# FINDING CURRENCY

## An examination of whether new information is reflected first in the direct rate for the AUD/NZD or in the indirect rate implied by the rates in the AUD/USD and NZD/USD markets.

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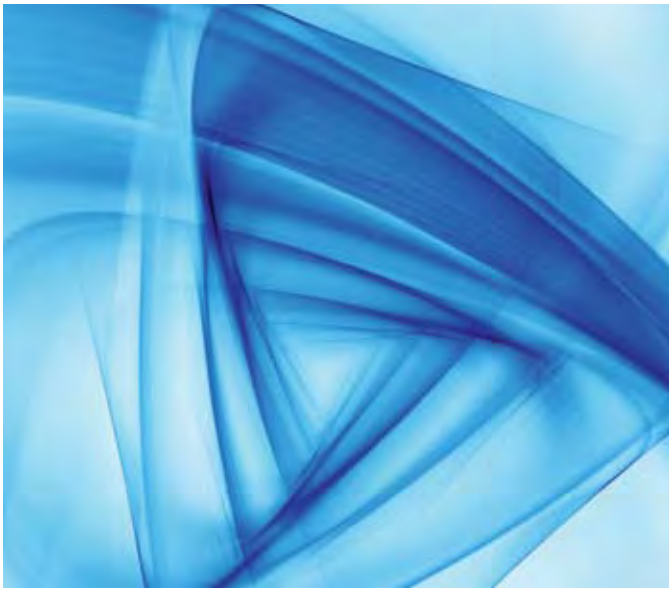


### 1. INTRODUCTION

Recent years have witnessed strong growth in trading in the Australian dollar/New Zealand dollar (AUD/NZD) cross rate, most notably as a result of trading by investors who wish to take a position on the Australian or New Zealand dollar but do not want to be exposed to US dollar (USD) trends (Smyth, 2005).

We examine the role of the direct market in the price discovery process for the AUD/NZD rate. Our focus is on whether new information is reflected first in the direct rate for the AUD/NZD or in the indirect rate implied by the rates in the AUD/USD and NZD/USD markets. The size of the US dollar vehicle currency markets relative to the AUD/NZD market suggests that the direct market will be a satellite market of the more liquid US dollar markets. In the extreme case where order flow through the direct market has no influence on the cross-rate implied by the US dollar rates, the direct market will be "informationally redundant".

The remainder of this paper is structured as follows. Section 2 discusses the likely roles of the direct and indirect markets for the AUD/NZD currency pair in the price discovery process. Section 3 describes the data set and the methodology employed in this paper. Section 4 presents the empirical results. Section 5 concludes.

### 2. SPECULATIVE CAPITAL FLOWS, CURRENCY EXCHANGE AND PRICE DISCOVERY

The Australian and New Zealand dollars are both regarded as "commodity currencies" since their real exchange rates are heavily influenced by the real price of their commodity exports (Chen and Rogoff, 2003). Although the two currencies tend to "move in tandem" against the US dollar – i.e. are cointegrated (Zhou, 1998), the AUD/NZD cross is influenced by movements in relative commodity prices and other factors, including the nominal interest rate, output and inflation rate differentials between Australia and New Zealand (Huang, 2004). These "empirical regularities" seem to make a wager on the AUD/NZD cross rate an attractive proposition for currency speculation.[1]

One interesting question is the identity of the market(s) in which the underlying speculative capital transactions will be conducted. An investor wanting to take a position on the AUD/NZD cross rate has a choice between trading the AUD/NZD directly in the AUD/NZD market or trading the AUD/NZD indirectly through the US dollar vehicle currencies (i.e. AUD/USD and NZD/USD) in two separate transactions. Under the first alternative, speculative capital flows will emerge in the AUD/NZD market while, under the second alternative, they will emerge in the US dollar markets. If speculative capital flows concentrate overwhelmingly in the direct AUD/NZD market, then one should expect the direct market to dominate the price discovery process. The opposite applies when speculative capital flows concentrate in the indirect market.

