"EMPIRICAL METHOD AND CENTRAL BANK STATISTICS"

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We are informed about the material world by our interactions with it. Our observations are part of this interaction. To understand how systems operate, we need to collect and analyse a broad range of data. Some of these data may appear to be unrelated to the things we are actually interested in.

For millennia, policy makers have needed data to make informed policy recommendations to decision makers. A difficulty which has dogged policy makers through the ages is having access to quality, pertinent information to analyse. This can be due to a number of reasons. For example:

- lack of understanding of the problem(s) and hence what information is needed;
- no ability to collect information (issues of legal authority, compliance, and technical capacity);
- mechanical issues of compilation, storage and retrieval; and
- funding and resources more generally.

Without high quality information, poor or even erroneous policy decisions may be made.

There is a wide variety of sources for central bank statistics. Because of the breadth and volume of data the management of it can be overwhelming. Having the right tools to collect, store, manipulate and analyse the data is crucial.

Over the past two decades, electronic data services have significantly reduced the costs and improved the availability of large quantities of data at various frequencies. Three decades ago it was not economically viable even for some institutions to have live pricing information available to them.

For a central bank, although of some interest, data which is "more of the same" is not necessarily better. Consider foreign exchange data. These can be collected at very high frequencies. To a degree, decreasing the periodicity of collection adds to an analyst's understanding of the dynamics of a particular exchange rate. However, below a periodicity of a day it is not necessarily meaningful. Rather than collect more and more of the same type of observations of the same variable, of greater value is data from a different perspective.

To recognise that a problem is multi-dimensional, that more of the same is not necessarily helpful, first of all requires an inquiring mind: a mind that wants to understand how a system "works". Secondly, those who want to make such a study need to have the resources to proceed with such an investigation. At one level, this is merely re-stating what is obvious to many. However, we are occasionally faced with two practical issues. Firstly, there is routine, the apparently mundane, operational collection of data for financial statistics. The second is one of divorce.

The generation and collection of data is often a work of mechanical routine. Once things are routine it is hard for many to stay alert, to inquire as to what the data actually are. Regrettably, with financial statistics, the bulk of the data is of a "low-grade" routine nature, with little meaningful information content. To compound this, the surveys which are often used to collect the data are highly technical and detailed.

Thus, without a degree of concentration the information is lost in the noise.

Hence the second issue, the one of divorce. Divorce has at least two components: time and function. The reasons why particular financial data are collected, more often than not, are a

long-forgotten policy decision. Those who generate, collect, and analyse the data are divorced in time from why the data is collected. Unless the reason remains relevant, the data are collected (and the method of collection) because "that is the way it has always been". It is therefore important that there are reasonably frequent reviews of the proper purpose for the collection of the data. For many types of data, the periodicity of such reviews should be no less frequent than five-yearly. This way the institutional memory and the reasons for the collection remain current.

The review process should cover matters such as:
- purpose – has it changed, is it appropriate;
- method of collection – as technologies change, more efficient ways of collecting, storing and transforming data present themselves;
- who are the users? – the user base evolves over time, for some data the user demographic can change significantly as the purposes of the organisation change; and
- data management and dissemination.

It is important to note that at such a review, the collection of data series is not discontinued unless there is no doubt that such data are likely to be needed in the future. Potentially short-lived policy trends – and such trends can last for more than a decade – should be adjusted for when making such decisions.

Functional divorce pervades most institutions. It is rare for officials to be competent across a number of functions and disciplines. Specialisation is, unfortunately, a necessity. There are few "philosopher kings" in central banking. Having a close interaction between the policy, statistics and infrastructure teams within a central bank is an important part of the policy decision making process. A close interaction ensures that information freely and correctly flows within the institution. Frequent contact informally and formally ensures that those who understand the institutions, the data generation and collection processes and the users of the processed data have a common understanding of what the data actually represent. Without such a shared understanding, data can be unwittingly misinterpreted. The statistics function needs to work hard at maintaining visibility with both the policy and operational functions of a central bank – statistics departments don't fit into either "policy" or "operations". They sit at the heart of them.

