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Editor's Note

Over recent years, a range of indicators and much anecdotal evidence has pointed to a significant increase in trading activity in the New Zealand dollar (NZD). In the first article of this issue, Nick Smyth of the Financial Stability Department undertakes an in-depth look at trends in New Zealand's foreign exchange (FX) market for the period from 2001 to 2006. He does so using data drawn from Spot Matching from Reuters, an electronic trade matching system used by the banks to trade the New Zealand dollar globally. This system tracks trading activity in real time and in many dimensions, providing a rich dataset for analysis. We are grateful to Reuters for permission to use this data for the purposes of this article.

Nick's article reveals a significant increase in trading volumes and a general increase in liquidity within the NZD market. Two case studies in the article demonstrate the speed with which the FX market is able to absorb and reflect new information in pricing as it comes to hand.

In the second article, Andrew Coleman of the Economics Department and Brian Silverstone (University of Waikato and NZIER Research Associate) review research undertaken by central banks to try and understand firm-level pricing behaviour. This international research has revealed considerable diversity in the way firms alter prices and has contemplated the driving factors behind those decisions.

To date, little research has been done on this topic in New Zealand. Using data drawn from the New Zealand Institute of Economic Research's Quarterly Survey of Business Opinion, Andrew and Brian present some preliminary evidence, which appears broadly in line with the international studies. New Zealand firms also appear to display considerable diversity in the frequency with which they adjust prices. It appears firms tend to adjust prices more in response to cost changes than demand changes and prices appear to respond more in the face of negative demand changes than positive demand changes. Andrew and Brian indicate a range of future research possibilities in this area.

In the third article, the Bank's Legal Counsel, Nick McBride, briefly explores the concept of legal tender. Although legal tender is a concept that few people actively contemplate when making transactions, Nick explains that without the

safeguard of legal tender, cash transactions could not always take place with sufficient certainty to satisfy the needs of consumers and sellers. Nick illustrates the concept with a few practical examples that draw on the experience of New Zealand's recent change-over to new, lighter coins.

This is my last issue as editor of the *Bulletin*, having held the role for the past three years. The new editor will be Tim Ng of the Bank's Economics Department, who will take over the reins with the December 2007 issue. I am sure Tim will continue to strive to make the *Bulletin* a useful source for those interested in topics related to monetary policy, financial stability and central banking in general.

Bernard Hodgetts

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 **RESERVE
BANK**
MUSEUM

The Reserve Bank Museum celebrates and records New Zealand's economic and banking heritage.

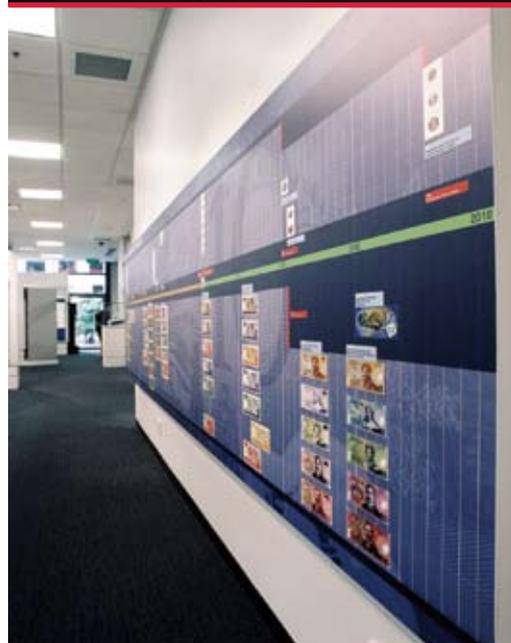
New displays for 2007 include the only working example in New Zealand of the MONIAC hydro-mechanical econometric computer developed by New Zealand economist and inventor Bill Phillips in the late 1940s.

Between July and November 2007 the museum is also hosting an exhibition of coins from the collection of James Berry, designer of New Zealand's decimal coins, celebrating his life and the fortieth anniversary of decimalisation.

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Colour photography by Stephen A'Court.

ARTICLES

A profile of the NZ dollar foreign exchange market¹

Nick Smyth, *Financial Stability Department*

In this article we review developments in the NZD/USD market between January 2001 and March 2006 using a new and detailed dataset from Reuters. Given the traditionally opaque nature of the global FX market, the dataset provides some insights into the NZD/USD market that have previously been unavailable. We show that trading volumes and other measures of market activity, like the depth of the limit order book, have increased significantly since 2001. We also show that market activity changes at different times of the trading day, with considerably more trading volumes taking place in London and New York.

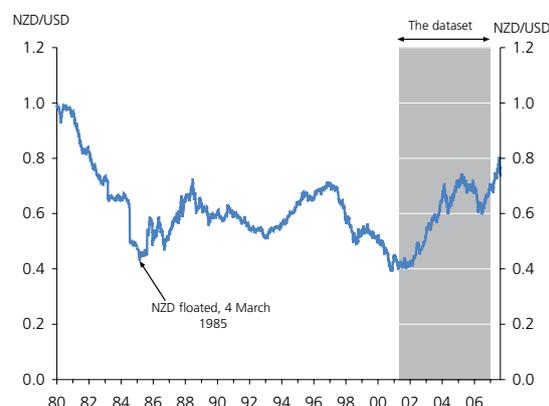
1 Introduction

In recent years the New Zealand dollar (NZD) has attracted unprecedented attention in the global financial markets. There have been a number of reasons for this, including greater trading activity in the global foreign exchange (FX) market, and the relatively high level of New Zealand interest rates compared to some major overseas economies. One well-publicised source of interest in the NZD has come from the 'carry trade', a practice whereby investors borrow in low yielding currencies, like the Japanese yen, and invest in higher yielding ones, such as the NZD.

A wide range of market participants are now increasingly active in the NZD market and follow New Zealand economic developments closely. Of course, there has also been far greater public attention in New Zealand, as earlier this year the Reserve Bank intervened for the first time since the NZD floated back in 1985 (see figure 1 below), and the NZD rose to its highest level against the USD in 25 years.

Despite the level of interest in the NZD over the past few years, it has been difficult for the Reserve Bank to gather precise information on trading activity. Until recently, the Reserve Bank has had to rely on anecdotes from market participants and other central banks, the RBNZ daily FX turnover survey of the New Zealand-based banks, and the

Figure 1
NZD/USD since 1980



Source: Reserve Bank

triennial BIS FX turnover survey, as its major sources of information on trading activity in the NZD.² However, the growth of electronic trading platforms in the FX market in recent years has now allowed us access to a far richer and more comprehensive set of information on the FX market.

High-frequency data from the Reuters Spot Matching service, the main trading platform banks use to trade NZD with one another globally, gives us an opportunity to 'look under the hood' and update our understanding of the NZD market. While the data is historical – meaning the Reserve Bank does not have access to the data in real time – it is still very useful to look back at past episodes and understand how the market dynamics worked at the time.

¹ This article builds on some earlier work undertaken at the Reserve Bank by Wai Kin Choy and Victor Gaiduch. We would like to thank Reuters for access to the data and permission to publish it, and for other assistance.

² A forthcoming *Bulletin* article will discuss the results of the 2007 BIS triennial FX turnover survey, which has detailed statistics on FX trading volumes worldwide.

The article proceeds as follows. In Section 2, we provide an overview of the global foreign exchange market. In Section 3, we discuss the Reuters Spot Matching service – the source of the data – and the main platform that banks use to trade NZD with one another globally. In Section 4, we show how different indicators of trading activity in the NZD market, such as trading volumes, have changed between 2001 and mid-2006. In Section 5, we look at how these indicators vary at different times of the trading day. In Section 6, we look at how the NZD market reacts to new information, using the release of New Zealand retail sales in March 2006 and 'September 11' as examples. Finally, in Section 7 we conclude.

2 The global foreign exchange market

The FX market is very large. Average daily trading volumes in the spot FX market across all currencies were almost USD 1.8 trillion in 2004 (BIS).³ To put this in context, average daily trading volumes on the New York Stock Exchange were 88 billion USD and in US Treasury bonds were 700 billion USD in 2007. A forthcoming article outlining the results to

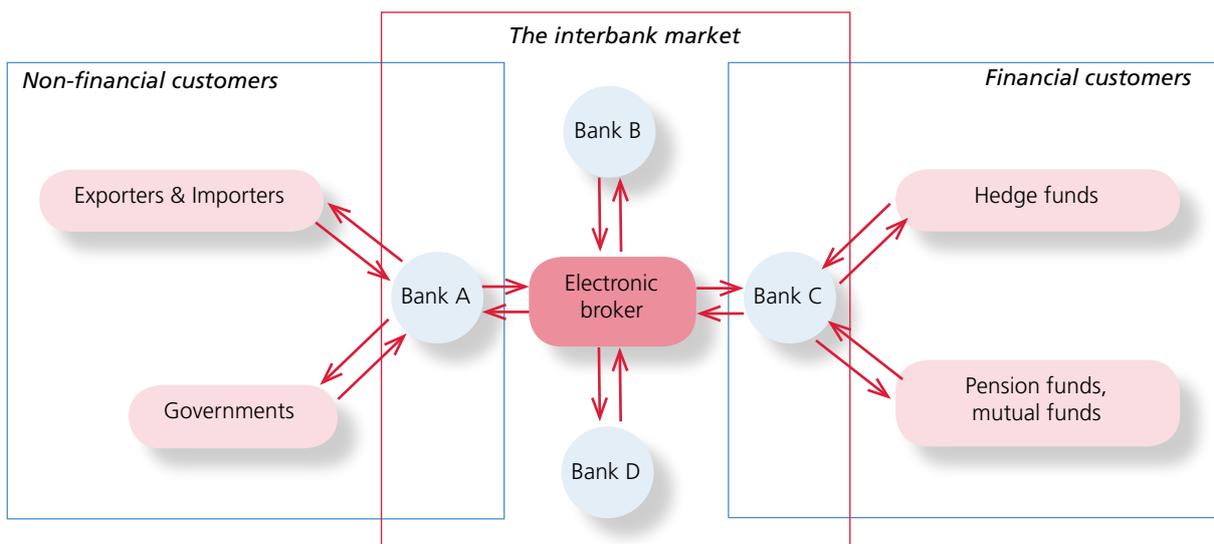
the 2007 Bank of International Settlements (BIS) FX turnover survey will provide a more recent update on global FX trading activity and the reasons for these developments.

The FX market is made up of many different types of participants. These participants can be roughly broken down into:

- financial customers: participants such as hedge funds and pension funds who invest in financial assets, such as bonds and stocks, and speculate on the direction of currencies;
- non-financial customers: participants such as exporters and importers who use the FX market to pay for goods and services;
- dealers: participants, typically working as traders at banks, who intermediate between buyers and sellers, and sometimes trade for themselves.

In 2004, trading by dealers accounted for around 50 percent of global FX turnover, trading by financial customers accounted for around 35 percent, while non-financial customers accounted for the remaining 15 percent (BIS, 2005). Figure 2 below is a stylised view of the structure of the FX market.

Figure 2
Stylised view of the modern FX market



³ The 'spot' FX market is what people usually refer to when they mention the FX market. The 'spot' market is the main driver of movements in the exchange rate. See Smyth (2005) for information on the other FX markets, and Sager and Taylor (2006) for a detailed explanation on the structure of the global spot FX market.

Financial and non-financial customers buy and sell currencies directly with dealers at commercial banks. Traditionally, this has occurred over the phone, but increasingly it now takes place via computer systems. As dealers take the opposite side of customer trades, they accumulate currency positions over the trading day. At some point, dealers 'close out' their positions by on-selling to dealers at other banks (trading between dealers occurs in what is known as the 'interbank market', as shown in figure 2). Over the past few years, electronic broker systems have consolidated their position as the main mechanism by which dealers at banks trade with each other in all the major currencies, including the NZD.

Often, dealers will buy or sell currencies for themselves for short periods, or decide to hold onto the positions for longer than usual, if they have a view on the likely direction of the exchange rate. Dealers are quick to respond to new information, such as the release of economic statistics, which influences the value of currencies. Because dealers are typically the first to react to new information, it is in the interbank market – via the Spot Matching service – where much of the price discovery occurs in the FX market.

3 The Reuters spot-matching system

In the NZD, the Reuters Spot Matching service is the dominant trading platform that banks use to trade with one another globally. Discussions with market participants suggest that a significant proportion – perhaps even greater than 90 percent – of NZD trading between banks takes place over the Reuters system. Since the interbank market is where customer flows are usually cleared, and where much of the price discovery takes place in the FX market, the Reuters dataset should provide a very representative view of global FX trading trends in the NZD.

The Reuters system is an electronic limit order market, just like the trading platforms used to trade in many sharemarkets around the world (the difference being that an exchange rate is quoted in the FX market rather than a stock price in

the sharemarkets).⁴ Like the sharemarket trading systems, dealers can trade in the Reuters system by leaving one of two types of orders – limit orders or market orders.

A limit order is a commitment to buy (a bid) or sell (an offer) a specific quantity of currency at a chosen exchange rate. A collection of limit orders makes up what is known as the limit order book. Figure 3 shows a subset of the limit order book at one point during 16 March 2006. In this instance, one dealer has left a limit order to buy 4 million NZD against the USD at 0.6394. When the dealer entered the order into the electronic broker, it did not result in an immediate trade, because there was no willing seller at this price. The limit order stays in the system until either the dealer cancels the order, another dealer decides to sell to him at 0.6394, or until the order expires.⁵ Limit orders provide liquidity to the market, because they provide firm prices at which other dealers can trade on.

Figure 3
NZD/USD limit order book at one point on 16 March 2006



Source: Reuters

A market order, in contrast, is an order to buy (a take) or sell (a hit) a given quantity immediately at the nearest exchange rate. In figure 3, a dealer could sell 4 million NZD against the USD at 0.6394 immediately using a market order. The advantage of using a market order is that the dealer can be certain he will complete a trade. In contrast, a dealer who

⁴ Here, the aim is to discuss the basic characteristics of the Reuters Spot Matching service, rather than provide a very detailed description. We do simplify some of the aspects of trading using the Reuters Spot Matching service. A detailed description of the way the system works is available on the Reuters website.

⁵ Limit orders automatically expire over the weekend, after 5pm New York time on Friday afternoon.

places a limit order cannot be certain that he will complete a trade because the exchange rate might well move in the opposite direction.⁶

Figure 3 also illustrates the bid-offer spread, which is the difference between the lowest offer rate and the highest bid rate. In this case, the bid-offer spread is 3 points (each 'point' refers to 0.0001 USD). Dealers can always see the lowest offer and the highest bid on their Reuters electronic broker screen, so dealers always know at what exchange rate they can trade immediately. However, dealers (and the Reserve Bank) cannot see what bids and offers lie at other exchange rates. That is, dealers cannot see the entire limit order book.⁷ In figure 3 for instance, dealers would not know that there were 25 million NZD of offers from 0.6398 to 0.6403.

In the NZD/USD, the minimum trade size using the Reuters Spot Matching service is 1 million NZD. Dealers can enter orders for much larger amounts than this, but for all limit orders greater than 10 million NZD, the Reuters system, perhaps counter intuitively, displays an 'R', indicating a 'regular' trade size. The market is able to see the volume attached to the highest bid and lowest offer, so dealers have some idea how much they can trade at the nearest exchange rate.⁸

When a trade between two dealers is completed, the Reuters Spot Matching service screen displays the price at which the transaction took place, and the direction of the aggressive, or incoming, order.⁹ An aggressive sell order

is signalled by a 'G' – which stands for 'given' – while an aggressive buy order is signalled by a 'P' – which stands for 'paid'. No information on the volumes of each transaction or the counterparties involved is made available to the rest of the market.