**Although the two currencies tend to "move in tandem" against the US dollar, the AUD/NZD cross is influenced by movements in relative commodity prices and other factors.**

We suggest that speculative capital flows will gravitate to

FOOTNOTES

1. An example is a recent report in the financial press of a large international investment bank advising its clients to sell the Australian dollar and buy the New Zealand dollar based on the perception that the AUD/NZD cross-rate fully priced the likelihood of the Reserve Bank of Australia raising interest rates (New Zealand Herald, 2006).

# ABSTRACT

We use a high frequency data set to examine information flows between the direct market and the indirect AUD/USD and NZD/USD markets for the Australian dollar/New Zealand dollar cross-rate. Our results show that information flows are dominated by the contemporaneous information flow during the most active part of the trading day and by the lagged flow of information from the indirect to the direct market when trading activity is low. These results show that the US dollar markets for the Australasian currency pair remain the locus of price discovery. However, the leading role of the US dollar markets cannot be exploited profitably. This suggests the direct AUD/NZD market is transactionally efficient and market participants can use this market to make their pricing and trading decisions.


**TABLE 1 – COMPARISON OF THE THREE CURRENCY PAIRS (BASED ON INDICATIVE QUOTE DATA)**

| | AUD/USD | NZD/USD | AUD/NZD |
|---|---|---|---|
| **No. of quotes** | 721,455 | 646,487 | 153,761 |
| **No. of dealers** | 43 | 38 | 7 |
| **No. of dealers → 5,000 quotes** | 23 | 22 | 4 |
| **Median spread (pips)** | 3 | 5 | 11 |
| **Median spread (%)** | 0.04% | 0.08% | 0.10% |

This table presents summary data on the final samples of indicative quotes from the US dollar markets for the Australian and New Zealand dollars and the direct market for the AUD/NZD cross-rate for the interval 1300 GMT to 1600 GMT daily over the period 1 January 2006 to 30 June 2006. The data has been filtered to remove likely input errors and low activity days. The spread equals the ask less the bid rate divided by the mid-rate (equal to the mean of the bid and ask rates).

the route that minimises transaction costs, including the bid/ask spread, search costs and price impact costs. The theoretical literature suggests that dealer bid/ask spreads in foreign exchange markets will be lower where the volume of customer orders is large or there are many dealers and volatility is relatively low, although high enough to attract speculators (Black, 1991).[2] The US dollar vehicle currency markets attract more dealers and account for the largest share of trading in both Australasian currencies, suggesting that spreads will be lower in these markets.[3] A larger number of dealers in the US dollar markets will also (a) reduce the time it takes to find a dealer (Levich, 1998), reducing execution risk and search costs, and (b) reduce the price impact of large transactions since the dealer has greater ability to unload any unwanted inventory position.

To summarise, our analysis suggests that speculative order flow in the AUD/NZD currency pair will tend to concentrate in the US dollar markets for both currencies rather than in the direct AUD/NZD market.

## 3. DATA AND METHODOLOGY

### 3.1. Data

We collect high frequency indicative quote data for the AUD/USD, NZD/USD and AUD/NZD for the six-month period from 1 January 2006 to 30 June 2006 from Securities Industry Research Centre Asia-Pacific. The initial data set comprises 3.9 million quotes on the AUD/USD rate, 3.6 million quotes on the NZD/USD rate and 0.5 million quotes on the AUD/NZD cross-rate.

We restrict our analysis to the busiest time of the trading day, 1300 GMT to 1600 GMT, since preliminary analysis of the raw data reveals that quote activity, particularly in the AUD/NZD cross-rate, is highest during daytime trading hours in London and New York. Our final data set (see Table 1) comprises 721,455 AUD/USD quotes, 646,487 NZD/USD quotes and 153,761 AUD/NZD quotes.[4]

The data shows much higher liquidity of the US dollar markets is reflected in substantially lower bid/ask spreads. Indirect trading of the AUD/NZD incurs a cost of 0.12% (0.04% plus 0.08%) compared to a direct cost of 0.10%. However, the 0.02% premium associated with indirect trading might well be offset by reductions in search costs and price impact costs.

