



Reserve Bank of New Zealand Analytical Notes

Diving in the deep end of domestic deposits

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NON-TECHNICAL SUMMARY¹

Deposits are an important part of the New Zealand financial system. Deposits play a large role in funding bank lending – banks try to attract deposits in order to build up funds to lend out to borrowers. Over the past couple of years, lending has been growing faster than deposits, requiring banks to source funding from offshore wholesale funding markets. External funding can increase risks in the financial sector, as deposits are typically a more stable (“core”) source of funding than offshore wholesale funding.

This paper explores deposit growth in New Zealand in order to answer two questions:

- 1) What factors drive deposit growth in New Zealand, particularly in the past few years?
- 2) Can banks increase deposits by increasing interest rates?

We use two models to explore the dynamics of household deposits in New Zealand’s banking system in order to answer these questions. The first model uses bank-specific data from New Zealand’s four largest banks, while the second uses aggregate data for the entire banking system.

The paper highlights that the rate of domestic deposit growth has varied significantly since the Global Financial Crisis, and sharply slowed over 2016. We provide evidence that a range of supply and demand factors influence deposit growth, and that the recent slowing was largely driven by a reduction in supply (that is, households wanting to allocate less money to deposit products). We also find that banks increased their demand for deposits in late 2016 in an effort to close the gap between deposit growth and lending.

We also consider the degree to which banks are able to increase deposit growth materially by raising interest rates. We find that a 1 percentage point increase in the six-month deposit rate can increase the level of household deposits by about 1 percent after four quarters, and by 1.3 percent in the long-run. As we find that deposits are not strongly responsive to interest rates, if banks wish to maintain robust funding profiles by not becoming too reliant on offshore wholesale funding, they may need moderate credit growth or use a combination of approaches to bring deposit growth in line with credit growth.

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1. Introduction

Deposits play an important role in New Zealand's financial system. They are an investment asset for households and businesses, and support the core functions of money by being a store of value and enabling efficient transactions. Deposits are also an important source of funding for banks and other deposit-taking financial intermediaries, with the majority of household deposits residing in the banking system.

As at May 2017, deposits represented around 60 percent of bank funding, with households providing more than half of all deposits (table 1). As deposits are considered a relatively stable source of funding, they are included in the Reserve Bank's definition of core bank funding.²

Table 1 – Banking system funding (as at 31 May 2017)

	Share of total deposits (%)	Share of total bank funding (%)
Deposits from households	56.7	
Deposits from other sources	43.3	
Total deposits		60.7
Other liabilities (such as debt)		32.1
Equity		7.1

Note: Numbers do not sum to 100 due to rounding.

Since mid-2015 credit growth has consistently exceeded deposit growth. Household deposit growth has slowed to its lowest rate since 2011 and this has resulted in banks increasing their use of offshore wholesale funding to meet credit demand.

This paper seeks to explore what has caused the decline in deposit growth. We look to disentangle whether the slowing could have been driven by a reduced supply of deposits from households due to changes in consumption or investment behaviour or, alternatively, reduced demand for deposits by the banking system due to favourable conditions in other funding markets. Identifying the factors associated with the slowing in deposit growth will help to determine whether banks' ability to extend credit to the real economy is being constrained by the availability of deposits.

In addition, this paper estimates the sensitivity (elasticity) of household deposits to changes in interest rates. This will help to determine if banks can influence the growth of deposits by changing interest rates, and how much it is likely to cost to raise more deposits.

The responsiveness of deposits to changes in interest rates is also important for the transmission of monetary policy. Higher deposit interest rates are likely to encourage saving

² Core funding includes Tier 1 capital, the majority of retail deposits, all wholesale funding with a residual maturity of more than one year and half of wholesale debt funding with a residual maturity of between six months and one year (for bank debt issued with an original maturity of at least two years); see the Reserve Bank's liquidity policy document BS13.

over consumption or investment, leading to lower aggregate demand.³

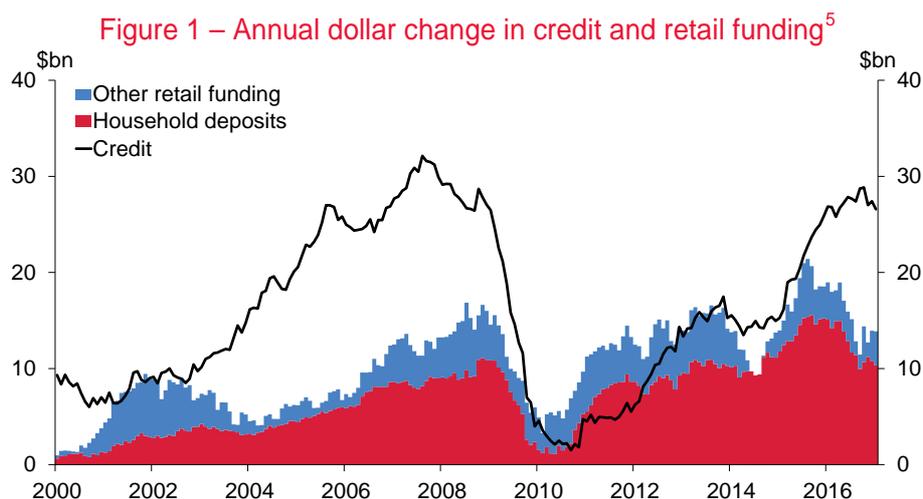
Developments in the domestic deposit market are outlined in section 2. Section 3 applies a model by Chiu and Hill (2015) to decompose deposit growth into supply and demand factors to gain a greater understanding of changes in deposit growth using individual bank data. In section 4 we develop an alternative model using system-wide data. Section 5 seeks to determine the ability and cost of raising additional deposits by exploring the interest rate elasticity of household deposits and retail funding. Section 6 concludes the paper.

2. Developments in the deposit market

Pre-global financial crisis period⁴

Leading up to the Global Financial Crisis (GFC), economic growth was supported by strong credit growth (figure 1). Deposit growth was substantially lower than credit growth and the household saving rate was negative. The current account deficit increased significantly with banks sourcing funds from offshore markets to fund lending. Offshore funding costs were very low, especially at short terms. Due to the easy offshore funding conditions, banks had no incentive to offer deposit interest rates higher than the costs of the offshore funding, and therefore no incentive to encourage more saving by households. The average six-month deposit rate was lower than the six-month bank bill interest rate until late 2008.

The GFC revealed the fragility of wholesale funding markets. At the peak of the GFC, offshore short-term wholesale funding markets became illiquid, funding costs increased significantly, and banks increased their demand for domestic funding, including from the Reserve Bank. Banks faced pressure from market participants to build resilience into their funding profiles by making greater use of stable funding sources, such as long-term wholesale funding and deposit funding.



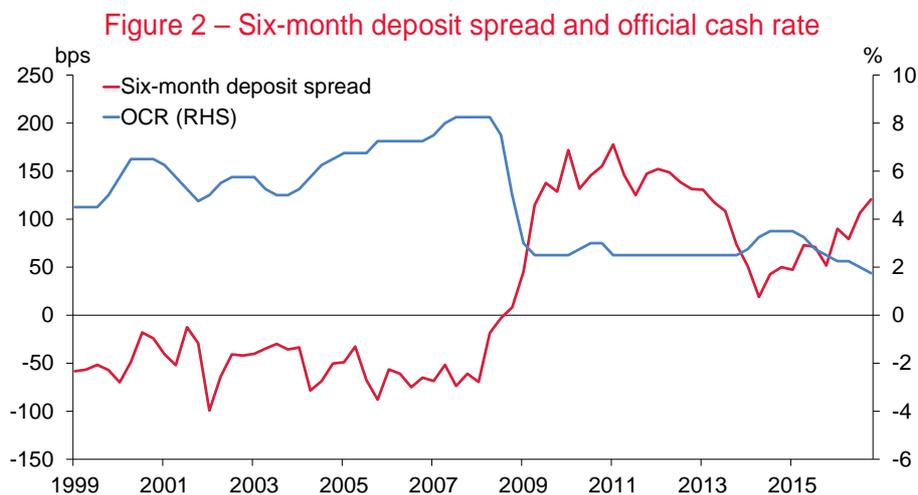
Source: RBNZ *Standard Statistical Return* (SSR).