To fulfil its role, the statistics function: needs quality staff and systems; must have engaging relationships across other functions within the central bank and with external institutions; and advocates at the key decision making fora.
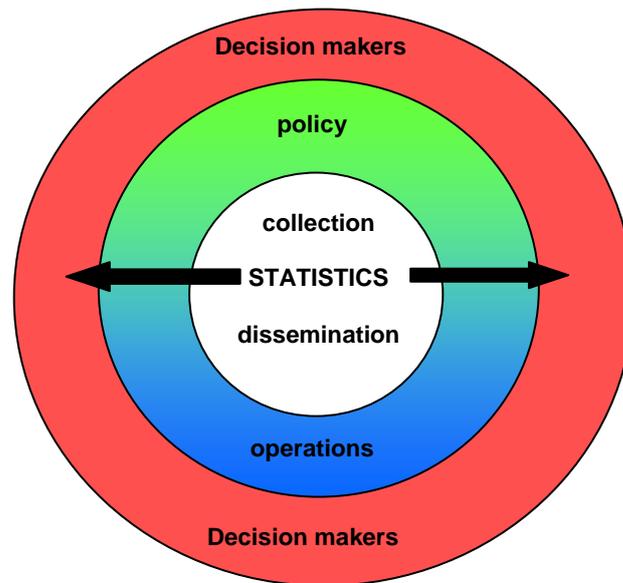
Decision makers

policy

collection

STATISTICS

dissemination

operations

Decision makers

Figure (1): *Statistics is at the "bullseye" of a central bank's decision making*

The non-statistics functions need some people who take an active interest in statistics. Who know how the data is generated, collection and processed. Such an interest may extend to mentoring and educating the statistics function so as to ensure that the statistics staff are fully aware of how the data is generated and used.

So, what do statistical and other analysts need to know? Firstly, the need to know Aristotle:

"*When the objects of an inquiry, in any department, have principles, conditions, or elements, it is through acquaintance with these that knowledge, that is to say scientific knowledge, is attained. For we do not think that we know a thing until we are acquainted with its primary conditions or first principles, and have carried our analysis as far as its simplest elements. Plainly therefore in the science of Nature, as in other branches of study, our first task will be to try to determine what relates to its principles.*"[1]

Without this key teaching at the heart of their work, those involved with statistics will have weakness in their method. They will not seek to fully understand the system they are monitoring. They may become enamoured by the intricacies of the way they work, the techniques or other aspects. Generating numbers, data points and models rather than producing valued adding information.

Econometricians need to be very conscious of this. Models are built using powerful mathematical methods. However, unless these models and data are fully grounded in reality, these models may be nothing more than highly refined graphing tools. Keynes may have been disingenuous when he said of Tinbergen that he seemed to "*prefer the mazes of arithmetic to the mazes of logic*"[2], but there is a great deal of truth in this statement when we survey the way in which some econometric models are constructed and used.

Macroeconomic, market and various forms of bank accounting data are the key sources of data for central banks. Until relatively recently alternative sources of data were often overlooked. A significant alternative source is the administrative systems which banks and others use, in particular the payment and settlement system and associated systems.

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[1]"The Physics", Aristotle, Book 1, Chapter 1, English translation by RP Hardie and RK Gaye
[2]Keynes, J.M. (1939). 'Professor Tinbergen's Method', Economic Journal, 49, pp. 558-568.

The settlement systems form the core "plumbing" of the financial system – they are a critical component of any financial system. For many jurisdictions around the world, the wholesale financial markets rely on this plumbing. In the past two decades settlement systems and the custody and registry networks around them have become highly efficient and nearly riskless. To the initiators of transactions, settlement systems have become almost invisible. The importance of their role has until the recent financial crisis frequently been derided. Not only is their role important, but they hold sources of data, albeit low-grade, which can be readily transformed into high quality information.

Administrative sources can be used both as a primary and corroborative sources of data. To gain access to them, central banks need appropriate legislative authority and people who understand how the financial system works. Some authorities have limited data collection powers and are only able to collect data from the institutions which they directly supervise. Such constraints prevent them making use of such sources.

In conclusion, if monetary or supervisory authorities are seeking to improve the quality of their decisions and supervision, a first principles approach may be helpful.

