The effects of changes in liquidity rules under Basel III: evidence from New Zealand

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Abstract

In the aftermath of the Global Financial Crisis (GFC), many international banking regulators have sought to shore up the positions of the systems they control by adopting new liquidity rules. Much of this effort has been subsumed into the Basel III project.

This paper examines the new liquidity rules implemented by the Reserve Bank of New Zealand (RBNZ) on 1 April 2010, and examines their effect. Although the RBNZ rules are not an exact equivalent to Basel III, they are sufficiently similar to provide a basis for expectations as to outcomes in other countries when the Basel III rules are adopted.

The New Zealand experience shows that banks have increased the average maturity of their liabilities, and achieved some shift from wholesale to retail funding. Coincident with both these changes and the GFC, New Zealand banks have suffered an increase their funding costs.

Keywords

Banking, liquidity ratios, New Zealand.

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1 Introduction

For most of the history of banking, one of the major risks faced by bank managements was of a run on the bank. Were demand depositors and holders of notes going to demand repayment, and if they did, would the bank have the cash to pay them back? This concept of a run was formalised in the model of Diamond & Dybvig (1983).

Following the establishment of the FDIC in the United States, and following World War II, concerns about bank runs became much less of an issue. Queues at bank doors became a thing of the past, and if banks found that they needed liquidity, they were generally able to go to financial markets (the interbank market in particular) to obtain it. In any case, cash became much less important, and people used transaction account balances to make payments, initially through cheques and other paper-based transactions, but more recently through electronic transfers. As long as banks were able to meet payment obligations on their customers' behalf, facilitated by short-term funding in the interbank market if need be, liquidity stopped being an issue for bank management.

In many countries, this simplified approach to liquidity management was facilitated by both formal and informal deposit insurance or guarantee schemes. Formal schemes usually only protected small depositors, while depositors in general were often protected informally by government bail-outs, usually justified on an ad hoc too-big-to-fail basis for fear of the adverse consequences (systemic disruption) from allowing a major bank to fail. A number of countries abandoned the requirement to hold mandatory reserves with the central bank in support of their deposit liabilities, preferring to rely on banks to manage their own liquidity prudently, although this also acknowledged the inefficiencies that followed from the imposition of mandatory reserves (see, for example the discussion in Goodhart, 2008).

Until the onset of the Global Financial Crisis (GFC), beginning in 2007, the relaxed approach to liquidity management, based on the idea that funds could also be raised when needed, worked well enough. The run on Northern Rock in September 2007 was the first sign that things might not be so simple, a realisation that was confirmed by a number of other events over the following 18 months or so, most spectacularly with the flow-on effects of the failure of Lehman Brothers in September 2008. The immediate reaction in many cases was to extend coverage of existing deposit insurance or guarantee schemes, and for those countries that did not have them (Australia and New Zealand in particular), schemes were introduced.

These schemes were not without their actual or potential impacts on taxpayers, who were the ultimate sources of funds for bailouts, however, and this stimulated regulators internationally to revisit their approaches to bank liquidity (and capital), so as to reduce the risks to which taxpayers might be exposed in the future. This led to a new international agreement on bank capital, which we now know as Basel III, with Basel III also imposing guidelines on bank liquidity. These liquidity guidelines are structured around two new measures – a liquidity coverage ratio (LCR) and a net stable funding ratio (NSFR), covering short and longer term funding respectively. The Basel Committee's December 2010 paper proposes that the LCR should come into effect in 2015, and the NSFR in 2018 (Basel Committee on Banking Supervision, 2010, December). Because of the potential effect of these new rules in restricting banks' freedom to operate, they have attracted a certain amount of negative comment, with suggestions that banks' capability to undertake financial intermediation may be constrained in consequence. These criticisms have been directed more at the increases in required capital, but criticisms have also been extended to the new liquidity rules, which almost by definition must require banks to hold more in the way of liquid assets and to reduce their lending.

After having been one of the first countries to remove formal rules specifying holdings of (supposedly) liquid assets, in February 1985, the Reserve Bank of New Zealand (RBNZ) had already been reviewing bank liquidity when the GFC started to show its effects. This process had acknowledged vulnerabilities in New Zealand bank funding, in particular, the very significant dependence on non-resident funding and the generally short maturity of both domestic and offshore funding. A consultative paper on a new liquidity policy was released on 31 October 2008, and after due consideration of the responses, a new policy was confirmed in October 2009 to come into effect on 1 April 2010. In doing so, the RBNZ acknowledged that they were aware of the Basel III process and actions being taken by other regulators internationally (Hoskin, Nield & Richardson, 2009). This contrasted with the approach followed by some other regulators, such as the Australian Prudential Regulatory Authority (APRA), who preferred to hold off finalising policies until such time as the Basel III policies had been finalised.

What the New Zealand case therefore offers us is the opportunity to observe how new, Basel III-type liquidity rules can work in practice, in terms of how bank liquidity changes, and the extent to which other bank behaviours can change in consequence. This paper is the first attempt to report on this, and it provides an opportunity to develop some appreciation of what might happen in other countries as the changes in liquidity rules associated with Basel III are implemented. Will the Basel III

rules bring about the adverse consequences that are feared? While the New Zealand approach does not exactly match the proposals outlined by the Basel Committee, the Reserve Bank of New Zealand has indicated that it does not expect to have to make significant changes to achieve compliance with the Basel III proposals.

The rest of this paper is structured as follows. The next section outlines the new policies adopted in New Zealand, against the background of the previously evident structure of New Zealand bank funding. Section 3 looks at the data and method that are used for the study that was undertaken, while Section 4 reports on the changes that have been observed, and the significance of these. Section 5 concludes.

2 Background on the New Zealand banking system and the new liquidity rules

Key characteristics of the New Zealand banking system, since it was deregulated in the 1980s, are the extent of foreign ownership (95%, as of mid-2011) and its historic lack of any deposit insurance scheme. During the 1990s, the RBNZ implemented a disclosure regime, requiring banks to publish up-to-date financial information, including an income statement and balance sheet, on a quarterly basis. This was argued as enabling depositors to exercise their own judgement as to bank soundness, and absolving the RBNZ from any specific responsibility, as it was not to receive any alternative superior information, except what was in the public disclosures. The RBNZ's role was to ensure that the disclosures complied with the relative accounting rules and other disclosure requirements.[1] Thus, prior to the adoption of the new disclosure rules in 2010, the extent of liquidity regulation in New Zealand was that banks were required to report their liquidity risk management policies and their financial data, some of which could be expected to shed some light on their liquidity risk exposures.

The dominance of the four largest Australian banks as owners of the largest New Zealand banks has had some positive effects for banks' access to funding. The higher credit ratings of the Australian parent banks (all of which had ratings of AA from Standard & Poors as at October 2011)[2] were also enjoyed by these banks' New Zealand subsidiaries, and are significantly higher than would be expected to apply if the New Zealand banks were stand-alone entities. These higher credit ratings

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[1] See McIntyre et al (2009) for further discussion of the role of the disclosure regime as the basis for New Zealand's financial system oversight.
[2] Ratings were reduced to AA- in December 2011, reflecting among other things, concerns about the risky funding strategies to which these banks and their New Zealand subsidiaries were exposed.

meant that the banks had good access to wholesale funding, domestically and more particularly internationally, with correspondingly less reliance on retail funding.

This dependence on wholesale and non-resident funding was identified as a risk factor for the New Zealand banking sector as long ago as November 2006, where the RBNZ's Financial Stability Review recorded that New Zealand was "vulnerable to the effects of potential shifts in investor sentiment" (Reserve Bank of New Zealand, 2006, November, p 9). These concerns were borne out during the depths of the GFC, as discussed by Bedford (2008).[3] The generally short maturity of funding was also an issue, and Figure 1 shows us the aggregate position for the New Zealand banking sector as at 31 December 2007.