### 3.2. Methodology

We construct our data set of direct and indirect quotes on the AUD/NZD rate in calendar time by recording the most recent quote in each market at sampling intervals of five seconds. We use this data to calculate the midrate for each series and then calculate the "indirect" AUD/NZD midrate from the midrates of the AUD/USD and the NZD/USD. We calculate returns over this five-second interval by taking the natural logarithm of the ratio of successive midrates.

Panel A of Table 2 shows that the return on the indirect rate is more variable than the return on the direct rate,

2. A number of empirical studies have confirmed the hypothesized inverse relationship between bid/ask spreads, and trading volumes / number of dealers (see Black, 1991; Huang and Masulis, 1999).

3. Survey data compiled by the Reserve Bank of New Zealand shows that during the six-months ended 30 June 2006, total domestic spot market turnover in the NZD versus the USD was NZ$161.4 billion compared with NZ$37.0 billion against the AUD (Reserve Bank of New Zealand, 2007).

4. We filtered the quote data since prior research indicates the presence of human and technical errors in data sets of high frequency indicative quotes (Muller et al., 1990). We also deleted 15 days from the sample where the number of quotes in the direct AUD/NZD market was unusually low.

## TABLE 2 – SUMMARY STATISTICS

**Panel A: Descriptive statistics on returns**

| | AUD/USD | NZD/USD | Direct AUD/NZD | Indirect AUD/NZD |
|---|---|---|---|---|
| **Mean** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Median** | 0.0 | 0.0 | 0.0 | 0.0 |
| **Maximum** | 0.0022 | 0.0084 | 0.0077 | 0.0084 |
| **Minimum** | -0.0024 | -0.0083 | -0.0075 | -0.0084 |
| **Std deviation** | 0.0001 | 0.0002 | 0.0002 | 0.0003 |

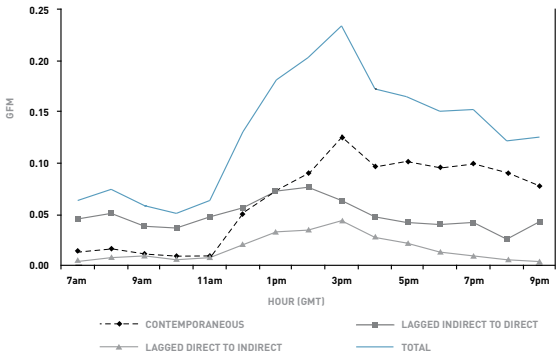
**Panel B: Cross-correlations between direct rate returns and leads and lags of indirect rate returns**

| Lead | | Lag | |
|---|---|---|---|
| **3** | -0.0100*** | 1 | 0.1339*** |
| **2** | -0.0160*** | 2 | -0.0317*** |
| **1** | -0.0283*** | 3 | -0.0158*** |
| **0** | 0.1349*** | | |

This table presents summary statistics on returns in the four exchange rate series where observations of the prevailing midrate are taken at five-second intervals. Returns are measured by the natural logarithm of the ratio of successive midrates. The cross-correlations are tested for significance using the Z-test.

*** Significant at the 0.001 level.

## FIGURE 1: GEWEKE FEEDBACK MEASURES (7:00AM TO 10:00PM GMT)




consistent with prior research (De Jong et al., 1998).[5] Panel B of Table 2 shows a large contemporaneous correlation between the two return series, suggesting that tools such as vector autoregressive or vector error correction models will be inappropriate since these models ignore the contemporaneous channel. The substantial correlation at the first lag (0.1339) suggests that the information flow from the indirect market to the direct market will also play a prominent role in the information transmission process.