In particular review:
- the way the institution thinks about data and information – how the data are collected and processed;
- who is responsible for the day-to-day processes;
- what the interactions are between the different departments which make use of the data and the department which collects and stores it within the institution;
- what the sources of the data are – what other potential sources are available; and
- the statutory authority to collect data.

A culture of continuous improvement where inquiry, innovation and integrity are highly valued is essential in a top-performing central bank. A litmus test of this is found in the statistics function as it is from this function that information is sourced upon which the institution's decisions are made.

Case study 1 – The Reserve Bank of New Zealand non-resident holdings survey

Introduction
Over time, central banks around the world have gradually increased their ability to collect information which they believe to be pertinent to their role. The Reserve Bank of New Zealand is no exception. The original 1934 Act did not provide the Bank with any particular powers to collect data. It was not until the 1964 Act was amended in 1973 that some data collection powers were granted to the Bank. These powers have been gradually extended since then. At present the Bank has fairly comprehensive collection powers to enable it to carry out is functions.

A survey of non-resident holdings of New Zealand government securities was first taken in March 1985. The survey has been taken on a monthly basis since then and undergone a number of changes both in the information collected and its use. The current survey collects information on nearly all New Zealand registered securities on a security-by-security basis and is complemented by data held in other systems operated by the Reserve Bank.

The early years
In 1984 the concept of surveying the non-resident holders of New Zealand government securities was to assist the Bank in estimating the timing of capital flows. The Bank was the Registrar for the government securities so determining the ownership structure of direct holdings of securities was straightforward. The Bank understood that holders would not only be directly named on the registry but also held in nominee structures. So from the beginning the Bank knew it had to survey the various nominee firms.

The first survey asked two questions of respondents. Firstly the amount invested by clients in New Zealand government securities over the previous three months. Secondly the amount held by offshore investors and the maturity dates of the holdings. In subsequent surveys, only the second question was asked.

Although the first survey was in 1985, it was not until January 1988 that the data were first made publicly available. Since then, the results have been published on a monthly basis towards the middle of the month following the survey date.

In the early years, processing of the information was mainly manual or at best on a semi-automated basis. It was not until the advent of Excel based spreadsheet collection and automated reading of them in 1998 that the bulk of the processing became more-or-less automated at the Reserve Bank. Unfortunately, many respondents were still completing the survey manually.

By the early 1990's the survey was being used to assist with the balance of payments statistics. There were discussions as to which government agency (the Reserve Bank or the Department of Statistics) was best suited to collect the data. It was decided that the survey should remain with the Reserve Bank, but this necessitated a few changes to the survey. In particular, broadening the survey from government securities to other government and private sector debt securities and the inclusion of the income earned during the period. Respondents were asked about these extensions in mid-1992. The survey was broadened from the December 1992 return, but did not include the yield questions as a number of respondents were not able to comply with the request.

Between 1984 and 1992 the financial markets had evolved considerably in New Zealand, as had the international appeal of the New Zealand government's domestic securities. One aspect of the market which had been overlooked was the "repurchase" market. During 1993 the Bank started to deliberate about collecting repurchase data and a formal proposal was put forward in January 1994. From the end of March 1994 the survey collected the repurchase information.

It was not until 1995 that the Reserve Bank started collecting more detailed information on the residency of the ownership of the securities. It was at this time that those involved in the survey realised that this information, though useful, would be limited due to an inability to survey beyond the main international depositories.

<u>The new millennium – our purpose, the costs and the benefits</u>
With changes in need within the Reserve Bank, and of Statistics New Zealand, it was desirable to make a number of alterations to the survey. This led to a review of the way the data was obtained and processed.
An initial review merely redesigned the spreadsheet template. When respondents were surveyed about the use of the proposed template, it was clear there were issues both with the respondents and the internal mechanisms for processing it. The review's overall mandate was changed with the following criteria:
- Information:
  - quality,
  - granularity, and
  - depth / breadth;
- Timeliness;
- Flexibility;
- Compliance; and
- Synergies.

As its starting point the revised review took a broader view of the purpose of the survey and how it fitted with other functions of the Reserve Bank. In particular, the Reserve Bank is the

operator of the primary wholesale settlements system and central depository. For example, historically, there had been no way of checking the accuracy of the respondents' data, the broader view opened up the possibility of significantly improving the integrity of the survey.