³ Of course, household savings decisions are also likely to reflect other factors such as income growth and expectations of future states of the economy.

⁴ For the purpose of the discussion in this section the pre-GFC period is defined as prior to 2008Q4, and the post-GFC period is 2008Q4 onwards.

⁵ Retail funding is defined as any funding that banks' do not classify as wholesale. This includes household funding and non-household (other retail) funding, with this distinction determined by the banks.

In the second half of 2008, the Official Cash Rate (OCR) was lowered by 300 basis points. This resulted in a significant fall in deposit interest rates. However, as banks were trying to attract deposits, the spread between the six-month term deposit rate and the six-month bank bill increased from the pre-GFC average of -50 basis points to an average of around 100 basis points since the end of 2008 (figure 2).⁶



Source: RBNZ SSR, Thomson Reuters, RBNZ.

Note: Six-month deposit spread is over six-month bank bill.

Post-GFC structural changes

A number of structural changes have affected the domestic deposit market since the GFC. In response to liquidity pressures experienced during the GFC, the Reserve Bank introduced a liquidity policy in April 2010. The policy introduced a core funding ratio (CFR) requirement which requires banks to fund at least 75 percent of their loans and advances from stable funding sources, such as deposit funding or long-term wholesale funding. The policy has encouraged banks to maintain well-established domestic deposit franchises to ensure the banking system's funding profile is robust to volatility in international funding markets. This policy is reinforced by the major credit rating agency methodologies for assessing funding and liquidity risk.⁷ In light of these changes, banks have changed their internal policies; for example, some banks have imposed internal limits on the share of funding which they source from offshore.

Household behaviour also changed following the GFC. The household saving rate increased and deposit growth exceeded credit growth from 2010 through to 2014. This relative increase in the supply of deposits enabled banks to restructure their funding profiles. A sustained increase in deposit spreads has supported the greater share of bank funding now sourced from deposits.

Recent weakness in deposit growth

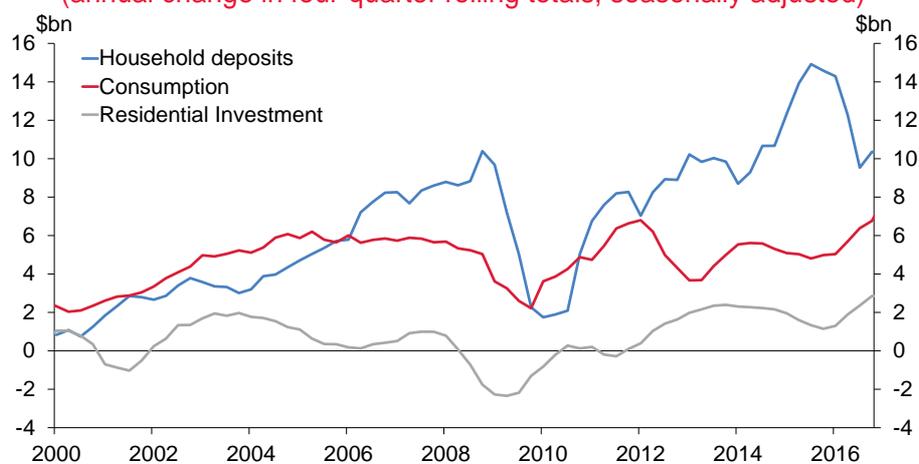
Annual growth in household deposits has slowed from around 11 percent in mid-2015 to

⁶ See Wong (2012) for a more detailed discussion of the change in composition and pricing of bank funding following the GFC.

⁷ Major rating agencies include Standard and Poor's, Moody's, and Fitch. Bank credit rating methodologies are available through their respective websites.

7 percent at the end of 2016. Some of the slowing in household deposit growth coincides with a rise in household consumption and residential investment (figure 3). This change in household behaviour has transferred deposits into business accounts, which, combined with increased saving by the business sector (reflecting weak business investment), has led to an increase in non-household deposits. Increased consumption and residential investment is suggestive that confidence has increased, which could be associated with a reduction in household risk aversion. Therefore, households may have also increased investment in riskier financial assets, such as equities.

Figure 3 – Consumption, residential investment and household deposit growth (annual change in four-quarter rolling totals, seasonally adjusted)



Source: RBNZ Bank Balance Sheet.

Since mid-2015, annual banking system credit growth has averaged 7.6 percent and materially outstripped deposit growth (figure 1). At the end of 2016, annual credit growth exceeded annual retail deposit growth by \$13.5 billion. The strength of credit growth has put funding pressure on the banking system and banks have turned to long-term offshore markets to meet core funding requirements. This is not the first time a gap between credit and deposit growth has been observed. From late 2002 through to the end of 2009 credit growth exceeded deposit growth by a significant margin. However, considering post-GFC reforms of bank funding profiles, changes in bank appetite for offshore exposures, and the discipline of credit rating agencies, it seems unlikely that banks will ever again be as reliant on external funding. Therefore, in the current environment, banks may need to restrict credit to grow more in line with deposit growth or increase deposit growth to support credit growth.

3. A panel model for identifying the drivers of deposit growth

Modelling the dynamics of household deposit growth

In order to understand the current deposit deficit and what the banking system can do to overcome it, we model the dynamics of household deposit growth using a framework developed by Chiu and Hill (2015). This framework is useful because it bases a time-series model around a robust theoretical model. The theoretical model generates a set of identifying restrictions which allows us to differentiate between supply shocks and demand shocks in the

market for household deposits.⁸ In the remaining discussion we think of banks as having a derived demand for deposits as an input into their production of credit, while depositors are suppliers of deposits to the banking system.

The analysis is based on a panel vector-autoregressive (VAR) model (hereafter the 'panel VAR') using bank-specific data from the four largest banks in New Zealand⁹ and some system-wide variables (outlined in table 2). The panel VAR was estimated using monthly data from January 2008 to December 2016. Following Chiu and Hill (2015) we used six lags of each endogenous variable.

Table 2: Variables in the panel VAR model

Bank-specific variables	Transformation
Household deposit growth	Monthly percent change
Credit default swap (CDS) spread ¹⁰	Basis point spread over the average of the big four banks
180-day retail deposit rate spread	Basis point spread over OCR
System-wide variables	Transformation
Household deposit growth	Monthly percent change
ANZ Business Outlook - Activity Outlook Index	Index
OCR*	Percent
Merrill-Lynch Option Volatility Estimate (MOVE) index*	Index

Note: Exogenous variables in the model are indicated with an asterisk.

Source: RBNZ SSR, Thomson Reuters, ANZ, RBNZ, Bloomberg.

- Deposits can be classified as transactional, savings, or term deposits. Transactional deposits are held by households and businesses to make payments and to withdraw as cash on demand. Transactional deposits are either non-interest bearing or earn very low rates of interest. Savings deposits can be withdrawn at any time, but often earn a low interest rate or bonus interest if not withdrawn. Term deposits have a contractual period over which they earn interest with a proportion of interest usually forfeited if the customer requests and is granted an early withdrawal. These differences mean that different types of deposits have different levels of interest rate sensitivity. For example, the level of transactional deposits is likely to be driven by structural features of the economy, whereas household demand for term deposits is

⁸ A brief overview of the theoretical model and the associated sign restrictions is given in Appendix A.