## 4. EMPIRICAL RESULTS

### 4.1. Price discovery

We use Geweke (1982) feedback measures to capture the size of the information flows between the direct and indirect markets. The Geweke methodology identifies three specific types of feedback: the contemporaneous feedback between the indirect market and the direct market (G1), lagged feedback from the indirect market to the direct market (G2), and lagged feedback from the direct market to the indirect market (G3). These three measures can also be summed to provide a measure of the total feedback between the two markets (G4).[6]

## TABLE 3 – GEWEKE FEEDBACK MEASURES

| | Feedback measure |
|---|---|
| **G1 Contemporaneous** | 0.0956*** |
| **G2 Indirect leads direct** | 0.0665*** |
| **G3 Direct leads indirect** | 0.0353*** |
| **G4 Total** | 0.1974*** |

This table presents estimates of the Geweke feedback measures. The feedback measures are tested for significance using the Đ-square test.

*** Significant at the 0.001 level

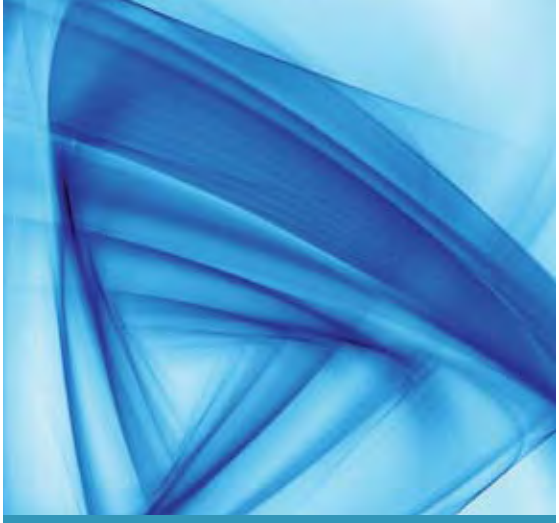
All three Geweke feedback measures reported in Table 3 are significant at the 0.001 level. More importantly, the results show that the contemporaneous channel is the most important channel, with G1 almost equal to the sum of G2 and G3. G2 is also nearly twice the size of G3, showing that the lagged information flows from the indirect market to the direct market dominates the lagged information flow from the direct to the indirect market.

To check the sensitivity of the results to the time of the day, we re-estimate the Geweke feedback measures for each one-hour period between 0700 GMT when trading begins in London and 2200 GMT when markets close in New York. The results depicted in Figure 1 show that the lagged information flow from the indirect to the direct market is the dominant information channel in morning trading in London and it is not until markets open in New York that the contemporaneous information flow assumes the dominant role. We conjecture that the prominence of the lagged indirect rate early in the trading day reflects the relatively low level of quote activity in the direct market during this time and dealers basing their AUD/NZD quotes on prevailing quotes in the more active US dollar markets for the Australasian currency pair. We also attribute the dominance of the lagged information flow from the indirect market to the direct market over the lagged information flow in the reverse direction to the much higher order flow in the US dollar markets for the AUD and NZD.

In summary, our empirical analysis shows that the information flow between the direct and indirect markets for the AUD/NZD is dominated by the contemporaneous flow of information between the two markets at times during the day when the level of quote activity is relatively high and by the lagged information flow from the indirect market at times during the day when the level of quote activity is more subdued.

5. The difference between the variances is significant under the Brown-Forsythe test of homogeneity of variances.

6. The Geweke feedback measure provides a summary statistic of the amount of additional information a set of variables adds to a time-series prediction model. Details of these measures are available from the authors on request.



**The direct market is a satellite market of the larger US dollar markets for the AUD and NZD since these markets are more liquid and are the principal avenue for transactions in the Australasian currencies.**

### 4.2. A simple trading strategy

The results in the previous section show that the information flow from the indirect market for the AUD/NZD is far larger than the information flow in the reverse direction. We test for the economic significance of this phenomenon by examining if a trader can profit from trading in the direct market based on recent movements in the indirect rate.