4 Trends in the NZD market: January 2001 to March 2006

The very detailed and high-frequency nature of data available from the Reuters Spot Matching service allows us to look at a range of indicators of market conditions in the NZD/USD. Some of these indicators, such as the depth of the limit order book, have not been available until now for the global FX market. These indicators provide a view of the liquidity of the market – that is, how easily and cheaply market participants can transact.¹⁰

Transaction volumes

The number of transactions and the volumes traded in the NZD/USD over the Reuters Spot Matching service increased significantly between 2001 and 2006. In 2001, transaction volumes averaged around 500 million NZD each day. In March 2006, transaction volumes had increased to over 5.5 billion NZD on an average day. The forthcoming article on the triennial BIS FX turnover survey results will discuss some of the reasons for the growth in NZD trading.

On some days, particularly large amounts were traded. For example, on one day in January 2006 over 9 billion NZD was traded. These volumes are substantial compared with both the size of the New Zealand economy and the volume of New Zealand exports and imports.

⁶ In actual fact, dealers tend to use limit orders aggressively to complete trades by entering an exchange rate that will guarantee a trade will take place. For instance, in Figure 3, a dealer might leave an offer for 10 million NZD at 0.6394. This would complete a trade for 4 million immediately, while the remaining 6 million NZD would become the best (lowest) offer in the market at 0.6394.

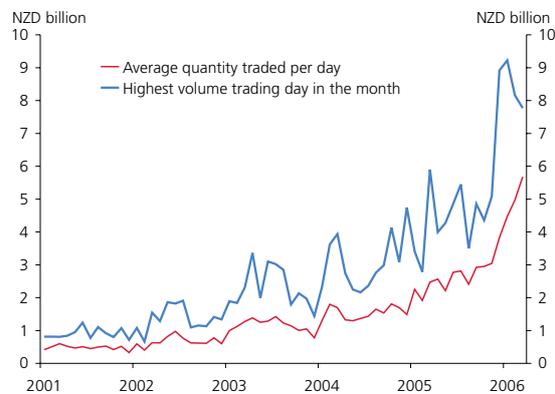
⁷ In contrast, most sharemarkets make information on the entire limit order book available in real time.

⁸ The Reuters electronic broker allows dealers to enter a 'more quantity' option. Dealers can enter a limit order that displays only a portion of the total amount to the market – i.e. a dealer could submit an order to buy 1 million NZD with a 'more quantity' option for 9 million at 0.7000. The market would only see 1 million NZD displayed on the screen, not the 9 million NZD that is also in the limit order book.

⁹ Another way of describing an aggressive order is as an order that is entered into the system that immediately results in a trade – this can be either a market order or a limit order that is entered at the same price as the best opposing order in the limit order book.

¹⁰ The semi-annual *Financial Stability Report* has a Financial Markets section that usually includes the Reserve Bank's assessment of liquidity in the NZD/USD market. The most recent *Report* is available on the Bank's website. A description of the different indicators of liquidity in the NZD/USD market is contained in a 2001 *Bulletin* article by Lauren Rosborough. Readers can refer to a BIS paper on market liquidity in 1999 for a more comprehensive discussion of the various elements of liquidity in a market.

Figure 4
Average and maximum daily trading volumes in NZD/USD



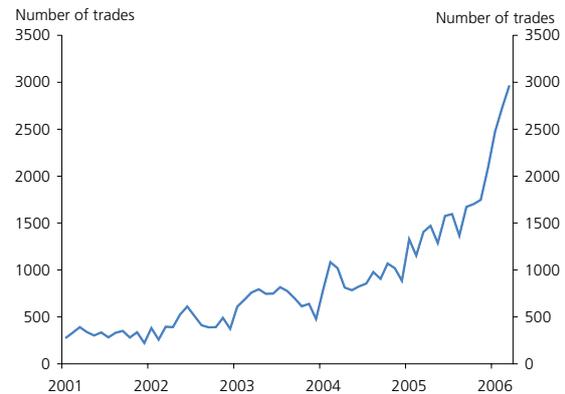
Source: Reuters

It is worth keeping in mind that the large increase in trading volumes in the NZD as captured by our data is partly due to the growth of electronic brokers as trading platforms. In 2001, the Reuters electronic broker was not used by banks to trade NZD with one another to the extent that it is now. However, even accounting for greater use of the Reuters Spot Matching service in the NZD market, NZD volumes globally appear to have increased substantially between 2001 and 2006, reflecting greater interest in the New Zealand economy and New Zealand financial markets.

The depth of the limit order book

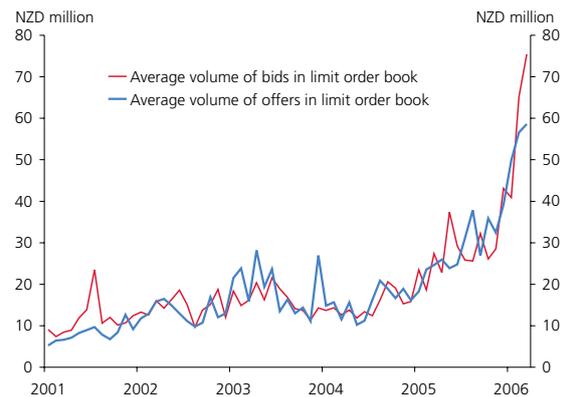
The volume of orders in the limit order book also increased between 2001 and 2006. In March 2006, there were, on average, around 60 million NZD of offers and 75 million NZD of bids in the electronic broker continuously during the day. Dealers prefer when there are substantial limit orders in the market, because it means there are a number of different banks willing to take the opposite side of the trade with them. A deep limit order book gives dealers the ability to buy and sell large amounts immediately if they need to, and is a sign of a well-functioning and liquid market.

Figure 5
Average number of trades per day in NZD/USD



Source: Reuters

Figure 6
Average volumes of bids and offers in the NZD/USD limit order book



Note: Order book 'snapshots' are taken every five minutes and the number and volume of orders are recorded. The averages are then worked out for each month.

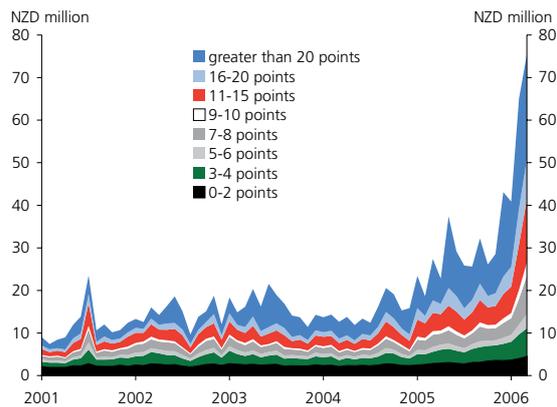
Source: Reuters

Dealers also prefer when limit orders are clustered close to the current market exchange rate, because it means they can trade immediately at a competitive price. For instance, in figure 3 a dealer who wanted to buy 4 million NZD immediately would have had to pay 0.6397 for 1 million, 0.6398 for 1 million, and 0.6399 for 2 million – a dealer would prefer that there was an offer for 4 million (or a larger amount depending on how much he wanted to buy) at 0.6397 because it would make it cheaper for him to buy NZD.

Figure 7 shows the volume of limit buy orders by how close they are to the highest bid rate while figure 8 shows the volume of limit sell orders by how close they are to the

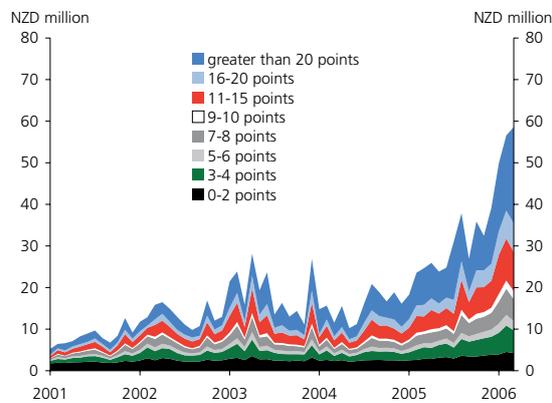
lowest offer rate. The volume of orders close to the best market rates – such as those within 2 points of the best bid or offer – increased between 2001 and 2006, a sign that liquidity in the NZD market has improved and dealers can transact more cheaply. However, the bulk of orders in the limit order book remained concentrated well away from the best bid and offer.

Figure 7
Average volume of bids in the limit order book



Source: Reuters

Figure 8
Average volume of offers in the limit order book



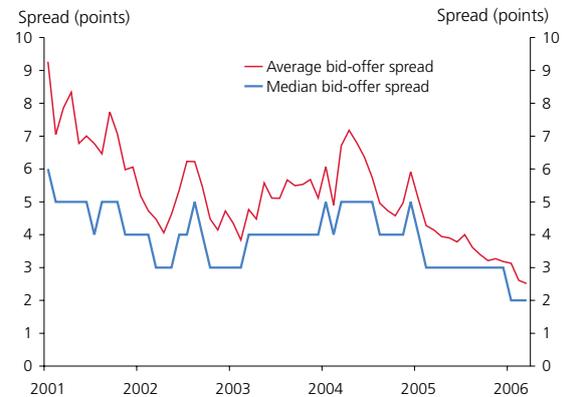
Source: Reuters

The bid-offer spread

The bid-offer spread (or bid-ask spread) is the difference between the highest bid rate and the lowest offer rate. When there is a narrow bid-offer spread, dealers can trade immediately at a rate close to the 'market' exchange rate, effectively making it cheaper for them to transact.¹¹ The

¹¹ In addition, when the bid-offer spread is narrow, there is less confusion about where the market exchange rate lies. During periods when the bid-offer spread is wide, it can be difficult to tell where within the spread the market exchange rate lies. This in turn makes it difficult for dealers to quote customers a fair exchange rate to transact on.

Figure 9
Average and median bid-offer spread in the NZD/USD in the Reuters electronic broker



Source: Reuters

Note: 'Snapshots' of the bid-offer spread are taken every five minutes. The median bid-offer spread is taken as the median observation of all the recordings over the month.

median bid-offer spread in the Reuters electronic broker narrowed between 2001 and 2006, from around 5-6 points towards the start of the period to around 2-3 points in March 2006, another sign that conditions in the NZD market have improved.

5 Trends in the NZD market across the trading day

Transaction volumes

Transaction volumes have two distinct peaks over the trading day – the first after London opens for the day and a second, larger peak towards the London 'fix' (see box 1). There is a dip during the middle of the London trading session, which probably reflects the lunchtime for dealers and other market participants.

Volumes in the NZD/USD tend to be much higher during offshore trading – particularly so in London and New York – where most of the major financial participants are based. Volumes are significantly lower during the New Zealand trading day, particularly in the period after New York closes for the day, and before Singapore and Tokyo open. Nonetheless, trading volumes in the NZD/USD have still increased substantially over the New Zealand trading day. The trading patterns in the NZD/USD over the trading day

Box 1

FX trading in different time-zones

The FX market is a 24-hour global market with trading activity switching from one trading centre to another as the day wears on. The trading week begins at 5am Sydney time on Monday morning and continues uninterrupted until 5pm New York time on Friday evening. Global banks tend to pass their customer orders onto the trading desk at the next time-zone at the completion of their local business day.

The major time-zones are:

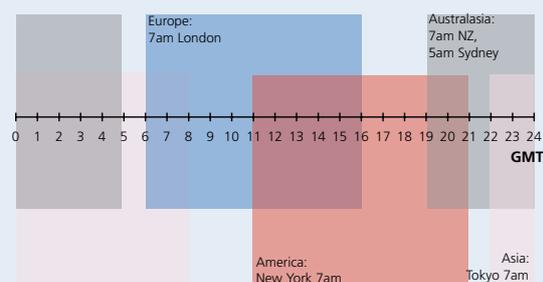
- The Asian time-zone: the major trading centre is Tokyo, but other important regional trading centres include Singapore, Sydney and Hong Kong.
- The European time-zone: the major trading centre is London, with other regional trading centres including Frankfurt, Zurich and Paris.
- The American time-zone: the major trading centre is New York, with Toronto being the other significant regional trading centre.

Figure 10 shows when the major trading centres are open over the trading day during the New Zealand winter months (the opening and closing hours for different trading centres in GMT change slightly during the New

Zealand summer months). The largest trading centre for FX has been London for some time, followed by New York, and then Tokyo. There is often overlap when two major trading centres are open for operation at the same time.

The busiest period in the trading day occurs around the London 'fix' – at 4pm London time – when the London and New York markets are both open. The exchange rates at the time of the London 'fix' are often used as the reference rates for global fund managers and for some financial contracts. Market participants, knowing there will usually be heavy trading activity over this period, often choose this time of the day if they need to trade large amounts.

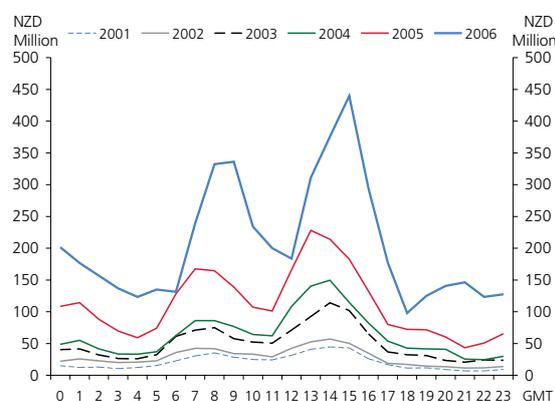
Figure 10
Different time-zones during New Zealand winter months



are very similar to those for most major currencies that are traded globally, including the Australian dollar (AUD/USD).

The average number of transactions has an almost identical pattern to the volume of transactions over the trading day. The average number of transactions in an hour tends to peak around the time of the London fix. In 2006, there were around 225 transactions on average in the hour of the London fix. In comparison, the number of transactions over the New Zealand morning session averaged around 75 transactions in 2006.

