The NZD OIS market: An Introduction

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Abstract:

The New Zealand dollar Overnight Indexed Swap (hereon, NZD OIS) market began in February 2002. Although turnover in the NZD OIS is still relatively low compared to other money market instruments, activity and general interest in the market is picking up. If trends in offshore OIS markets are mirrored here, the NZD OIS market is likely to be increasingly used by market participants. From the Reserve Bank's perspective, the OIS instrument is useful in providing estimates of the market's expectations of the Official Cash Rate (OCR). The OIS has been touted as providing the "cleanest" measure of cash rate expectations. A "rough and ready" analysis undertaken in this paper seems to lend some support to this claim for the New Zealand case. Average forecast errors for the NZD OIS market seem smaller than those of the NZD bank bill market, particularly for short maturities (say, out to 3 months). However, given the limited data to date, it is not possible to econometrically estimate a term premium for the NZD OIS market. This paper derives an estimate of the NZD OIS term premium, by subtracting the difference in term premium between the Australian bank bill and OIS markets, from the term premium estimate according to Krippner's (2002) more established bank bill model. An illustration of how New Zealand and Australian cash rate expectations (allowing for a term premium) have evolved this year is shown.

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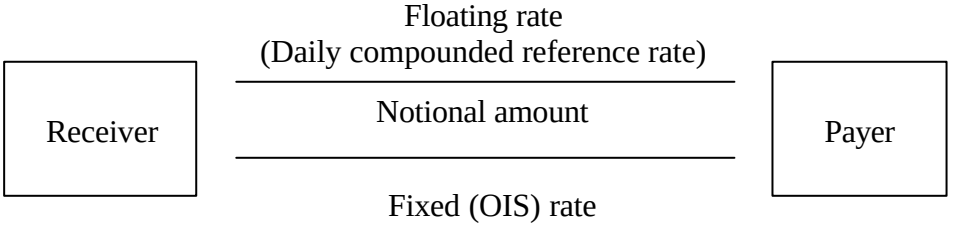
1 Introduction

In February 2002, market participants began to trade Overnight Indexed Swaps (OIS) for the first time in New Zealand. OIS contracts have become one of the fastest growing – and in some countries, the most widely traded – derivative instruments globally since they were first introduced in the early- to mid-1990s. OISs are now available in most major countries. For example, in Switzerland, the OIS market emerged in 1998 and has already become the dominant money market instrument. Closer to home, turnover in the Australian OIS market, which started in October 1999, rose by around 130 percent from $508 billion in the year to June 2001 to $1,164 billion in the year to June 2002 (AFMA, 2002).

This paper reviews the early development in the New Zealand OIS market and shows how OIS rates can be used to derive market expectations of the Reserve Bank of New Zealand's (hereon, the Bank) official cash rate (OCR) – an area of interest to the Bank. The paper is organised as follows. Section 2 provides an overview of the OIS instrument, and highlights some of its uses and advantages. Section 3 summarises the development of OIS markets offshore. Against this international backdrop, Section 4 reviews the development of the NZD OIS market so far. Section 5 outlines a framework that relates market expectations of the future OCR to OIS rates. With the aim of fine-tuning these estimates of OCR expectations, Section 6 derives an estimate of the term premium for the NZD OIS market. Section 7 provides an illustration of New Zealand and Australian cash rate expectations in 2002. Section 8 concludes.

2 The Overnight Indexed Swap

An interest rate swap involves an exchange of a fixed rate obligation for a floating rate obligation. An Overnight Indexed Swap is a special type of interest rate swap, where the floating rate obligation is tied to some overnight reference interest rate. The fixed rate is the quoted OIS rate at the time of the swap transaction and in principle represents the rate at which both parties are indifferent between investing (or borrowing) at a fixed rate for the term of the contract versus taking the risk of receiving (or paying) the sequence of overnight rates that occur over the term of the contract. To put a very simple diagrammatic representation of the OIS:[1]



Overnight Indexed Swaps are different to standard interest rate swaps in a couple of respects. Firstly, OIS contracts are for shorter term maturities – for example, from one week to one year – whereas interest rate swaps usually have longer maturities – for example, from 1 to 30 years. Secondly, the floating reference rate in the OIS is the *overnight* rate whereas the floating rate for interest rate swaps is generally set less frequently with reference to a quarterly or semi-annual interest rate.

Counterparties agree to exchange the difference between the interest accrued on the fixed (OIS) rate and the interest accrued through compounding the floating rate at the conclusion of

[1] The normal swap terminology applies. To *pay* an OIS, the counterparty pays fixed, and receives floating. And to *receive* an OIS involves receiving fixed and paying floating.

the contract. There is no exchange of any principal amount although the contract has an associated notional principal amount from which the interest payments are calculated. This means that an OIS carries very little credit risk for the contract participants and requires them to allocate a relatively small proportion of their unsecured credit limits to the contract. In this respect, an OIS contract has an advantage over money market instruments for market participants seeking to manage interest rate risk. For example, an institution wanting to invest at the current interest rate for 3 months could either buy a 3-month money market security, or deposit their cash in an overnight deposit account (to be rolled-over on a daily basis) and simultaneously enter into a 3-month OIS in which it would receive the fixed rate. Under the former approach, the institution would take on a risk that the issuer of the money market security will default before the bill matures, in which case the principal is at stake. In contrast, under the latter approach, the institution faces much less credit risk since it can, in principle, consider on a daily basis whether to withdraw their cash from one bank and reinvest at another bank.

The OIS instrument is equally useful from a borrower's perspective. In a world without OISs, corporations and banks wanting to raise term funds at floating overnight rates would have to continually roll-over overnight loans. This process is inefficient and places a greater strain on credit limits as maturing loans sometimes in part remain counted as a credit exposure until repayment is final and irrevocable, which sometimes is not until the day after a loan matures. This hangover reduces the amount of new loans that can be initiated, limiting the ability of the corporate or bank to raise new loans. Instead, an OIS allows counterparties to raise term funds (say, via bank-bills or commercial paper) but pay overnight interest rates – this involves only one derivative transaction (which is more efficient) and places less of a strain on credit limits. Therefore, OISs more effectively separate funding maturity from interest rate duration.

Aside from their uses as a risk management tool, OISs are also an excellent tool for expressing a view on the future direction of official interest rates. For example, a bank that had relatively strong expectation that the cash rate was going to rise could pay the fixed OIS rate now and receive the (floating) actual cash rate over the period of the swap. There are a few advantages for using the OIS in this way. First, a transaction is easy to reverse as quoted spreads are relatively narrow. Second, an OIS can be tailored to specific needs since rates are quoted for specific maturity dates. Money market securities often trade in "buckets" or within half-month tranches. Similarly, money market futures contracts have fixed (quarterly) maturity dates and are not as flexible. Third, since the floating rate exactly follows the cash rate, rate rises or cuts can be directly exploited. Fourth, the OIS market may potentially have more liquidity than the bank-bill or term cash markets given that the smaller credit exposures implied by using OISs allows some traders to take larger positions before they breach their unsecured credit limits.

3 International backdrop

Before we look at the recent development of NZD OIS, this section reviews the developments in offshore OIS markets. The focus is particularly on the Australian market given that the Australasian markets are closely integrated implying that the Australian market is likely to be a good candidate for representing what the NZD OIS market might become or aspire to.

