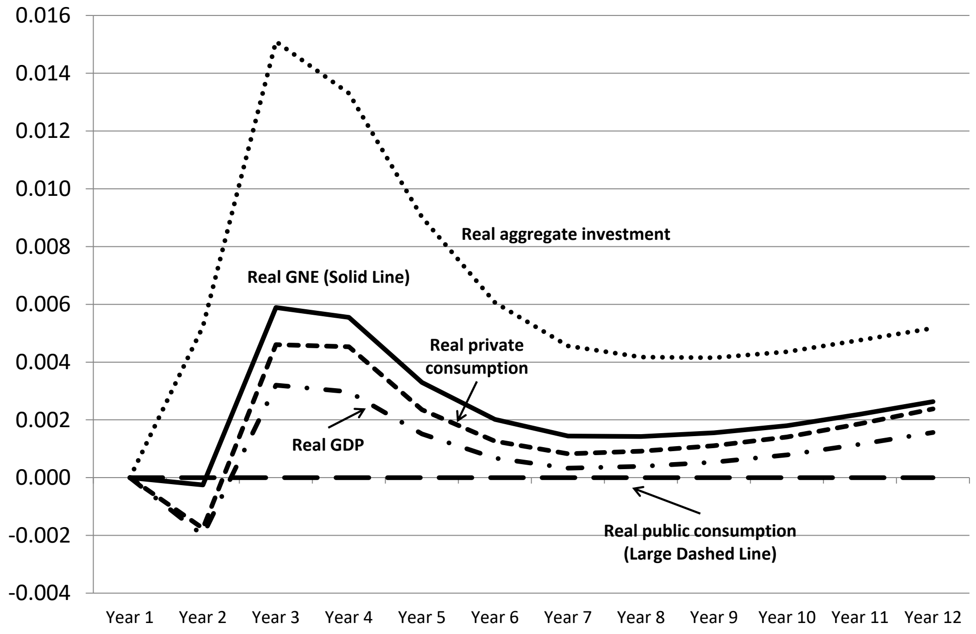
Notes: Summary of the basis-point deviation in the U.S. Federal Reserve deposit and lending rate, when the U.S. commercial bank CAR is increased by 100 basis points. In the short-run, the reduction in the deposit rate is clearly driven by the reduced employment rate and consumer price level described in Figure 9.

Figure 11: Real GDP, employment, capital stock and real investment, percentage deviation from baseline



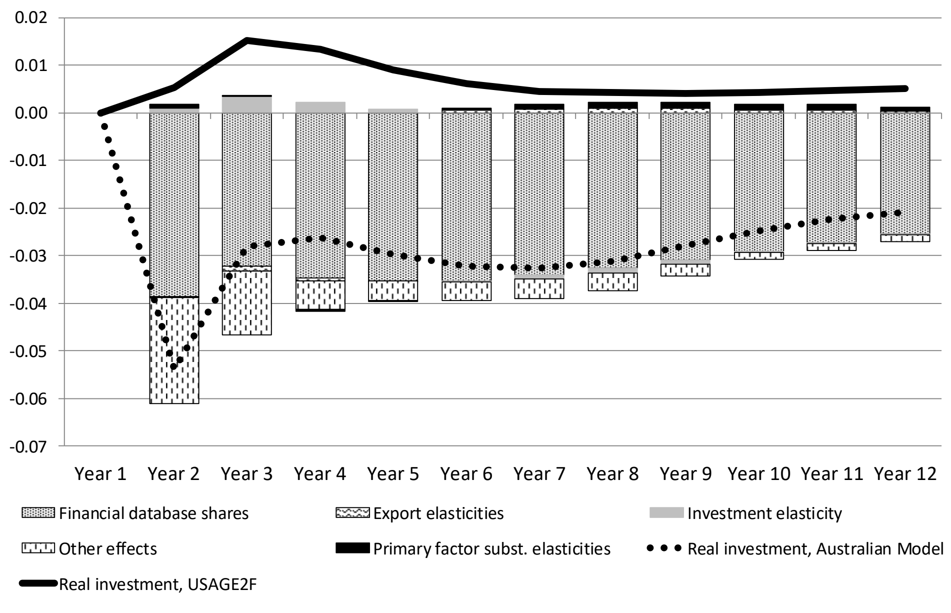
Notes: Summary of key real-side aggregates, when the U.S. commercial bank CAR is increased by 100 basis points. In the short-run, with capital stocks (dashes) sticky real GDP (dots) falls because employment falls. In the long-run, capital stocks respond to elevated real investment (solid), driving real GDP above baseline.