Figure 1: Maturity of New Zealand bank funding as at 31 December 2007[4]
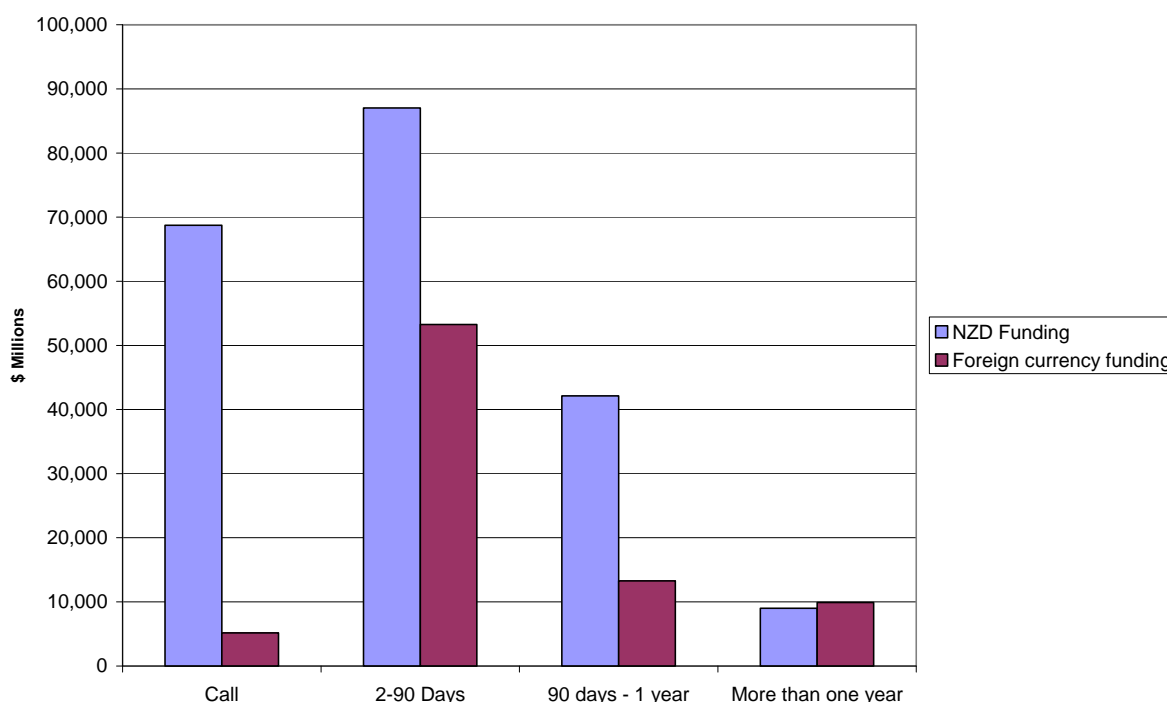
This was the background to the RBNZ's liquidity proposals which were initially presented in a discussion paper at the end of October 2008. After consultation, the final version of the liquidity policy was promulgated on 22 October 2009, and the banks were then given through to 1 April 2010 to realign their portfolios, before it finally came into effect.

The new liquidity requirements are based around mismatch ratios (which correspond to some extent to the LCR of Basel III) at one week[5] and one month, and a core funding ratio (which corresponds to

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[3] See also Allen & Moessner (2011).
[4] Data are from the RBNZ data Table SSR Part B1

some extent to the NSFR of Basel III) at one year. The standard definitions of the mismatch ratios are the mismatch dollar amount for the relevant period divided by total funding: the essence of the requirement is that the mismatch dollar amount must be positive for the ratio to be greater than zero. The mismatch dollar amount is calculated as:

> primary liquid assets after accounting for haircuts,
> *plus*   contractual inflows due within the relevant period,
> *plus*   75 per cent of undrawn committed lines granted to the registered bank available within the relevant period, up to a maximum amount from any one provider of 3 per cent of the bank's total funding, and a maximum amount from all providers together of 9 per cent of the bank's total funding,
> *minus* 100 per cent of market funding withdrawable at sight or with a residual contractual term within the relevant period,
> *minus* non-market funding[6] that is withdrawable at sight or with residual contractual term within the relevant period, applying the percentages in Table 1 to such funding falling within each size band,
> *minus*   other contractual outflows due within the relevant period,
> *minus* 15 per cent of the undrawn balance of committed lines, other than revolving retail facilities, granted by the bank, drawable within the relevant period.
>
> (Hoskin et al, 2009, p 11)

Market funding is then defined as the total of:

(a) deposits/debt securities of the bank held by financial institutions or related parties of financial institutions;
(b) tradable debt securities issued by the bank not already included in (a) above;
(c) any funding received from related parties of the bank not already included in (a) or (b) above; and
(d) any funding that the registered bank is unable to, or chooses not to allocate between market and non-market funding.

The percentages of non-market funding in each size band to be included as outflows (with a negative sign) in the mismatch ratio calculations are set out in Table 1.

Table 1: Bands identifying proportion of non-market funding for calculation of mismatch ratio

Size band	Up to $5m	$5m to $10m	$10m to $20m	$20m to $50m	Over $50m
Percentage to be included	5%	20%	40%	60%	80%

The core funding ratio was initially set at 65%, but has been increased to 70% with effect from 1 July 2012. It is scheduled to increase further to 75% (which is likely to be the final figure) as at 1 January

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[5] The one-week mismatch ratio is more extensive requirement than the standard under Basel III, where the LCR looks only at banks' one month position.
[6] Non-market funding means total deposits/debt securities issued by the bank not falling within the definition of market funding. See the further discussion below.

2013.[7] The one-year core funding ratio is defined as the one year core funding amount relative to total loans and advances. The one year core funding dollar amount is specified as:

> all funding with residual maturity longer than one year, including subordinated debt and related party funding
>
> *plus* 50 per cent of any tradable debt securities issued by the bank with original maturity of two years or more and with residual maturity at the reporting date of more than six months and not more than one year
>
> *plus* non-market funding that is withdrawable at sight or with residual maturity less than or equal to one year, applying the percentages in Table 2 to such funding falling within each size band
>
> *plus* Tier 1 capital

(Hoskin et al, 2009, p 12)

The categorisations of non-market funding applying to the core funding ratio are reported in Table 2.

Table 2: Bands identifying proportion of non-market funding for calculation of core funding ratio

Size band	Up to $5m	$5m to $10m	$10m to $20m	$20m to $50m	Over $50m
Percentage to be included in core funding	90%	80%	60%	40%	20%

The overall effect of these rules would be to expect banks to try and avail themselves both of more retail funding, and of funding for longer maturities (longer than one year in particular).

It is expected that, in due course, banks will report their performance relative to the mismatch and core funding ratios, under the disclosure regime, but at the time of writing this reporting had not commenced. Data reported by the RBNZ in its November 2011 Financial Stability Review shows that banks were, to that stage, comfortably exceeding the minimum core funding ratio (CFR), and that the CFR appeared to be showing an increasing trend.

3 Data and method

Data was collected from the Reserve Bank of New Zealand through the Standard Statistical Return (SSR) survey. Our main focus is on the table SSR Part B1, which reports retail and wholesale funding in New Zealand dollars (NZD), non-resident funding in NZD, M3 institution funding, non-resident and resident funding in foreign currencies, total NZD funding, and foreign currency funding. This is used to analyse changes in maturity structure. SSR Part B1 is also used to analyse changes in the retail and

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[7] This was originally scheduled to occur as at 1 July 2012, but in November 2011, the RBNZ announced an extension of the date, because of the funding pressures that were arising from turmoil in European Union financial markets.

wholesale mix. Specifically, we use "Retail funding", "Wholesale funding", and "Total NZD funding". This data is then grouped as follows:

1) Data used are aggregated, based on time to maturity, as follows:
   - less than 90 days (< 90 days) includes "Cheques", "other call", and "2 < 90 days";
   - between 90 days and 1 year (90 days < 1 year) using the actual figure from SSR B;
   - All others as longer than 1 year (>= 1year).

2) All figures are converted into percentages, allowing us to examine changing funding structures through time. In analysing maturity, we use percentages of funding within a particular maturity category to total funding. For the retail/wholesale mix, we calculate percentages relative to NZD funding. For example, "Retail" is calculated using data "Total retail funding"/"Total NZD funding" , and "< 90 days" is calculated using data "< 90 days in Retail"/ "< 90 days in Total NZD". We also calculated the percentages for each sector relative to total NZD funding.