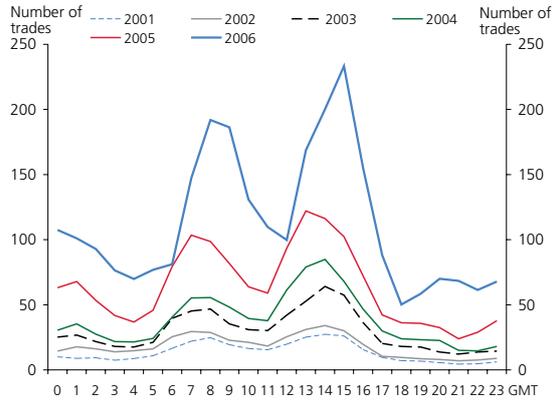
Figure 11
Average hourly trading volumes in NZD/USD



Source: Reuters

Figure 12

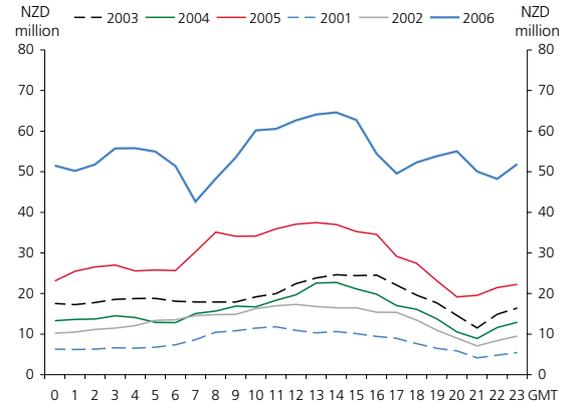
Average number of transactions in NZD/USD



Source: Reuters

Figure 14

Average volume of offers in the NZD/USD across the trading day



Source: Reuters

The depth of the limit order book

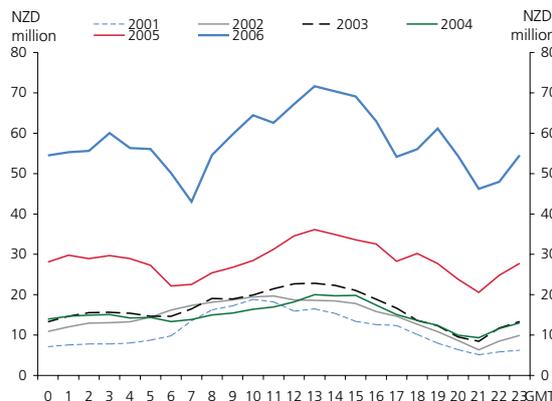
The limit order book also tends to be deepest – in that there are usually the most orders in the limit order book – during the offshore sessions, particularly so around the time of the London fix. The volume of bids averaged around 70 million around the time of the London fix in 2006, while the volume of offers averaged around 65 million. At quieter times of the day, such as the period before London opens and the period before Tokyo opens, the volume of outstanding orders was somewhat less.

The bid-offer spread

The bid-offer spread tends to be narrowest during the London and New York trading sessions. In 2001, the median bid-offer spread was around 7-9 points during the New Zealand morning session and around 4-5 points over the remainder of the trading day. In 2006, bid-offer spreads had narrowed significantly and were relatively stable across the trading day – the median bid-offer spread was usually between 2–3 points over the trading day.

Figure 13

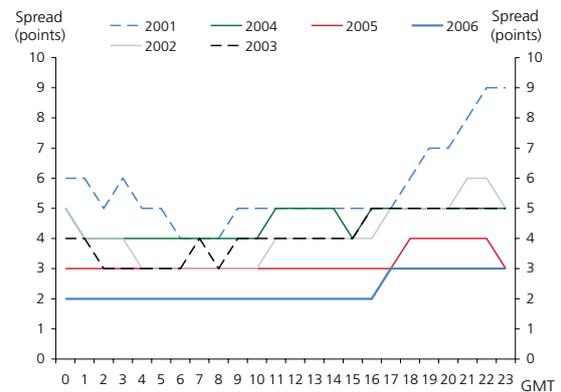
Average volume of bids in the NZD/USD across the trading day



Source: Reuters

Figure 15

Median bid-offer spread in the NZD/USD across the trading day

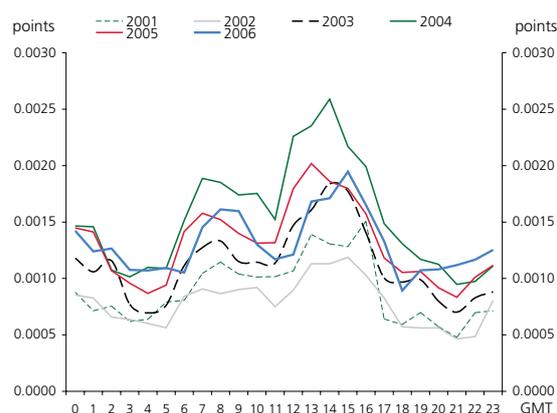


Source: Reuters

The trading range

The trading range is the difference between the highest traded price and the lowest traded price over a specified period. The hourly trading range tends to be wider during the London and New York sessions, where most of the trading is concentrated. Most major market moving events, such as the regular releases of US and European economic statistics, take place during the offshore sessions and can cause large price movements in the major exchange rates. While the NZD/USD can move significantly after New Zealand monetary policy announcements and New Zealand economic data, movements in the NZD/USD, on average, tend to be fairly subdued during the New Zealand trading day.

Figure 16
Average hourly trading range in the NZD/USD across the trading day



Source: Reuters

6 Two case studies: September 11 and the February 2006 retail sales release

The FX market incorporates new information into exchange rates very quickly. Dealers are quick to react to the release of information that affects the perceived value of currencies, and they trade accordingly. Here we look at the reaction of the NZD market to two interesting events – the attacks on the World Trade Centre and Pentagon on 11 September 2001 and the release of NZ retail sales on 14 March 2006. One of the very appealing features of the data from the Reuters Spot Matching service is that it is very high frequency, so we can look at how the market dynamics evolved second-by-second around the time of these events.

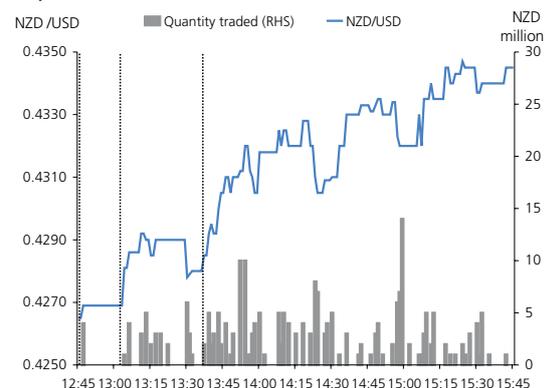
The September 11 attacks

The attacks on the World Trade Centre and the Pentagon took place on the morning of 11 September 2001 New York time. A plane struck the World Trade Centre at around 8:46am New York time (12:46 GMT), and two further attacks took place over the next hour (a second plane struck the World Trade Centre at around 13:03 GMT and a third plane struck the Pentagon at around 13:37 GMT). The timings of the three attacks are highlighted by the dashed lines in figures 17 to 21.

In the minutes following each attack, the NZD/USD increased slightly, although it is difficult to determine whether this was a direct response to the attacks. It took time for news agencies to report on the attacks and longer still to confirm that terrorists were behind the plot, so there was considerable uncertainty in the market during this period.

Once people became aware of the seriousness of the attacks, the market's response was to sell the USD, presumably because the market (on balance) believed that the economic implications of the attacks would be worse for the US than other countries, including New Zealand. Three hours after the first attack had taken place the NZD/USD had risen almost 80 points, or close to 2 percent.¹²

Figure 17
NZD/USD and trading volumes around the September 11 attacks



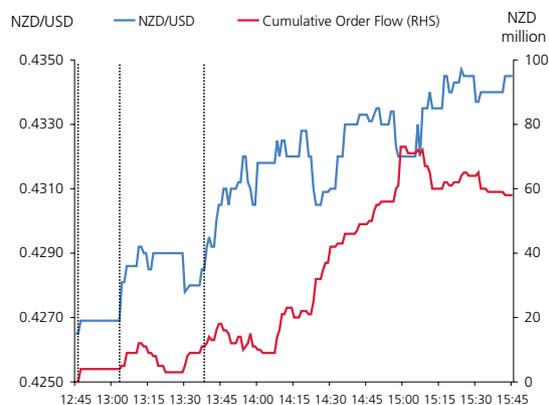
Source: Reuters

¹² It is interesting to note that in the days following the attacks, the NZD/USD started weakening, as market participants came around to the view that it was safer to have money in the US than in smaller economies, such as New Zealand, in such uncertain times.

Trading volumes were relatively small in the hour after the first attack, but increased somewhat after the attacks became widely reported. NZD 138 million was traded in the three hours after the first attack, around the average trading volume in 2001 and 2002 over this time of the day. Figure 17 shows the trading volumes minute-by-minute over the three hour period.

Figure 18 shows the cumulative NZD/USD 'order flow' over the three-hour period. Order flow is the total volume of aggressive buy orders less the total volume of aggressive sell orders.¹³ Order flow effectively measures the net buying or selling pressure in the market. Positive order flow indicates there is net buying pressure in the market, whereas negative order flow indicates there is net selling pressure. Over the three-hour period after the first attack, dealers aggressively bought the NZD/USD, causing the NZD/USD to appreciate.¹⁴ Cumulative order flow for the three-hour period was around 60 million NZD.

Figure 18
NZD/USD and cumulative order flow around the September 11 attacks



Source: Reuters

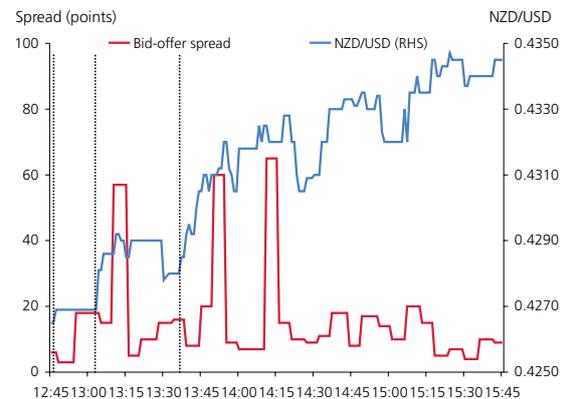
On several occasions in the hours following the first attack, the bid-offer spread widened significantly as dealers cancelled their limit orders and waited to determine the severity of the

¹³ As mentioned in Section 3, an aggressive order is any order that once entered into the Reuters system results in an immediate trade being completed. This can be either a market order, or a limit order entered at the same price as the best opposing limit order in the limit order book.

¹⁴ There is now a substantial literature on the link between order flow and exchange rate changes. See Osler (2006) for a recent review of the literature or Lyons (2001) for a more comprehensive review.

attacks. Soon after the second attack took place, the bid-offer spread widened from around 20 points to almost 60 points. The bid-offer spread usually widens during times of uncertainty, as dealers do not want to commit to buying or selling large amounts in potentially volatile circumstances. The bid-offer spread returned to more normal levels around two hours after the first attack.

Figure 19
The Bid-offer spread around the September 11 attacks

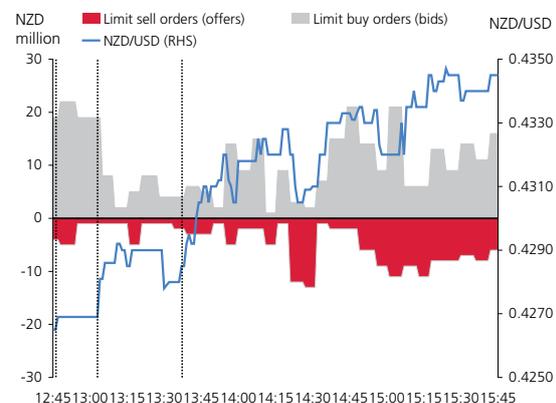


Source: Reuters

Note: The spread is taken every five minutes when 'snapshots' of the order book are captured.

For the most part, the limit order book was skewed towards buyers, and at times there were almost no offers in the market (see figures 20 and 21). After the second attack, the limit order book became thinner as dealers cancelled existing orders and were hesitant about entering new orders

Figure 20
The depth of the limit order book around the September 11 attacks

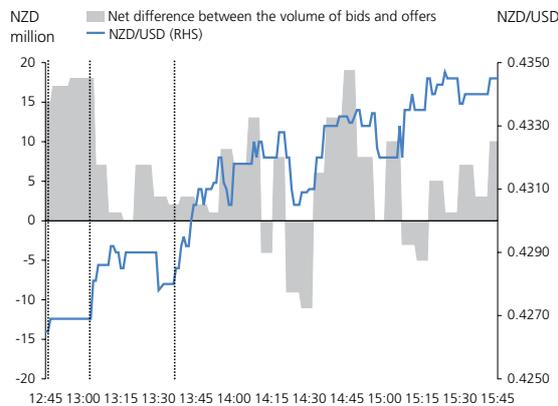


Source: Reuters

Note: The volume of bids and offers is recorded every five minutes when 'snapshots' of the order book are captured.

Figure 21

The net difference between the volume of bids and offers around the September 11 attacks



Source: Reuters

in such an uncertain environment. Dealers started entering more limit orders around two hours after the first attack, and the order book became more balanced between bids and offers.

September 11 provides an interesting case study into the dynamics of the NZD market around a period of significant uncertainty. As news of the attacks became public, the liquidity in the market decreased – the limit order book became shallower (meaning dealers could not buy or sell as much as before), the bid-offer spread widened, and the exchange rate became volatile (increasing almost 2 percent in under three hours). The liquidity in the market appeared to return to more normal levels several hours after the initial attacks.

The release of New Zealand retail sales – 14 March 2006

Economic statistics – such as GDP and CPI – are an important determinant of exchange rates. Market participants pay close attention to the release of economic statistics, and often revise their views on the exchange rate if the statistics are well away from their expectations. The release of New Zealand’s retail sales in March 2006 provides an interesting example. In early 2006, a series of weak New Zealand economic statistics had led the market to anticipate interest rate cuts by the Reserve Bank. Dealers were watching the release closely to see whether it would confirm some commentators’ views that the economy was about to slow sharply.

On 14 March at 10:45am NZT (13 March, 21:45 GMT) Statistics New Zealand announced that retail sales were ‘flat’ (unchanged) between January and February 2006, much lower than what economists were expecting (the median economist estimate was +0.5 percent). Following on from a ‘flat’ retail sales release the previous month and other indicators that suggested the New Zealand economy was slowing considerably, markets moved to anticipate further interest rate cuts by the Reserve Bank. The NZD/USD fell around 35 points (or just over 0.5 percent) immediately after the release, as dealers reacted to the lower than expected headline number.

Trading volumes were relatively small in the hour leading up to the release. However, once the data was released, trading activity increased substantially, with some very large trades taking place. Almost 450 million NZD was traded in a one minute period after the release, much higher than usual.

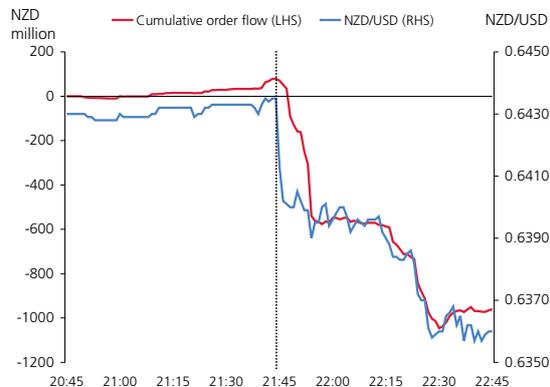
Figure 22
NZD/USD and trading volumes around the retail sales release



Source: Reuters

Cumulative order flow was around -1 billion NZD in the hour following the retail sales release, meaning dealers were large aggressive sellers of the NZD/USD. Dealers determined that the economy was not as strong as they had expected and that the Reserve Bank might have to cut interest rates sooner than they had anticipated, and they subsequently sold the NZD aggressively. The aggressive selling occurred in two main ‘waves’ – first, straight after the release, and then again around 30 minutes later. This corresponded with the NZD/USD falling around 80 points (just over one percent) over the hour following the release.