The OIS contract was first traded in Europe around 1994 where the French traded a version of the modern day European OIS. This instrument spread quickly to the UK in 1997, the US in 1997/98, Switzerland in 1998, Canada, Japan, and finally reaching Australia in late 1999. While OIS contracts traded around the world are broadly similar, the main difference is in the

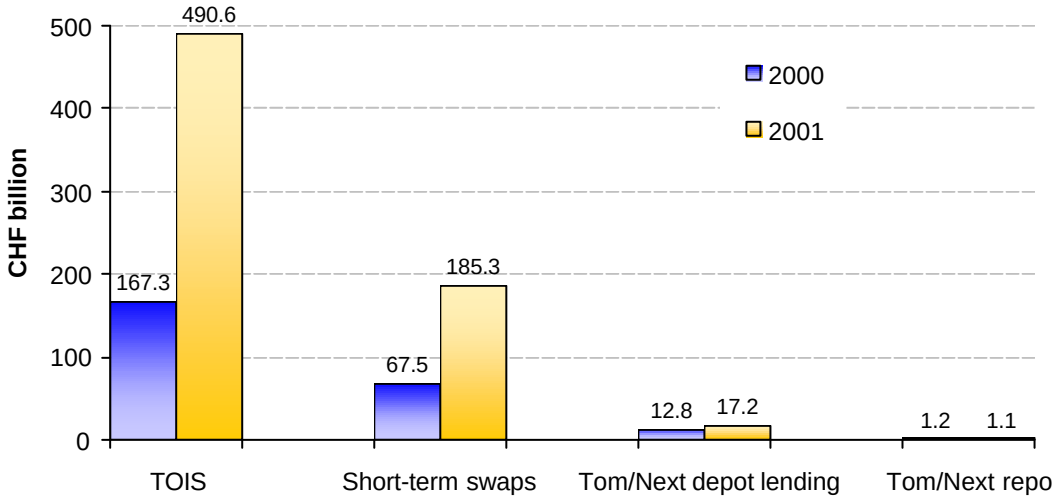
overnight reference rate used for the floating side of the swap. The overnight reference rate used is generally the weighted average rate for overnight money market transactions (i.e. determined by the market). In contrast, in New Zealand's case, the reference rate is the Reserve Bank of New Zealand's Official Cash Rate (OCR), which is determined by the central bank rather than by the market. Appendix 1 provides information on the reference rate used in a range of OIS markets around the world.

Size and growth in offshore OIS markets outside Australia

It is worth pointing out at the outset that since the OIS is an over-the-counter instrument (as opposed to an exchange-traded instrument), it is difficult to track down data on exact volumes transacted. While the Bank for International Settlements (BIS) collects data on derivatives markets via their Triennial Survey of FX and Derivatives Market Activity and semi-annual survey of the global over-the-counter derivatives market, the BIS do not collect data on individual interest rate products such as the OIS.[2] We were only able to collect detailed data on the AUD OIS market.

That said, market estimates suggest that activity in OIS markets around the world has increased considerably in the past few years. For example, the Swiss Tomorrow/Next OIS (TOIS) was first traded in 1998, and has already become the dominant money market instrument in Switzerland (CSFB, 2002). As the chart below shows, the average trading book volume tripled in size over a year, reaching around CHF 500 billion in 2001. These markets have also become very liquid over time. For example in the US OIS market, it is possible to transact around 1 billion USD of 3-month OIS at a bid/offer spread of only 1 or 2 basis points. In some countries, OIS contracts are available for maturities beyond the 1 week to 1 year horizon. For example, in the US OIS market, while most contracts have been written in the 1- to 3-month, 6-month and 1-year maturities, trading activity is active for swaps that mature in up to 2 years. In addition, some market participants will quote prices for contracts that mature as long as 30 years.

Total average book volume of Swiss money market instruments



Source: CSFB (2002)

[2] It is worth noting though that according to the latest semi-annual BIS survey results (BIS, 2002), activity in interest rate swaps (including the OIS and a host of other types of interest rate swaps) have risen considerably in the past few years, particularly in USD and euro-denominated markets. The total estimated notional amounts outstanding in USD (euro) interest rate swaps have increased from USD10 trillion (USD13 trillion) in the first half of 1999 to USD22 trillion (USD25 trillion) in the first half of 2002.

AUD OIS market

The structure of the market

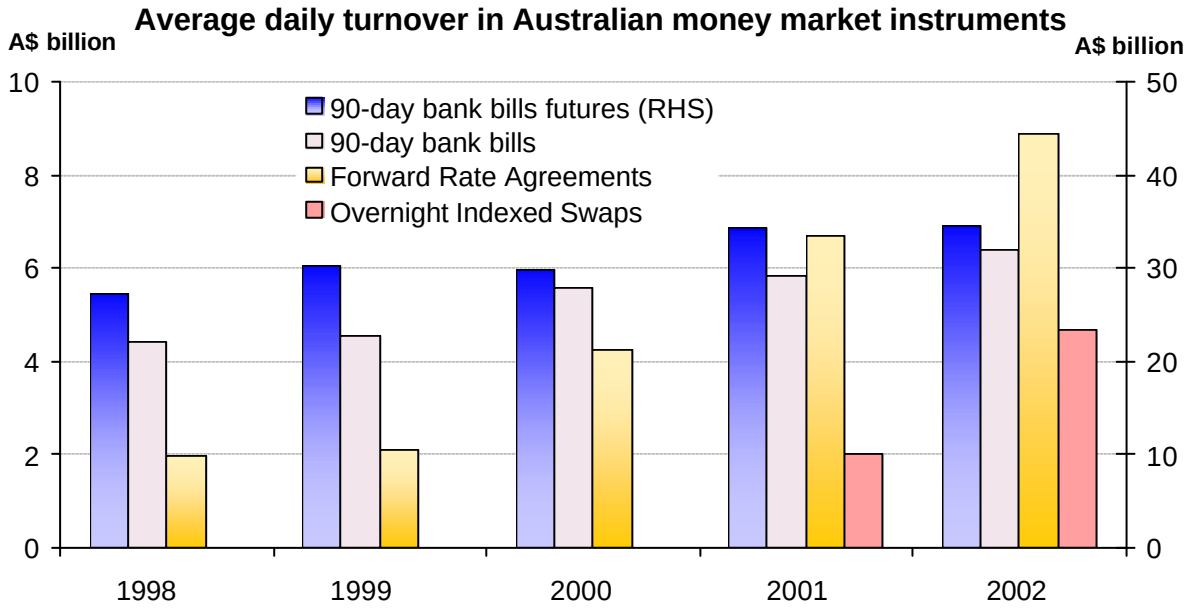
There is no formal price-making arrangement in the AUD OIS market, but a wide range of counterparties can be contacted for quotes. Although these counterparties quote prices and trade only on a "best efforts" basis, they usually quote prices on demand, particularly the larger and more active market participants (around five banks and five non-bank institutions). The usual market convention is to quote prices, in normal market conditions, at a 2 basis point spread in up to AUD500 million 3–month equivalent.

The majority of deals (around 60 percent) are transacted via the brokers. Around 30 percent of deals are transacted directly between banks, with the remainder (up to 10 percent) comprising deals between banks and their institutional clients.

Bid-ask spreads are currently around 2 bps for maturities of 1 to 6 months, and 3 bps for 9 months to 1 year maturities. These spreads have narrowed by about 1 bp in the last year – consistent with the increased depth and liquidity of the AUD OIS market.

Market turnover

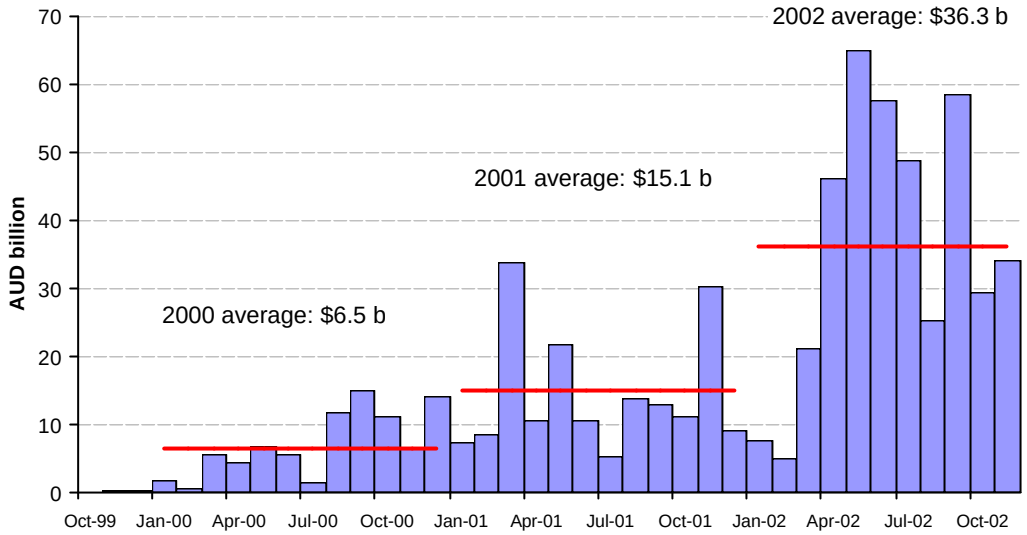
The Australian OIS market began in October 1999 and has grown rapidly since then. Average daily turnover was about $2 billion in the year to June 2001, and has more than doubled to just under $5 billion this year. The chart below compares the average daily turnover in a range of money market instruments in Australia over a five-year period. The OIS and Forward Rate Agreement (FRA) are the two fastest growing money market instruments (although bank bill futures are still dominant).