3) The overall sample period is from Dec 2004 to Jan 2011. Data classifications and categories are the same as reported by RBNZ. Data are subdivided into 3 periods[8] according to global funding market pressure. These are abbreviated in subsequent data tables, as indicated.
   - Pre-Financial Crisis from December 2004 to July 2007 (Pre);
   - During-Financial Crisis from August 2007 to January 2009 (During); and
   - Post-Financial Crisis from February 2009 to January 2011 (Post).

We use August 2007 as a start for financial crisis because TED and similar indicators like the 3 month Libor-OIS spread increased at this point, and this is also consistent with the structural shift in money markets after 9 August 2007 as the first signs of the turmoil to follow became apparent (Brunnermeier, 2009). In New Zealand, the signs of stress (as evidenced by a decrease in trading volume and increase in yield for bank bills and an increase in bank bill less overnight index swap spread) on money market emerged by late July (Nield, 2008).

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[8] Our main purpose is to observe banks' willingness to shift funding structure according to the Reserve Bank's new liquidity policy. However, the funding changes are not only driven by the banks' willingness to absorb funding, but also depend on the availability of market funding, both globally and domestically. Thus it is difficult to avoid the influence of the global financial crisis which caused significant funding pressure in funding markets. In order to understand the changes in different periods, we separate the data into three distinct sub-periods, as below, based on global funding pressures, indicated by the TED and Libor-OIS spreads.

We identify the post-financial crisis period as starting on February 2009 because we are more focused on the funding pressure rather than the credit crisis. It was then that the funding pressure indicated by TED dropped to the level of the beginning of the crisis. The New Zealand yield curve also twisted to the traditional positive slope in February 2009, which may have encouraged depositors to seek longer term deposits (the previously prevailing, negative-sloping yield curve is understood to have discouraged customers from taking out longer term deposits). [9]

It may be noted that February 2009 was more than 12 months prior to when the new liquidity rules came into effect, but this nonetheless appears to be the date at which the patterns of bank funding were seen to change. Because the new rules were originally proposed to come into effect at earlier dates (at one time or another, dates suggested were 1 July and 1 October 2009), it is not unreasonable to expect that banks might have started to restructure their funding as early as February 2009. Also, by that date, the most severe consequences of the GFC had started to abate, which gave the banks scope to start to look for longer term funding.

SSR Part D (HC8) provides a sectoral analysis of outstanding NZD funding: registered banks, which covers the funding from different sectors, household, finance, non-resident, insurance, and so on.

Additionally, individual bank data are used as an alternative view of changes in maturities, with these collected from the Big Four major banks' reports in New Zealand (semi-annual) and Australia (annual) from 2007 to 2010. We have not found any comparable published data on the maturity of Australian banks' funding, although some data are reported on types of funding (discussed in Section 4.3 below).

Due to limited sample size, samples are unlikely to conform to a normal distribution, meaning that the t-test is not an appropriate method to compare the samples. We therefore use the Mann-Whitney test, which should be more robust to outliers than the t-test, to explore statistical significance.

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[9] Further evidence to support our choice of dates is reported in Section 4.3 below.

4 The observed changes

4.1 Changes in Maturity Structure

Our first expectation is that the proportion of funding at longer maturities should have increased after the adoption of the new liquidity policy. Our tests start with non-resident funding and funding in New Zealand dollars based on data from the Reserve Bank of New Zealand. Next we use individual bank data to conduct alternative tests and to check robustness to other factors that impact on funding structure.

4.1.1 Non-resident Funding

We use data from SSR_B: Non-resident funding in NZD (item B5) and non-resident funding in foreign currency (item B6). By summing B5 and B6 we get total non-resident funding. Non-resident funding in foreign currency accounts for around 70% of total non-resident funding and about 27% of bank funding overall.

Table 1: Sample Description: Non-resident Funding

Descriptive Statistics: Proportional Observations of Non-resident Funding								
	Dec 2004 to July 2007			Aug 2007 to Jan 2009			Feb 2009 to Jan 2011		
No. of Observations	32			18			24		
	Mean (%)	Median (%)	Std.Dev	Mean (%)	Median (%)	Std.Dev	Mean (%)	Median (%)	Std.Dev
Non-resident Funding in New Zealand Dollar									
<90 days	68.86	68.98	0.0340	74.25	74.19	0.0263	74.61	74.60	0.0208
90 days <1 year	19.93	19.64	0.0215	17.93	18.25	0.0221	17.97	17.94	0.0205
>=1 year	11.21	11.54	0.0333	7.83	6.93	0.0202	7.43	8.07	0.0227
Non-resident Funding in Foreign Currency									
<90 days	69.49	69.28	0.0449	70.33	71.00	0.0283	51.66	48.49	0.0788
90 days <1 year	17.98	17.78	0.0432	16.00	16.37	0.0373	17.18	17.18	0.0289
>=1 year	12.53	12.27	0.0227	13.67	13.96	0.0231	31.16	32.58	0.0599
Total Non-resident Funding									
<90 days	69.25	68.78	0.0303	71.58	72.02	0.0182	58.54	55.70	0.0603
90 days <1 year	18.74	18.04	0.0209	16.67	16.64	0.0301	17.43	17.84	0.0224
>=1 year	12.02	12.32	0.0190	11.75	12.12	0.0188	24.03	24.94	0.0427

Before the financial crisis, the percentage of funding with maturity less than 90 days was around 69%. This figure increased to above 70% during the financial crisis, reflecting the funding pressure during the crisis. After the crisis, this figure dropped to below 60% for foreign currency funding and aggregate non-resident funding, much lower than the pre-crisis level.

The standard deviation of funding in New Zealand dollars is smaller than funding in foreign currencies. Funding in foreign currencies have had to be specifically purchased by the banks, whereas New Zealand dollar funding reflects decisions by international counterparties to hold New

Zealand dollars, which must then be lodged with a New Zealand bank. We thus expect the New Zealand dollar funding to be less volatile.

Foreign currency amounts will be more volatile, including on a proportionate basis. Interestingly, the non-resident funding in foreign currency was less volatile during the financial crisis, which may suggest that global funding market pressure limited banks' activities during the crisis. Maybe it was more realistic to maintain a liquidity buffer than to adjust maturity structure. After the funding pressure had been released, the volatility increased significantly in the proportions of both short-term and long-term funding, which indicated that banks were making efforts to adjust their funding structure.

We conducted Mann-Whitney tests comparing the proportions of non-resident funding before and during the financial crisis, with the results reported in Table 2.

Table 2: Test Results: Non-resident Funding

Statistical Analysis: Maturity Changes in Non-resident Funding						
	During-Pre		**Post-During**		**Post-Pre**	
	Point estimate	Significance	Point estimate	Significance	Point estimate	Significance
Non-resident Funding in New Zealand Dollar						
<90 days	5.63%	0.0000	0.44%	0.6565	5.98%	0.0000
90 days <1 year	-1.86%	0.0048	0.08%	0.9696	-1.89%	0.0033
>=1 year	-3.86%	0.0002	-0.10%	0.9493	-3.82%	0.0000
Non-resident Funding in Foreign Currency						
<90 days	1.07%	0.2886	-21.28%	0.0000	-19.68%	0.0000
90 days <1 year	-1.75%	0.1173	1.13%	0.3278	-0.48%	0.6253
>=1 year	1.10%	0.0705	18.87%	0.0000	20.10%	0.0000
Total Non-resident Funding						
<90 days	2.52%	0.0037	-15.22%	0.0000	-12.61%	0.0000
90 days <1 year	-2.11%	0.0157	0.85%	0.5006	-0.97%	0.1065
>=1 year	4.90%	0.0000	13.24%	0.0000	12.87%	0.0000

The proportion of total non-resident funding with maturity less than 90 days decreased by 12.61%, while the proportion of funding with maturity longer than 1 year increased by 12.87%, at a 99% confidence level. The maturity of non-resident funding has been extended.