Figure 23
NZD/USD and cumulative order flow around the retail sales release

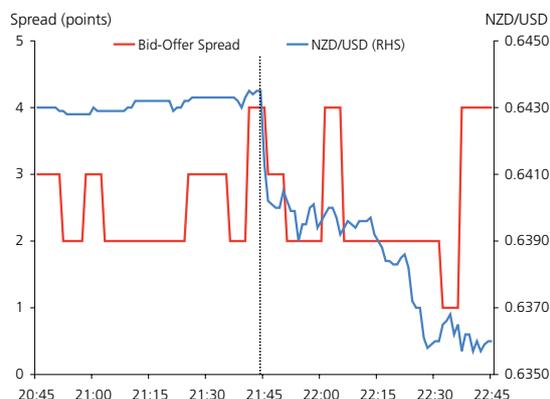


Source: Reuters

Figure 24 shows the bid-offer spread around the release. The spread widened just before the release as dealers withdrew their limit orders. Dealers who leave limit orders in the market over data releases risk buying or selling at unfavourable exchange rates, so they often prefer to cancel their limit orders beforehand and then re-enter them afterwards. While the spread spiked a little wider on a few occasions over the hour following the release, for the most part it was reasonably stable around 2 points.

An hour before the retail sales release, the limit order book was very deep and skewed towards buyers, suggesting there was good underlying demand for the NZD (the NZD/USD was increasing prior to the data release, and dealers may have been looking to buy at lower levels). However, dealers

Figure 24
The bid-offer spread around the retail sales release



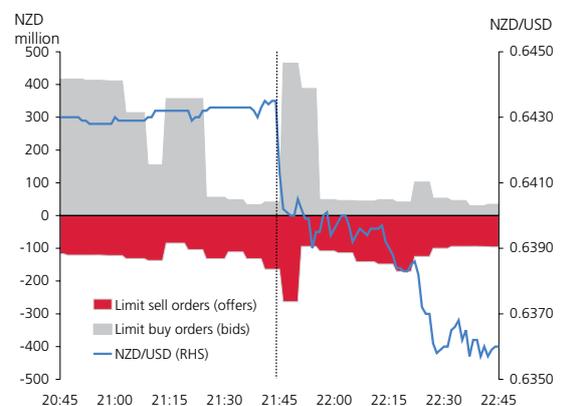
Source: Reuters

Note: The spread is taken every five minutes when ‘snapshots’ of the order book are captured.

withdrew their orders just prior to the data release – as noted above, this caused the bid-offer spread to widen.

After the data release, a number of limit orders were resubmitted – including two substantial bids. However, aggressive selling by other dealers eliminated these bids, and the order book switched to being skewed towards sellers (there were more offers in the market than there were bids). The volume of orders in the limit order book around the retail sales release was reasonably substantial compared to average.

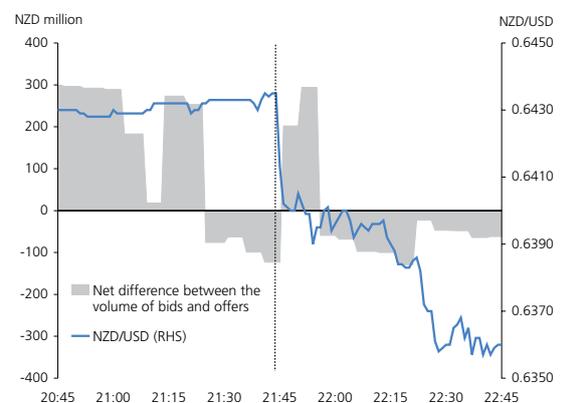
Figure 25
The depth of the limit order book after the retail sales release



Source: Reuters

Note: the volume of bids and offers is recorded every five minutes when ‘snapshots’ of the order book are captured.

Figure 26
The net difference between the volume of bids and offers after the retail sales release



Source: Reuters

The February retail sales release provides an insight into how the market reacts to scheduled releases. The exchange rate is very quick to incorporate new information – the exchange rate fell almost instantly, although in this case it continued to

fall over the following hour as market participants took time to determine the full implications of the release for the New Zealand economy. Trading activity fell away just before the release, but picked up again noticeably afterwards. Trading volumes were particularly heavy at times and the order book was sometimes full of several large limit orders.

7 Conclusion

From the Reserve Bank's perspective, we have an obvious interest in the FX market. A well functioning FX market is crucial to New Zealand as a small open economy. Importers and exporters rely on the FX market to make and receive payments for their goods and services, while some businesses borrow and lend money overseas. The Reserve Bank actively monitors conditions in the NZD market, and maintains a capacity to intervene in the FX market for monetary policy purposes and in the event that the market becomes disorderly.

Data from Spot Matching at Reuters allows us to take a detailed look back at how the interbank NZD market functioned between 2001 and 2006. While the data is historical, there are some clear trading patterns at different times of the day evident between 2001 and 2006 that are still the case today.

Most trading in the NZD/USD takes place in offshore markets, particularly in London, the major centre for foreign exchange globally. Trading volumes are around two-to-four times higher in London, the order book is generally deeper, and bid-offer spreads tend to be narrower, reflecting the wide range of active market participants who trade during the London timezone.

Across a broad range of indicators from the Reuters electronic broker, trading activity has picked up and the liquidity of the NZD market has increased over the past few years. Transaction volumes have increased, the limit order book has become deeper, and bid-offer spreads have narrowed, making trading generally easier and cheaper for dealers in the interbank market. This is consistent with anecdotes and other partial indicators that suggest there has been a much higher interest in trading the NZD in recent years.

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Price changes by firms in New Zealand – some evidence from the Quarterly Survey of Business Opinion¹

Andrew Coleman, Reserve Bank and Brian Silverstone, University of Waikato and NZIER Research Associate

In the last decade, central banks have conducted new research enhancing their understanding of firm-level price-setting behaviour. This work has revealed new information about the frequency with which firms change prices and provided explanations as to why prices are sticky. This information could potentially improve monetary policymaking and, as a result, reduce the real costs of policy changes and non-policy shocks. This article outlines the major themes and results from selected international research. It then examines price changing behaviour in New Zealand using firm-level data from the Quarterly Survey of Business Opinion (QSBO) published by the New Zealand Institute of Economic Research (NZIER). In line with international research, we find considerable diversity in the frequency of price changes by firms. Moreover, firms change prices more in response to cost changes than demand changes, and more in response to falling demand than increasing demand.

1 Introduction

A central focus of monetary economics is the frequency with which firms change prices. Beginning with David Hume (1752), it has long been argued that the speed that firms change prices determines the extent that fluctuations in the demand for goods and services lead to fluctuations in output rather than fluctuations in prices. When prices are inflexible, sticky or sluggish, a disproportionate fraction of the adjustment to economic shocks takes place as changes in firms' production, employment and capacity utilisation rather than in their prices. In turn, sluggish price adjustment makes the implementation of monetary policy more difficult, not only because there can be long lags between monetary policy changes and prices changes, but also because the resultant fluctuation in output levels can be costly.

In the last decade, researchers in many countries have used new data sources to examine the frequency with which firms adjust prices. Some of this research has been based on detailed surveys of firm behaviour and some has been

based on data collected by national statistical agencies. A clear picture has started to emerge. It is a picture of considerable diversity. At one extreme, a small fraction of firms appear to adjust their prices on a weekly basis. At the other extreme, a sizeable fraction of firms adjust their prices less than once every two years. In between, there are firms that adjust on a regular calendar cycle, often in January, and firms that adjust only when they are affected by a shock to their cost structure. There are firms that think nothing of having sales or specials every few weeks, and firms that agonise over every price change, often dispatching senior company personnel to customers to explain why a change was necessary (Zbaracki et al. 2004).

In conjunction with this work, there is new evidence that differences in the frequency with which firms change prices are important for monetary policy. Recent analysis of United States data has indicated that when monetary policy is tightened the size of a sector's output decline is inversely related to the frequency of price changes in that sector. Sectors that receive more sector-specific shocks tend to change prices more frequently, are faster to alter prices in response to monetary policy changes and have less output change when monetary policy is altered (Boivon, Giannoni and Mihov 2007).

In this article, we provide some evidence on the frequency with which New Zealand firms change prices. The evidence is

¹ Access to the data used in this study was provided by the NZIER under conditions that maintained the full confidentiality of respondent firms. The authors are grateful to the Institute and to its Chief Executive, Dr Brent Layton, for access to this data. The authors also thank Phil Briggs, Bob Buckle and the participants at a Reserve Bank seminar. The study was supported by Bank funding and by University of Waikato Research Grant X554. The results and views presented are the work of the authors and not the Reserve Bank or NZIER.

from the Quarterly Survey of Business Opinion (QSBO). This is a survey of firms in the manufacturing, building, merchant and service sectors published by the New Zealand Institute of Economic Research (NZIER). Since 1961, when it was first conducted, it has been an important source of information about New Zealand firms (see Box 1, overleaf). Consistent with the international evidence, we find considerable diversity in the frequency with which firms adjust prices. While many New Zealand firms adjust prices nearly every quarter, there are a significant number of firms that adjust prices infrequently, at most once every two years. In addition, the data indicate that the speed that firms adjust prices in response to demand and cost pressures is systematically related to their previous pattern of price adjustment.

The next section is a brief overview of the major themes and results on price-setting behaviour that have emerged from international research using business surveys. This is followed by a range of empirical questions regarding price changes in New Zealand using firm-level data from QSBO. The final sections contain our conclusions and directions for further research.

2 Major themes and international results

Recent research on the way that firms adjust prices can largely be traced to the contributions by Okun (1981), Kahneman, Knetsch and Thaler (1986), Blinder (1991) and, somewhat further back, to Hall and Hitch (1939).

Okun (1981) developed a theory of firm price adjustment based on the idea of 'costly search'. He argued that it is costly for customers to search for firms that provide good quality products at good prices on a reliable and timely basis. Once a customer finds such firms, he or she stays with them with the result that customers and firms form long-term relationships. Firms only change prices in a manner that does not harm these relationships. In particular, Okun hypothesized that firms are reluctant to raise prices in response to demand shocks for fear of alienating customers.

Kahneman et al. (1986) surveyed people about their views on when it is acceptable for firms to change prices. The

responses showed that a large majority of people thought it was fair for firms to raise prices when costs increased, although they did not mind if prices were not cut when costs declined. People also thought it was acceptable to cut prices when demand was low, although unfair for firms to raise prices above normal when demand was high. The authors argued that firms would act accordingly, so that asymmetric responses to demand and cost shocks should be observable.

Blinder (1991) and his team (Blinder et al. 1998) conducted intensive interviews of a large number of United States firms regarding their pricing behaviour.² The team asked a wide range of questions such as: How often do firms change their prices? How do firms respond to cost and demand changes? Do firms set prices according to the textbook theories of price stickiness? The answers were sufficiently groundbreaking that surveys into price setting behaviour have now been conducted in several other countries, often by central banks. In addition, researchers in Europe and North America have examined firm level price data provided to national statistical agencies to see how frequently firms changed retail and wholesale prices.

The results of this research have shed light on both the frequency with which firms change prices and the reasons why they change prices. Turning first to the frequency of price changes, a standard finding is that some firms change prices very frequently but a significant number only change them occasionally. Blinder found that 10 percent of United States firms changed prices once a week, but 50 percent of firms changed prices at most once a year. Subsequent research suggests that 25-30 percent of firms in the United States change prices every month, while the average duration between price changes is six or seven months (Bils and Klenow, 2004; Klenow and Kryvtov, 2005). European consumer prices seem to be stickier. Surveys across European countries suggest approximately 15 percent of consumer prices are changed every month, while the average duration

² Prior to Blinder, mainstream economists were skeptical at best, and hostile at worst, to the use of firm-level survey and interview data. "We are trained to study behaviour by watching what people do (usually in markets), not by listening to what they say" (Blinder 1991, p.90). Due to the success of this survey, this situation is changing rapidly.

Box 1

The New Zealand Institute of Economics Research (NZIER) has, since 1961, published a Quarterly Survey of Business Opinion (QSBO). The survey covers firms in the manufacturing, building, merchant and service sectors (with primary industries, utilities and government services the main omissions). It has long been an important source of forecasting and monitoring information and data for economic research. (On the latter, see Buckle and Silverstone 2004).

Almost all questions in QSBO are related to the experiences and outlook of respondent firms regarding profitability,

output, employment, investment intentions, costs, prices and similar variables. Table 1 shows most of the questions common to all sectors together with the June quarter 2007 responses. These aggregated responses are published in QSBO as net balances, that is, the difference between the percentage replying 'up' and the percentage replying 'down'. In table 1, for example, a net 37 percent of respondents expect the general business situation over the six months to December 2007 to deteriorate. The net balances, in turn, are often compared in QSBO with their underlying official statistics, such as GDP and the producer and consumer price indices.

Table 1
QSBO Economy-wide Questionnaire
Percentage of 518 replies to Survey 185, June 2007

How many employees are covered by this return?								
1-20	21-50	51-100	101-200	201-500	Over 500			
27	14	9	9	24	17			
Which district does this return primarily relate?								
Auckland	Wellington	Canterbury	Other					
34	11	10	45					
Do you expect the general business situation in New Zealand during the next six months to:								
Improve	Same	Deteriorate	N/A					
9	45	46	0					
Finding the skilled staff you want today compared with three months ago is:								
Easier	Same	Harder	N/A					
3	48	43	6					
What single factor , if any, is most limiting your ability to increase your activity:								
Sales	Materials	Finance	Labour	Capacity	Other			
52	3	5	19	11	8			
Do you expect new investment approvals (compared with the last 12 months) to be:								
Greater	Same	Less	N/A					
29	38	26	6					
Past and future trends. What has been your firm's experience during the past three months and what changes do you expect in your firm during the next three months in respect of:								
Experienced				Expected				
Up	Same	Down	N/A	Up	Same	Down	N/A	
23	56	21	0	24	63	13	1	
17	58	14	11	9	60	20	11	
22	66	9	3	11	73	12	3	
53	37	8	1	52	42	4	1	
34	54	10	2	42	48	8	2	
18	42	40	1	19	48	33	1	
26	53	19	2	28	50	20	2	
				Numbers Employed				
				Overtime Worked				
				Labour Turnover				
				Average Cost				
				Selling Prices				
				Profitability				
				Output/Sales				

Note: N/A means 'not applicable' or 'no answer'.

Source: NZIER *Quarterly Survey of Business Opinion* 185, June 2007.

between price changes was just over a year. (Dhyne et al. 2006).

Second, the research has also examined the reasons why firms change prices. Following Blinder, firms have been provided with a list of a dozen or so reasons why they do not change prices more frequently, and asked to rank their importance. The top five explanations in Blinder's survey were:

- Firms hesitate to raise prices in case their competitors will not follow (co-ordination failure).
- Firms change prices, with a lag, to changes in costs (cost-based pricing).
- Firms change non-price features, such as varying the quality of service (non-price competition).
- Firms have an implicit understanding with their customers not to increase prices when supplies are tight, unless justified by higher costs (implicit contracts).
- Firms have written contracts which usually make it difficult to change prices within the contract period (explicit contracts).

A full ranking of the explanations is shown in table 2, overleaf, along with the ranking of firms in the United Kingdom, the Euro area, Canada and Sweden. As can be seen, firms in each country had substantially similar rankings. In general, the surveys support the argument that firms change prices more in response to cost changes than demand changes.