Source: AFMA (2002)

The chart below provides a closer look at the monthly turnover in the brokered AUD OIS market since its inception in October 1999. There has been a noticeable upward shift in the level of activity in the AUD OIS market this year.

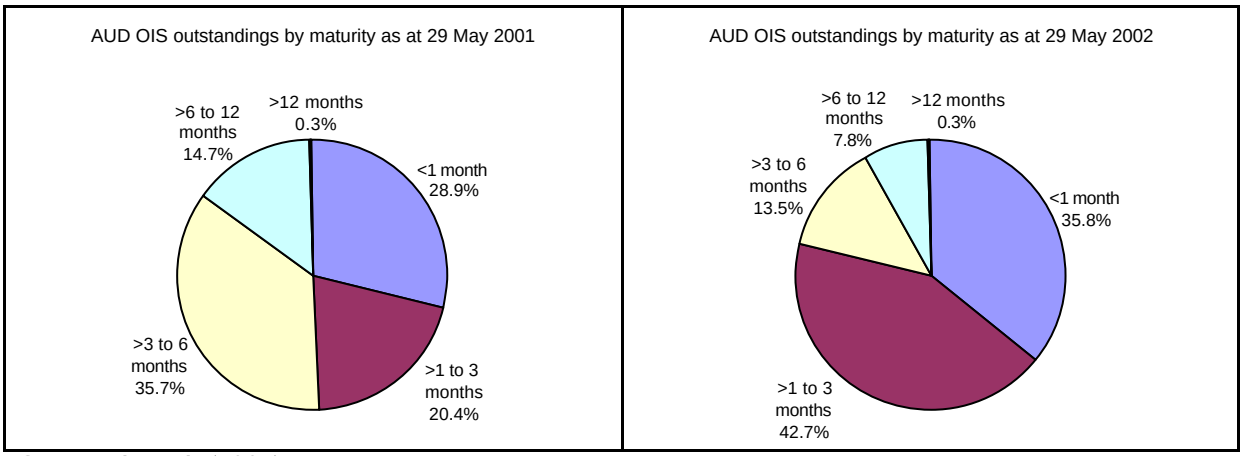
Monthly turnover in the AUD OIS market since its inception in October 1999



Source: Various brokers

The maturity of swaps transacted

Most swaps transacted have been for shorter maturities, especially more recently. According to the Australian Financial Markets Association (AFMA), around half of the outstanding OIS contracts as at 29 May 2001 matured within 3 months; in May 2002, that figure was just under 80 percent.



Source: AFMA (2002)

4 The development of the NZD OIS market in 2002

The structure of the market

The main participants in the NZD OIS market are banks, reflecting the relatively specialised nature of the market. Unlike the bank bill or FRA markets, there is no formal price making arrangement in the NZD OIS market. A range of onshore and offshore counterparties can be contacted for quotes, although they only have to do so on a "best efforts" basis.[3] The usual

[3] The early group of NZD OIS market participants included Commonwealth Bank of Australia, Credit Suisse First Boston, Morgan Stanley, Citibank, HSBC, ANZ, Rothschilds, and BNP. Westpac and BNZ have recently

market convention is to quote prices, in normal market conditions, at a 3 basis point spread in up to NZD500 million 3–month equivalent. However, at this stage, offshore parties are the dominant players, mainly because these offshore institutions already trade in OIS markets offshore and thus have knowledge and experience of the product, as well as settlement, accounting and risk management systems in place.[4] Over time, however, the largest users of NZD OIS are likely to be local banks because they have greater underlying exposures to NZD credit markets. A couple of institutions dominate the market which means that the market is not liquid as yet. Thus, it can be difficult to quickly transact larger amounts (e.g. greater than NZD500 million) without unfavourable movements in rates. Liquidity conditions are likely to improve as more participants enter the market.

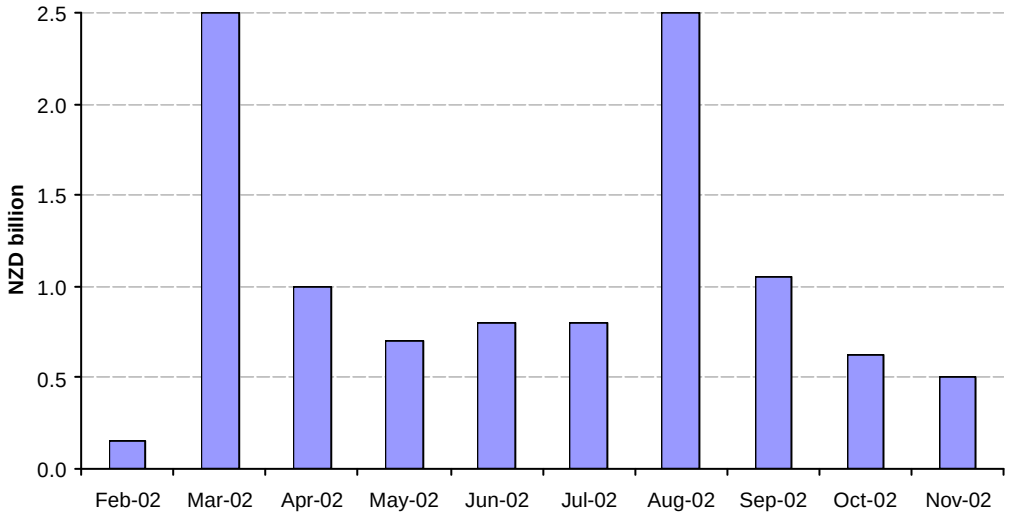
The two main brokers in the NZD OIS market are Prebon Yamane and Fixed Interest Securities (FIS). The majority of NZD OIS deals are currently transacted via a broker (between 70 and 80 percent) with the balance dealt directly between the interbank players. Trades between banks and their institutional clients are almost non-existent at this stage.

Bid offer spreads have remained relatively stable, and are around 2 basis points in the 1 month, 3 bps in the 2-3 month, 4 bps in the 4-6 month and 5 bps in the 9 and 12 month maturities.

Market turnover

The chart below shows an estimate of the monthly turnover in the NZD OIS market since its inception in February 2002. Activity has picked up considerably, with volumes traded having averaged around NZD1 billion a month, and volumes being as high as NZD2.5 billion per month at times. It is worth noting though that turnover in the NZD OIS market is still far below that in the FRA and bank bill futures markets.[5]

Monthly turnover in the NZD OIS market since its inception in February 2002



Source: Various brokers

started quoting prices, while Deutsche and NBNZ have still to overcome administrative hurdles before they can join the market.

[4] CSFB and CBA are the two largest counterparties in the NZD OIS market.

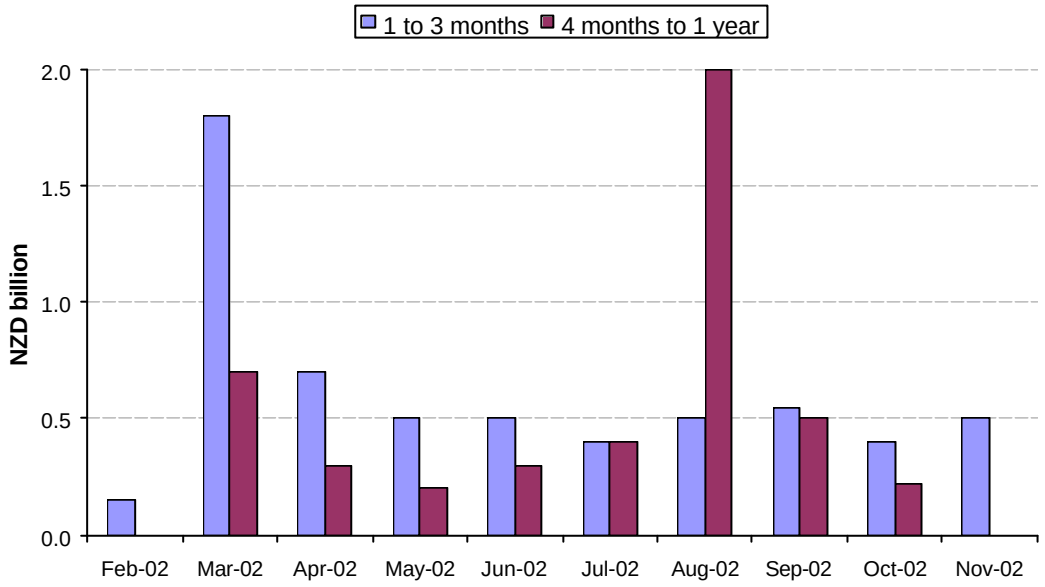
[5] Market anecdotes suggest that the average *daily* turnover in the aggregate NZD OIS market is between NZD100 and NZD200 million, compared to about NZD1 billion in each of the FRA and bank bill futures markets.