⁹ The four largest banks are ANZ Bank New Zealand Limited, ASB Bank Limited, Bank of New Zealand, and Westpac New Zealand Limited.

¹⁰ We used the CDS spread of the respective parent bank to proxy for the CDS for each bank as no New Zealand bank has traded credit default swap data. The CDS spreads of the four banks are very highly correlated, which means that some results must be treated with caution. These results will be discussed in more detail later in the paper.

more likely to behave like any other investment, with demand influenced by the risk and return. Therefore, term deposits are expected to be more sensitive to relative risk-adjusted asset returns. An understanding of the differences in interest rate elasticities will be important when a bank is setting its retail interest rates in order to attract sufficient levels of core funding. However, this paper focuses on household deposits and total retail deposits due to data constraints.

- The CDS spread was included in the model to capture the market's perception of the relative riskiness of a bank, in order to proxy the relative cost of that bank raising funds in the interbank market.
- The ANZ Business Outlook - Own Activity index was included in the model to capture economic conditions (which are likely to influence deposit growth).¹¹
- The OCR was included in the model to capture prevailing monetary conditions.
- The MOVE index measures the implied volatility of options on US Treasury bonds. The index was included in the model to proxy for wholesale funding market conditions and financial market volatility which may influence the behaviour of households.

The model was estimated using a Bayesian approach, with a fairly loose prior imposed.¹² The panel estimation technique and Bayesian methods provide a mechanism to cope with some of the issues arising from the relatively short data sample (e.g. imprecisely-estimated coefficients).

Once estimated, shocks in the model were identified using a series of sign restrictions and zero restrictions on the contemporaneous impact matrix.¹³ The necessary sign and zero restrictions were derived from the theoretical model presented in Chiu and Hill (2015). The identification strategy allows us to identify four shocks in the model: two demand shocks and two supply shocks.

Demand shocks

Fundamentally, bank deposit demand shocks are identified in the model as times when deposit growth and interest rates move in the same direction. A positive deposit demand shock increases deposit growth.

Aggregate deposit demand shock: This is a shock to system-wide bank preferences to seek funding via deposits rather than from other sources (such as interbank lending, or the offshore bond market). For example, a tightening in credit conditions abroad resulting in decreased foreign funding and increased deposit funding encouraged by higher deposit

¹¹ The ANZ Business Outlook – Activity Index has a correlation of 0.55 with annual growth in GDP.

¹² The prior imposed is a simple panel-VAR form of the Minnesota prior, allowing for a different degree of “similarity” between the four banks. We also estimated a version using the hierarchical linear estimation approach used by Chiu and Hill (2015). The results of the model were very similar under the two estimation approaches, so we opted for the simpler approach.

¹³ In particular, we use the sign-and-zero-restrictions algorithm developed by Arias, Rubio-Ramirez, and Waggoner (2013).

rates across the banking system would be interpreted as a positive aggregate deposit demand shock.

Idiosyncratic deposit demand shock: This is a shock to an individual bank's preferences for funding via deposits. For example, if a bank is suddenly perceived as more risky, the resulting fall in interbank lending to that bank (and hence increased need for deposit growth) would be interpreted as a positive idiosyncratic deposit demand shock.

Supply shocks

Fundamentally, household deposit supply shocks are identified in the model as times when deposit growth and interest rates move in opposite directions.¹⁴ A negative deposit supply shock decreases deposit growth.

Aggregate deposit supply shock: This is a shock to household preferences for holding deposits across the entire banking system. For example, a change in risk aversion that sees households want to invest more money in equities and hold less in deposits with all banks would be interpreted as a negative aggregate deposit supply shock.

Idiosyncratic deposit supply shock: This is a shock to household preferences for holding deposits with a particular bank. For example, a bad news story that impacts one bank but not others, and results in customers moving away from the affected bank, would be interpreted as a negative idiosyncratic deposit supply shock.

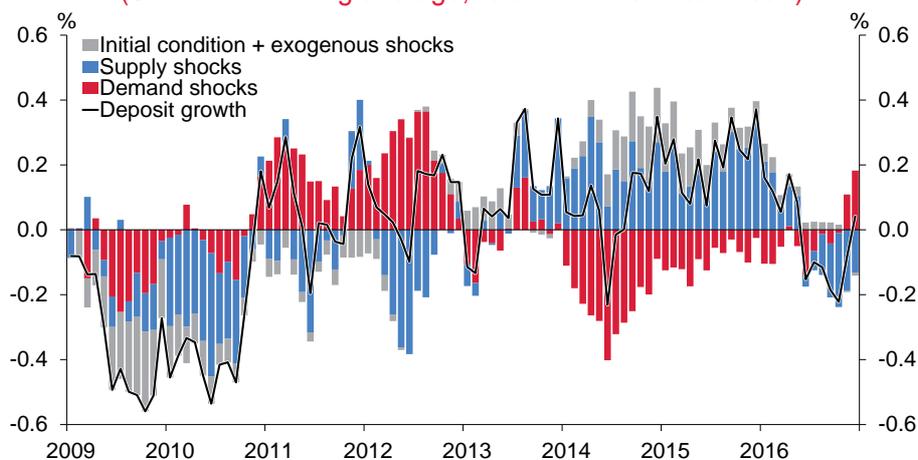
Are demand or supply factors more important in explaining recent deposit growth?

The banking system saw a large increase in deposit growth over 2015, followed by a slowdown over 2016. The panel VAR model allows us to determine whether these movements were driven more by demand factors (that is, banks deciding that they want more or less funding from deposits), or by supply factors (that is, households deciding that they want to increase or decrease the amount of money they hold in deposits). The contributions of these factors can be determined by decomposing the changes in the deposit growth rate into the underlying shocks that drove them.

This decomposition is shown in figure 4. The two supply and demand shocks are respectively summed due to the high correlation between the CDS spreads of the banks. The limited variation in CDS spreads may mean the identification of the idiosyncratic shocks compared to aggregate shocks may not be as robust as the identification of the overall supply and demand shocks. In order to preserve the confidentiality of individual bank data, we averaged the supply shocks and demand shocks across the four banks. Any movement not explained by these supply and demand shocks must be driven either by the exogenous variables in the model (economic conditions and financial market volatility) or by shocks originating prior to the estimation start point (January 2008).

¹⁴ Note that deposits will grow when they earn interest which is not withdrawn. The action of not withdrawing the interest income can be considered as an increase in the supply of deposits.

Figure 4 – Contributions of supply and demand factors to monthly household deposit growth
(Six-month moving average, relative to historical mean)



Key results

While the model allows us to identify supply and demand shocks, it does not provide any information about what may have caused these shocks. Below we discuss some of these shocks and speculate about some potential drivers.

- In the period immediately after the GFC, deposit growth was weak. The weakness was driven by demand factors (credit growth declined significantly and hence banks did not require as much deposit funding), supply factors (households had less discretionary income to save in deposits) and exogenous factors (perhaps related to volatile financial markets).
- There was strong demand for deposits during 2011 and 2012, which corresponded with the timing of banks building up their core funding ratios in response to the Reserve Bank's requirements.
- Demand for deposits was below average during 2014. This likely reflects the easing of credit growth and relative appetite to raise funds from other sources. Over the same period the spread between the six-month deposit rate and the bank-bill declined, indicating reduced compensation for borrowers (figure 2). Strength in deposit growth over 2014 and 2015 appears to be attributable to strong deposit supply (that is, households wanting to supply more deposits to the banking system). This may also reflect delayed insurance payments made to households from the Canterbury earthquakes.
- Over the first half of 2016 there appears to have been a change in household preference that resulted in households wanting to hold less money in deposits. This may be related to the increase in consumption and residential investment shown in figure 3. At the same time, demand for deposits from banks was modest. During this period, banks were largely funding the deposit deficit with market funding, given the easy availability and low cost of offshore funding.
- Since then (that is, through the second half of 2016), banks have increased their

demand for deposits in an effort to close the funding gap. For example, this change in bank behaviour may reflect that banks were reaching internal limits on the proportion of funding which they obtain from offshore markets. It may also indicate an increase in competition for deposits across the system.