These changes mainly happened after the financial crisis, as the change in median for the post-during test is 15.22% for short-term funding (maturity less than 90 days) and 13.24% for long-term funding (maturity longer than 1 year). This is consistent with our expectation that banks would adjust to the new liquidity policy after global funding market pressure eased.

The lengthening in maturity is mainly driven by foreign currency funding. At 99% confidence level, short-term funding decreased by 19.68%, while long-term funding increased correspondingly by 20.10%.

The changes of maturity of non-resident funding in New Zealand dollars are different to those for foreign currency, but remain statistically significant. The proportion of short-term funding increased by 5.98% and long-term decreased by 3.82%, both significant at 1%. This finding is unexpected as maturity shortened, contrary to what one would expect under the new liquidity policy. But this is not the case if the share of non-resident funding sector decreased relative to total funding in New Zealand dollars, a possibility which is investigated in Section 4.1.2.

In summary, the maturity of non-resident funding lengthened during and after the financial crisis. After funding pressure eased, banks still have a strong incentive to attract funding in longer maturities from non-resident depositors. This can be seen as an effect of the new liquidity policy that banks adjusted their funding structure in response to the new ratios, specifically, the core-funding ratio requirement. The non-resident funding increase was mainly driven by the threat of the financial crisis, as well as the new liquidity policy.
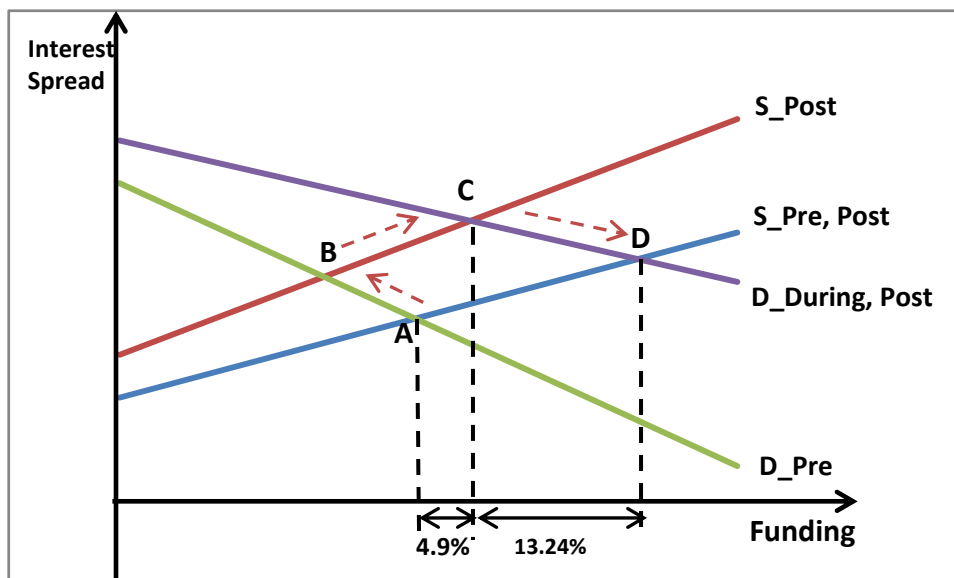
Figure 2: Demand and Supply Curve

Figure 2 illustrates the demand and supply of non-resident funding with maturity longer than 1 year. Point A is the equilibrium before the financial crisis. After pressure from the crisis passed on to the

global funding market, investors and depositors felt reluctant to deposit in longer maturities and the required risk premium increased. This means the supply curve shifted upward.

If banks did not react, the equilibrium would shift from A to B. But banks were actually unsure whether the crisis would last for years, so they preferred to raise interest rates for longer maturities and lock in funding. We also know that there was some wholesale issuance by the New Zealand banks subject to the government guarantee scheme. So the demand curve also shifted upwards, and the equilibrium moved to point C.

In our test, the proportion of funding with maturity longer than 1 year increased by 4.9% for non-resident funding. After pressure on global funding markets eased, the supply curve moved back to the initial level. However, the banks' demand curve did not move back. So the equilibrium moved from C to D after the crisis, generating a 13.24% increase in funding with longer maturity. As no other important events occurred during this time that could cause banks to lengthen maturity, we believe that the new liquidity policy was the driving force for this change.

4.1.2 New Zealand dollar funding

Data are taken from SSR_B: Retail Funding is extracted from B1; wholesale funding is from B2, and total New Zealand Dollar funding from B3.

Table 3: Sample Description: Funding in NZD

	Descriptive Statistics: Proportional Observations of New Zealand Dollar Funding								
	Dec 2004 to July 2007			Aug 2007 to Jan 2009			Feb 2009 to Jan 2011		
No. of Observations	32			18			24		
	Mean (%)	Median (%)	Std.Dev	Mean (%)	Median (%)	Std.Dev	Mean (%)	Median (%)	Std.Dev
Retail Funding									
<90 days	79.21	79.24	0.0096	75.76	76.02	0.0104	69.11	69.09	0.0331
90 days <1 year	18.63	18.76	0.0120	21.83	21.84	0.0148	25.99	26.12	0.0378
>=1 year	2.17	2.15	0.0046	2.42	2.11	0.0080	4.91	5.20	0.0083
Wholesale Funding									
<90 days	75.31	75.51	0.0260	74.63	74.37	0.0173	74.41	74.77	0.0164
90 days <1 year	16.26	15.85	0.0223	15.97	16.55	0.0174	12.30	11.61	0.0270
>=1 year	8.44	8.71	0.0184	9.40	9.78	0.0121	13.29	13.95	0.0240
Total Funding in New Zealand Dollar									
<90 days	77.54	77.72	0.0132	75.29	75.28	0.0105	70.98	70.85	0.0245
90 days <1 year	17.63	17.53	0.0123	19.47	19.73	0.0116	21.16	21.45	0.0229
>=1 year	4.83	4.82	0.0081	5.24	5.36	0.0074	7.87	7.86	0.0049

The proportion of short-term funding both in retail and wholesale markets were above 75% before the financial crisis, and gradually dropped thereafter. The proportion of funding with longer maturity

increased. The extent of the change is rather less that for the changes in non-resident funding in foreign currency.

As with non-resident funding, volatility increased after the financial crisis. This suggests banks actively adjusted their funding structure. Before the financial crisis, the funding proportion in terms of maturity in New Zealand dollars was more stable than non-resident funding.

Table 4: Test Results: Funding in NZD

Statistical Analysis: Proportional Observations of New Zealand Dollar Funding						
	During-Pre		Post-During		Post-Pre	
	Point estimate	Significance	Point estimate	Significance	Point estimate	Significance
Retail Funding						
<90 days	-3.26%	0.0000	-7.07%	0.0000	-10.37%	0.0000
90 days <1 year	3.23%	0.0000	4.35%	0.0003	7.49%	0.0000
>=1 year	0.11%	0.5243	2.52%	0.0000	2.83%	0.0000
Wholesale Funding						
<90 days	-0.83%	0.2214	0.18%	0.8688	-0.86%	0.0961
90 days <1 year	0.30%	0.4984	-4.19%	0.0001	-4.22%	0.0000
>=1 year	1.03%	0.0561	4.27%	0.0000	5.16%	0.0000
Total Funding in New Zealand dollar						
<90 days	-2.25%	0.0000	-4.55%	0.0000	-6.80%	0.0000
90 days <1 year	1.89%	0.0000	1.81%	0.0073	3.75%	0.0000
>=1 year	0.46%	0.0737	2.63%	0.0000	3.08%	0.0000

The proportion of funding in New Zealand dollars with maturity less than 90 days dropped 2.25% during the financial crisis and 4.55% after the financial crisis, at a 99% confidence level. In aggregate, the proportion of short-term funding decreased by 6.8%. The shares of funding with maturity between 90 days to 1 year, and funding with maturity longer than 1 year increased by 3.75% and 3.08%, respectively. These results are all significant at 1%. Therefore, we believe the trend of maturity being lengthened is reliable, although not large in magnitude.

Specifically, in the retail market the maturity shifted to longer periods, particularly from maturity less than 90 days to maturity between 90 days and 1 year. At 99% confidence level, the percentage of funding with maturity less than 90 days decreased by more than 10%. Longer term maturity correspondingly increased, by 7.49% for maturity between 90 days and 1 year, and by 2.83% with maturity longer than 1 year.