The chart above shows that NZD OIS volumes spiked up in August. Market contacts suggest that this spike occurred after the August *Monetary Policy Statement (MPS)* where there were large differences in views among market participants on the future track of the OCR. The decline in turnover since August reflects the sense that the divergence in views has since narrowed. At the margin, volumes would have been affected by the fact that a number of market participants have been taking annual vacation over this period and/or reducing their risk positions coming into year end.

The maturity of swaps transacted

The terms to maturity for NZD OIS are typically between one week and one year, with the bulk of the trading concentrated in relatively short maturities. Around 60 percent of NZD OIS turnover to date has been in maturities out to three months (see chart below). An exception to this pattern was in August, when most of the deals were in the 4- to 6-month maturities because that was the horizon where there was the greatest divergence in views among market participants after the August *MPS*.

Monthly turnover in the NZD OIS market by maturity



Source: Various brokers

5 The uses of OIS for the RBNZ: Inferring market expectations

Why should the Bank care about expectations?

The Reserve Bank is interested in market expectations of the OCR for a host of reasons. Firstly, knowledge of such expectations helps the Bank to predict whether a particular policy decision is likely to surprise market participants, and what their short-term response is likely to be to a given decision. Information on OCR expectations also acts as a "reality check" for the Bank's own thinking, particularly for horizons further in the future. Where differences exist between the Bank's own assessment of the state of the economy, and what markets are expecting, it should prompt the Bank to look further into what may be causing the differences in views (see Krippner and Gordon, 2001 for a more detailed discussion).

The theory behind expectations and market prices – the pure expectations hypothesis

The market's expectations of the future OCR can be inferred from observed interest rates. As a starting point, most studies begin with the pure expectations hypothesis of the yield curve (hereafter PEH). Under the PEH, the implied forward rates provide an unbiased estimate of market expectations of the future path of interest rates. The implied forward rates get their name from the fact that they constitute rates that are implied by the current term structure of the spot rate given there is no explicit forward rates. If the PEH were a valid assumption, then the expectation error (i.e. the difference between the actual OCR out-turn and the corresponding forward rate) should have a zero mean with the usual "white noise" properties.

Actual OCR out-turn = b(Forward rate) + "Genuine" expectation error

Deriving implied one-day forward rates from observed spot rates

While we are ultimately interested in one-day forward rates, what we observe in the market is the spot interest rate for standard maturities (e.g. half-month tranches for bank bills). The first step is to interpolate the spot yield curve so that we end up with day-by-day spot rates. There are various methods of interpolation, one of which is a simple linear interpolation.[6] The second step is to mechanically calculate the one-day forward rates from the day-by-day spot rates, using the following relationship.

$$f(1,n) = \left[\left(\frac{1 + \frac{i_{n+1}}{100} \times \frac{n+1}{365}}{1 + \frac{i_n}{100} \times \frac{n}{365}} \right) - 1 \right] \times 365 \times 100$$

where:

$f(1,n)$ is the implied 1-month rate, n days forward;

i_n is the interest rate for maturity n; and

n is expressed in terms of days.

The implied one-day forward rates can and do fluctuate around quite a lot at times. This "uneven" path between OCR announcement dates is not realistic since in practice, the OCR has almost always remained the same between scheduled OCR reset dates.[7] Therefore, the average of one-day forward rates between pre-specified OCR announcement dates is taken as an estimate of the expected OCR for that period.

Lack of empirical support for the pure expectations hypothesis

Recall that under the PEH, forward rates would equal expected future interest rates (put another way, the expectation error would have "white noise" properties). However, as many empirical studies (both locally and overseas) have documented, the PEH is generally not well supported. Forward rates are typically biased and unreliable indicators of such market

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[6] Another way is to use curve-fitting techniques which is essentially a smoothing technique that estimates directly the implied forward rate curve rather than the term structure of the spot interest rates (which is the case when we use mechanical calculations). Examples of such curve-fitting techniques include Nelson and Siegal (1987) and Svensson (1994). The advantage of using these curve-fitting techniques is that we get to utilise law governing the shape of the yield curve over time and across countries and perhaps to abstract from idiosyncratic market distortions at particular points in time.

[7] The one exception to date was the 50 basis point cut to the OCR on 19 September 2001, in the aftermath of the 11 September terrorist attacks.

expectations of future short-term policy interest rates, even for very deep and liquid markets (see for example Campbell, 1995 and Cutherbertson, 1996).

Actual OCR out-turn = b(Forward rate) + "Biased" expectation error

The expectations hypothesis allowing for a term premium

Since we do not expect the market to be consistently wrong on one side (that is, market participants can be expected to learn from their past mistakes), biased forecast errors – a systematic difference between forward rates and actual cash rate out-turns – are more likely to be attributed as a term premium.[8] Under the expectations hypothesis allowing for a term premium (hereafter EHP), the residual between actual OCR out-turns on the one hand and the sum of the term premium and implied forward rates on the other hand is the "genuine" expectations error.

Actual OCR out-turn = b(Forward rate) + Term premium + "Genuine" expectation error

Put another way, deducting a term premium off from the implied forward rate gives the market expectation of the future OCR. As it turns out, the EHP receives more empirical support in the literature (see for example Campbell, 1995 and Cutherbertson, 1996; see Guthrie et al., 1999 for a New Zealand application).

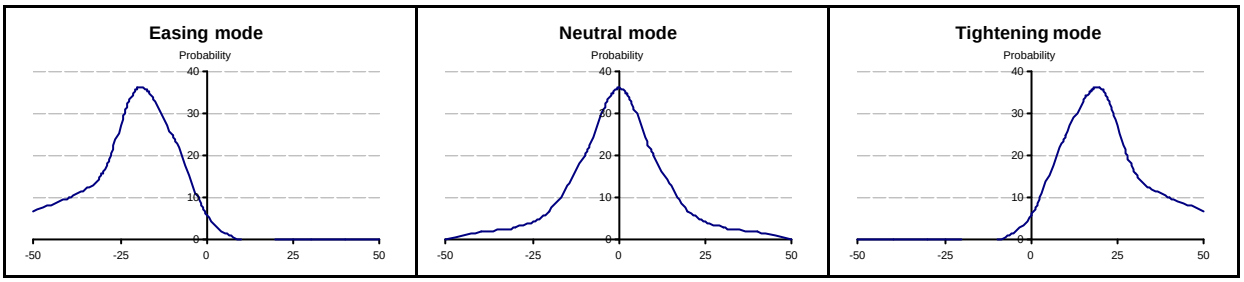
OCR expectations = Forward rate – Term premium

It is clear then that the key consideration when extracting OCR expectations from the yield curve is the size of the term premium. Without allowing for a term premium, we are likely to overestimate OCR expectations.

A time-varying term premium

There have been quite a number of studies that explicitly allow for a *time-varying* term premium (see for example, Dotsey and Otrok, 1995). One interesting question is what the term premium varies with. Market participants and researchers have noted that term premium seems to be larger in a tightening cycle than in an easing cycle. One reason why this might be the case is that during a tightening cycle, most market participants in aggregate might typically expect either a rate hike (of some magnitude) or a no change, but it is unlikely that many in the market would forecast a rate cut. As a consequence, the distribution of market expectations may be skewed towards rate hikes, resulting in a rise in the *mean* expectation, which may not be representative of the (lower) *median* or *mode* expectation. Admittedly, it is debatable which of these is the most reasonable concept of an "average" of expectations. However, it is fair to say that during a tightening cycle, the *mean* expectation is likely to overstate what the market on balance expects. To more accurately gauge market expectations then is to allow for a larger term premium in a tightening cycle. On the other hand, in an easing cycle, the distribution of market expectations may be skewed towards rate cuts and the *mean* expectations are likely to underestimate the "average" market expectation. Thus, a smaller term premium may be appropriate.

[8] Most studies provide a statistical measure of the term premium while some adopt a behavioural approach that requires an underlying theory for the presence of a term premium. A term premium generally allows for factor such as the liquidity preferences of the investor and the credit risk of the issuer relative to a strategy consisting of a series of rolled-over overnight investments (see Krippner and Gordon, 2001).