It became clear that over time there was likely to be an increasing demand for more refined categories for analysis. For example, the classification of the originator of the securities in the market and a general broadening of scope to include securities which had not been previously surveyed. The initial review had resulted in a spreadsheet template that was far too burdensome for respondents to complete – especially as it had been indicated that there may be more frequent changes to it.

The end result was a recommendation to migrate from the existing template to respondents sending a file of more-or-less raw data comprised of: security identifier, face amount held (i.e., a currency value for debt and a number of shares for equities), the country of domicile of the holder and a flag indicating whether it was an outright holding or held under a repurchase agreement. Nearly all respondents were able to make the modest adjustments to their main reporting systems to generate the data files with relative ease.

The implementation difficulties at the Reserve Bank did however result in a major reduction in compliance burden for respondents and improved the timeliness of the survey. Previously the survey was published towards the end of the month, it is now released around the middle of the month – a lag of two weeks from the time the data is collected.

By taking raw data the survey has been able to be expanded to cover all registered securities in New Zealand. Although at present equity market data is not analysed the intention is to do so as resources become available.

As a corollary, the information from the various registries has been able to be used to provide robust estimates of the size of the various securities markets. Similarly, the greater availability of raw data which can be manipulated has been of use in other areas of the Reserve Bank such as financial markets and prudential supervision.

Case study 2 – stress in the New Zealand wholesale payment system

In 2005 the Reserve Bank of New Zealand embarked on a project to review the way liquidity was provided to the banking system. As part of this project a study was made of the way in which payments are made during the banking day. The study demonstrated that as liquidity conditions became tighter, payments slowed through the system during the day.

Figure (CS2.1) below depicts the percentage of the volume transacted up until 6pm each day at the end of each hour for three periods in the exchange settlement account system (ESAS), New Zealand's gross real time settlements system. The "reference" period is the five year period ending December 2004. During 2005, whilst the Reserve Bank was deliberating on what changes needed to be made, liquidity conditions gradually worsened. The worst period was November 2005 to January 2006. At the end of January 2006 it was decided to make an initial adjustment to the system and the target level of settlement cash left in the payment system was increased from $25m to $2,000m in two stages. The third period in figure (CS2.1) is the period after the initial adjustment to the end of September 2006.
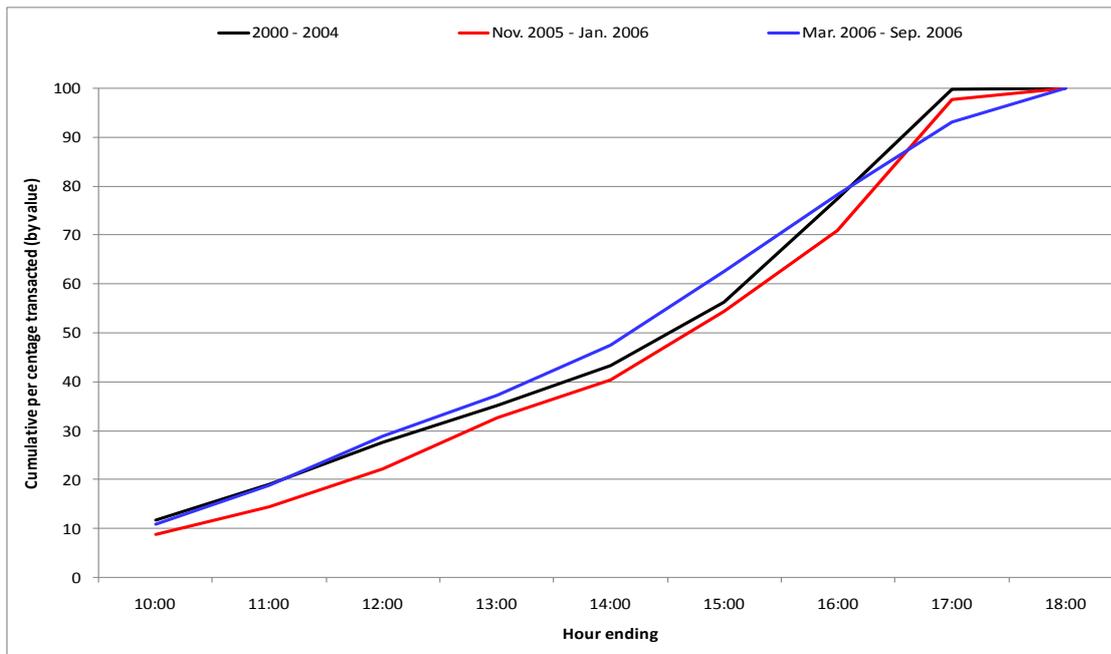
Figure CS2.1 Progress *during the day of payments in the gross real time settlements system on a cumulative percentage basis.*