Our trading strategy is as follows. If (i) the return on the indirect rate between times t-1 and t exceeds (is less than) a threshold of X (-X), and (ii) the indirect or implied rate exceeds (is less than) the direct rate, we buy (sell) the AUD in the direct market at the time t ask (bid) rate and close out this position n seconds later at the bid (ask) rate in the direct market. We impose a threshold return in the indirect rate of plus or minus X since investors will be unwilling to trade on potentially small movements in the direct rate where trading incurs the bid/ask spread in the direct market.

Table 4 reports summary statistics on profits when we set the threshold level (X) at five pips (0.0005) and 10 pips (0.0010) and durations (n) that range between 5 and 60 seconds. The results show that profits are made on only a small fraction of trades and both median and mean profits are negative for all combinations of n and X. The null hypothesis that the mean profit is zero is strongly rejected using the t-test.[7] These results show that the trader cannot make long-run profits from trading in the direct market based on recent movements and the leading role of the indirect rate.[8]

## 5. SUMMARY

Using a high frequency data set, our analysis shows that information flows between the direct and indirect markets for the AUD/NZD rate are dominated by the contemporaneous

**TABLE 4 – SUMMARY STATISTICS ON PROFITS FROM SIMPLE TRADING STRATEGY**

| | Duration 5 seconds | 10 seconds | 15 seconds | 30 seconds | 60 seconds |
|---|---|---|---|---|---|
| **Threshold of 5 pips** | | | | | |
| **No. of trades** | 18,498 | 18,485 | 18,479 | 18,458 | 18,409 |
| **Mean profit (%)** | -0.0838 | -0.0846 | -0.0850 | -0.0849 | -0.0858 |
| **Median profit (%)** | -0.0840 | -0.0846 | -0.0850 | -0.0848 | -0.0870 |
| **Std deviation (%)** | 0.0300 | 0.0336 | 0.0348 | 0.0394 | 0.0451 |
| **No. of positive profits** | 177 | 206 | 242 | 341 | 489 |
| **t statistic** | -380.3*** | -342.5*** | -331.8*** | -293.1*** | -258.1*** |
| **Threshold of 10 pips** | | | | | |
| **No. of trades** | 2,263 | 2,260 | 2,259 | 2,265 | 2,251 |
| **Mean profit (%)** | -0.0781 | -0.0806 | -0.0820 | -0.0815 | -0.0826 |
| **Median profit (%)** | -0.0814 | -0.0831 | -0.0833 | -0.0832 | -0.0839 |
| **Std deviation (%)** | 0.0408 | 0.0457 | 0.0452 | 0.0500 | 0.0561 |
| **No. of positive profits** | 100 | 86 | 84 | 104 | 127 |
| **t statistic** | -91.07*** | -83.76*** | -86.24*** | -77.28*** | -69.94*** |

This table presents summary statistics on the profitability of a simple trading strategy for various thresholds and durations. The mean profits are tested for significance using the t- test.

*** Significant at the 0.001 level

7. Similar results are obtained using the non-parametric sign test.

8. The results are qualitatively similar when we use thresholds of 2.5 pips, 7.5 pips and 12.5 pips.

information flow when trading activity is high. At other times the lagged flow of information from the indirect market is the dominant channel. However, we find the indirect market's leading role cannot be exploited to earn trading profits.

**The inability of traders to profit from knowledge of the leading role of the US dollar markets indicates that the direct AUD/NZD market is transactionally efficient.**

We are not surprised to find that the direct market is a satellite market of the larger US dollar markets for the AUD and NZD since these markets are more liquid and are the principal avenue for transactions in the Australasian currencies. However, whilst the direct market accounts for a minority of the price discovery, the market is far from informationally redundant. Furthermore, the inability of traders to profit from knowledge of the leading role of the US dollar markets indicates that the direct AUD/NZD market is transactionally efficient. This suggests that a wide range of market participants can use the direct AUD/NZD market to make their pricing and trading decisions, a development which should promote the continued growth of this market with consequent benefits for the role of this market in the price discovery process. ←

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