A range of money market instruments

When extracting OCR expectations from financial market prices, the obvious issue is the choice of the proper asset to be used. Appendix 2 outlines the range of money market instruments and associated derivatives available in New Zealand, highlighting the potential benefits and shortcomings of each as a measure of policy expectations.

How we do it now – the bank bill-based model

The Bank's current OCR expectations model calculates one-day forward rates from the bank bill curve, and subtracts an estimate of the term-premium to infer underlying OCR expectations held by the market (see Krippner (2002) for a more detailed discussion). The term premium estimates used at the various horizons are summarised below.[9]

Term premium estimate (%)	1 mth	2 mths	3 mths	4 mths	5 mths	6 mths
NZD bank bills	0.07	0.17	0.24	0.28	0.31	0.33

One problem with this model is that the assumption of a constant term premium may be too restrictive, as the model's author has acknowledged. In some periods, the term premium may be overstated and hence inferred OCR expectations may appear to be too low compared to other sources of information on market expectations (e.g. analyst surveys and direct feedback from traders).

Why and how we could use OIS rates

As alluded earlier, an investor will typically have a choice today between investing at a term rate, or investing for a succession of one-day rates. The method used in this paper to mechanically calculate forward rates from observed OIS rates is based on minimising the deviation in cash flows between the two strategies. This is done for the whole OIS curve (i.e. for different maturities) *simultaneously* by the minimisation of squared deviations (in cash flows between the two strategies).[10] In addition to the objective function of minimising squared deviations, a penalty is imposed on changes in OCR expectations over consecutive reset dates to avoid volatile swings in the forward rates.[11]

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[9] Note, however, that the bank bill model used a term premium that was estimated over a period (early 1999 to mid 2001) that encompassed a tightening cycle and half an easing cycle. Therefore, it is possible, and indeed likely, that the term premium estimate that was allowed for in the bank bill model is overstated.

[10] Thus, this is akin to the Ordinary Least Squares (OLS) regression technique that is already widely known.

[11] Yet another method to mechanically calculate forward rates from observed spot rates is the bootstrapping technique, which equates the difference between the two strategies to zero for the first month, and then use the implied OCR rate as a given for subsequently working out what the appropriate implied rate should be for the next nearest maturity. This process proceeds *step-wise* until the implied OCR expectations are obtained for the whole OIS curve (i.e. for all maturities). Therefore, for this alternative method, there is potential for anomalies in short-maturity OIS to be carried forward into OCR expectations for longer horizons. However, this second method is arguably simpler and is typically used by others in the market (hence has better "safety in numbers").

In principle, it is possible that the forward rates that are derived from the above procedure could directly represent market expectations. However, this is probably unlikely as term premia are almost always found to be present in market data. However, it is likely that the term premium will be smaller when using OIS rates compared to bank bill rates. The intuition for this is as follows. Assuming sufficient liquidity in the New Zealand market, the NZD OIS market has the potential of providing a "cleaner" gauge of policy rate expectations. OIS yields are likely to be less affected by constraints on credit limits that sometimes arise in the bank-bill market. Sometimes, bank bill yields rise because of seasonal funding pressures from local banks issuing more bills than usual, quickly filling up the ability of local institutions to buy the bills offered. (We saw this ahead of the March 2001 *Monetary Policy Statement* when bill rates overstated the real views of markets on the likelihood of an OCR increase.) This means that *theoretically* there should be a smaller and less variable term or liquidity premium in OIS yields, implying a more "pure" read on expectations. This is particularly the case for shorter forecast horizons such as the 1- to 3-month maturities, as we will see in Section 6. Also, given that the NZD OIS market uses the OCR (rather than the average inter-bank cash rate) as the floating reference rate, the expectations inferred are likely to be even more " pure" compared to some other markets, say in Australia, where the reference overnight inter-bank rate often differs slightly from the official rate.

Notwithstanding the advantages above, there are a couple of issues that need to be addressed if we are to use OIS rates for inferring OCR expectations. Given that the NZD OIS market only began in February 2002, a practical issue is the liquidity of the NZD OIS market and the reliability of OIS rates. As discussed in Section 3, turnover in the NZD OIS market is still far below that in the FRA and bank bill futures markets. Having said that, it is not clear that early participants in the NZD OIS market have been or are any worse at forecasting cash rates than participants in the more established bank bill, FRA or bank bill futures market. Furthermore, it seems reasonable to expect any sustained differences between the range of markets to be arbitraged away. A perhaps more important issue is that the data available to date is not sufficient for the expectations hypothesis to be tested econometrically, and hence a precise estimate of the NZD OIS term premium is not available.

6 "Estimating" the NZD OIS term premium

The general approach

Notwithstanding the limited data available to date, this section uses a "rough and ready analysis" to derive an estimate of the term premium for the NZD OIS market. The approach taken is generally as follows:

- Estimate the term premium for the AUD bank bill market
- Estimate the term premium for the AUD OIS market
- Derive the difference in term premium between the AUD bank bill and OIS markets
- Subtract this difference from the NZD bank bill term premium[12]

It is worth highlighting at the outset that we have taken a crude approach here by calculating implied forward *1-month* rates and comparing these to average 1-month future interest rates. Strictly speaking, one should calculate implied forward *one-day* interest rates and compare this to the corresponding actual OCR out-turn. The implied forward 1-month rates at

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That said, it is comforting that our preliminary analysis finds that both methods currently give largely the same estimates.

[12] This assumes that the relationship between the bank bill and OIS markets in New Zealand is similar to that in Australia.

different future points in time (1 month forward, 2 months forward, etc.) are calculated using the equation below. For example, from observed 1-month and 2-month rates, we can calculate the 1-month rate, 1-month forward. Then, from 2-month and 3-month rates, we can calculate the 1-month rate, 2-months forward. We repeat this process until we get forward 1-month rates for up to 5 months ahead.

$$f(1,n) = \left[\left(\frac{1 + \frac{i_{n+1}}{100} \times \frac{30(n+1)}{365}}{1 + \frac{i_n}{100} \times \frac{30n}{365}} \right) - 1 \right] \times \frac{36500}{30}$$

where:

$f(1,n)$ is the implied 1-month rate, n months forward;

i_n is the interest rate for maturity n; and

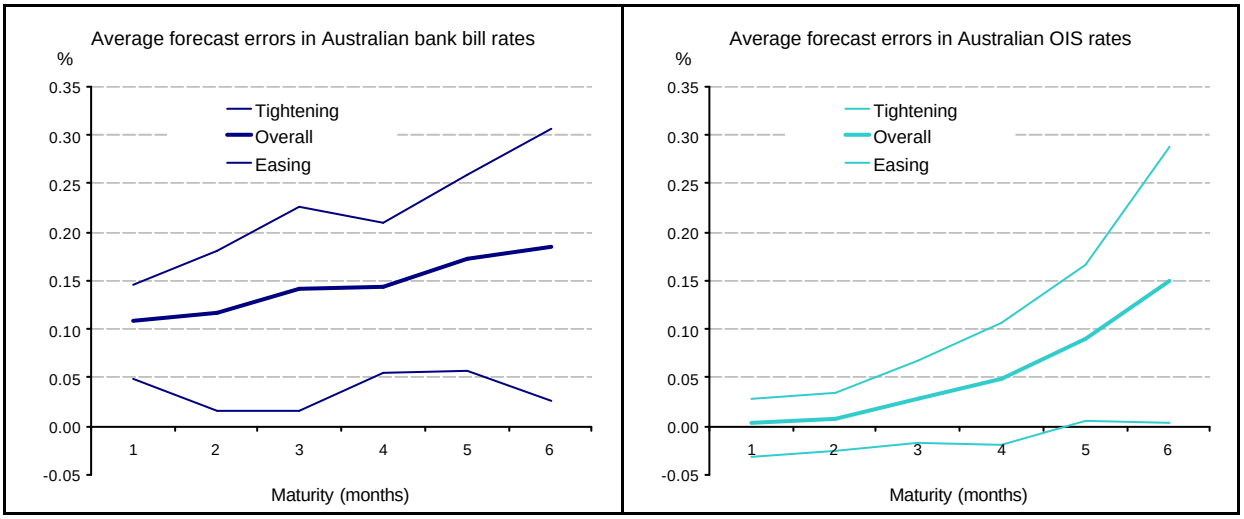
n is expressed in terms of months.