Figure 12: Real GDP, real GNE and the components of real GNE, percentage deviation from baseline



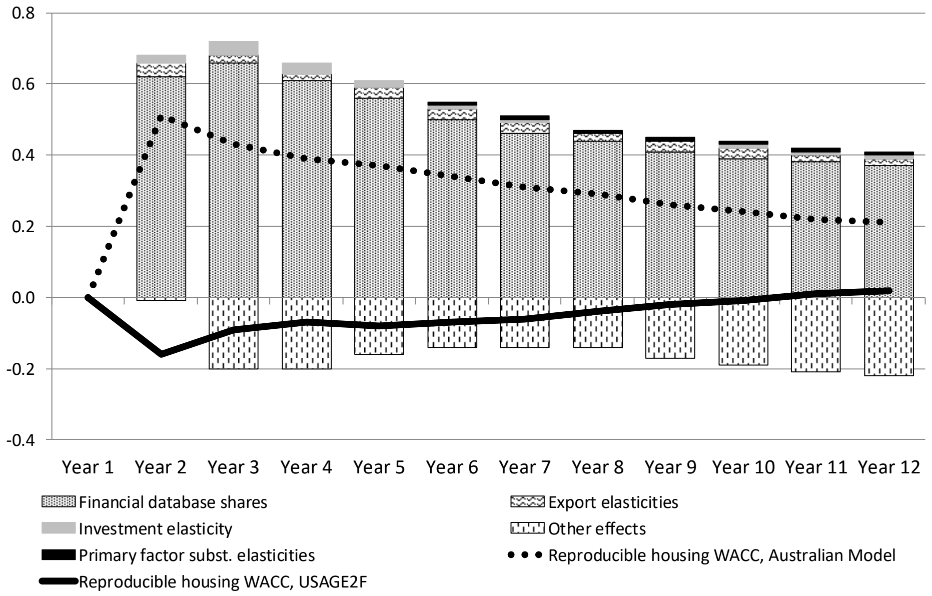
Notes: Summary of key expenditure-side aggregates, when the U.S. commercial bank CAR is increased by 100 basis points.

Figure 13: Decomposition of the differences in the percentage deviation from baseline of the real investment outcome in USAGE2F and VU-Nat