As can be seen, there was a significant improvement in the progress of payments through the system once liquidity constraints were eased in the system. Overall, payments were made earlier in the day, with the median payment occurring about an hour earlier. The impact of the introduction of the New Zealand dollar into CLS can be seen in the slightly lower volumes occurring for the third period (blue line) in the last hour or so of the day. It is also instructive to see the impact of the recent stresses in the global financial system on the payment system.
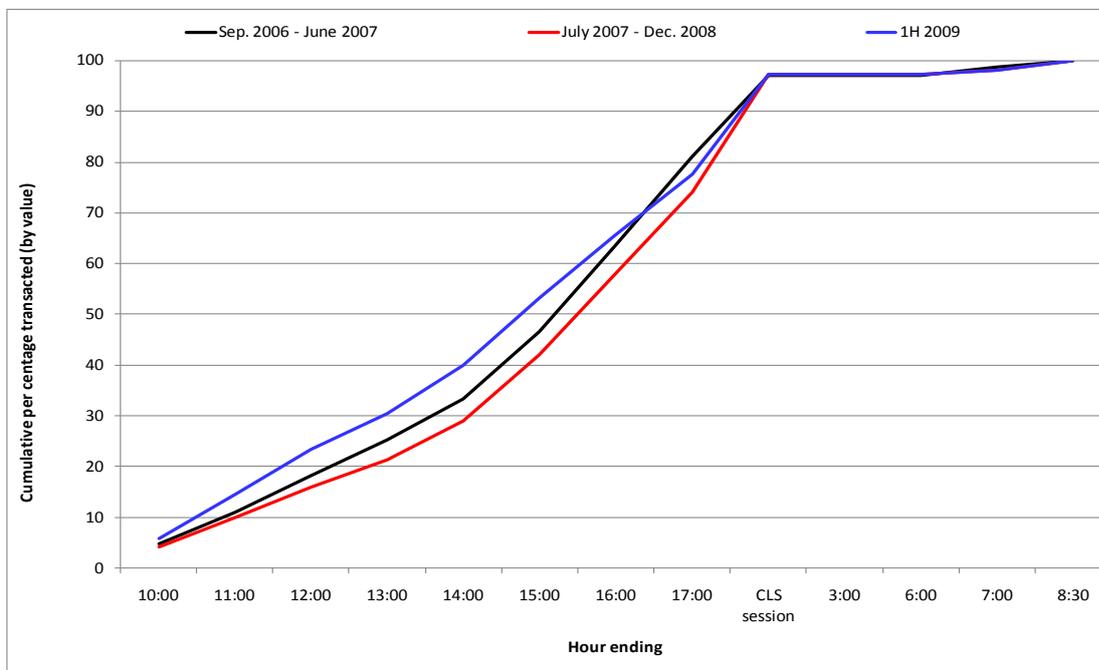

Figure CS2.2 *Transactions through the payment system for selected periods in 2006 to 2009. The CLS session runs in a three hour window. The commencement of the CLS session is 06:00 Central European Time - in New Zealand the actual time depends on the various daylight and standard time settings in New Zealand and Europe.*

Figure (CS2.2) follows the form of figure (CS2.1) and depicts the payment system behaviour for three periods in the past five years:

- A pre-stress period, post the implementation of the RBNZ's liquidity management reforms, from September 2006 to June 2007;
- the stressed period – July 2007 to the end of December 2008;
- and the first half of 2009 when there were few stress events.

During the most stressed period there was a shift to delaying payments into the CLS session. It would appear that banks with large payments to make on behalf of overseas banks delayed payments until they had received the funds as opposed to providing intraday credit to the offshore parties.