This may be impacted by changes in the shape of yield curve. Reacting to the shock of the global financial crisis, New Zealand bond yield curve twisted. Household depositors may then have preferred to deposit for longer terms because the quoted rates offered for longer term deposits

increased above those applying to short term deposits. One reason for the relatively small change is that New Zealand households have long been reluctant to deposit for longer maturities.

In the wholesale market the maturity structure also changed slightly, with a 5% increase in the proportion of maturity longer than 1 year and a decrease in the proportion of funding maturity between 90 days and 1 year.

In summary, the most important changes were the 10.37% of funding with maturity less than 90 days in the retail market shifting to longer terms, and in the wholesale market, the proportion with maturity longer than 1 year increased. Overall, funding maturity shifted to longer terms. Apart from other factors that could influence the structure of NZD funding, these adjustments are consistent with the new liquidity policy. In the new liquidity policy, the dollar amount of minimum mismatch offers a discount for funding withdrawal of non-market funding according to size, and the core funding dollar amount offers an extra advantage for non-market funding with maturity less than 1 year. These calculation methods gave banks incentives to collect funding from the retail market when they have a short-term funding need, and to prefer wholesale markets when the funding need is longer term.

4.1.3 Alternative Analysis

Data are collected from individual banks' annual and semi-annual reports from 2007 to 2010.[10] The figure for funding is the aggregation of funding in New Zealand dollars and in foreign currency. In line with prior tests, the figures are also consolidated to maturity less than 90 days, from 90 days to 1 year, and maturity longer than 1 year. These figures are then transformed into proportions. As ASB reported at different dates with different time buckets, we analyse its figures separately.

Figure 3 shows clearly that ANZ, BNZ and Westpac lengthened the maturity structure of their liabilities as a whole. Funding with maturity less than 90 days decreased from 65.19% to 56.16%, while the proportion of funding with maturity longer than 1 year increased from 14.62% to 21.17%. As for ASB, the proportion of funding with maturity less than 1 year also decreased by around 5% (as shown in Figure 4). These observations are consistent with our test results in section 4.1.1 and 4.1.2.

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[10] Changes in New Zealand reporting requirements with effect from the beginning of 2011 mean that we cannot construct comparable data series for ANZ, BNZ and Westpac past the end of 2010.

Figure 3: Analysis of Maturity Structure: Aggregation of Main Banks
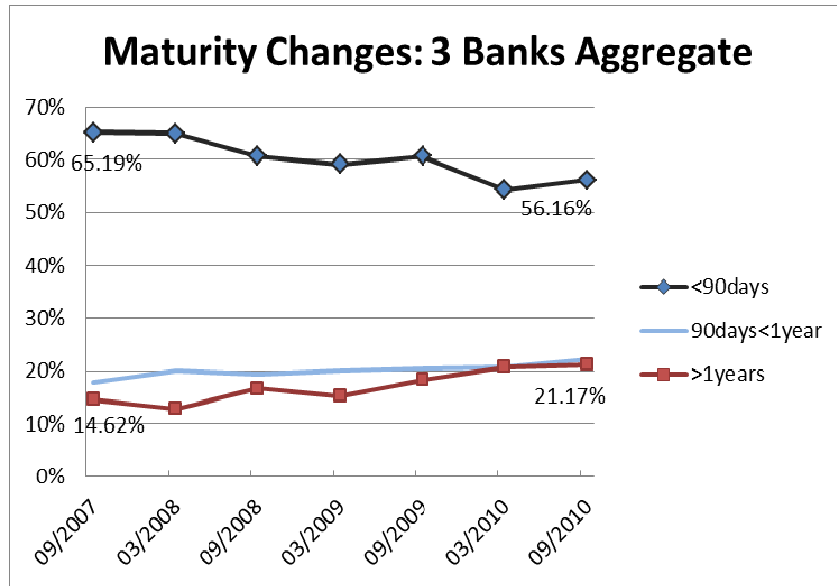
While the other 3 banks disclose information in March and September, ASB reports in June and December and has historically used different time buckets to the other banks. Its trend is reported separately in Figure 4.[11] Some increase in the maturity of funding is suggested.

Figure 4: Analysis of Maturity Structure: ASB
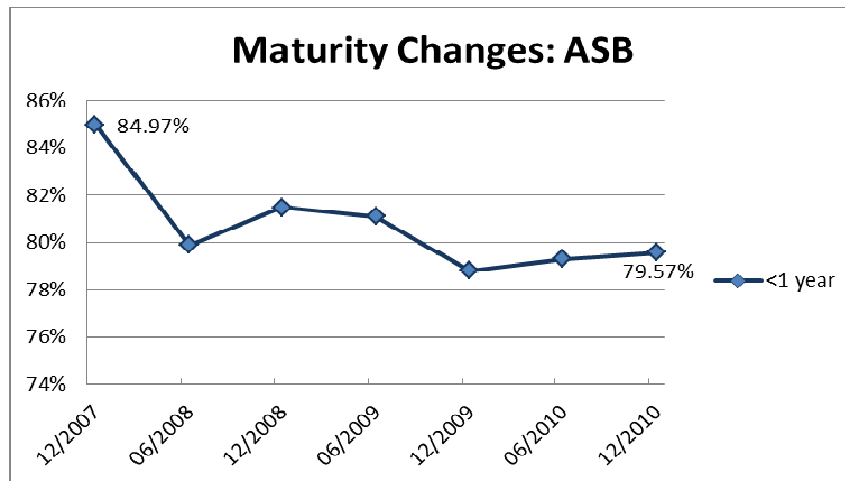
4.1.4 Comparison with Parent Banks

Although we have found a significant change in the banks' maturity structure, it cannot be concluded with certainty that these changes are manly driven by the new liquidity policy. Other factors driving

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[11] Data for June 2011 show a very similar structure of funding to those for December 2010.

this change could include bank managers' concern about future uncertainty and pressure on credit ratings. To control for the effects of those factors, we compare the maturity of the big four banks with their Australian parents, as Australia had not yet put any new liquidity policy into effect, although there had been concerns by rating agencies and others about the structure of bank funding with a high dependence of short-term non-resident funding.[12] If there was a significant difference between New Zealand banks and their parents, it would mean that our test results were relatively robust to other bank liquidity variables.

Figure 5 suggests that ASB lengthened the maturity compared with its parent Commonwealth Bank of Australia. BNZ also managed to increase the proportion of long-term funding, while its parent bank National Australia Bank shortened its maturity. Westpac seems to move along with its parent Westpac Group, both increasing their holding of long term funding. However, neither ANZ's nor its parent bank's proportion of funding maturity longer than 1 year changed significantly.

We conclude that BNZ and ASB have put more effort into attracting longer-term funding than their parent banks did. This evidence supports the idea that the new liquidity policy is encouraging banks to lengthen funding maturity. However, little support for this was found in the data from Westpac and ANZ, despite the Australian banks being exposed to similar structural funding risks as their New Zealand subsidiaries.

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[12] This was identified as a reason for downgrade of the banks' ratings by Moodys in early 2011.