4. A system model for identifying the drivers of deposit growth

The panel model identified the recent weakness in deposit growth is mainly due to a change in households' supply of deposits. Therefore, we also seek to understand the ability of banks to change this behaviour and encourage more deposit growth. This is important due to the role of deposit growth in funding additional credit growth, to ensure that banks maintain resilient funding profiles, and for the transmission of monetary policy.

A second VAR model was adopted to estimate the sensitivity of household deposits to changes in interest rates. The analysis provides some indication of how much it is likely to cost banks to raise more deposits, and whether increasing household deposit growth results in a redistribution of deposits from non-household accounts to household accounts. This model is also used to identify factors that have affected past deposit growth, similar to the panel VAR.

The system VAR model

The model is a structural vector-autoregressive model with exogenous variables (Sims, 1980). The model focuses on the relationship between changes in the deposit spread and deposit growth, whilst allowing and controlling for endogeneity with variables that capture both economic and financial conditions. The model uses quarterly data from 1999 to 2016, and is estimated with Bayesian techniques using a loose Minnesota prior (Litterman, 1980; Doan, Litterman, and Sims, 1984). As with the panel model, the Bayesian estimation helps us to cope with some of the issues arising from the relatively short data sample. The variables used in the model, and their form, are specified in table 3. Six lags for each of the endogenous variables were included based on Akaike information criterion and Schwarz information criterion tests.

Table 3 – Variables used in the system VAR model

Variable	Transformation ¹⁵
Household deposits (or total retail funding)	Quarterly percent change, seasonally adjusted
Household credit	Quarterly percent change, seasonally adjusted
Six-month term deposit interest rate	Quarterly change, average bank rate
Net working-age migration	Quarterly change, as a share of the working-age population, seasonally adjusted
Nominal gross domestic product (GDP)	Quarterly percent change, seasonally adjusted
MOVE index*	Level

¹⁵ The data was transformed in such a way that the input series were stationary

GFC dummy variable*	1999Q2–2008Q3 = 0
	2008Q4–2016Q4 = 1

Note: Exogenous variables in the model are indicated with an asterisk.

Source: RBNZ SSR, Stats NZ, Bloomberg.

- Household credit growth was included due to the link between credit creation and deposit growth (McLeay, Radia, and Thomas, 2014).
- The average six-month term deposit interest rate across the banks was used in absence of a weighted average interest rate on household deposits.
- Nominal gross domestic product was included to control for general economic conditions and underlying demand in the economy.
- Net working-age migration may be a driver of deposit growth as migrants purchase New Zealand dollars from wholesale market participants (largely banks), which may have the effect of transforming banks' market funding into deposit funding.
- The MOVE index is included as an exogenous variable to control for financial market volatility and also proxy for offshore funding conditions.
- Due to the structural changes outlined in section 2, a GFC dummy variable was included to control for the resulting level shifts in some of the input series.

Model identification

The VAR was identified using a Choleski (recursive) decomposition, which identifies shocks through theoretical restrictions on which variables can contemporaneously impact other variables. The ordering for the Choleski decomposition was selected based on prior beliefs about the causal ordering of the variables.¹⁶ The Choleski order (from most exogenous to most endogenous) was:

Net working age migration,
 Nominal gross domestic product,
 Household credit growth,
 Average six-month deposit interest rate, and
 Household (or retail) deposit growth.

- Net working age migration was ordered first (implying it is most exogenous) as changes are usually driven by arrivals, rather than departures, which are unlikely to be affected by domestic economic and financial conditions.
- Nominal gross domestic product contemporaneously affects household income, credit growth, and deposit growth.
- Credit creation also generates deposits and was therefore ordered above household deposit growth.

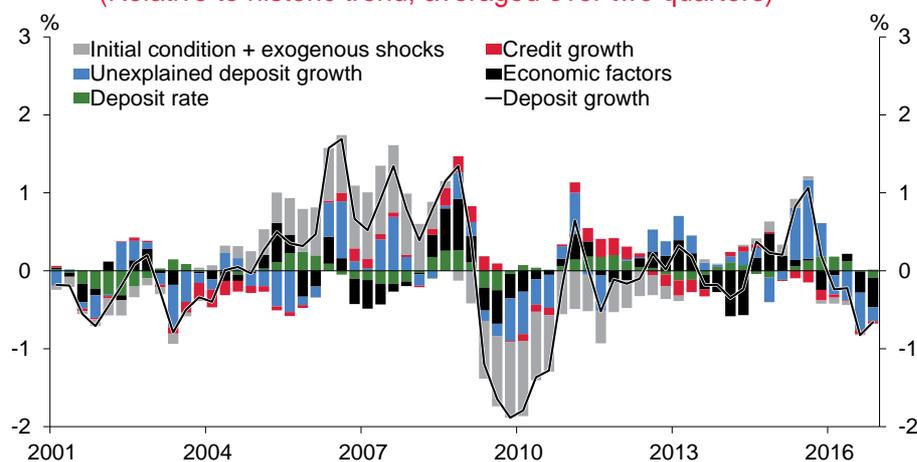
¹⁶ Changes to the Choleski ordering did not materially change the results of the model. Some of the alternative Choleski orders are presented in Appendix E.

- The average six-month deposit interest rate was assumed to reflect funding pressures in the current period and therefore comes before household deposit growth.
- Finally, household deposit growth is assumed to respond to changes in all previous variables in the current period (most endogenous).

What does the system VAR tell us about the drivers of deposit growth?

The historical shock decomposition can be a useful tool to understand how the model is identifying different shocks in the data set. Similar to the panel VAR, the system VAR can help us to understand what factors have influenced deposit growth in the past (figure 5). This must be interpreted carefully as the shock decomposition in the system VAR is sensitive to the Choleski ordering.¹⁷ Nevertheless, it provides a valuable check that the shocks make economic sense.

Figure 5 – System VAR historical shock contributions to quarterly deposit growth (Relative to historic trend, averaged over two quarters)



Note: Economic factors include net working age migration and nominal gross domestic product.

Comparisons can be drawn between the shock decompositions of the panel VAR and system VAR over the post-GFC period.

- The initial condition for the system VAR reflects historical shocks that pre-date the sample period. As this component's contribution early in the shock decomposition is relatively small, we conclude that the majority of the 'Initial condition and exogenous shocks' contribution is due to the exogenous shocks and GFC dummy.
- In the two years following the GFC both models identify large negative shocks. The panel VAR identified these negative shocks as being both demand and supply shocks. The system VAR identifies a persistent economic shock and also a combination of deposit rate shocks and unexplained deposit growth shocks. The 'Initial condition and exogenous shocks' component is identified as the largest factor weakening deposit growth during this period, capturing the increase in volatility in funding markets.

¹⁷

Alternative Choleski orders were tested and these did not materially change the results presented.

-
- Throughout 2011 and 2012 the panel VAR identified positive deposit demand shocks and negative deposit supply shocks. The system VAR identified positive shocks from credit growth through 2011, and deposit growth through 2012. This reflects a period where deposit growth exceeded credit growth which helped the banks to restructure their funding profiles.
 - In 2016, both models showed noticeable changes in depositor behaviour. The panel VAR identifies significant negative deposit supply shocks, with positive deposit demand shocks toward the end of 2016. In the first half of 2016, the system VAR also identifies a large negative shock that it cannot attribute to economic or financial factors (reflected in the unexplained deposit growth shocks). In late 2016, the negative shock to deposit growth from economic factors (nominal GDP and new working age migration) may reflect the increase in consumption and residential investment over this period. Households may have funded this change in behaviour by reducing their deposit growth. Both models imply that the below trend deposit growth in 2016 was driven by reduced supply of households, and this reduction was not driven entirely by economic or financial conditions.