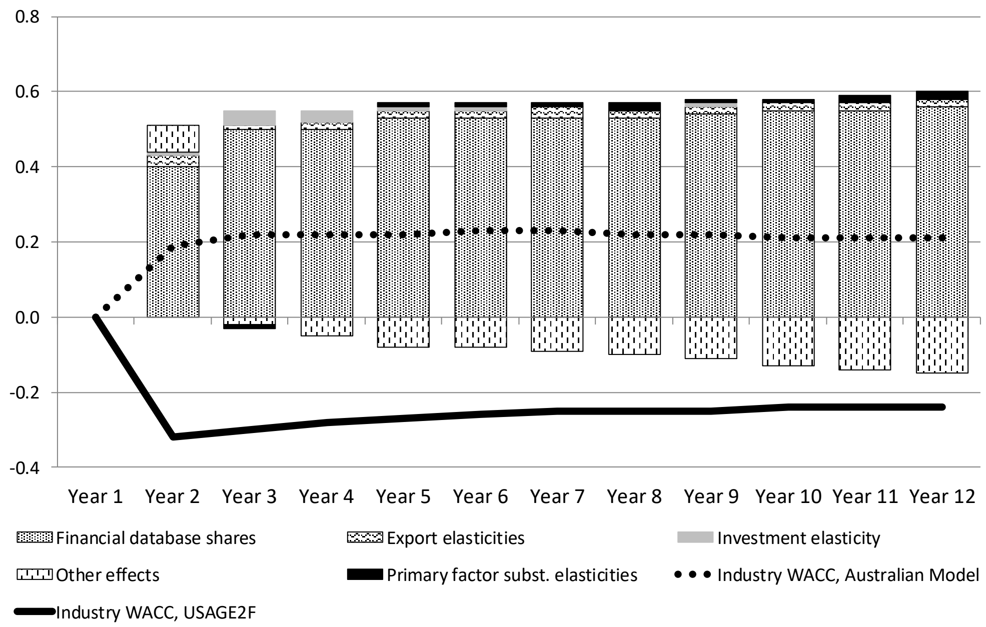
Notes: Decomposition of the differences in real aggregate investment response in the U.S. and Australia, when we use USAGE2F and VU-Nat (respectively) to simulate a rise in U.S. (solid line) and Australian (dotted line) commercial bank CAR by 100 basis points. We quantify the contribution of several factors to the difference between the two sets of results (dotted minus *dashed). The dotted bars clearly illustrate that differences in financial structure are the dominant explanatory variable. This is because differences in the WACC response of the industry and housing agents (Figure 14 and Figure 15) are explicable in terms of differences in financial structure.*

Figure 14: Decomposition of the differences in the basis point deviation from baseline of the WACC of the reproducible housing agent in USAGE2F and VU-Nat



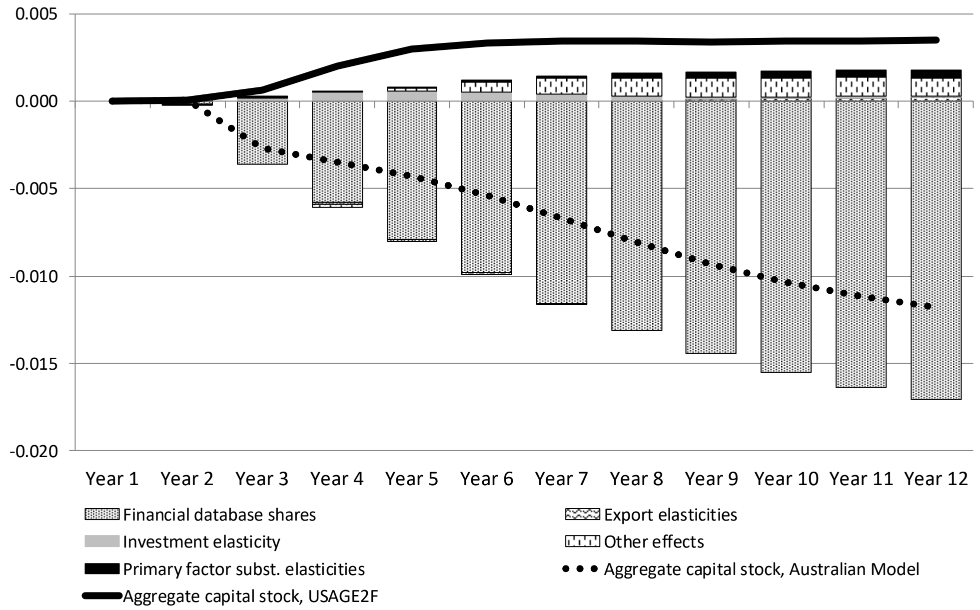
Notes: Decomposition of the differences in the reproducible housing agent WACC in the U.S. and Australia, when we use USAGE2F and VU-Nat (respectively) to simulate a rise in U.S. (solid line) and Australian (dotted line) commercial bank CARs by 100 basis points. We quantify the contribution of several factors to the difference between the two sets of results (dotted minus *dashed). In section 5.1.1, we describe why financial structure (dotted bars) are the dominant explanatory variable.*