In the stressed period about 23% of the payments were made during the CLS session as opposed to 16% previously and about 20% in the first half of 2009. This type of behaviour in the payment system probably demonstrates the concern of the banks about the potential risks due to the deterioration in the credit quality of many overseas banks.

Case study 3 – August 2007

In August 2007 the first major wave of the 2007-2009 global financial crisis was felt in New Zealand as short-term money markets were disrupted by offshore events. Other than the events in overseas markets, initial indications in New Zealand were the sudden rise in the overnight deposit rate and anecdotes of possible disruption in the domestic bank bill market.
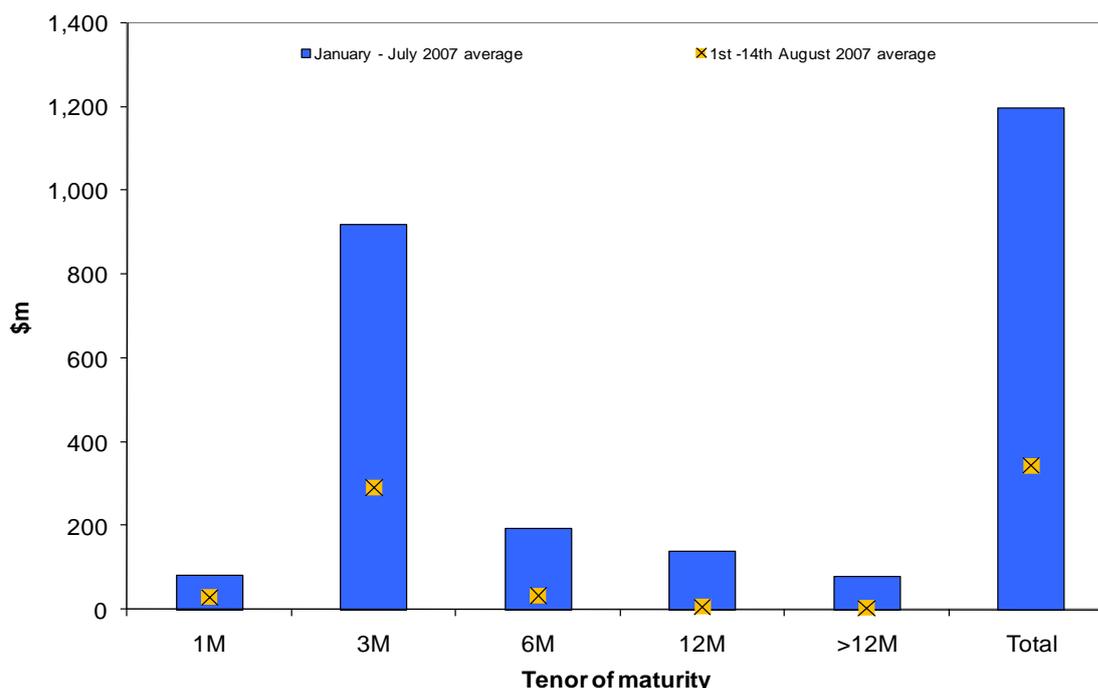

Figure CS3.1 Issuance *volume of bank bills, broken down by maturity, pre-August 2007 and during the first two weeks of August 2007.*

Figure (CS3.1) depicts the issuance data from one of the registries for a pre-crisis period and during the crisis. As can be seen, there was a significant drop in the issuance of securities in the first two weeks of August 2007. This data from the settlement system was used to verify market anecdote and assist the Governor in deciding to re-allow bank bills to be discounted at the Reserve Bank. Following the announcement of this decision, the bank bill market rapidly reverted to more normal behaviour.