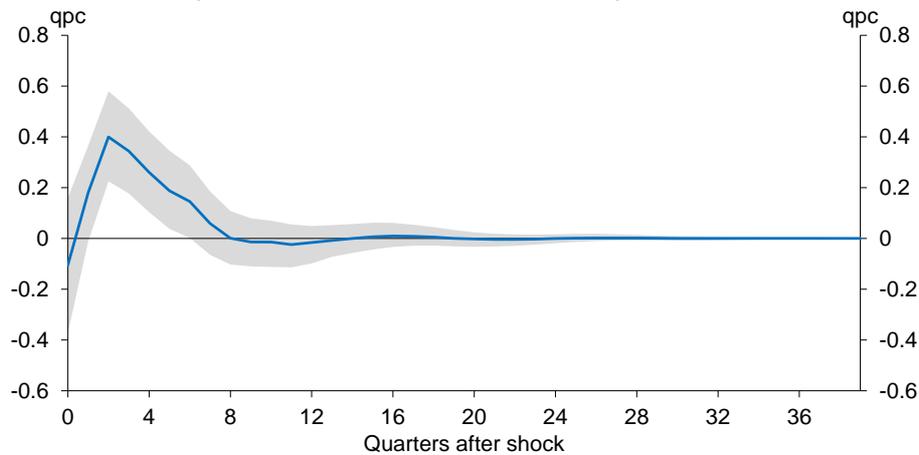
5. Can banks increase system-wide deposit growth by increasing deposit rates?

Both the panel VAR and system VAR models enable us to estimate the interest rate elasticity of household and retail funding. We focus most of our discussion on the elasticities of the system VAR given it incorporates a full business cycle, but also compare the elasticities of the two models as useful crosscheck.

The system model estimates the pure elasticity of deposit growth to changes in the deposit interest rate. This model shows that household deposits increase in response to an increase in the six-month deposit rate.¹⁸ The impulse response function below indicates that an increase in the deposit interest rate would, after a one quarter lag, cause deposits to grow above trend for up to two years (figure 6). This one quarter lag may reflect the time it takes households to shift investments into deposit products. Due to the persistent nature of interest rates and the dynamics in the model, this shock results in a permanent increase in the deposit rate (see Appendix C).

¹⁸ A full set of impulse response functions for deposit growth and the responses to a deposit rate shock are presented in Appendix B and Appendix C respectively.

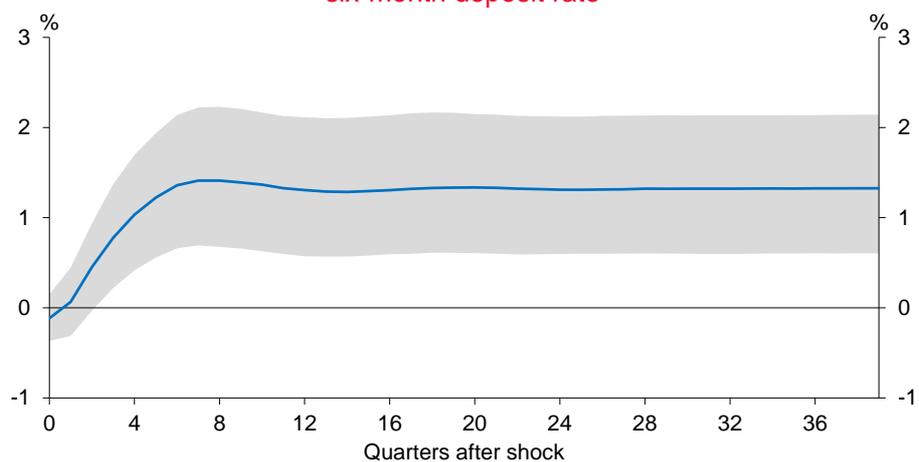
Figure 6 – Impulse response function for quarterly household deposit growth given a 100 basis point increase in the six-month deposit rate



Note: The one standard deviation confidence band is shown in grey.

Figure 7 below indicates that a 100 basis point increase in the six-month deposit rate would increase the level of household deposits by around 1 percent after one year. This is equivalent to \$0.8 billion, based on the average level of household deposits over the sample period. If the elasticity is applied to the level of household deposits at end December 2016, a 100 basis point increase in the six-month deposit rate could increase household deposits by around \$1.6 billion. The results of the baseline model are robust to alternative specifications.¹⁹ In reality, the sensitivity of deposit growth could be slightly higher or lower than the central, as is reflected by the confidence bands in the figures.

Figure 7 – Change in the level of household deposits given a 100 basis point increase in the six-month deposit rate



Note: The one standard deviation confidence band is shown in grey.

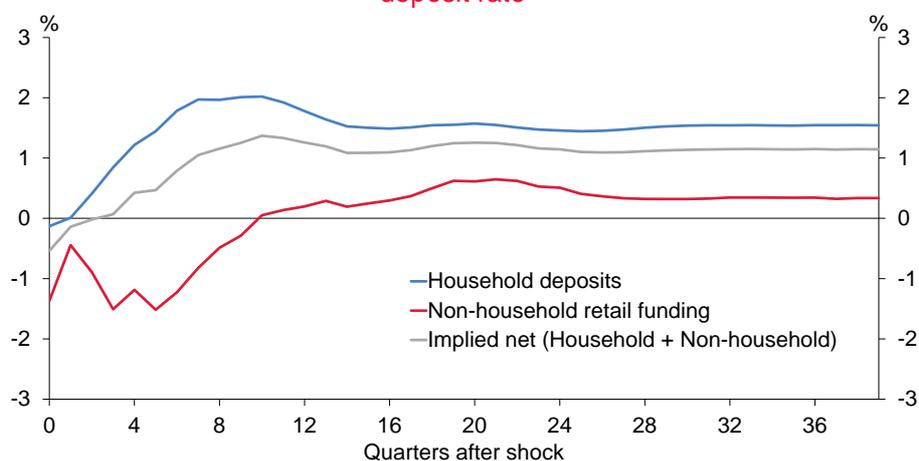
The long-run sensitivity suggests that a 100 basis point increase in the household deposit rate will increase the level of household deposits by around 1.3 percent (\$1.1 billion using the average level of household deposits over the sample period), most of which is complete after six quarters. However, given that current interest rates are at a low base, a 100 basis point increase is proportionately large compared to the pre-GFC period.

¹⁹ Robustness specifications are presented in Appendix E.

Will growth in household deposits cause a redistribution of other retail deposits?

The system VAR suggests that banks can marginally increase household deposit growth by increasing deposit rates. Assuming that banks increase deposit rates for households, this may result in slower growth in other retail deposits, such as small business deposits, due to slower household spending growth. In addition, it may see account holders shift deposits from non-household (business) accounts into household accounts. Some smaller businesses may simply choose to hold deposits in household accounts rather than business accounts in order to earn extra interest. To investigate this dynamic an additional specification was tested – referred to as the retail funding model. By taking total retail funding and subtracting the household deposit component enables the model to estimate the flows between the two types of accounts for a given shock. Figure 8 below displays the cumulative impulse response functions.

Figure 8 – Change in the level of deposits after a 100 basis point increase in the six-month deposit rate²⁰



Note: The implied net line was calculated by multiplying the respective growth by its average share of retail funding over the sample period.
 Implied net = 0.67*Household + 0.33*Non-household.