The research has generated many other findings. The following list, based on Fabiani et al. (2007 p7-8, 47), summarises the research conducted in most of the Euro area countries by the Eurosystem central banks. These results are similar to those from other countries.

- The frequency of price changes varies considerably from firm to firm.
- The average frequency of price changes varies by sector.
- Energy sector firms change prices more frequently than other firms.
- Firms that use a lot of raw materials change prices more

frequently than firms that use few raw materials.

- Firms that are labour intensive, particularly in the service sectors, change prices less frequently than others.
- Firms in the Euro area change their prices less frequently than those in the United States.
- There is little evidence of downward price rigidity, except in the services sector.
- Price-setting responds asymmetrically to factors such as changes to cost and demand.
- The dominant approach to price setting is for firms to mark up prices over costs.

3 New Zealand evidence from the Quarterly Survey of Business Opinion

The analysis of the QSBO survey is presented as a series of questions and answers. Most of the analysis is based on firms' response to a question asking whether their selling price had decreased, stayed the same, or increased in the previous three months. Since firms often sell more than one item, the question is normally interpreted to refer to the selling price of the firm's main product. The firms are also asked whether their costs or sales changed over the previous three months (see box 1).

Question 1: What fraction of firms change prices each quarter?

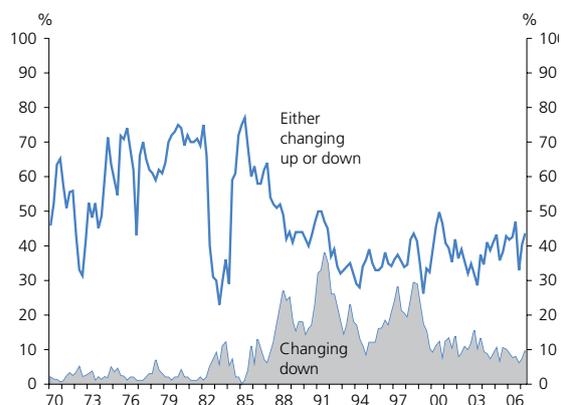
Figure 1, overleaf, shows the fraction of firms that claimed they had changed their selling prices in the previous quarter. The figure shows the fraction that either increased or decreased prices and the fraction that just decreased prices. Two points stand out. First, the fraction changing prices depends on the inflation rate. Prior to 1987, when the inflation rate was high, around two thirds of firms changed prices in a quarter. Since 1990, when the inflation rate has

Table 2
Explanations, importance and ranking of price stickiness theories

Theory	Explanation	Country Study and Rank				
		US	UK	EA	CA	SW
Cost-based Pricing	Prices depend mainly on input costs and do not change until costs change.	2	2	3	1	2
Explicit Contracts	Written contracts make it difficult to change prices while the contract is in force.	5	1	2	3	3
Implicit Contracts	Firms have an implied understanding with customers not to increase prices in tight markets.	4	5	1	2, 7	1
Coordination Failure	Firms delay price changes because they do not want to be the first price-mover in the industry.	1	3	4	5, 8	4
Non-price Competition	Firms change non-price feature, such as delivery times and services, rather than prices.	3	8	7	4	
Pricing Thresholds	Prices may be sticky because firms are reluctant to cross pricing thresholds such as \$9.95.	8	4	10		7
Constant Marginal Cost	Factors influencing prices, such as marginal costs, do not change over the business cycle.	9	6		9	
Cost of Price Adjustments	Firms may change prices infrequently due to the costs of gathering information for pricing decisions and notifying the changes.	6 11	11	8 9	10 11	11 13
Procyclical Elasticity	Prices are sticky because firms lose customers when prices raised but gain few when lowered.	7	9			10 12
Stock Adjustment	Firms adjust stocks rather than prices to accommodate shocks to market conditions.	10	7			
Price Means Quality	Firms may be unwilling to cut prices in case customers think there is a decline in quality.	12	10	5		
Liquidity Constraints	In a recession price may need to be maintained to cover costs and to finance projects.					5, 6
Price Wars	Price wars contribute to keeping prices down during booms.					9
Temporary Shocks	If firms believe a shock affecting them is temporary, they may forego a price change.			6		
Low Inflation	Low inflation makes large price changes more noticeable.				6	

Sources: United States (US): Blinder *et al.* (1998, Table 5.2), United Kingdom (UK): Hall *et al.* (2000, Table 3), Euro Area (EA): Fabiani *et al.* (2006, Table 8), Canada (CA): Amirault *et al.* (2004, Table 4), Sweden (SW): Apel *et al.* (2005, Table 4).

Figure 1
Percentage of all firms changing prices each quarter, 1970–2007



Source: NZIER

been low, only 40 percent of firms have changed prices in a quarter.³ Second, a much greater proportion of firms increased prices than decreased prices. Price decreases were rare in the high inflation period before 1987. Even when the inflation rate has been low, only a small proportion of firms have decreased prices, except during the 1991 and 1998 economic downturns. Since 2000 the average number of firms that have reduced prices has only been 10 percent per quarter, a third of the number of firms that have increased prices.

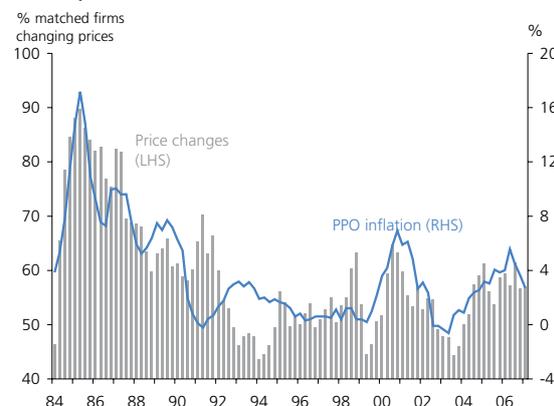
Question 2: What fraction of firms change prices over two quarters?

Further insight into the frequency of price changes can be gained by examining the fraction of firms that changed prices at least once over a six month period. To do this,

one needs to limit the sample to firms who respond to consecutive surveys. Table 3 presents detailed data for the 322 firms who answered both the March and June 2007 surveys. Of these firms, 43 percent said they changed prices in March and 47 percent said they changed prices in June. These outcomes are similar to the number of firms reporting a selling price change in the full sample, 44 percent (see table 1). The results in table 1, however, do not disclose the underlying dynamics seen in table 3. For example, the table shows that 37 percent of firms did not change their prices in either the March or June quarters of 2007 while 27 percent changed their prices twice. (See Silverstone 2000 for further analysis of these dynamics and related probabilities).

Figure 2 shows the proportion of firms changing prices at least once in a six month period and the producers' price index for outputs (PPO) between 1983 and 2007. The two

Figure 2
Percentage of matched firms changing prices each quarter and PPO Inflation, 1983-2007



Source: NZIER

Table 3: Price changes in March and June 2007
 The fraction of firms changing prices in each quarter.

March 2007	June 2007			Total
	Up	Same	Down	
Up	21.1%	12.7%	0.9%	34.8%
Same	15.8%	37.6%	4.3%	57.8%
Down	0.6%	2.8%	4.0%	7.5%
	37.6%	53.1%	9.3%	100%

Source: NZIER. Authors' calculations. 322 firms responded in both quarters.

³ The mean and standard deviation for the period 1973:1-1987:4, excluding the price freeze period 1982:3-1984:1, are 64 percent and 8.5 percent, respectively. The mean and standard deviation for the period 1990:1-2007:2 are 38 percent and 5.4 percent.

Table 4: Price changing behaviour: all firms, 1994-2006

Distribution of the number of times firms changed prices in 8 quarters									
Mean Number 2.84									
Number	0	1	2	3	4	5	6	7	8
pdf (%)	17.4	17.8	15.4	15.2	9.9	9.0	6.1	5.1	4.1
cdf (%)	17	35	51	66	76	85	91	96	100.0

Distribution of the number of quarters since the last price change									
Number	0	1	2	3	4	5	6	7	8+
pdf (%)	34.8	16.8	7.6	8.7	4.4	4.3	2.9	3.1	17.4
cdf (%)	35	52	59	68	72	77	80	83	100.0

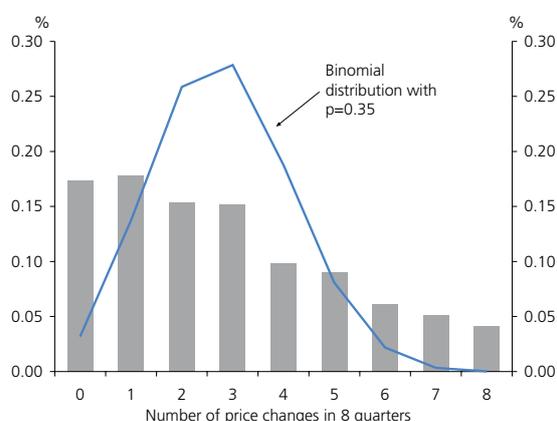
Source: NZIER. Authors' calculations. The pdf or probability function is the fraction of firms in each category. The cdf or cumulative distribution function is the cumulative sum of the probability distribution function.

series track each other very closely: the correlation over the period 1983-2007 is 0.81. The high correlation between these two series is consistent with European evidence that the number of firms changing prices is a good predictor of changes in the producer price index.

Question 3: Are firms equally likely to change prices?

To explore the frequency with which different firms change prices, we examined the responses of firms that replied to eight consecutive surveys in the periods ending in the fourth quarter of 1994, 1996, 1998, 2000, 2002, 2004 and 2006. Since firms often miss responding to a survey, this sampling procedure substantially reduces the sample size to 1013 observations.

Figure 3
Distribution of the number of price changes over eight quarters, 1994-2006



Source: NZIER

Figure 3, and the upper part of table 4, shows the number of times firms changed prices during an eight quarter period. The mean number of price changes was 2.8 changes every eight quarters, or one change every eight and a half months. This average, however, disguises a very wide distribution. At one end of the distribution, 35 percent of firms recorded one change or fewer every eight quarters, of which half recorded no changes. At the other end, 15 percent of firms recorded at least six changes in the eight quarters.

It is of interest to know whether this distribution is consistent with the hypothesis that every firm was equally likely to change prices. The simple answer is no. If every firm were equally likely to change prices each quarter, the number of price changes made over eight quarters would follow a binomial distribution. Figure 3 shows this binomial distribution together with the actual distribution of the number of changes made by firms.⁴ The two distributions are clearly very different. Compared to the binomial distribution, the actual distribution has more firms changing prices very frequently and many more firms changing prices very infrequently. The hypothesis that the two distributions are the same can be formally rejected at the five percent significance level using a Wilcoxon-Mann-Whitney non-parametric test.⁵ In broad terms, this distribution is similar to results found internationally.

⁴ The binomial distribution is calculated using a probability of change equal to the fraction of firms that change prices each quarter, in this case 35 percent.

⁵ The Wilcoxon-Mann-Whitney test tests whether the cumulative distribution functions of two distributions lie above each other. The test statistic has a standard normal asymptotic distribution. The test statistics comparing the two distributions is 2.41, significant at the 1 percent level.

The lower part of table 4 shows the length of time since a firm last changed its prices. The table indicates that 35 percent of firms changed prices in the previous quarter and another 17 percent reported that they last changed prices in the quarter before that. In total, 68 percent of firms reported they had changed prices at least once in the previous four quarters. Of the remaining 32 percent, 17 percent had not reported any price changes in the previous eight quarters.

It is natural to ask two questions about these latter results. First, is it likely that the 17 percent of firms that reported that they had not changed prices in the previous eight quarters were simply misreporting? This could be the case. We think it unlikely for two reasons. First, if one extends the period of analysis from eight quarters to ten quarters, one finds that a quarter of these firms (4 percent out of 17 percent) changed their prices in the additional two quarters. This fraction is similar to the fraction of respondents that reported they last changed seven or eight quarters ago, suggesting a natural decay process. Secondly, only 10 percent of the firms that reported no price changes in the previous eight quarters also reported no demand changes over the same period. Since these two questions are adjacent in the survey, it seems unlikely that the respondent firms were simply choosing to tick the 'no change' boxes in the questionnaire.

Question 4: Are differences in the frequency with which firms change prices related to the size and sector of firms?

To answer this question, table 5 shows aspects of the distribution of price changes for firms in three different size categories in the manufacturing and building, merchant

and service sectors. The three size categories are firms with fewer than 50 employees, firms with 50-200 employees, and firms with more than 200 employees.

Three results are immediately apparent. First, merchants change prices more frequently than either manufacturing or service firms. This result holds for firms of all sizes and therefore does not reflect differences in the size composition of sectors. Second, small firms change prices less frequently than medium sized firms, who change prices less frequently than large firms. This result holds in each sector, although, as discussed below, the differences between medium and large firms are not statistically significant. On average, large firms changed prices one more time during every two year period than small firms. Third, there are significant differences in price setting behaviour within each size-sector category. At least nine percent of each category changed prices very frequently and at least another 16 percent changed prices very infrequently.

Closer inspection of the data shows that large firms are twice as likely as small firms to change prices very frequently (at least six times in eight quarters), but much less likely to change prices very infrequently (at most once in eight quarters). A quarter of large firms changed prices nearly every quarter. In contrast, over 40 percent of small manufacturing and service sector firms, and a third of small merchant firms, changed prices at most once in a two year period, of which more than half reported no changes. The tendency of small firms to change prices less frequently than large firms is found in most international studies. Amirault et al. (2004, p.34) offer the following explanation. Because many senior staff at small firms have numerous tasks in addition to reviewing

Table 5: Distribution of the number of times firms changed prices in eight quarters
Disaggregated by size and sector, 1994-2006

	Small	Medium Mean	Large	Small	Medium Sample Size	Large
Manufacturers	2.31	2.90	3.57	144	137	69
Services	2.36	2.87	3.40	250	126	77
Merchants	2.79	3.70	3.90	104	63	43
	Percent with 0 or 1 Changes			Percent with 6 to 8 Changes		
Manufacturers	41	35	28	9	17	23
Services	45	37	19	10	17	22
Merchants	34	21	16	13	22	28

Source: NZIER. Authors' calculations.

Table 6
Seasonal Distribution of Price Changes 1992-2007
 Percentage of Total Price Notifications

Prices	March	June	September	December	Totals
Up	6	6	6	5	23
Same	17	16	15	15	63
Down	4	4	3	3	14
Totals	27	26	24	23	100

Source: NZIER. Authors' calculations.

and adjusting prices, the administrative and management costs associated with the price-setting process are particularly onerous and so prices are changed less frequently.

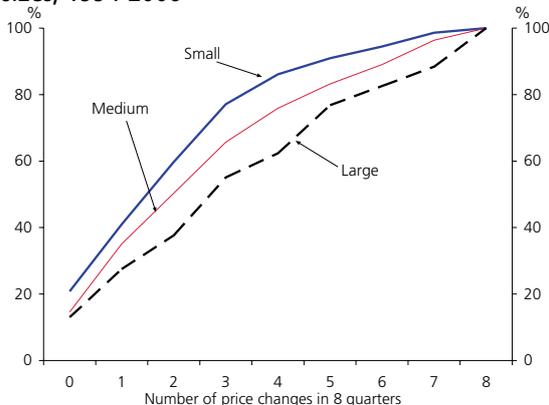
Figure 4 shows the cumulative distribution function of the number of price changes made by small, medium and large manufacturing firms. It shows that large firms are much more likely to change prices than small or medium firms. For example, 38 percent of large firms change prices at most twice every two years, whereas 50 percent of medium firms and 60 percent of small firms change prices at that frequency. The hypothesis that small manufacturing firms have the same distribution of price changes as either medium or large manufacturing firms can be rejected at the five percent significance level using a Wilcoxon-Mann-Whitney test.⁶ In contrast, it is not possible to reject the hypothesis that medium and large manufacturing firms have different

distributions at the five percent level. A similar pattern of results is found for the merchant and service sectors, namely that small firms change prices less frequently than medium or large firms, but the differences between medium and large firms are smaller and not statistically significant.⁷

Question 5: Is there seasonality in the frequency of price changes?