Case study 4 – Foreign exchange rate data

The foreign exchange market is an important source of data for central banks. The key item that is most frequently focussed on is the exchange rate itself, typically between the United States dollar and the local currency. With the access to real time market data, there is often a desire to have higher frequencies of collection, from daily, to hourly, five minutely and even "tick-by-tick".
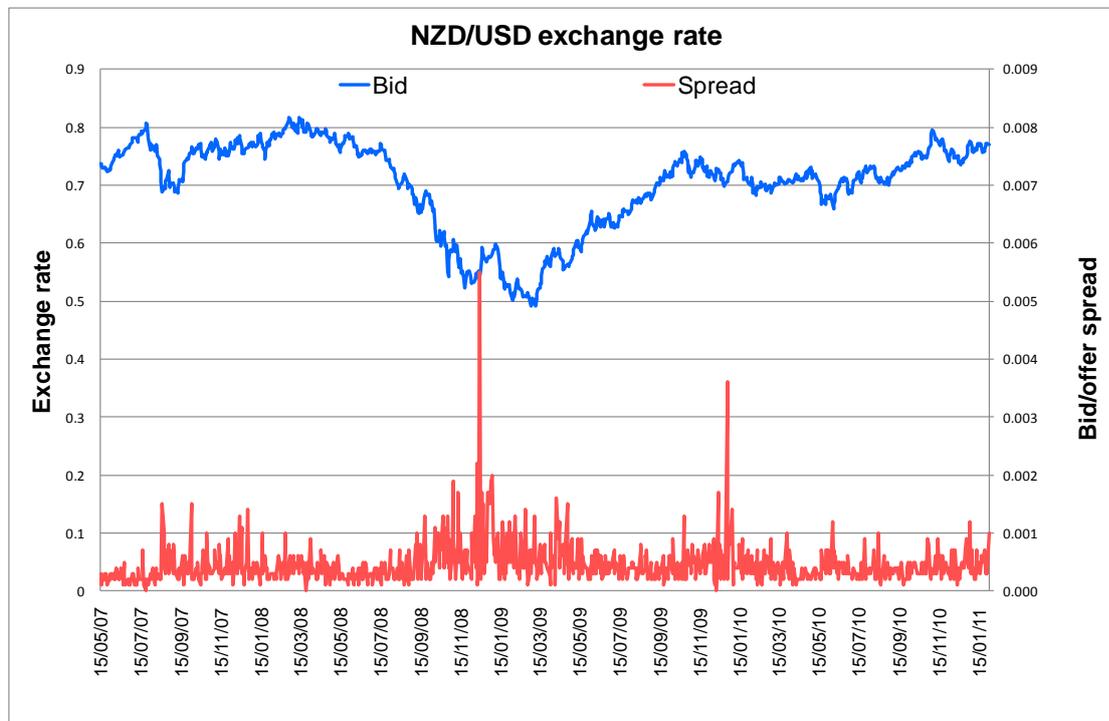

Figure CS4.1 – *Foreign exchange rate data, bid price and the spread to the offer price.*

It is instructive to examine the dynamics of the foreign exchange rate market from other perspectives. Price wise, this can be in the "bid-offer" spread quoted by dealers. For those with access to the "depth" information – the buy and sell trades either side of the currency quotation – is a also a valuable guide to near term dynamics. Looking at the various different dimensions of an item of interest can provide significantly more information than looking for "more of the same". Below are graphs of the New Zealand dollar turnover data.
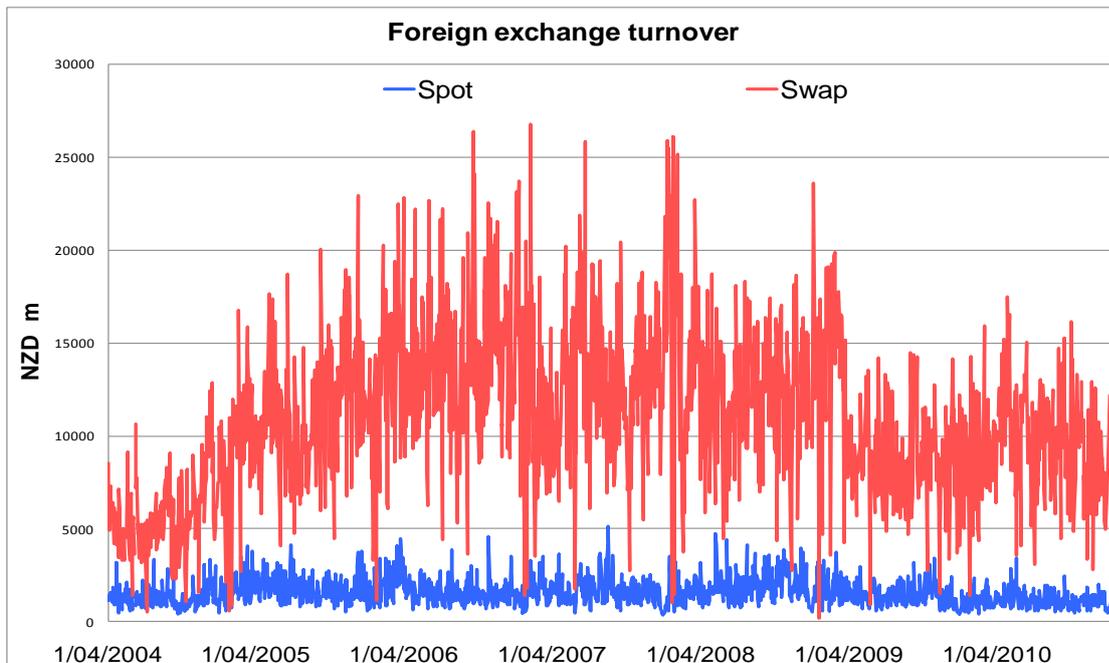
Figure CS4.2: Foreign exchange turnover data