The retail funding model supports the redistribution hypothesis that non-household deposits decline in the short term when the interest rate on household deposits is increased. However, the response of non-household deposit growth is not statistically different from zero beyond four quarters after the shock.²² Overall, this retail funding specification implies that system retail funding will increase by around 0.5 percent after one year (\$0.7 billion using the average level of retail funding over the sample period, \$1.2 billion using the level of retail funding at end December 2016).²¹

In both the retail funding model and the original model (with just household deposits),

²⁰ See Appendix D for the individual cumulative impulse response functions and associated confidence bands.

²¹ As a robustness check total retail funding growth was used in place of household deposit growth. This specification produced a similar result to the combined effect line in figure 8 (grey). This specification stabilised at a lower overall long-run increase of 0.7 percent more retail deposits, indicating that it is harder for banks to increase total retail deposits. The cumulative impulse response is presented in Appendix D.

household deposits increased by more than the total retail deposits. The growth in household deposits is similar in the original model and the retail funding model for the first year. Both models also settle around the same level in the long-run. Therefore, it can be concluded that some of the growth in household deposits is deposits diverted from non-household deposit accounts.

Can banks close the gap between credit and deposits by raising deposit rates?

Overall, the system VARs indicate that banks can collectively increase the level of household deposit growth if they increase interest rates. We are interested in what these elasticities imply about banks' ability to reduce the \$13.5 billion gap between credit and deposit growth. Applying these results to more recent deposit balances implies that a 100 basis point increase in the six-month deposit rate may increase total retail funding by \$1.2 billion after one year. Therefore, these results indicate that banks may only be able to marginally reduce gap between credit and deposits by increasing deposit rates by 1 percentage point. Expanding household deposits, even if at the expense of non-household deposits, may still be valuable for banks as household deposits are their preferred source of funding.

How do system-wide deposit elasticities compare to those from the panel VAR?

The panel VAR model can also be used to generate elasticities, and these can act as a useful crosscheck for the system VAR model. We calculate conditional elasticities for this model as follows. For each of the four shocks, we scale the identified shock so that the change in the deposit rate is 1 percent on impact. We then look at the cumulative change in deposits over 12 months, and divide by the average change in the deposit rate over 12 months to generate a pure elasticity. We calculated the deposit-share-weighted average elasticity to compare to the pure elasticity from the system VAR.

In the panel VAR, we find that an increase in the six-month deposit rate of 100 basis points generates around \$1 billion of household deposits across the system after one year.²² This is in line with the system VAR which, for the same shock, suggested an increase in household deposits of about 1 percent (which translates to around \$1.2 billion²³) after one year.

However, there are some important differences between the models, which mean that comparisons must be treated with caution. Conceptually, the elasticities are different between the two models for three reasons:

- The system VAR model generates a pure elasticity – we can shock the deposit rate to determine the response of deposit growth to this shock. By contrast, the panel VAR does not have a 'deposit rate' shock identified. Instead, we must look at the implied elasticities under each of the four shocks.
- The system VAR model can tell us the elasticity at an aggregate level, while the panel VAR can only tell us the elasticity for each bank. We produce a deposit-share-

²² Depending on the type of shock driving the movement, a 100 basis point interest rate increase can generate between \$0.7-1.5 billion of deposits, with significant confidence intervals therein.

²³ This figure is calculated by taking the average of the system-level deposits across the sample period of the panel VAR.

weighted average, which is similar, but the conceptual difference between the two persists.

- The system VAR model is estimated over a much longer data sample, incorporating a full economic cycle, while the panel VAR is estimated over a shorter, entirely post-crisis sample.

6. Conclusion

The domestic deposit market has evolved significantly following the GFC as a result of changes in household and bank behaviour combined with regulatory reform. Increased deposit supply from households helped banks to build resilience into their funding profiles. However, more recently credit growth has outstripped deposit growth.

The recent weakness in household deposit growth appears to be driven by a deposit supply shock (households shifting their asset allocation away from deposits). Our modelling suggests banks can increase the rate of household deposit growth by increasing deposit interest rates. Our models suggest that a 1 percentage point increase in the six-month household deposit rate would increase household deposits by around 1 percent after four quarters, and by 1.3 percent in the long-run. However, total retail deposits would grow by less, as the growth in household deposits appears to come partly at the expense of lower growth in other retail deposits. Deposits are also more expensive if raised quickly, rather than over a longer time horizon.

Overall, banks would only be able to marginally reduce the recent gap between credit and deposits by increasing deposit rates by 1 percentage point. Therefore, if banks wish to maintain robust funding profiles by not becoming too reliant on offshore wholesale funding, they may need moderate credit growth or use a combination of approaches to bring deposit growth in line with credit growth.

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Appendix A – Overview of the theoretical model and identification strategy²⁴

The model has two types of agents – households and banks. They meet in a market for deposits, with households supplying deposits and banks demanding deposits. The equilibrium outcome is characterised by the level of deposits each household supplies to each bank being equal to the level of deposits each bank demands.

In order to find the equilibrium, the households and the banks must each solve an optimisation problem.

Household problem

The household seeks to maximise the risk-adjusted return on a portfolio of two types of assets – low-risk assets (bank deposits²⁵), and risky assets. Each household has a parameter which governs their preference for risky assets – their risk-preference parameter. As this increases, households want to hold riskier assets (in the hope of getting a higher return).

When choosing which bank(s) to provide deposits to, the household has an idea of how much they like or dislike each bank, given by a ‘cost’ parameter for each bank. The real-world interpretation of this parameter may be the cost of travelling to a particular bank, or the customer service that that bank offers.

The household's problem is to determine how much it wants to save as deposits (versus risky assets) with each bank, given its risk-preference parameter, the bank-cost parameter for each bank, and the interest rate each bank offers.

Bank problem

Each bank has some monopoly power, and is able to set their interest rate r_i subject to an upwards-sloping supply curve (that is, as a bank's interest rates increase, the quantity of deposits offered by households to that bank will increase). Banks can also choose to obtain funding from non-deposit sources (such as offshore funding markets). The amount that banks must pay for non-deposit funding can be split into two components – an interbank interest rate plus a risk spread. The interbank interest rate is common to all banks and reflects market funding conditions, while the risk spread is idiosyncratic and picks up the riskiness of lending to a given bank.

The bank's problem is to determine what interest rate to charge in order to attract the right quantity of deposits, given the cost of alternative funding (that is, given the global interbank interest rate and that bank's risk spread).

Equilibrium and shock definition

Equilibrium in this model arises when the households and banks jointly solve their problem and arrive at a common solution in terms of the quantity of deposits and interest rates paid. We can

²⁴ See Chiu and Hill (2015) for a full description of the model.

²⁵ The assumption that bank deposits are risk-free does not hold in New Zealand where deposits are not insured by the government. However, the assumption holds for the purpose of modelling investor behaviour in this context.

then identify four shocks which might disturb the market from its equilibrium:

- A positive **aggregate deposit supply shock (Agg-DS)** is a decrease in risk preference – households would prefer to hold less risky assets, and so deposit supply increases for all banks.
- A positive **idiosyncratic deposit supply shock (Id-DS)** is a decrease in the ‘cost’ parameter of a single bank – deposits to a given bank rise due to; for example, better branding or improved customer service by that bank.
- A positive **aggregate deposit demand shock (Agg-DD)** is an increase in the interbank interest rate – it becomes more expensive for all banks to obtain non-deposit funding, and so all banks demand more deposits.
- A positive **idiosyncratic deposit demand shock (Id-DD)** is an increase in the risk-spread in the non-deposit funding market – it becomes more expensive for a single bank to obtain non-deposit funding, and so that bank demands more deposits.