Table 6 shows the seasonal distribution of price changes using the 35,600 responses given between 1992 and 2007. There is little evidence of a seasonal pattern in the data. The number of price changes, expressed as a percentage of total replies, is about the same in each quarter, at between eight and 10 percent. This result is also found when the data are disaggregated by sector. This outcome could be explained partly by the questionnaire which asks respondents to exclude seasonal variations in their replies.

Figure 4
 Cumulative distribution of the number of price changes, manufacturing sector, all employment sizes, 1994-2006



⁶ The test statistics comparing the small and medium size firms is 2.01, significant at the 5 percent level. The test statistic for the small and large firms is 3.32, significant at the 1 percent level. The test statistic for the medium and large firms is 1.73, significant at the 10 percent level.

Question 6: Do firms change prices when costs and demand change?

The above results show the frequency with which firms change prices but do not explain why firms change prices. The QSBO data cannot be used to answer question 6 directly as firms are not asked why they change prices. The data can be used indirectly, however, as firms are asked whether or not they have faced cost or demand changes. We apply regression analysis to determine if firms change prices when they experience demand or cost changes.

The approach adopted here was first used by Buckle and Carlson (2000a, b) in their analysis of the QSBO data. Like

⁷ The Wilcoxon-Mann-Whitney statistics for merchants are: small-medium 2.67, small large 2.70 and medium large 0.54. The statistics for service firms are small-medium 2.10, small large 3.59 and medium large 1.73.

them, we estimate an ordered probit model that relates a firm's likelihood of changing prices in a particular quarter to changes in cost and demand conditions. We assume that a firm has a desired or target price. The firm adjusts its actual price to this value whenever the gap between its actual price and its target price becomes too large or, to put differently, whenever this gap exceeds a certain threshold. The price gap of the i^{th} firm, denoted, p_i^* depends on various factors facing the firm including changes in its cost structure and demand conditions and an additional idiosyncratic term e_i :

$$(1) p_i^* = \alpha^{c+} D_i^{c+} + \alpha^{c-} D_i^{c-} + \alpha^{d+} D_i^{d+} + \alpha^{d-} D_i^{d-} + e_i$$

D_i^{c+} and D_i^{c-} are dummy variables indicating whether or not a firm had a positive or negative cost change, and D_i^{d+} and D_i^{d-} are dummy variables indicating whether or not a firm had a positive or negative demand change. The coefficients ($\alpha^{c+}, \alpha^{c-}, \alpha^{d+}, \alpha^{d-}$) indicate how firms respond to the cost and demand changes. Firms are assumed to increase prices whenever p^* exceeds an upper threshold k^+ and to decrease prices whenever p^* is less than a lower threshold k^- .

The model can be written as:

$$(2) \quad \text{Prob}(\text{price increase}) \\ = \text{Prob}(\alpha^{c+} D_i^{c+} + \alpha^{c-} D_i^{c-} + \alpha^{d+} D_i^{d+} + \alpha^{d-} D_i^{d-} + e_i > k^+) \\ = \text{Prob}(e_i > k^+ - (\alpha^{c+} D_i^{c+} + \alpha^{c-} D_i^{c-} + \alpha^{d+} D_i^{d+} + \alpha^{d-} D_i^{d-}))$$

$$(3) \quad \text{Prob}(\text{price decrease}) \\ = \text{Prob}(\alpha^{c+} D_i^{c+} + \alpha^{c-} D_i^{c-} + \alpha^{d+} D_i^{d+} + \alpha^{d-} D_i^{d-} + e_i < k^-) \\ = \text{Prob}(e_i < k^- - (\alpha^{c+} D_i^{c+} + \alpha^{c-} D_i^{c-} + \alpha^{d+} D_i^{d+} + \alpha^{d-} D_i^{d-}))$$

The ordered probit regression estimates the parameters ($\alpha^{c+}, \alpha^{c-}, \alpha^{d+}, \alpha^{d-}, k^+, k^-$) given the observed pattern of cost, demand and price changes and the assumption that e is normally distributed.

We estimate four separate models. First, we estimate the model using all firms that responded to any survey between 1992 and 2007. There are 36,255 observations in this regression. In the second, we restrict the sample to firms that responded to eight consecutive surveys ending in the December quarters of 1994, 1996, 1998, 2000, 2002, 2004

and 2006. There are 1,003 observations in this regression, as we only use the December observations. The last two regressions are estimated using two subsets of these data. The first subset contains the firms that frequently adjusted prices, defined as those firms that changed prices at least five times in the previous seven quarters. There are 185 firms in this group. The second subset contains the firms that infrequently adjusted prices, defined as those firms that changed prices at most once in the previous seven quarters. There are 394 firms in this group. This split was made as firms differ in their tendency to change prices.

Table 7, overleaf, shows the regression results. The coefficient estimates and associated standard errors are shown, together with a "marginal probability" measure indicating how a cost or demand change increases the likelihood that prices will be changed in the same direction. The "marginal probability" measures are best interpreted by considering an example from the first regression. The coefficient on the increase cost dummy D^{c+} is 0.74 and the upper threshold k^+ is 0.98. If there was no change in costs, the firm would increase prices whenever the term e exceeded 0.98, that is, 16 percent of the time. If there was an increase in costs, the firm would increase prices whenever e exceeded 0.24, that is, 41 percent of the time. A cost increase, therefore, increases the probability of increasing prices by $41 - 16 = 24$ percent (these percentages have been rounded).

The results in table 7 are consistent with the main findings of international surveys and the earlier work of Buckle and Carlson (2000b). Firms are more likely to increase prices when costs increase than to reduce them when costs decrease. Firms are also more likely to reduce prices when demand decreases than to increase prices when demand increases. The latter asymmetry is large. In the first regression, analysing the behaviour of all firms, an increase in demand only increased the probability of increasing prices by four percent, whereas a decrease in demand increased the probability of reducing prices by 16 percent. In the remaining regressions, an increase in demand was estimated to slightly reduce the probability of increasing prices, although these estimates were not statistically significant. In these last cases, however, a decrease in demand was estimated to increase the probability of reducing prices by between 13

Table 7: Ordered Probit Models

	D^{c+} <i>cost+</i>	D^{c-} <i>cost-</i>	D^{d+} <i>demand+</i>	D^{d-} <i>demand-</i>	k^-	k^+	Log Ratio (4)
Firms responding to the survey in any quarter.							
Coefficient	0.74	-0.52	0.14	-0.28	-0.98	0.98	4897**
(se)	(0.013)**	(0.020)**	(0.014)**	(0.016)**	(0.011)**	(0.012)**	
probability	24%	16%	4%	8%	16%	16%	N=36255
Firms with responses to eight consecutive quarters ending December 1994 – 2006							
All Firms							
Coefficient	0.78	-0.56	-0.04	-0.48	-1.13	0.96	147**
(se)	(0.08)**	(0.14)**	(0.08)	(0.11)**	(0.07)**	(0.07)**	
probability	26%	13%	-1%	13%	13%	17%	N=1003
Firms with responses to eight consecutive quarters ending December 1994 – 2006							
Firms that frequently change prices							
Coefficient	0.94	-0.85	-0.14	-0.66	-0.69	0.29	58**
(se)	(0.19)**	(0.29)**	(0.20)	(0.24)**	(0.19)**	(0.18)**	
probability	36%	32%	-5%	24%	25%	39%	N=185
Firms with responses to eight consecutive quarters ending December 1994 – 2006							
Firms that infrequently change prices							
Coefficient	0.57	-0.51	-0.05	-0.73	-1.63	1.44	29**
(se)	(0.17)**	(0.29)	(0.16)	(0.20)**	(0.14)**	(0.13)**	
probability	12%	8%	-1%	13%	7%	5%	N=394

Results of an ordered probit model regressing a firm's decision to increase, not change or decrease prices against dummy variables indicating cost and demand changes. The sample is split according to whether firms had 5 or more or 1 or fewer price changes in the previous seven quarters.

percent (for firms that changed prices infrequently) and 24 percent (for firms that changed prices frequently).

A comparison of the first two regressions shows that the results for the firms that only answered eight consecutive quarters are broadly consistent with the results for the firms that answered any survey. In both cases, a positive cost change increased the probability of an increase in prices by approximately a quarter, while a negative demand change increased the probability of reducing prices by approximately 15 percent. In addition, they both have a small response to positive demand changes and a somewhat larger response to negative demand changes. Since these results are so similar, there is no obvious reason to suspect that the small sample results for the firms that frequently or infrequently adjust prices are not representative of the results for all firms.

4 Conclusions

The results of this exploration of price-setting behaviour in New Zealand are in line with the results of recent international studies. Four aspects stand out. First, there

is considerable diversity in the frequency with which firms adjust prices. About a sixth of firms in the sample adjusted prices nearly every quarter, while a third had adjusted prices at most once every two years. Small firms are more reluctant to change prices than others. Second, firms change prices more in response to cost changes than demand changes. Third, firms seem to respond more to negative demand changes than to positive demand changes. In this regard, it is noticeable that the two episodes of widespread price reduction that occurred in the last twenty years occurred during economic downturns. Fourth, firms are more likely to have reported price increases rather than price decreases. Since 2000, for example, firms were three times as likely to report price increases as price decreases.

The most original finding of the article relates the propensity to change prices in response to cost and demand changes to a firm's prior history of price changes. Not surprisingly, firms that have a history of changing prices are much more likely to respond quickly to changes in cost and demand conditions than firms that only occasionally change prices. Previously, findings of this type have been indirect, based

on the tendency of large firms or firms in the distribution sector to change prices more often than other firms. This paper has been able to exploit the longitudinal nature of the QSBO data to make the link explicit. It seems that some firms of all sizes and in all sectors adjust prices infrequently and these firms are slow to adjust prices in response to changing economic conditions.

For a long time, central banks have understood that the speed that firms adjust prices is a crucial factor behind the effectiveness of and costliness of monetary policy. The growing body of international research has shed new light on aspects of the transmission mechanisms of monetary policy, particularly the length of time it can take before changes in monetary policy affect the inflation rate. So far, this research has not provided central banks with a blueprint to “fine-tune” monetary policy to take account of the differential speed that different firms adjust prices. Nonetheless, there is growing recognition that greater knowledge of the reasons why firms change prices could assist central banks as they implement monetary policy. For instance, a better understanding of the asymmetric adjustment by firms to positive and negative demand shocks may provide a better guide to the operation of monetary policy in economic downturns.

Directions for further research

Internationally, it is becoming clear that better use could be made of firm-level survey data to analyse behaviour. This is due partly to software and econometric advances and partly to those researchers, such as Blinder et al. (1991, 1998), who have urged economists to include surveys and interviews in their analysis. While the Bank monitors the QSBO survey and also conducts regular interviews with New Zealand businesses as part of its monitoring of the economy, there has been relatively little attempt to build and use statistical models using firm-level responses from these surveys.

In this article, we have attempted to show that the firm-level responses in the QSBO can provide important insights into price-setting behaviour in New Zealand. Our initial conclusions have been based on the survey responses

of manufacturers, builders, merchants and services to the questions about selling prices, costs, demand and employment. We have not used the responses to any of the other survey questions relating, for example, to profit, business confidence, recruitment, investment approvals and constraints. Neither have we used the responses from the QSBO sector-specific questionnaires relating to principal activity, capacity utilisation, productivity, stocks, export sales and overseas orders.

The responses to these other survey questions should enable us not only to test the robustness of our initial conclusions but also to allow us to consider a wide range of questions. For example: Are firms backward or forward-looking regarding their own price-setting behaviour? Do they respond to cost and demand changes with a delay? What is the relationship, if any, between price changes and profitability, output, employment and business confidence? Can our understanding of the changes in the inflation process in New Zealand as described, for example, in Hodgetts (2006), be enhanced by an understanding of firm-level price changes? The answers to these questions and others may help us better understand how firms respond to shocks and thus how monetary policy may be implemented optimally.

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Payments and the concept of legal tender

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This article briefly looks at the concept of legal tender, drawing on the experience of New Zealand's recent change-over to new, lighter coins. Legal tender is a tender of payment that, by law, cannot effectively be refused in settlement of a debt denominated in the same currency. Although the basis for most cash transactions is generally taken for granted, the article notes that without the concept of legal tender, cash transactions could not always take place with sufficient certainty to satisfy the needs of consumers and sellers.

1 Introduction

On 31 July 2006, the Reserve Bank issued smaller, lighter 50, 20 and 10 cent coins and announced that on 1 November 2006 the existing 50, 20, 10 and 5 cent coins of cupro-nickel composition would no longer be legal tender.¹ For three months, the two alternative sets of coins were in circulation and could be used to pay for goods and services.

This unique situation brought into rare focus the arcane but important concept of legal tender. While legal tender underpins literally millions of ordinary payment transactions that take place daily and therefore supports the functioning of the economy at its most basic level – the exchange of goods and services for money – it is a concept that is taken for granted and frequently misunderstood. This article uses the coin change-over as an opportunity to briefly explore the legal theory that underpins legal tender and the continuing relevance of the concept.

2 Legal tender in theory²

The concept of legal tender in New Zealand is enacted by section 27 of the Reserve Bank of New Zealand Act 1989. This section gives an exclusive benefit to the currency issued by the Reserve Bank, as follows:

Legal tender

- (1) Every bank note issued, or deemed to be issued, under this Act shall be a legal tender for the amount expressed in the note.

- (2) A tender of payment of money, to the extent that it is made in coins issued, or deemed to be issued, under this Act, shall be a legal tender,-

- (a) In the case of coins of a denomination of \$10 or more, for the payment of any amount:
- (b) In the case of coins of a denomination of \$1 or more but less than \$10, for the payment of any amount not exceeding \$100:
- (c) In the case of coins of the denomination of 5 cents or more, but less than \$1, for the payment of an amount not exceeding \$5:
- (d) In the case of any coins of the denomination of less than 5 cents, for the payment of an amount not exceeding 20 cents.

- (3) The references to coins and bank notes in subsections (1) and (2) of this section do not include references to coins and bank notes that have been called in.

However, the Act does not say what 'legal tender' actually means and 'legal tender' is commonly confused with the related concept of 'payment'. In fact, to offer to pay for goods with legal tender is not the same as actually paying for them, and an offer of legal tender does not always conclude a payment obligation.

During the coin change-over, when two sets of same-denomination coins were in circulation for three months, a situation that faced many consumers and sellers was whether a seller had to accept payment for goods in the 'old' cupronickel coins. A number of sellers were reluctant to do so and put up signs in their shops to inform consumers that they would only accept the 'new' coins.

¹ However, the Bank noted that it would always redeem the coins in the future, as it is required to do under section 26(5) of the Reserve Bank of New Zealand Act 1989.