Under the PEH, the difference between the implied forward rate and the actual OCR out-turn is the forecast error. A positive forecast error would mean that the implied forward rates "over-predicted" the future OCR. On the other hand, a negative forecast error implies that forward rates have "under-predicted" actual cash rates. However, given that markets are not likely to consistently be wrong on one side, a biased forecast error is more likely to be attributed as a term premium. For the purpose of this section, however, the terms forecast error and term premium will be used interchangeably.

Forecast error = Forward rate – Actual OCR out-turn

Term premium for the AUD bank bill and OIS markets

The charts below illustrate the average forecast errors over various forecast horizons. We look first at the average forecast errors for Australian bank bill and OIS rates for the different phases of the OCR cycle (tightening in 2000, easing in 2001 and tightening in 2002).[13]



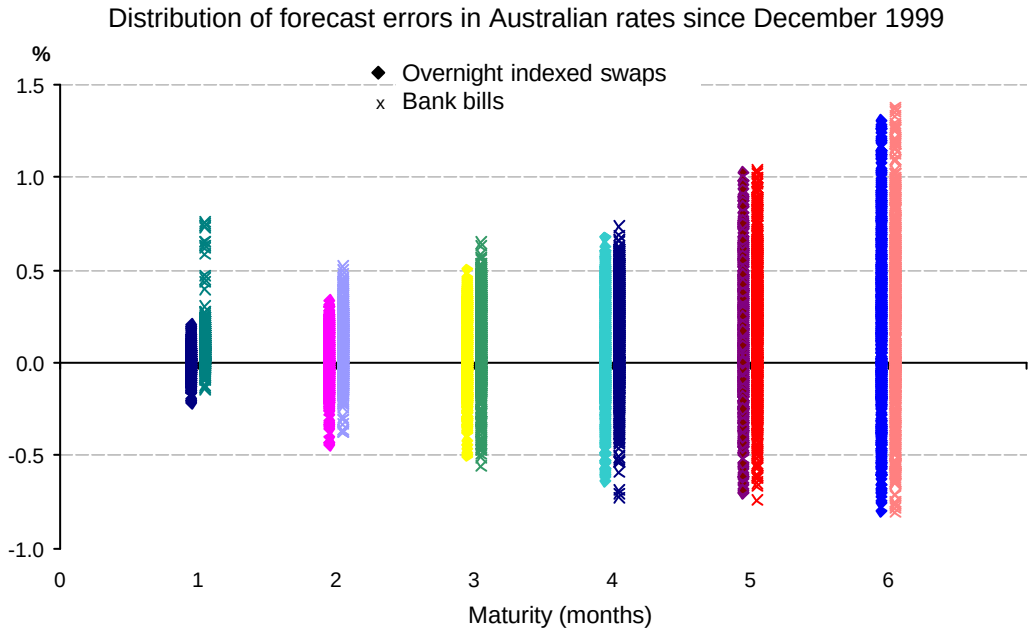
Three points are worth noting. First, average forecast errors are generally relatively larger in the case of expectations over longer horizons. In other words, interest rates implied by longer

[13] In terms of the starting and end points for the tightening and easing cycles, where possible, we included observations from 2 months before the first rate change in the cycle to 2 months after the last rate change. Exact dates underlying the charts are available upon request from the author.

horizon contracts (be it in bank bills or OIS) on average are likely to overestimate future spot interest rates to a larger extent than shorter-maturity contracts. Secondly, there are indications – consistent with the evidence documented in the literature – that the average forecast errors are larger during tightening cycles than easing cycles. Finally, average forecast errors for Australian cash rate expectations derived from OIS rates seem smaller than those derived from bank bill rates, particularly for shorter horizons. This is indicative of the relatively higher credit risk premium built into bank bill yields (as discussed in Section 2). The actual numbers of these term premium estimates are as follows.

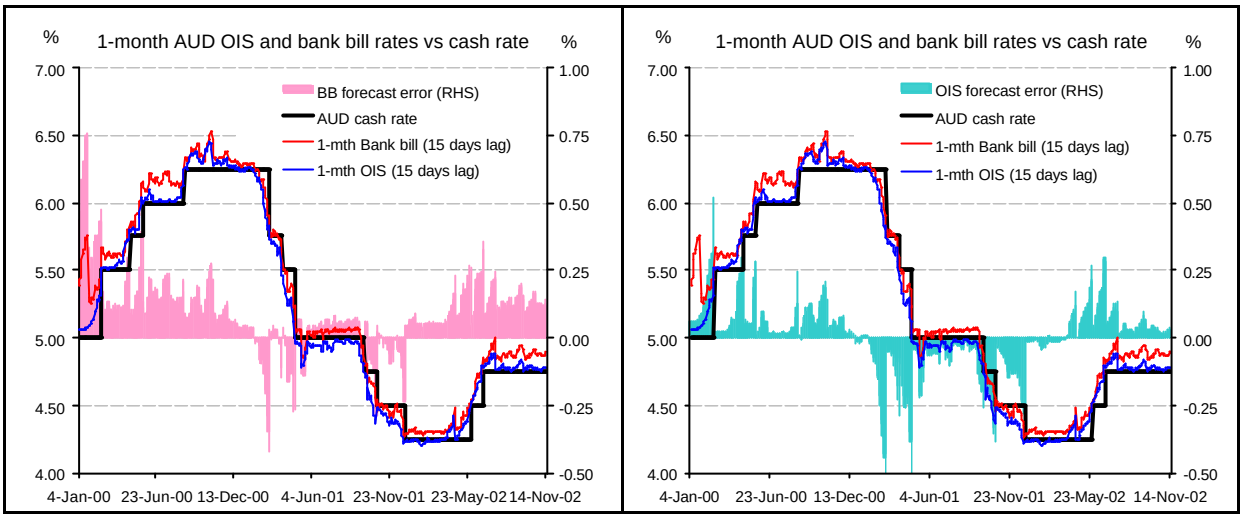
Average forecast errors (%)	**1 mth**	**2 mths**	**3 mths**	**4 mths**	**5 mths**	**6 mths**
AUD BB (overall)	0.108	0.116	0.141	0.144	0.171	0.185
AUD BB (tightening)	0.146	0.180	0.227	0.209	0.258	0.306
AUD BB (easing)	0.049	0.016	0.015	0.054	0.056	0.027
AUD OIS (overall)	0.002	0.008	0.029	0.048	0.089	0.149
AUD OIS (tightening)	0.028	0.034	0.067	0.106	0.166	0.287
AUD OIS (easing)	-0.032	-0.026	-0.018	-0.019	0.005	0.003
Difference btw AUD BB and AUD OIS (%)	**1 mth**	**2 mths**	**3 mths**	**4 mths**	**5 mths**	**6 mths**
Overall	0.11	0.11	0.11	0.10	0.08	0.04
Tightening	0.12	0.15	0.16	0.10	0.09	0.02
Easing	0.08	0.04	0.03	0.07	0.05	0.02
Range	0.08-0.12	0.04-0.15	0.03-0.16	0.07-0.10	0.05-0.09	0.02-0.04

The charts and table above show *average* forecast errors – that is, point estimates – at each horizon. To get an idea of the *distribution* of forecast errors, the chart below shows forecast errors in the Australian bank bill and OIS markets since December 1999. It is clear that forecast errors are typically larger over longer horizons.[14] This is not surprising given that there is much more that can happen between now and 6 months out than in the very near term.