Figure 5: Comparisons with Australian Parent Banks: Proportions of Funding with Maturity Longer than 1 year

Data of New Zealand banks are collected from banks' semi-annual reports, while data from Australian banks are gathered from annual reports. Again, data from ASB is consolidated differently due to its reporting date. Other consolidations are similar to prior charts.
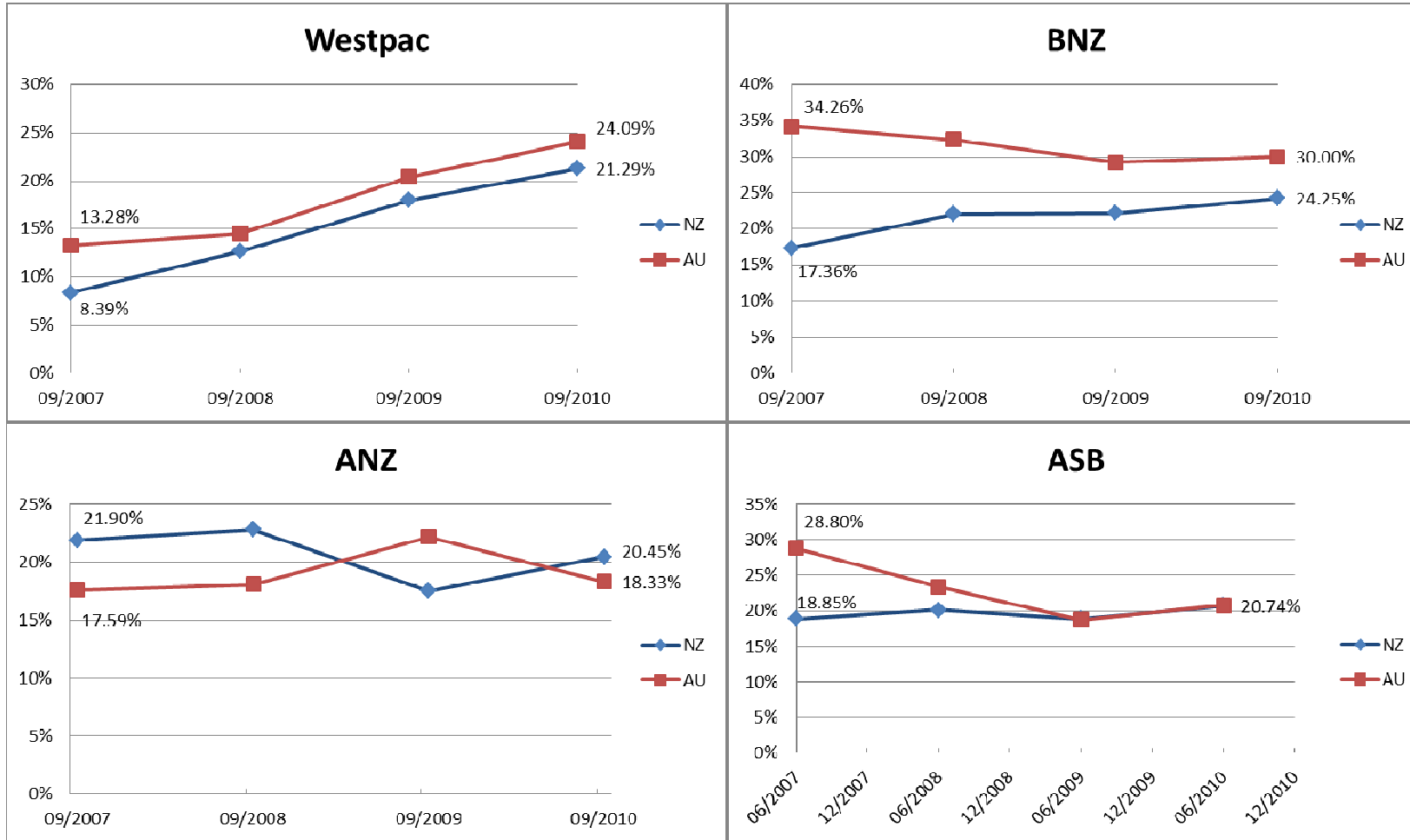
4.2 Changes in Retail and Wholesale Mix

Our expectation here is that the proportion of retail funding will have increased and that the proportion of wholesale funding will have decreased. This reflects the benefits of holding non-market funding compared to market funding.

4.2.1 Retail & Wholesale Mix

Retail/Total here means the proportion of retail funding to total funding in New Zealand dollars (which is around 70% of total funding). The balance of funding is assumed to be wholesale.

Table 5: Sample Description: Retail & Wholesale Mix in NZD

Descriptive Statistics: Proportional Observations of Retail Funding in New Zealand Dollar								
	Dec 2004 to July 2007			Aug 2007 to Jan 2009			Feb 2009 to Jan 2011		
No. of Observations	32			18			24		
	Mean (%)	Median (%)	Std.Dev	Mean (%)	Median (%)	Std.Dev	Mean (%)	Median (%)	Std.Dev
Retail/Total	57.57	57.66	0.0070	59.61	59.79	0.0126	63.82	65.11	0.0269
<90 days	58.82	58.84	0.0076	59.98	59.98	0.0102	62.09	62.43	0.0226
90 days <1 year	60.96	61.42	0.0349	66.86	65.75	0.0344	78.28	79.80	0.0716
>=1 year	26.56	25.63	0.0761	27.24	26.99	0.0616	39.68	41.10	0.0564

Descriptive statistics suggest that the proportion of retail funding to total funding in New Zealand dollars was below 60% before the financial crisis, and increased thereafter. The ">1 year" category was only around 26% before the financial crisis, much lower than the proportion of retail in aggregate funding in New Zealand dollars. It means the maturity of retail funding was relatively short compared to wholesale funding. After the financial crisis, this figure boosted to about 40%. We presume that the maturity of retail funding has lengthened compared to wholesale.

Table 6: Test Results: Retail & Wholesale Mix in NZD

Statistical Analysis: Proportional Observations of Retail Funding in New Zealand Dollar					
	During-Pre		Post-During		Post-Pre	
	Point estimate	Significance	Point estimate	Significance	Point estimate	Significance
Retail	2.12%	0.0000	4.82%	0.0000	7.31%	0.0000
<90 days	1.21%	0.0001	2.33%	0.0068	3.45%	0.0000
90 days <1 year	5.36%	0.0000	12.93%	0.0000	18.43%	0.0000
>=1 year	1.70%	0.4016	12.73%	0.0000	14.50%	0.0000

At 1% significance, the proportion of retail funding increased by 7.31%. The adjustments occurred mainly after the financial crisis.

In addition, the proportion of retail funding with maturity more than 90 days increased at a 99% confidence level. More precisely, the proportion of retail funding in the "90 days < 1 year" and ">= 1 year" categories increased 18.43% and 14.5% respectively. These results reject the null hypothesis at 99% confidence level, strongly suggesting that the maturity in retail market has been lengthened more than that of wholesale funding.

The changes observed in the retail market are consistent with expectations about the impact of the Reserve Bank policies. The proportion of retail funding increased significantly, and the banking system is less reliant on the wholesale market after the crisis.

4.2.2 Sectoral Analysis

Data are collected from SSR_D and HC8. The household, finance and non-resident sectors account for more than 76% of total funding in New Zealand dollars.

**Table 7: Sample Description: Funding in Sectors**

Descriptive Statistics: Sectoral Analysis of Funding in New Zealand Dollar								
	Dec 2004 to July 2007			Aug 2007 to Jan 2009			Feb 2009 to Jan 2011		
No. of Observations	32			18			24		
	Mean (%)	Median (%)	Std.Dev	Mean (%)	Median (%)	Std.Dev	Mean (%)	Median (%)	Std.Dev
Household	34.62	34.77	0.0057	36.82	37.00	0.0071	39.73	40.40	0.0152
Finance	19.54	19.38	0.0070	19.33	18.88	0.0135	18.65	18.11	0.0204
Non-residents	19.78	20.03	0.0107	18.72	18.58	0.0089	17.28	17.11	0.0069

The proportion of funding from households was about 35% before financial crisis and has increased to around 40%. In contrast, the proportions from the finance and non-resident sectors both decreased slightly from around 20%.

Figure 4 shows the changes in the funding from the different sectors in January 2011 relative to the average from November 2007 to January 2011. Funding from the household sector increased by 27.47% while funding from both the finance and non-resident sectors dropped.

The increase in household deposits may also be a reflection of the failure of non-bank competitors. During the period from 2006 to 2008 (although not necessarily as a consequence of the crisis), many non-bank deposit-taking institutions failed (particularly in the finance company sector), encouraging depositors to shift their funds to the banks.