² This section draws on the following sources: Mann (2005), Chapter 7 in particular; and Brindle and Cox (eds) (2004), Chapter 1.

Some consumers were displeased by that and disputed the validity of the signs. Their argument was that they had the right to pay in the old coins on the basis that the old coins were legal tender. It was typically asserted that 'legal tender means that payment has been made legally'.

The actual legal situation was more complex and hinged on the legal distinction between tender and payment, and was fact-dependent to the extent that it could be determined whether the consumer and seller had concluded a sales contract before or after the old coins were tendered in payment.

The distinctions are as follows: 'tender' refers to an act of the consumer to take steps to complete the payment required to conclude a contract, such as to offer old coins as means of paying the agreed price for goods in order to complete their side of a sales contract. It is a unilateral act of the debtor.

'Payment' is a bilateral act requiring the consent of both the consumer and the seller, ie, it is the offer of old coins tendered by the consumer and its acceptance by the seller, thus fulfilling that particular term of the sales contract.

These concepts only have relevance in the context of a contract, in which payment by the consumer is one of the terms. In this article we are referring to sales contracts (but the principles obviously apply more widely to other types of contracts). The conclusion of a sales contract creates a debt on the part of a consumer which is fulfilled by payment of the agreed price.

The consumer (or 'debtor' at this point) having incurred the debt may tender payment for it. For example, they may offer 'legal tender' in notes or coins under current issue by the Reserve Bank.³ Between 31 July and 1 November 2006 they had a choice of offering old or new coins. However, as explained above, offering legal tender does not mean that payment has technically been made – only tendered.

The important point here is that the seller is under no positive legal duty to accept the payment that is tendered

by the debtor. The statement that 'legal tender means that payment has been made' is, in technical terms, incorrect. So what is the relevance of legal tender? Most consumers would naturally assume that having offered valid notes and coins they have done all that could reasonably be expected of them to meet their side of the bargain.

The answer has greater theoretical than practical relevance. While the seller ('creditor' at this point) is not required to accept the payment, the fact that a valid tender has been made means that in refusing to accept it, the seller is barred from recovering the debt in court. Therefore, in practical terms, the creditor has little choice but to accept the legal tender payment.

3 The relevance of legal tender in practice

The principles above can now be applied to retrospectively resolve the dilemma that faced consumers and sellers during the coin change-over between 31 July and 1 November 2006. The situation typically brought to the Bank's attention was a sale of goods taking place in a shop.

If a consumer offered to pay for the goods with 'old coins', which were still valid legal tender, the seller did not have to accept the tender. As long as there was no concluded sales contract at that point and therefore no debt owed by the consumer, the consumer would have had no legal or practical means of unilaterally settling the transaction.

However, if a sales contract had been concluded – for example, the consumer had been allowed possession of the goods and owed the price, or had consumed the goods before paying (eg a restaurant meal) – then a debt would be owed by the consumer to the seller. The consumer may settle the obligation with legal tender: old or new coins. If they offered old coins the seller could refuse to accept them, but as discussed earlier, they would then be left with no legal remedy to enforce payment.

While these situations are interesting in order to illustrate the concepts of legal tender and payment, and to apply them in a unique situation, in reality the legal issues

³ **Bear in mind the limitations on legal tender imposed by s 27(2): eg by virtue of s 27(2)(c) offering to pay a price of \$20 in 20 cent pieces would not be a valid tender of the price; the debtor would not have performed their contractual commitment to pay the contract price in this case.**

were not important during the coin change-over. This is because consumers and sellers dealt with the issues in a practical way based on their common desire to complete the transaction.⁴ Fine legal distinctions were not pertinent to those motivations, and with little detriment the buyer could easily walk away from the transaction if their payment in old coins was unacceptable. Alternatively, the seller could change its mind and accept the new coins in the knowledge that the coins could be re-used for value.

In addition, the sums involved where payment is made in legal tender of coins were far too trivial for any party to consider resolving the issues by resorting to the legal position. The issues in this context are really only of theoretical, and now historical, interest.

However, it is interesting to apply the principles discussed here to a far more substantial transaction - for example, the settlement of a large commercial deal, perhaps running into millions of dollars. Do section 27 of the Reserve Bank of New Zealand Act and the principles discussed above allow such a deal to be settled in cash?

To assume on the basis of section 27 (2)(a) that the answer is 'yes' would be to misread the section. While section 27 provides what is legal tender, it does not say that payment must be in legal tender or that any payment in legal tender is sufficient for the debtor to meet their payment obligations.

The actual form of payment – whether it is by legal tender or some other method – is determined by the contractual context. A contractual provision may specify the form of payment as something other than legal tender. For example, it may specify that payment be made electronically or by cheque, in which case the debtor has no right to insist on payment in legal tender. With small sums and routine transactions, contracts are frequently silent on this matter and payment in cash is not considered unreasonable.

With large sums, where the contract is unspecific as to

the form of payment the courts are likely to conclude that payment by legal tender is, in the words of one author “unthinkable and cannot possibly be within the contemplation of the parties”.⁵ This is because the courts will take into account the commercial context in which the transaction takes place and the practical difficulties faced by the creditor who must count out very large sums of cash. Professor Roy Goode makes a similar remark.⁶

‘In describing the legal characteristics of physical money we have made reference to one that is generally considered to be of fundamental importance, namely the right of the creditor to be paid in legal tender, that is, bank notes and coins which meet the statutory requirements for legal tender. This is no doubt true in the case of small transactions where payment of legal tender would be a reasonable method of payment; it is undeniably false in the case of transactions of any size, where in the absence of a clear agreement for payment in legal tender it would be absurd to suppose that this was the method of payment intended by the parties.’

4 Conclusion

This article has drawn upon practical, but unusual, scenarios to illustrate the concept of legal tender. Legal tender is a tender of payment that, by law, cannot effectively be refused in settlement of a debt denominated in the same currency. Without the concept of legal tender cash transactions could not always take place with sufficient certainty to satisfy the needs of consumers and sellers. The enactment into law of the concept also supports and reinforces the issue of currency by the state by guaranteeing its currency has an exclusive legal status that is good to settle debts. These benefits are largely taken for granted.

On the other hand, the practical limitations of legal tender should be acknowledged. It is always subject to the intention of the parties, who may contract to receive payment in other than legal tender. For larger transactions, the courts would be likely to presume that the parties did not contemplate legal tender. And where disputes arise over payment, members of

⁴ For instance although a retailer’s sign warning that ‘old coins’ would not be accepted might have had dubious legal validity when it came to disputed payments for a debt already incurred, it had the practical advantage of persuading consumers carrying old coins to take their business elsewhere thus preventing such disputes arising in the first place.

⁵ Proctor, pp 162-163.

⁶ Goode (2004), p 451.

the public are likely to rely on pragmatic solutions, while the formal rules underlying legal tender would rarely have any bearing on the outcome.

References

Brindle, M and R Cox (eds), (2004), *Law of Bank Payments*, 3rd Edition, Sweet & Maxwell.

Goode, R, (2004), *Commercial Law*, 3rd Edition, Penguin.

Mann, C P, (2005), *On the Legal Aspect of Money*, 6th Edition, Oxford University Press.

DISCUSSION PAPERS

DP2007/10

Understanding the New Zealand current account: a structural approach

Anella Munro and Rishab Sethi, July 2007

In this paper we use a small open economy model to identify the causal factors that drive New Zealand's current account. The model features nonseparable preferences, habit in consumption, imperfect capital mobility, permanent productivity shocks, fiscal shocks and two foreign shocks to explore features that are important in understanding the dynamics of the current account. The results suggest that permanent technology shocks and world cost of capital shocks account for the bulk of variation in the current account at short horizons; at longer horizons, external valuation shocks (reflecting terms of trade and exchange rate developments) account for most of the variance. Habit in consumption and a debt-sensitive risk premium are features that improve overall model fit as measured by posterior odds ratios. These features, and the contribution of foreign and permanent technology shocks, help to explain why the one shock present value model of the current account fails to appropriately characterise the dynamics of the New Zealand current account, as discussed in Munro and Sethi (2006).

DP2007/11

Credit constraints and housing markets in New Zealand

Andrew Coleman, July 2007

The paper develops an overlapping generations model incorporating a realistic depiction of the credit constraints facing home buyers to explain why home ownership rates have declined in New Zealand since 1990 despite a significant relaxation of credit constraints. The model focuses attention on the role of property investors in the property market, and suggests changes in credit constraints mainly affect the tenure decisions of individual households, but not the aggregate level of house prices. The model suggests the decline in real interest rates is likely to be the cause of the rise in house prices and the decline in home ownership rates since 1990.

DP2007/12

Housing Markets and Migration in New Zealand, 1962-2006

Andrew Coleman and John Landon-Lane, September 2007

This paper uses a structural vector autoregression model to analyse the relationship between migration flows, housing construction and house prices in New Zealand. It shows that a net immigration flow equal to one percent of the population is associated with an approximately 10 percent increase in house prices. This size of this relationship, which has existed since the 1960s, is an order of magnitude larger than would be expected from the average change in the population and house prices in the long term. One explanation is that migration flows occur at times when locals are changing their demand for housing because of revised expectations about future income growth. A second explanation is that migrant flows have a destabilising effect on agents' expectations about the fundamental value of houses. While the paper cannot satisfactorily distinguish between these two options, the results suggest that monetary policy can still be used to dampen the house price changes that occur at times when migration flows are unusually large.

DP2007/13

An analysis of the informational content of New Zealand data releases: the importance of business opinion surveys

by Troy Matheson, September 2007

We examine the informational content of New Zealand data releases using a parametric dynamic factor model estimated with unbalanced real-time panels of quarterly data. The data are categorised into 21 different release blocks, allowing us to make 21 different factor model forecasts each quarter. We compare three of these factor model forecasts for real GDP growth, CPI inflation, non-tradable CPI inflation, and tradable CPI inflation with real-time forecasts made by the Reserve Bank of New Zealand each quarter. We find that, at some horizons, the factor model produces forecasts of

similar accuracy to the Reserve Bank's forecasts. Analysing the marginal value of each of the data releases reveals the importance of the business opinion survey data – the Quarterly Survey of Business Opinion and the National Bank's Business Outlook survey – in determining how factor model predictions, and the uncertainty around those predictions, evolves through each quarter.

DP2007/14

Which nonlinearity in the Phillips curve? The absence of accelerating deflation in Japan

by Emmanuel De Veirman, September 2007

It is standard to model the output-inflation trade-off as a linear relationship with a time-invariant slope. We assess empirical evidence for three types of nonlinearity in the short-run Phillips curve. At an empirical level, we aim to discover why large negative output gaps in Japan during the period 1998-2002 did not lead to accelerating deflation, but instead coincided with stable, albeit moderately negative, inflation. We document that this episode is most convincingly interpreted as reflecting a gradual flattening of the Phillips curve. Our analysis sheds light on the determinants of the time-variation in the Phillips curve slope. Our results suggest that, in any economy where trend inflation is substantially lower (or substantially higher) today than in past decades, time-variation in the slope of the short-run Phillips curve has become too important to ignore.

NEWS RELEASES

Hugh Fletcher reappointed to Reserve Bank Board

27 June 2007

The Minister of Finance announced today that Mr Hugh Fletcher had been reappointed to Board of the Reserve Bank of New Zealand. Mr Fletcher will serve a further a further five year term, expiring in June 2012, as a non-executive director.

The primary role of the Board is to monitor and review the performance of the Reserve Bank, and the Governor, in the delivery of its monetary policy objectives and other responsibilities. Mr Fletcher is currently Chair of the board of directors of IAG New Zealand and a board director of Fletcher Building, and has a number of other private and voluntary sector board appointments.

Reserve Bank issues Statement of Intent

3 July 2007

The Reserve Bank has released its Statement of Intent (SOI) for 2007-2010.

Reserve Bank Governor Alan Bollard said the SOI reflects the Bank's undertaking in its five-year Funding Agreement to renew its tools and systems to ensure it can deliver on its policy and operational goals in the face of significant change.

"As we have noted on a number of occasions, we are facing a challenging environment," Dr Bollard said. "We have seen the longest period of growth since 1968-75; the lowest unemployment rate in 20 years; sustained high commodity prices, especially for dairy; unprecedented access to international credit; and worldwide booms in housing and oil prices.

"The outcomes have surprised forecasters and markets. New Zealand households have taken to borrowing, investing in houses and general consumption to an extent never seen before.

"We are continuing to invest in upgrading our forecasting and policy tools, improving our understanding of household balance sheets, and improving the quality of our statistics.

We have also reviewed and offered advice to Government on whether other tools could assist us in managing inflation."

Dr Bollard said the Bank is strengthening its analysis of risk in the financial sector. Its programme of systems renewal continues in this SOI: back-office systems that support the Bank's functions, such as the payments system, forecasting and data systems, web capability, financial reporting, document management.

40th Anniversary of Decimalisation

10 July 2007

The Reserve Bank of New Zealand today marked the 40th anniversary of currency decimalisation.

Forty years ago on the 10th of July 1967 New Zealand replaced pounds, shillings and pence with decimal currency.

Reserve Bank Head of Currency Alan Boaden said the idea of switching New Zealand to decimal currency was raised in 1933 by the New Zealand Numismatic Society. "The idea was rejected at the time because of the cost, and - funnily enough - because there was a thought that the imperial fractions were easier for most people to handle.

"The idea did not go away, however, and there was further talk of decimalisation in the 1950s. In 1957 the Government set up a special committee to investigate; the idea fell on fertile ground, and in 1963 the Government decided to decimalise - setting the change over, dubbed 'Decimal Currency' (DC) day, for 10 July 1967.

"A great deal of work was required to make the change, including a huge publicity campaign. There were public discussions over what the new decimal money might be called. Words such as 'kiwi' and 'zeal' were proposed to avoid confusion with 'dollar', which most people at the time associated with American money," said Mr Boaden.

Mr Boaden said in the end, though, the word 'dollar' was selected, and "Mr Dollar' became the symbol of transition.

To celebrate the 40th anniversary the Reserve Bank museum in Wellington will be hosting, with the help of Westpac's Archives, a James Berry exhibition from 16 July until 26 October 2007.

James Berry was commissioned in 1966 to produce designs for all the coins. Over the years the designs on New Zealand's coins have changed but Berry's ten and fifty cent coin designs remain in use today.

Reserve Bank announces changes to FX management

13 July 2007

The Reserve Bank today announced changes to its financing and management of New Zealand's foreign currency reserves.

The moves arise from a review of the Bank's balance sheet, announced in its Statement of Intent in June 2006. The review was aimed at enabling the Bank to manage its balance sheet to best meet monetary policy, currency, liquidity management and foreign reserves requirements.

Reserve Bank Governor Alan Bollard said that for the last 20 years, the Bank's foreign currency assets have been fully matched by foreign currency liabilities.

"That was an unusual approach by international standards and we are now moving in the direction of a more conventional approach," Dr Bollard said.

In the future we will hold some portion of our foreign reserves on an unhedged basis - an "open FX" position. This means that part of the foreign reserves portfolio will be funded in New Zealand dollars rather than in foreign currencies."

Dr Bollard said that the main reason for this new approach to foreign exchange (FX) management is to give the Bank a more effective means of responding to crisis situations involving sharp falls in the NZ dollar.