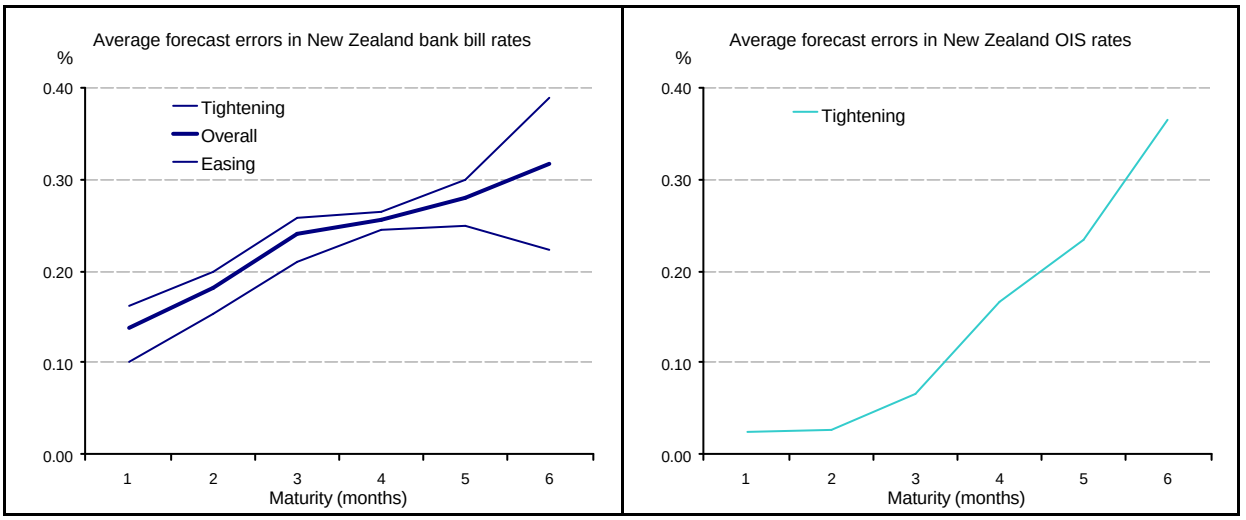
[14] However, in some cases, forecast errors are larger in the very short horizons (e.g. 1 month) than further out (e.g. 3 and 4 months). One reason this may have occurred is that market participants tend to get the timing wrong for the first rate hike (cut) in a tightening (easing) cycle but they tend to be less wrong in terms of predicting rate the total amount of hikes (cuts) in the medium term.

Another way to illustrate how accurate AUD OIS and bank bill rates have been at predicting the cash rate is to look at a time series of the forecast errors. The charts below focus just on the 1-month maturities. Forecast errors for AUD bank bill rates are larger in tightening cycles than in an easing cycle. Forecast errors for Australian 1-month bank bills were on average 17 bps and 11 bps during the tightening cycles in 2000 and 2002 respectively, whereas the corresponding figure for the easing cycle in 2001 was 5 bps. AUD OIS rates seem to be biased largely in the same direction, although to a smaller extent. For example, the average forecast error for the 2000 and 2002 tightening cycles was 3 bps, whereas the average forecast error for the easing cycle in 2001 was –3 bps.



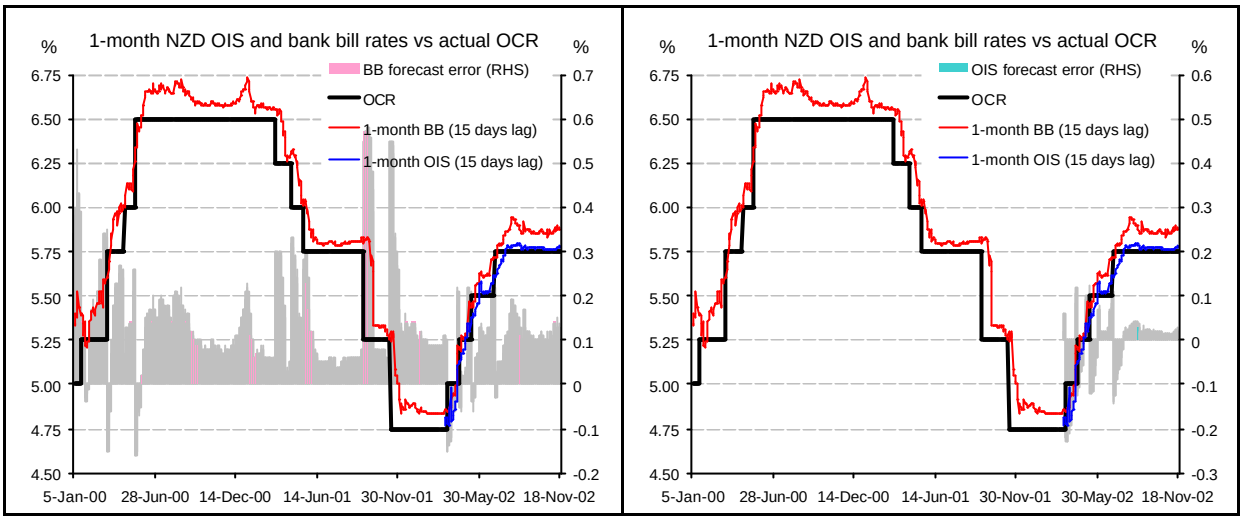
Comparable charts for the New Zealand case

For completeness sake, the comparable charts for the New Zealand case are presented below. As with Australia, in both the NZD bank bill and OIS markets, average forecast errors are typically larger for longer horizons. The observation that forecast errors tend to be larger during a tightening cycle than an easing one is also supported here. To the extent that inferences can be drawn on the data available to date, the NZD OIS market seems to have smaller forecast errors than their bank bill counterparts, particularly for shorter horizons. This is true even when we compare the average forecast errors from the two markets over exactly the same period (i.e. since February 2002).



Looking at the time series of the 1-month forecast errors in the New Zealand case, NZD bank bill rates seem to be biased upwards almost all of the time throughout the 3-year period.

NZD OIS rates since February 2002 seem reasonably accurate, with smaller forecast errors compared to those from bank bill rates. Again, this is indicative of the relatively higher credit risk premium built into bank bill yields.



Application to NZD OIS term premium

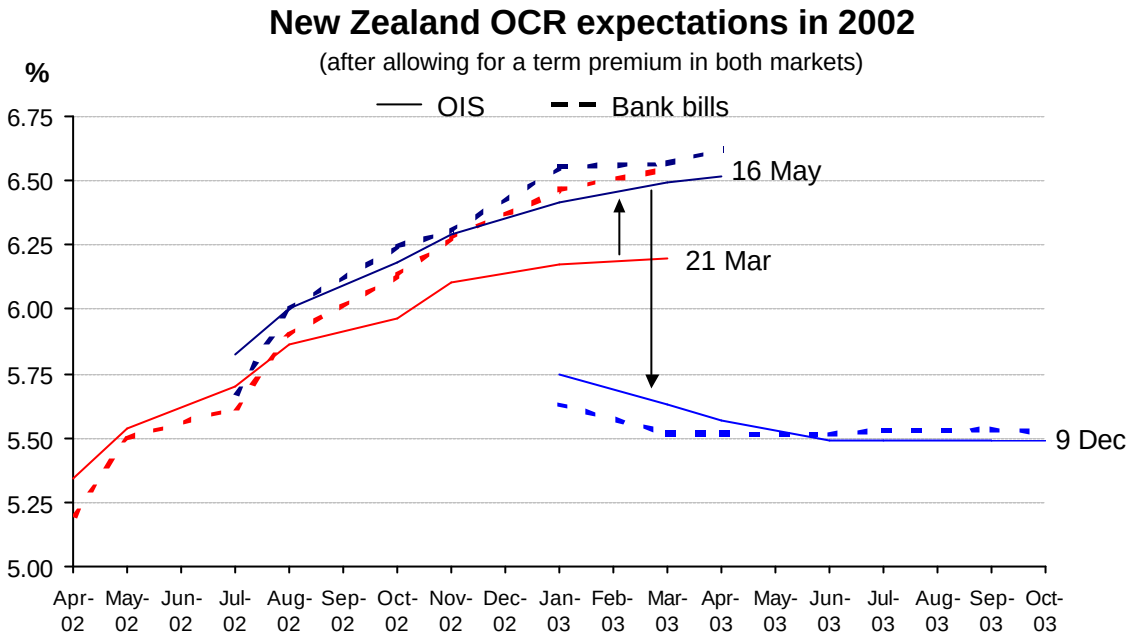
Given that we already have the relative size of the term premium for the AUD bank bill and AUD OIS markets, we can subtract this from the term premium previously estimated for the NZD bank bill market to arrive at an estimate of the NZD OIS term premium. Therefore, our best estimate of the term premium for the NZD OIS market at the moment would be around –4 bps at the 1-month maturity, 6 bps (2 months), 13 bps (3 months), 18 bps (4 months), 23 bps (5 months) and 29 bps (6 months).