Figure 6: Sectoral Analysis: Average from Nov 2007 to Jan 2011
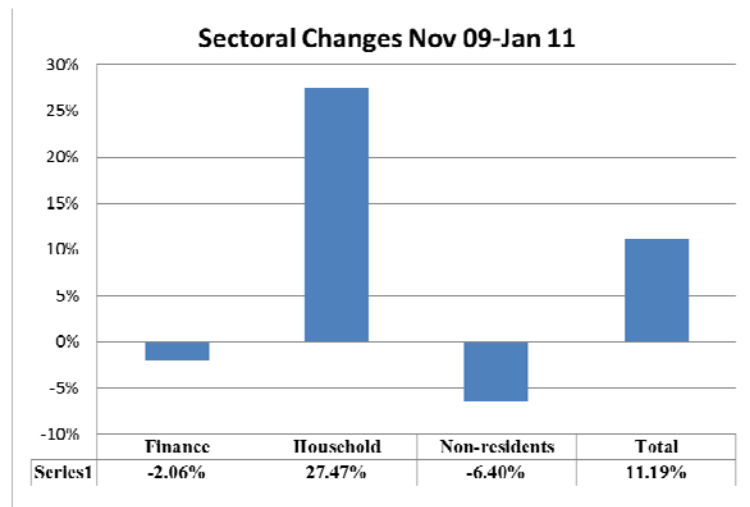
Data Source: SSR_D Hc8.

Table 8: Test Results: Funding in Sectors

Statistical Analysis: Sectoral Analysis of Funding in New Zealand Dollar					
	During-Pre		Post-During		Post-Pre	
	Point estimate	Significance	Point estimate	Significance	Point estimate	Significance
Household	2.22%	0.0000	3.24%	0.0000	5.52%	0.0000
Finance	-0.52%	0.0488	-0.90%	0.1439	-1.22%	0.0751
Non-residents	-1.26%	0.0006	-1.49%	0.0000	-2.68%	0.0000

Funding from the household sector increased by 5.52%, a difference which was significant at the 1% level. This is consistent with the test results in Section 4.2.1 that the retail proportion increased by 7.31%. A slight decrease in the shares of finance and non-resident sectors, which would be expected to represent wholesale funding, is also significant at 10% and 1% respectively. These changes in the scale of finance and non-resident sectors are relatively trivial, so the impact of the new liquidity policy may not be very significant in changing the scale of wholesale funding.

Recalling Section 4.1.1, the maturity of non-resident funding in New Zealand dollars was not lengthened, which appeared to be inconsistent with the effect of the new liquidity policy. However, it is not impossible that the non-resident sector in New Zealand dollars may also shift in favour of the ratio requirements as the new liquidity policy also encourages banks to reduce market funding. To meet the ratio requirements, banks could choose to either lengthen maturity or reduce market funding. So in the non-resident funding sector, bank managers reduced net holdings instead of shifting maturity. Evidence of this is the reduction in non-resident funding of 2.68% at 1% significance. Although this figure is not particularly large, we find that from November 2009 to January 2011 the net non-resident funding in New Zealand dollars decreased by 6.4%, while aggregate non-resident funding in New Zealand dollars increased by 11.19%. In addition, New

Zealand dollar funding accounts for a smaller part of non-resident funding, and is possibly less sensitive to markets, as such funds may be held more as a place to hold New Zealand dollar balances (acquired through other transactions), rather than reflecting any deliberate decision by non-residents to invest in New Zealand dollars.

4.3 Funding costs

The third area in which changes would be expected would be in respect of funding costs. In particular, it is expected that increased pressure to raise non-market (retail) funding and funding for longer maturities should have increased funding costs relative to benchmark interest rates.

Figure 7: Marginal Funding Costs Relative to OCR
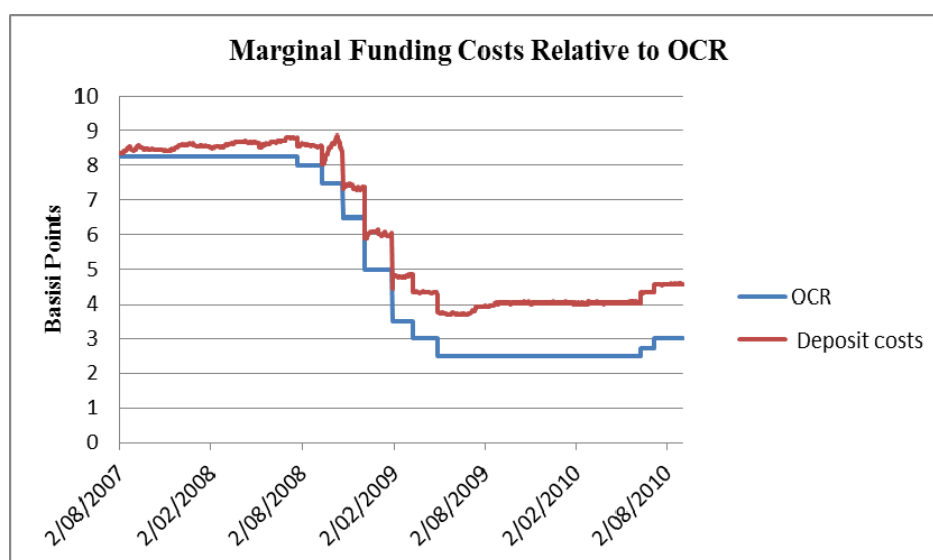
Data Source: RBNZ estimates, Monetary Policy Statement, September, 2010.

Figure 7 shows that actual funding costs relative to the official cash rate have increased gradually since early 2008, and stabilized at around 150 basis points. Mann-Whitney test results shown in Table 9 suggest that the difference between "During_crisis" and "post_crisis" is significantly not equal to 0 and the median of cost spread increased from 43 to 153 basis points.

Table 9

Mann-Whitney Test: Funding cost relative to OCR: during, post

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         N   Median
0.12   548   0.4300
1.34   579   1.5300