Figure 15: Decomposition of the differences in the basis point deviation from baseline of the WACC of the industry agent in USAGE2F and VU-Nat



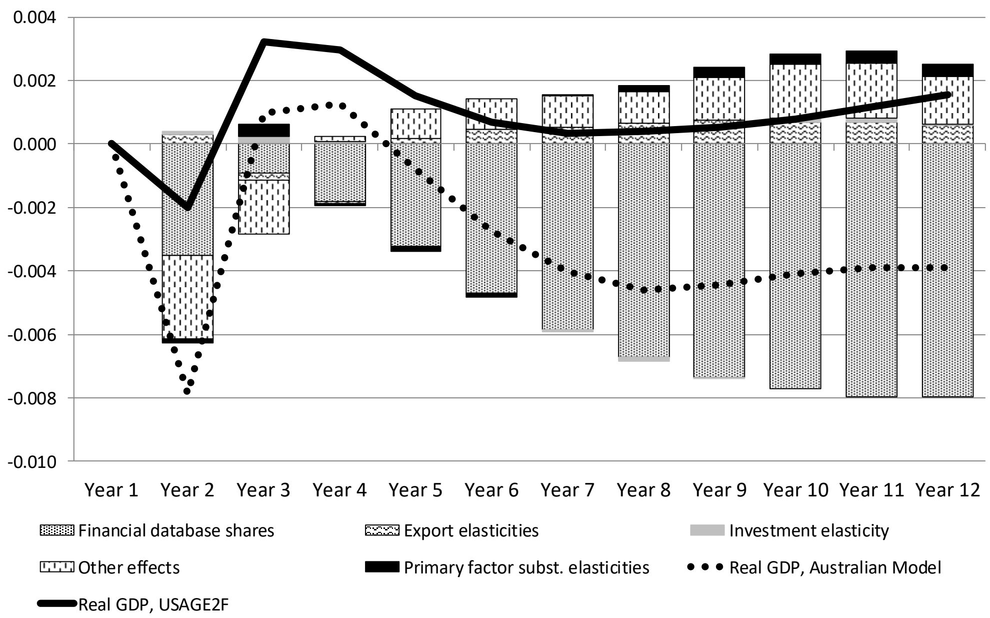
Notes: Decomposition of the differences in the industry agent WACC in the U.S. and Australia, when we use USAGE2F and VU-Nat (respectively) to simulate a rise in U.S. (solid line) and Australian (dotted line) commercial bank CARs by 100 basis points. We quantify the contribution of several factors to the difference between the two sets of results (dotted minus *dashed). In section 5.1.1, we describe why financial structure (dotted bars) are the dominant explanatory variable.*

Figure 16: Decomposition of the differences in the percentage deviation from baseline of the aggregate capital stock in USAGE2F and VU-Nat



Notes: Decomposition of the differences in capital stocks in the U.S. and Australia, when we use USAGE2F and VU-Nat (respectively) to simulate a rise in U.S. (solid line) and Australian (dotted line) commercial bank CARs by 100 basis points. We quantify the contribution of several factors to the difference between the two sets of results (dotted minus *dashed). From Figure 13, because the majority of the real investment deviation between the two simulations in explicable in terms of differences in financial structure (dotted bars), so too is the majority of the difference in capital stocks.*

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



Notes: Decomposition of the differences in real GDP in the U.S. and Australia, when we use USAGE2F and VU-Nat (respectively) to simulate a rise in U.S. (solid line) and Australian (dotted line) commercial bank CARs by 100 basis points. With long-run differences in capital stocks driven by differences in financial structure in the U.S. and Australia (see Figure 16), so too are long-run differences in real GDP responses.