Term premium estimate (%)	1 mth	2 mths	3 mths	4 mths	5 mths	6 mths
NZD bank bills	0.07	0.17	0.24	0.28	0.31	0.33
Difference btw AUD BB and AUD OIS	0.11	0.11	0.11	0.10	0.08	0.04
NZD OIS	**-0.04**	**0.06**	**0.13**	**0.18**	**0.23**	**0.29**

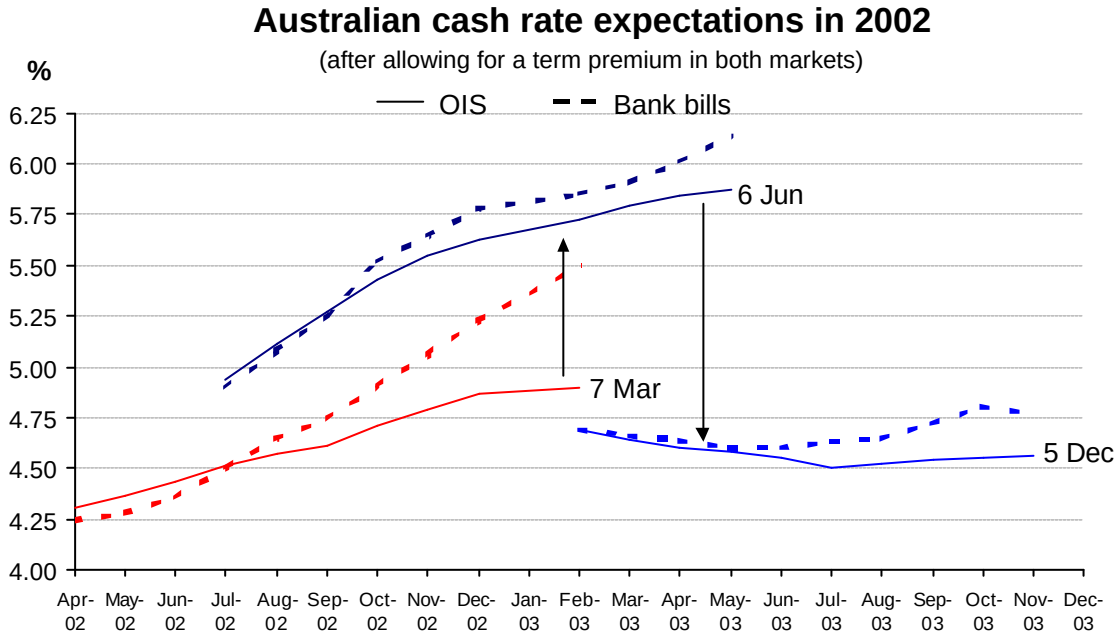
7 NZ and Australian cash rate expectations in 2002 – an application

Using the estimates of the NZD OIS term premium in the previous section, the chart below shows how OCR expectations derived from the OIS market have evolved this year, as compared to those from our more established bank bill model.[15] The solid line represents OCR expectations from the OIS model, while the dotted line shows the corresponding expectations derived from the bank bill model.

[15] We assume further that the NZD OIS term premium remains at 29 bps beyond the 6-month forecast horizon. The term premium for dates falling in between two forecast horizons is taken as the simple average of the two corresponding term premium estimates.



The chart below compares Australian cash rate expectations derived from OIS rates and bank bill rates after accounting for a term premium. The term premium estimate used for the AUD OIS market are taken from the previous section, whereas the estimates for the AUD bank bill model are obtained from a modified version of the NZD bank bill model (see Gordon, 2002).[16]



8 Concluding remarks and future work

The New Zealand dollar Overnight Indexed Swap (OIS) market began in February 2002. Although turnover in the NZD OIS market is still relatively low compared to other money market instruments, our market contacts suggest that activity and general interest in the market is picking up. To the extent that offshore OIS markets are of any guide in terms of the

[16] We assume further that the AUD OIS term premium remains at 15 bps beyond the 6-month forecast horizon.

potential depth and liquidity, the NZD OIS market is likely to be increasingly important to market participants.

The OIS instrument has been touted as providing the "cleanest" measure of cash rate expectations. Indeed, a "rough and ready" analysis undertaken in this paper reveals indications that the NZD OIS term premium is smaller than the term premium for bank-bills, particularly for short maturities (say, out to 3 months). But a couple of issues remain to be addressed. Firstly, given there is overwhelming empirical evidence that financial asset prices are biased indicators of market expectations of future policy rates, the size of a term premium is key to obtaining precise estimates of OCR expectations. More data is required before we can examine this more formally. Another issue we face would be the liquidity of the NZD OIS market. It is likely that we will be able to rely more heavily on the OIS market once it has matured.

There is much potential to complement our estimates of expectations based on bank-bill yields with information from OIS yields. We will continue to monitor OCR expectations gleaned from a range of money market instruments and feedback from market participants.

We will also investigate how other central banks use their respective OIS markets and the issues they have had to face as we better refine our use of OIS yields as indicators.

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Appendix 1: Overnight reference interest rate for an array of OIS markets

Country	Reference rate
US	The Fed Funds Effective Rate is calculated by the New York Fed based on broker-reported overnight Fed Funds transactions OIS
Europe	Euro Overnight Index Average (EONIA)[17] is calculated by the ECB and published by the European banking federation. The basic data is contributed to the ECB by the banks of the Euribor fixing panel.
UK	Sterling Overnight Index Average (SONIA) is calculated by the British Bankers' Association and published by the Wholesale Markets Brokers' Association. It is the daily average interest rate, weighted by volume, of all overnight unsecured interbank deposits of more than £5 million made through the largest money brokers.
Switzerland	Unlike other offshore OIS markets that sets their reference rate against the daily overnight market rate, the Swiss Tomorrow/Next Overnight Index Swap (TOIS) ties its index to the tomorrow-next day market rate.
Japan	The Mutan (uncollateralised) overnight weighted average call rate is published by the Bank of Japan and is available on Reuters page TONAR.
Canada	The Canadian overnight repo rate average (CORRA) is the weighted average of general collateral (GC) repo rate.
Australia	The reference rate is the interbank overnight cash rate published by the RBA.
New Zealand	The only country where the policy rate as published by the RBNZ is directly used as the reference rate for the floating leg.

[17] In addition to EONIA, the European OIS is sometimes called the EURONIA swap.

Appendix 2: An overview of NZ money market instruments and associated derivatives available

A bank bill is short-term securities issued by banks as part of their short-term borrowing requirements. Since bank bill rates are quoted for maturities in each half-month (late December, early January, etc.), they have a "high density". Official price makers exist for this market. The New Zealand bank bills market is also relatively liquid. See Krippner (2002) for an illustration of how NZ bank bill rates are used to extract OCR expectations.

A Forward Rate Agreement (FRA) is a forward contract on short-term interest rates. For example, a 2x5 FRA would be a 2-month forward contract on a 3-month interest rate. Unlike futures (see below), each FRA contract is customised for each client (i.e. not standardised). Yields are quoted for a wider range of maturities as compared to futures, hence are better for interpolating the short-term yield curve to infer OCR expectations. Official price makers exist.

Like FRAs, futures are contracts under which two parties agree on the short-term interest rate at a future date. However, unlike FRAs, futures are standardised in terms of maturity, notional amounts, etc and are traded on exchanges. In the New Zealand market, bank bill futures used to have greater liquidity than FRAs, but this is slowly changing with the FRA market increasingly becoming more liquid. Futures, however, lack the "high density" of FRAs since futures contracts are only quoted for *quarterly* settlements (in March, June, September and December) whereas FRAs are quoted for monthly settlements.

In New Zealand, Treasury bills are short-term securities issued on behalf of the Crown by the Debt Management Office. It is not practical to use T-bills to derive OCR expectations because the T-bills market is not liquid, and hence the quoted yields may not be representative of market OCR expectations.

Another relatively illiquid instrument in New Zealand is the option on 90-day bank bills. An option is an instrument that gives the holder the right but not the obligation to buy or sell the underlying asset at a predetermined price at a future date. In the New Zealand market, interest rate options are not usually actively traded. Indeed, trading is almost exclusively on a "best efforts" basis by the main banks themselves – corporates are not active users of options.

Another instrument that is increasingly used by market participants is the swap contract, both at the short end and in the long end. An interest rate swap is a contract that involves an exchange of fixed rate obligation for floating rate obligation. In New Zealand, we do not have interest rate swaps shorter than the 1-year maturity except for the recently started overnight indexed swaps (OIS). What the OIS instrument is and how it works have already been discussed in Section 2. Due to reasons such as a lower credit risk in the OIS, market participants suggest that OIS rates should provide the "cleanest" measure of OCR expectations, although estimates are better for 1- to 3-month maturities. OIS rates will also allow for "clean" cross-country comparisons since OIS yields are available for other markets as well.