Given this theoretical description, we can build a set of restrictions for the parameters in our empirical model as follows

Table A: Identifying restrictions (for positive shocks)

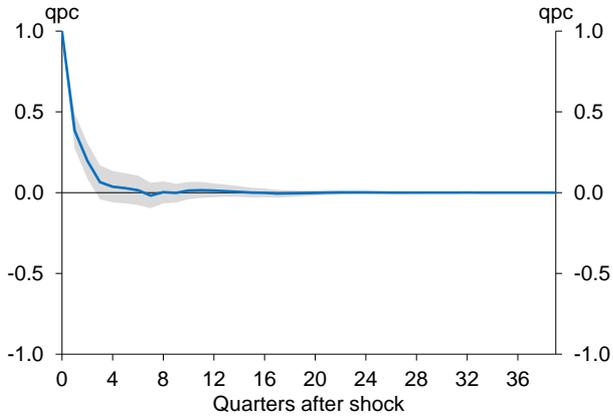
	Agg-DS shock	Id-DS shock	Agg-DD shock	Id-DD shock
Bank-specific deposits	+	+	+	+
Bank retail interest rate	–	–	+	+
Aggregate system deposits	+	0	?	?
Bank-specific risk-spread	?	?	0	+

Note: ? indicates that we do not restrict that parameter. The above restrictions apply on impact only as in Chiu and Hill (2015).

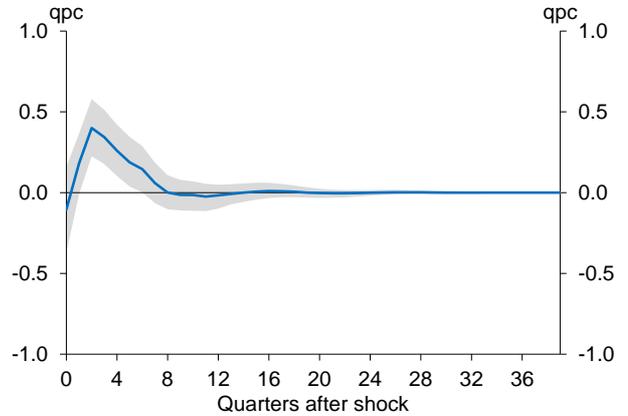
In order to implement the sign and zero restrictions, we proceed following Arias et al. (2013). This algorithm builds contemporaneous parameter matrices (B_0) that satisfy the zero-restrictions above. The B_0 matrices are produced by randomly rotating the variance-covariance matrix to find the impact matrices that respect the sign and zero restrictions. We perform the algorithm 500,000 times for each bank, and keep only those B_0 matrices that satisfy the sign restrictions.

Appendix B – Impulse responses of quarterly household deposit growth to a one unit shock in the following variables

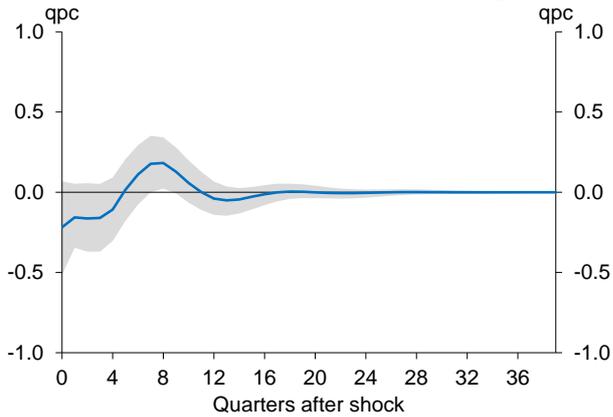
Response to shock in household deposit growth



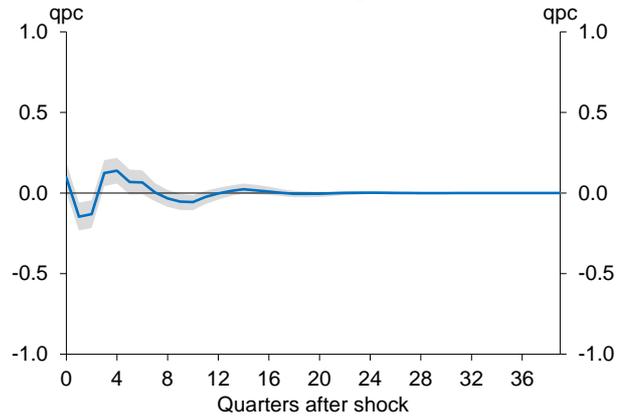
Response to shock in the six-month deposit rate



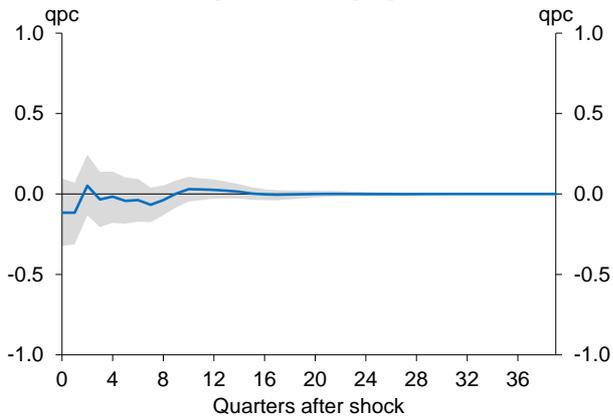
Response to shock in household credit growth



Response to shock in nominal gross domestic product

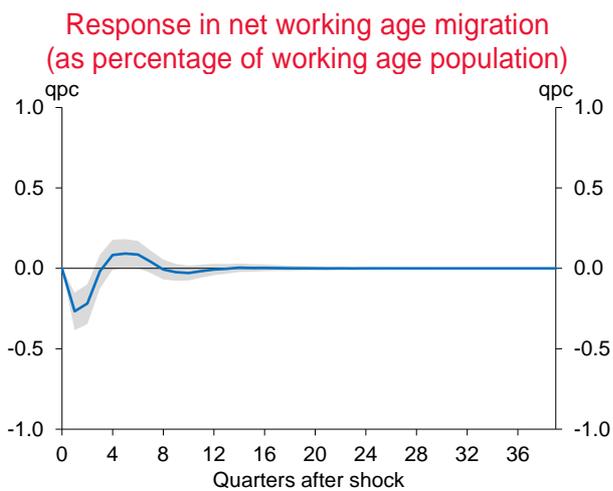
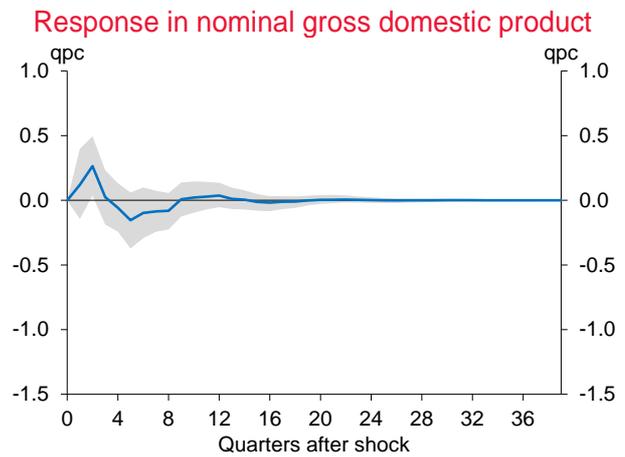
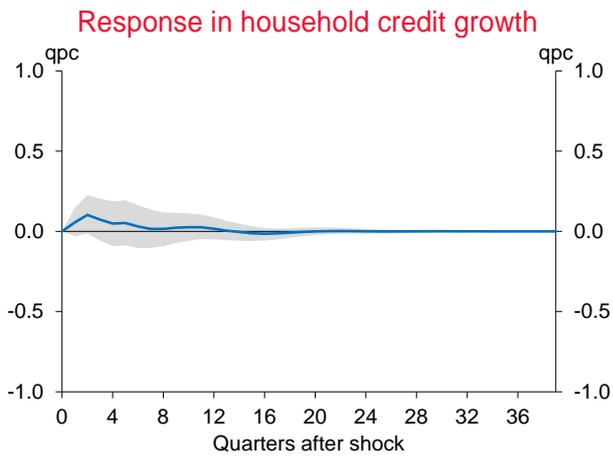
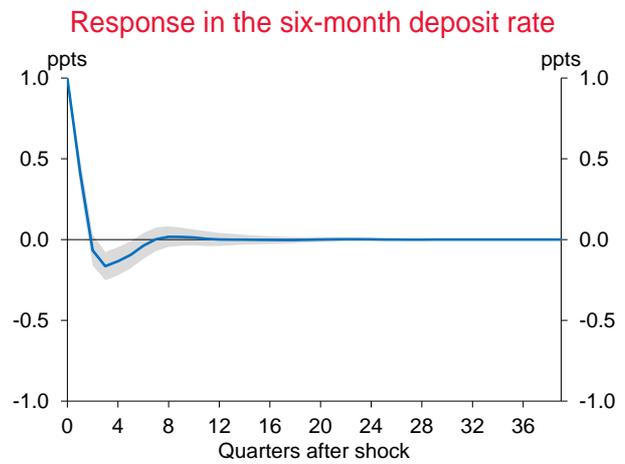
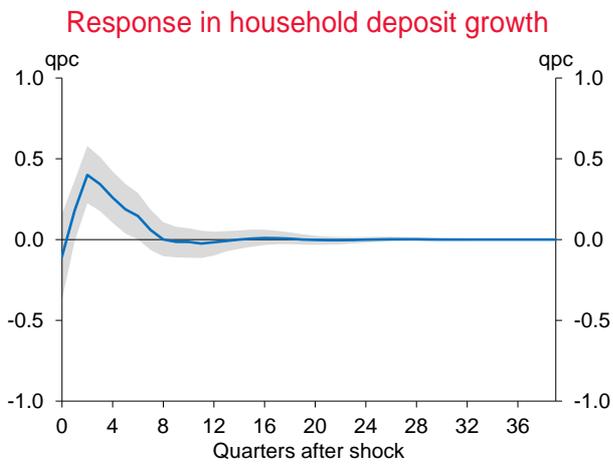