These data are multi-dimensional. For example, in figure (CS4.2) the aggregate data is displayed for both the "spot" and "swap" turnover. In the New Zealand market, where the banks have a large proportion of their balance sheets funded in the overseas wholesale markets, the fx swap market is an important conduit for their funding. The volumes in the fx swap market give an indication of the state of funding. Figure (CS4.3) below provides a profile of the maturity structure of the fx swap market.
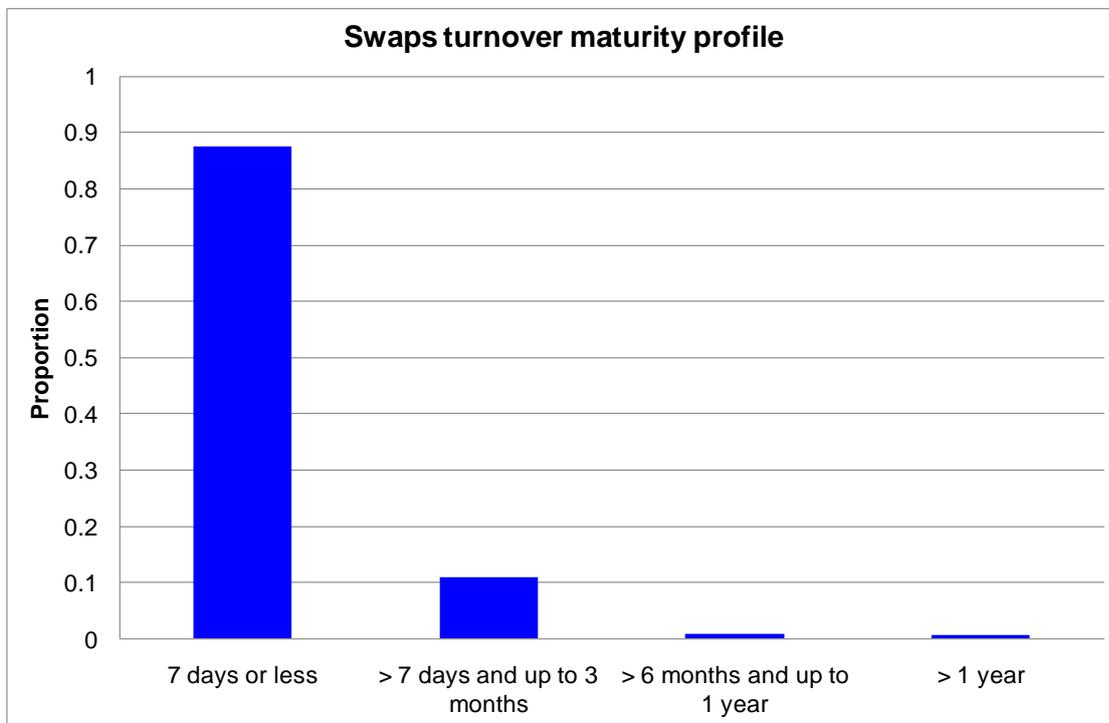

Figure CS4.3: *Maturity profile of New Zealand dollar fx swaps market turnover.*