Point estimate for ETA1-ETA2 is -1.0100
95.0 Percent CI for ETA1-ETA2 is (-1.0400,-0.9900)
W = 151445.0
Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at 0.0000
The test is significant at 0.0000 (adjusted for ties)
```

There are, however, a number of factors which could have contributed to this increased spread, and the RBNZ report this additional margin in three categories: a short-term wholesale margin, a long-term wholesale margin, and extra deposit costs (presumed to relate to the additional aggressive pursuit of retail deposits as banks have sought to position themselves for the new liquidity rules). Figure 8 shows the decomposition of these additional funding costs for the whole of the period for which the relevant information has been reported (which was through to the beginning of September 2010).[13]

Figure 8: Decomposition of the additional funding costs

**Decomposition of additional funding costs in GFC period**
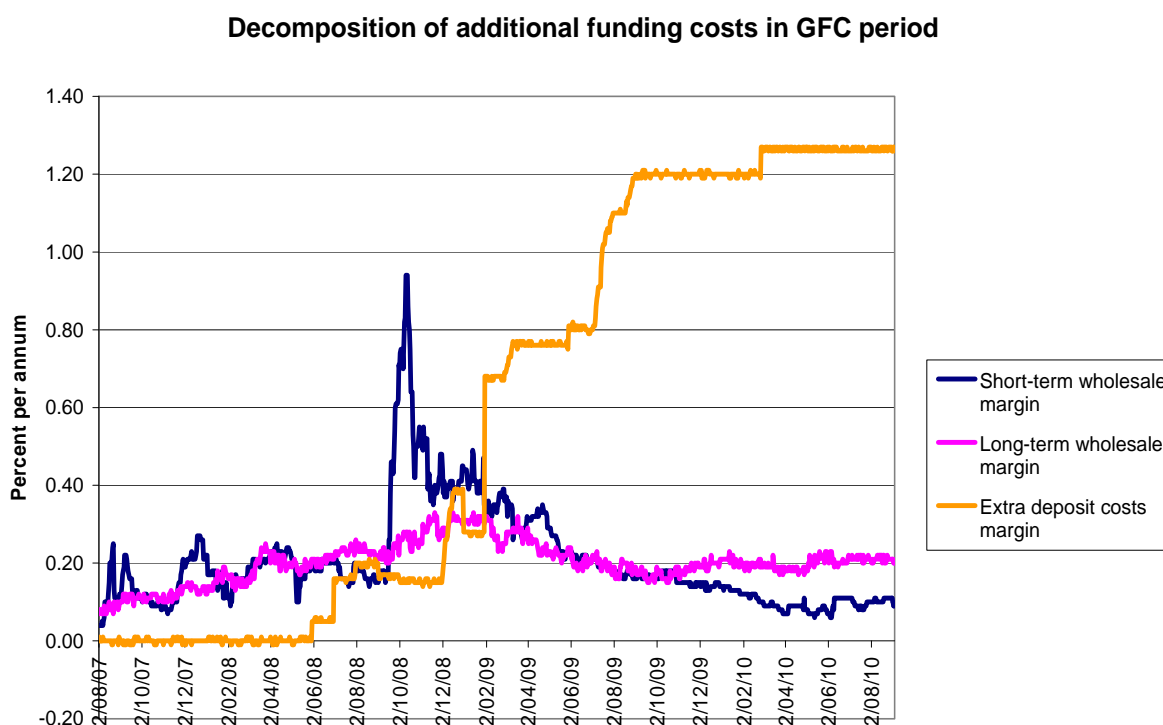
Data Source: RBNZ estimates, Monetary Policy Statement, September, 2010.

It is reasonable to argue from this that the new liquidity regime has increased banks' funding costs, with these increased costs being passed through to borrowers, thus impacting on the whole economy. It is also noteworthy that the largest increase in retail deposit related funding costs occurred in early 2009, just when the banks' retail and longer-term deposit volumes began to increase.

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[13] Reporting covering subsequent periods shows the aggregate margin only, with no breakdown. The aggregate impact averaged 155 basis points from the beginning of September 2010 through to November 2011. RBN Z data also show that increased funding costs have been applicable to both retail and long-term wholesale funding (although the impact of the latter is less because of the smaller proportion of such funding).

Further evidence for the impact of increased relative funding costs for New Zealand banks is provided in Figure 9, which shows the trend in aggregate funding costs relative to interest-bearing liabilities, derived from the RBNZ data table G4. This is compared with the 90-day bank bill rate, which has historically been the key (transfer-pricing) rate for New Zealand banks in managing their costs of funding.

Figure 9: Margin between bank bill rate and banks' actual funding costs

90 day bank bill rate less banks' actual funding costs
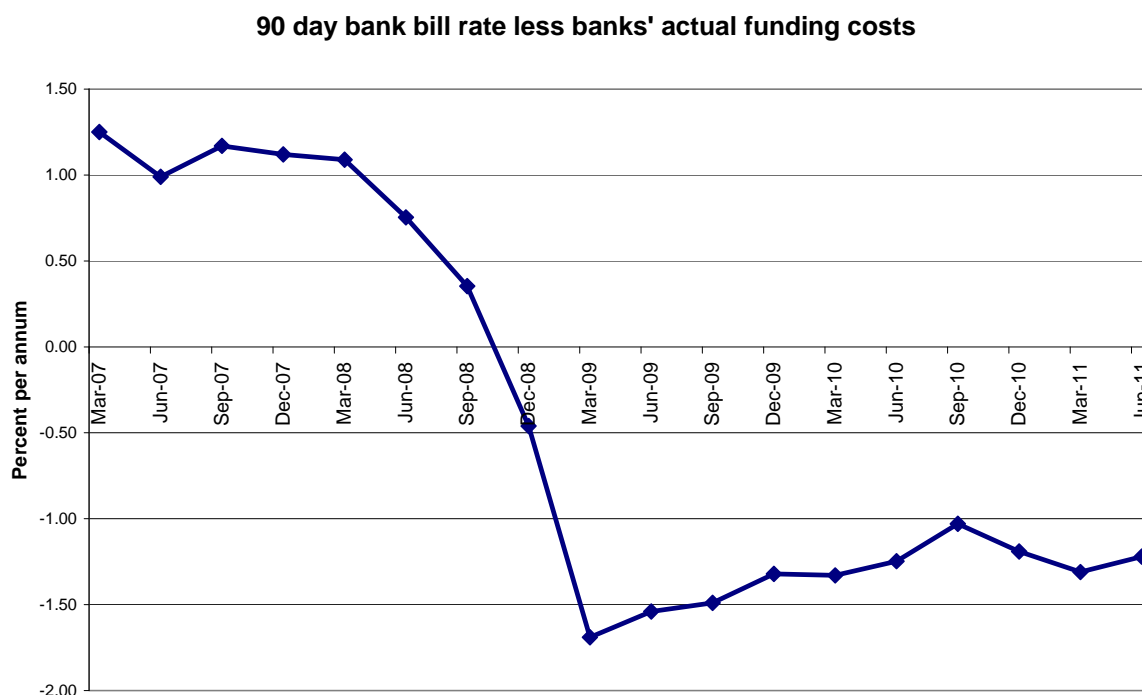
Individual bank level data for New Zealand also suggest that banks with a higher proportion of retail funding no longer enjoy the advantage of lower funding costs, as they did prior to the GFC.

Although we have identified a liquidity premium that banks appear to be paying, we cannot say for certain that this is solely a consequence of the new liquidity rules. It may be that banks would have decided that they should be holding more retail deposits, and deposits for longer maturities, anyway, so as to reduce their own liquidity and funding risk exposures.

Against this background, it is useful to look at what has happened in Australia, whose major banks faced similar risks, in respect of the structure of their funding, to the major New Zealand banks (which are subsidiaries of those major Australian banks). Brown et al (2010) report a trend by the major Australian banks to increase their deposit funding and reduce their usage of wholesale debt, reflecting the greater stability of such funding. They also note the increased cost of funding,

reflecting both the GFC and the premiums needed to secure the more stable sources of funding (with reduced reliance on short term wholesale funding and securitisation). By early 2010, the average cost of the major banks' funding was estimated at 130-140 basis points higher than it was in mid-2007, prior to the crisis. A more recent estimate by Fabbro & Hack (2011) puts that additional cost of deposits at 130 basis points.

One would expect further pressure on the cost of longer-term wholesale funding in both New Zealand and Australia since the widening of CDS spreads, following the intensification of difficulties with the Euro in mid-2011, but we do not yet have the data to allow us to study the effects of this.

5 Discussion and conclusion

When we began this research, we thought that we might find some small effects, in terms of changes to the mix and maturity of funding being used by New Zealand banks. The effects observed are generally quite strongly statistically significant, in terms of New Zealand banks' reactions to the risks that banks found they faced during the GFC, and the expected adoption of rules to govern the structure of funding. It would appear that the effects in New Zealand might be stronger than those in Australia, even though banks there faced essentially similar funding pressures in respect of non-resident wholesale funding during the GFC.[14]

There are a number of questions that remain around these results, however. One is to look at the economic downturn that New Zealand has faced since the middle of 2008, which has caused households to look to reduce indebtedness (deleveraging), with there being a consequent reduction in the demand for new borrowing. This would to be consistent with depositors becoming more willing to lodge funds with banks for longer maturities.

The fact that threatens to undermine this argument, however, is the effect on the cost of funding. Funding costs have increased significantly above benchmark interest rates, which would suggest that banks had been actively pursuing retail funding, rather than being mere recipients of the largesse of public who were looking to lodge funds with banks regardless. Nevertheless, it will be interesting to see what happens when (rather than if) growth in bank lending resumes. Will banks still be able to

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[14] Examination of the APRA data on bank liabilities shows an increased utilisation of deposits, but there was no particular data at which this might be said to have occurred.

retain retail funding, particularly for longer maturities? Would the funding of lending growth be associated with even more severe increases in banks' funding costs?

It will also be interesting to see what happens in terms of international developments, particularly as other countries move to adopt the Basel III liquidity rules. Will financial markets in all countries be able to handle the transition to greater reliance on longer term and retail funding simultaneously? How much has New Zealand protected itself from further instances of rollover risk that may arise in future periods of financial stress?

For all this, the New Zealand experience is of value internationally, in terms of letting us get to see what the impacts are of the adoption of new policies, such as are scheduled for implementation under Basel III. The New Zealand experience suggests that change can be effected successfully, although there is an ongoing problem with funding costs increasing, particularly in the case of retail funding.

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