"In crisis situations it is of paramount importance that the Bank retains access to foreign currency reserves. With a portion of our reserves no longer borrowed from abroad, but funded internally, we will become less dependent on international capital markets in times of crisis.

"Also, the use of unhedged reserves in this situation will be less costly and give rise to less additional risk than would be the case using hedged reserves. Unhedged foreign reserves

provide a more effective form of insurance against a currency crisis."

The Bank's guidelines for operating in the foreign exchange market have also been modified. Overt intervention intended to affect the exchange rate directly may still occur. In addition, the Bank will be able to more gradually accumulate or reduce its foreign exchange position when the exchange rate is at extreme levels and unjustified by medium-term economic fundamentals.

Dr Bollard said that the Bank's more passive FX transactions will not necessarily be expected to directly affect the exchange rate.

"However, such transactions will allow the Bank to give concrete signals regarding the extent to which the exchange rate is seen as over- or under-valued. That may indirectly affect the exchange rate by discouraging speculators from pushing the currency to extreme levels."

Because the interest rates on the Bank's New Zealand dollar borrowings are higher than on foreign currency borrowing, the annual cost of holding foreign reserves is expected to increase somewhat with the change in approach.

The increased open FX position on the Bank's balance sheet is also expected to result in greater variability in the Bank's net income, as a result of foreign exchange gains and losses. However, the Bank's foreign exchange positions could be expected to be profitable on average over the medium term.

The Bank has been using and will continue to use its FX market operations to lift the level of its unhedged reserves towards a new long-run average level. The Bank publishes its open foreign exchange position monthly on its website, with a lag of one month.

Background documents on this new policy are available on the Reserve Bank and New Zealand Treasury's websites:

<http://www.rbnz.govt.nz/finmarkets/foreignreserves/>

<http://www.treasury.govt.nz/release/rbnzeri/>

Reserve Bank raises OCR to 8.25 percent

26 July 2007

The Official Cash Rate (OCR) will increase by 25 basis points to 8.25 percent.

Reserve Bank Governor Alan Bollard said: "The New Zealand economy is running strong. We are recording continued big increases in international commodity prices, especially dairy, reflecting solid world demand for our products.

"This is very good news for New Zealand. Given this positive situation, some of the negative commentary circulating about the economy is unwarranted.

"However, the continued tight labour market, high capacity use, and rising oil and food prices all point to sustained inflationary pressures. That is why we are increasing the OCR today.

"The New Zealand dollar has reached very high levels recently, driven by US dollar weakness and New Zealanders' heavy demand for borrowing. This level of the currency has been hurting exports.

"The high New Zealand dollar is not sustainable medium term and investors should understand this. The higher OCR now gives strong incentives to New Zealanders to save.

"New Zealanders have been showing early signs of moderating their borrowing.

Provided they keep this up, and the pressure on resources continues to ease, we think the four successive OCR increases we have delivered will be sufficient to contain inflation."

RBNZ MPS and OCR dates for 2008

3 August 2007

The following is the Reserve Bank's schedule for the release of its quarterly Monetary Policy Statements and Official Cash Rate announcements for 2008. Each Monetary Policy Statement includes within it an OCR announcement, so, as usual, in total there will be eight OCR announcements during 2008. Each announcement will be made at 9.00 am on the day concerned.

24 January	OCR announcement
6 March	Monetary Policy Statement
24 April	OCR announcement
5 June	Monetary Policy Statement
24 July	OCR announcement
11 September	Monetary Policy Statement
23 October	OCR announcement
4 December	Monetary Policy Statement

The Reserve Bank reserves the right to make changes to this schedule, if required due to unexpected developments. In that unlikely event, the markets and the media will be given as much warning as possible.

National finalists announced in Reserve Bank Monetary Policy Challenge

9 August 2007

The Reserve Bank announced today the six secondary schools that have made it through to the national final of the 2007 Monetary Policy Challenge (MPC).

All national finalists were selected from 56 schools that competed in regional finals from 30 July to 6 August. Regional finals were held in Auckland, Hamilton, Wellington, Christchurch and Dunedin. Two economists from the Reserve Bank were judges.

The national finalists are: Avondale College and Kristin Senior School from the Auckland regional final; New Plymouth Girls' High School from the Waikato regional final; Lindisfarne College from the Wellington regional final; Burnside High School from the Christchurch regional final; and Timaru Boys' High School from the Southern Region regional final. All winning team members will receive a \$50 book voucher and certificate in recognition of their achievement.

Judges were impressed with the level of comprehension each winning team demonstrated in their written submission and oral presentation. "Their ability to take the economic theory they had learned in the classroom and apply it to a real-world situation took a great deal of skill," they commented.

The MPC is designed to expand senior secondary school economics students' understanding of monetary policy and links to NCEA achievement standards.

Just like economists working in the Reserve Bank, each team analyses the economic conditions facing New Zealand and the outlook for inflation. On the basis of that analysis, they decide on an appropriate setting for the Official Cash Rate (the Reserve Bank's interest rate). Each team presents the reasons for their decision in a written submission and, if selected as a regional finalist, an oral presentation.

Acting Reserve Bank Governor Grant Spencer said: "The Challenge gets students thinking about how the New Zealand economy works, what influences it and the impacts of economic policy. It confronts students with the difficulties and considerations involved in a decision-making process."

The national final takes place at the Reserve Bank in Wellington on Wednesday, 22 August. The winning team will receive \$2,500 for their school and will be invited back to the Reserve Bank on 13 September 2007 to watch the Governor announce the Monetary Policy Statement.

Reserve Bank Monitoring Financial Markets

16 August 2007

Reserve Bank Acting Governor Grant Spencer said today that the Reserve Bank is closely following developments in the financial markets, both domestically and offshore.

"Following the recent disruptions in global credit markets, the Reserve Bank has been closely monitoring the impact on the domestic markets and liquidity conditions," said Mr Spencer.

"While some additional pressures have been present, we believe the level of cash within the banking system is adequate and markets continue to function satisfactorily.

"The Bank will continue to monitor conditions closely and stands ready to provide additional liquidity should that be necessary," Mr Spencer concluded.

Reserve Bank Head of Human Resources appointed

20 August 2007

The Reserve Bank today announced the appointment of Lindsay Jenkin as the Bank's Head of Human Resources.

Ms Jenkin brings with her a wealth of experience to the role, having worked in a number of human resource positions including a senior consulting role with Hewitt Associates and 13 years as Human Resources Director for Colgate-Palmolive Ltd.

This move follows the appointment of the former Head of Human Resources, Tanya Harris, to the position of Chief Information Officer at the Bank.

Ms Jenkin takes up her appointment on 24 September 2007.

RBNZ to accept NZ bank paper in repo facility

23 August 2007

As stated on 16 August, the Reserve Bank has continued to closely monitor the impact of global market disorder on developments in the domestic financial markets.

Reserve Bank Deputy Governor, Grant Spencer, said: "Pressures have persisted over the past week warranting steps to ease liquidity conditions in the interbank market.

"As a temporary measure the Bank will now accept NZ bank bills in its overnight reverse repurchase facility, at a cost of OCR + 100 basis points.

"This change will commence from 24 August 2007."

Mr Spencer added, "At the same time the Reserve Bank will introduce its previously announced Exchange Settlement Account tiering regime which was due to be introduced from 3 September 2007."

Mr Spencer emphasised: "This measure is aimed solely at easing short-term interbank liquidity pressures and has no implications for the Bank's monetary policy stance."

Operational details of the facility can be obtained from the Reserve Bank's website: <http://www.rbnz.govt.nz/finmarkets/liquiditymanagement/3067314.html>

National Winners announced in Reserve Bank Monetary Policy Challenge

24 August 2007

The Reserve Bank announced today that New Plymouth Girls' High School is the national winner of the Reserve Bank of New Zealand 2007 Monetary Policy Challenge (MPC). Timaru Boys' High School placed second in the national final and Lindisfarne College from Hawke's Bay came third.

The national final took place at the Reserve Bank in Wellington on 22 August and was hotly contested. Two economists from the Reserve Bank were judges.

New Plymouth Girls' High School won \$2,500 in prize money for their school and will visit the Reserve Bank on 13 September to watch the announcement of the next Monetary Policy Statement by Governor Alan Bollard.

Timaru Boys' High School won \$1,500 and Lindisfarne College won \$750 in prize money for their respective schools. The other competitors in the national final were Avondale College (Auckland), Kristin Senior School (Auckland) and Burnside High School (Christchurch).

Judges said the winning teams demonstrated an exceptional level of understanding about the economy. "Their ability to apply the economic theory they had learned in the classroom to real-world situations was impressive," they said.

The MPC is designed to expand senior secondary school economics students' understanding of monetary policy and links to NCEA achievement standards.

Just like economists working in the Reserve Bank, each team analyses the economic conditions facing New Zealand and the outlook for inflation. On the basis of that analysis, they decide on an appropriate setting for the Official Cash Rate (the Reserve Bank's interest rate). Each team presents the reasons for their decision in a written submission and, if selected as a regional finalist, an oral presentation.

Reserve Bank Governor Alan Bollard said: "The Challenge gets students thinking about how the New Zealand economy works, what influences it and the impacts of economic policy. It confronts students with the difficulties and considerations involved in a decision-making process."

The MPC is open to all New Zealand secondary school economics students and runs annually from May to August. This year over 70 schools from Whangarei to Invercargill entered the competition.

Reserve Bank issues enforcement notice to ABN Union Bank Limited

31 August 2007

The Reserve Bank has issued an enforcement notice to ABN Union Bank Limited, a company incorporated in the United Kingdom.

It is a breach of section 64 the Reserve Bank of New Zealand Act 1989 to carry on any activity in New Zealand using a name that includes the word "bank", unless the entity using the name is a registered bank in New Zealand, or is otherwise exempted. If the Reserve Bank is satisfied that a company is contravening section 64 of the Act, it is empowered by the Act to issue a notice to that company requiring it to take specified actions to achieve compliance.

ABN Union Bank Limited is not a registered bank in New Zealand, and is not exempted from section 64 of the Act. Reserve Bank enquiries show that ABN Union Bank Limited has been carrying on activities in New Zealand.

The enforcement notice issued by the Reserve Bank to ABN Union Bank Limited requires it to cease carrying on any activity in New Zealand using a name that includes the word "bank".

Reserve Bank welcomes new deposit-taker requirements

12 September 2007

Reserve Bank Governor Alan Bollard today welcomed the Cabinet decision for the Bank to be the new prudential regulator of non-bank deposit-takers.

Under the new arrangements the Bank's role will be to license deposit-takers, develop and enforce minimum prudential and governance requirements and apply credit rating requirements. Trustee corporations will continue to be the front-line supervisors of deposit-takers.

Dr Bollard said the proposals are expected to provide a more consistent approach to the supervision of deposit-takers and provide a stronger basis for confidence in the deposit-takers sector. "Improved disclosure and credit ratings will assist depositors to make better-informed investment decisions."

"Credit ratings from reputable rating agencies will play an important role in the new regulatory arrangements. Credit ratings assist depositors to better appreciate the risk they are taking with the matched return when they invest in a deposit-taker," commented Dr Bollard.

The Reserve Bank will engage with stakeholders, including deposit-takers and trustees, in developing the regulations once the legislation has been enacted. The Bank will also assist in the revision and simplification of public disclosure requirements for deposit-takers.

Legislation will be introduced into Parliament later this year to implement most of the proposals, with further legislation being introduced in 2008.

OCR unchanged at 8.25 percent

13 September 2007

The Official Cash Rate (OCR) will remain unchanged at 8.25 percent.

Reserve Bank Governor Alan Bollard said: "The outlook for economic activity and inflation has become more uncertain since we reviewed the OCR in July. Credit concerns and heightened risk aversion have led to significant turbulence in global financial markets. This development increases the likelihood of a weaker economic outlook for the United States and New Zealand's other key trading partners than in recent forecasts.

"The consequences of this financial market turmoil for New Zealand remain unclear at this stage. However, we continue to expect a significant boost to the economy over the next two years from the sharp rise in world prices for dairy products and some other commodities that has occurred over the past year. A sharp decline in the New Zealand dollar since July, if sustained, will act to reinforce the effects of higher world prices on export sector revenues.

"Recent inflation outcomes have highlighted widespread inflation pressures but indicators in recent weeks suggest that previous increases in the OCR are starting to dampen domestic spending, which will help to reduce those pressures. In particular, household borrowing growth is beginning to slow and turnover in the housing market continues to fall.

"We expect the effects of stronger export revenues on activity and inflation to be broadly offset by a further braking effect from the interest rate increases undertaken earlier this year. However, in the short term, CPI inflation is likely to rise due to the effects of a lower exchange rate and higher food prices. It is important that this temporary increase in inflation does not affect price- or wage-setting behaviour in the medium term.

"The recent collapse of a number of finance companies and reduced liquidity within the non-bank lending institution sector generally could further act to dampen activity in some areas of the economy, such as property development or consumer financing. However, we currently expect those negative effects to be relatively contained.

"At this point, we believe that the current level of the OCR is consistent with future inflation outcomes of 1 to 3 percent on average over the medium term. However, given greater than usual uncertainty at present, we will be watching to see how the upside and downside risks to the outlook are developing."

PUBLICATIONS

<i>Annual Report</i>	Published in October each year.
<i>Financial Stability Report</i>	Published six-monthly. A statement from the Bank on the stability of the financial system.
<i>Monetary Policy Statement</i>	Published quarterly. A statement from the Bank on the conduct of monetary policy.
<i>Reserve Bank of New Zealand Statement of Intent, 2007-2010</i>	
<i>Snakes and Ladders – a guide to risk for savers and investors</i>	
<i>Testing stabilisation policy limits in a small open economy: proceedings from a macroeconomic policy forum</i>	
<i>Finance and expenditure select committee inquiry into the future monetary policy framework: submission by the Reserve Bank of New Zealand</i>	

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2007

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DP2007/14	Which nonlinearity in the Phillips curve? The absence of accelerating deflation in Japan <i>Emmanuel de Vierman</i>

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Pamphlets

Explaining Currency

Explaining Monetary Policy

The Reserve Bank and New Zealand's Economic History

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Your Bank's disclosure statement – what's in it for you?

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Articles and speeches in recent issues of the Reserve Bank of New Zealand *Bulletin*

Vol. 69, No. 3, September 2006

Articles

The policy origins of the Reserve Bank of New Zealand

Modelling New Zealand inflation in a Phillips curve

An assessment of recent Reserve Bank forecasts

Vol. 69, No. 4, December 2006

Assessing core inflation

The Reserve Bank's local-incorporation policy

The Reserve Bank of New Zealand Amendment Act 2006

Changes to the liquidity management regime

Testing stabilisation policy limits in a small open economy:
editor's summary of a macroeconomic policy forum.

Vol. 70, No. 1, March 2007

The impact of fiscal policy on the business cycle

New Zealand's productivity performance and prospects

Emerging Asia and global inflation

Tradables and non-tradables inflation in Australia and New Zealand

Economic and financial chronology 2006

Reserve Bank workshop on 'Housing, savings, and the household balance sheet'.

Vol. 70, No. 2, June 2007

The transmission mechanism of New Zealand monetary policy

A review of the trade-weighted exchange rate index

The Reserve Bank's policy on outsourcing by banks

Financial literacy and its role in promoting a sound financial system