Response to shock in net working age migration (as percentage of working age population)



Note: The one standard deviation confidence band is shown in grey.

Appendix C – Impulse responses in respective variables to a 100 basis point increase in the six-month deposit interest rate

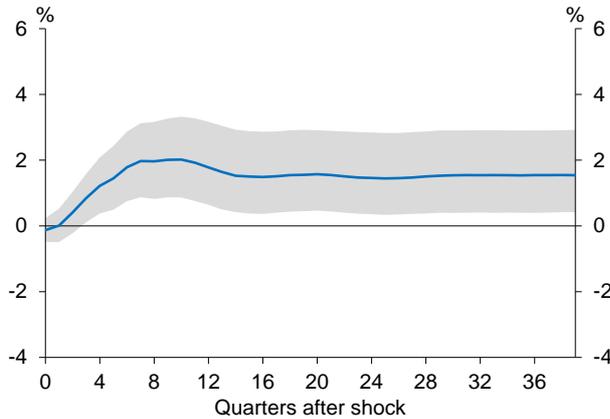


Note: The one standard deviation confidence band is shown in grey.

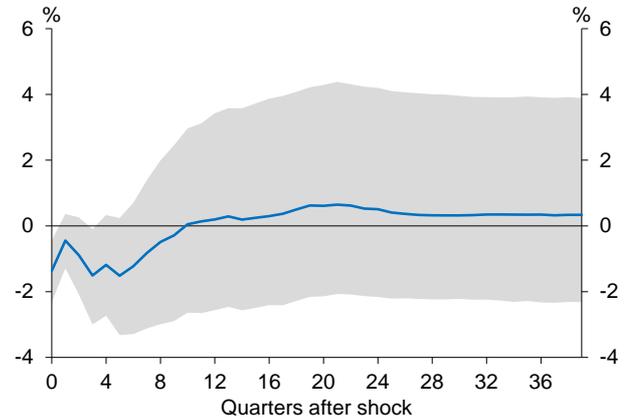
Appendix D – Cumulative impulse responses for a 100 basis point shock in the six-month deposit rate for the additional specifications with retail funding

The first additional specification included both household deposits and non-household deposits. The resulting impulse response functions are presented below.

Additional specification: Household deposits

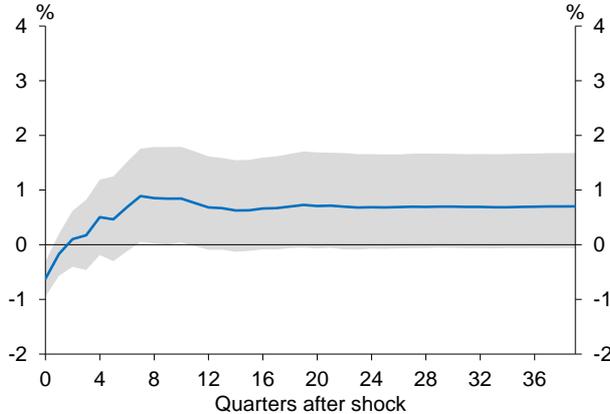


Additional specification: Non-household deposits



As a robustness check, a second additional specification was tested with only total retail funding in the model. The resulting cumulative impulse response is presented below.

Response in total retail funding

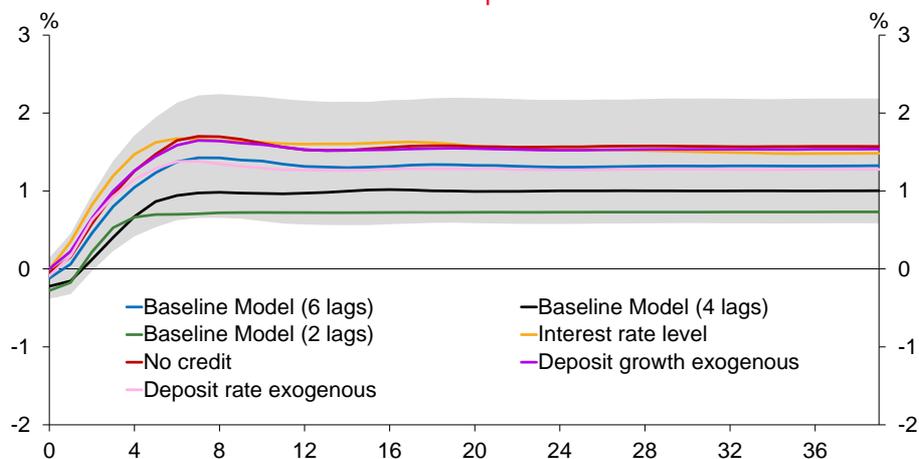


Note: The one standard deviation confidence band is shown in grey.

Appendix E – System VAR robustness tests

In order to test the robustness of the model, a number of different specifications were explored. Changes in the Choleski ordering and entering the interest rate level (rather than the change), resulted in slightly greater rate-elasticities, but these differences were not statistically different from the original specification. The figure below presents some of the impulse responses from the various models tested. Most of the central cumulative impulse responses indicate a 100 basis point increase in the six-month deposit rate is associated with a 0.7-1.5 percent increase in deposits after one year. The baseline model sits broadly in the middle of this range and hence is the central model used in the paper.

Cumulative impulse response in household deposit growth for a 100 basis point shock in the six-month deposit rate



Note: The one standard deviation confidence band for the original model (Baseline Model (6 lags)) is shown in grey.