Intra-day liquidity and real-time gross settlement - 18 months on

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At the heart of the business of banking is the need for banks to have sufficient cash[2], or assets that can readily be used to generate cash, to settle the payments arising from their own business and that of their customers. Last year the Reserve Bank and the New Zealand banking system shifted to a system of real-time gross settlement (RTGS) for large wholesale payments, as a way of substantially reducing the level of risk associated with the inter-bank settlement process. Shifting to a system of settling each trade individually markedly increased the amount of liquidity – cash or encashable assets – banks need to support their payments business. This article explains the choices made as to how to provide the additional liquidity, reviews the successful first 18 months of the new system, and outlines some refinements that have recently been announced.

1 Introduction

On 5 March 1998 the Reserve Bank and the New Zealand banking system shifted to a system of real-time gross settlement (RTGS) of wholesale financial market transactions[3]. Under this system, each transaction is settled individually and is final and irrevocable once it is settled. By contrast, under the previous system the inter-bank[4] settlement leg of all transactions, whether resulting from direct or customer dealing, had been stored up until the end of the day, even though in many cases customers' accounts had already been credited with funds. Only at the end of the day were the inter-bank claims settled, on a net basis. In normal circumstances the system worked well: so long as all the resulting payments could be made then settlement went ahead. However, if just one bank could not make its payments, the whole inter-bank settlement process would have been disrupted. This exposed a severe vulnerability – potentially threatening the stability of the entire financial system – if a bank failed.

The change to RTGS was in line with global trends. Central banks around the world have focused on the increasing risks being assumed in the settlement process, as the volume and value of transactions going on in wholesale markets increased sharply after the liberalisation of the financial system. The predominant international response has been to adopt an RTGS system. However, settling deal by deal had big implications for bank liquidity, and in the transition there were inevitable uncertainties. This article focuses on the structure chosen to provide and manage this liquidity and the way it has worked in the eighteen months since it was introduced. As part of the transition to RTGS the Reserve Bank had indicated a review of liquidity arrangements would occur after the system had been operating live for a year. This article reports on the outcome of that review, which also took account of the shift to the Official Cash Rate (OCR) system for implementing monetary policy.

2 Liquidity provision options

Settling all payments on a net basis at the end of the day requires much less liquidity than settling each deal on a gross basis. This is particularly so in banking systems with deep wholesale money, bond, and foreign exchange markets, which generate a large number of individual high value payments between the major banks each day. End-of-day settlement aggregated all of the payments made and received by each bank, and only the net payments were made at the end of the day. So for settlement purposes, banks required

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[2] In this article "cash" is settlement cash; balances held in settlement accounts at the Reserve Bank.

[3] White (1998) discusses in detail the reasons for the change to real-time gross settlement.

[4] For this article "banks" is shorthand for those institutions holding settlement accounts at the Reserve Bank. However: (i) not all registered banks hold settlement accounts; (ii) at present only banks hold settlement accounts; (iii) holding a settlement account is not restricted to registered banks.

sufficient cash or liquid assets to cover only one end-of-day net payment. Net positions did not often change by more than a couple of hundred million dollars, and in any case at the end of the banking day those banks with excess cash typically lent to those who were "short". On a typical day, end-of-day settlement was achieved with no more than $20 million of aggregate balances in settlement accounts and a few hundred million dollars of securities to secure any overnight inter-bank lending in excess of individual banks' own unsecured lending limits to each other. By contrast, settlement on a real-time basis means that banks must have access to sufficient cash to settle each payment individually during the day – not just the net of the day's total receipts and payments. Individual transactions can at times be in excess of $1 billion.

In assessing how to provide this additional liquidity, the Reserve Bank had in mind a number of desirable features:

• minimising disruption and transitional risk to monetary policy;

• avoiding shifting undue credit, or other, risks onto the Reserve Bank;

• providing for payments to be settled in a smooth and timely fashion;

• avoiding unnecessary changes to banks' balance sheets and asset holdings;

• avoiding unnecessary or unwarranted costs to the banks of accessing intra-day liquidity.

Recall that the goal of shifting to RTGS was risk reduction. Those risks arose in the course of banking business, so it was appropriate for the bulk of the costs to be borne by the banks themselves, but subject to that, we sought to design a solution involving least cost and least disruption.

In the early to mid-1990s, when decisions were being made about the new intra-day liquidity arrangements, only a few other countries had RTGS systems in place. International experience and reflection suggested that there were three broad alternative approaches available for providing these funds:

• banks are given access to unsecured intra-day overdrafts at the central bank;

• banks hold sufficient credit balances in their settlement accounts at all times to cover their intra-day payments as well as their end of day needs;

• banks have access to a secured intra-day central bank liquidity facility.

The Fedwire system operated by the United States Federal Reserve is an example of an RTGS system in which banks are entitled to unsecured intra-day overdrafts. Each bank has its own individual overdraft limit and any overdraft must be cleared by the end of the day. For many decades US banks had had unlimited intra-day overdraft access. More recently, as policymakers' attention focused on the increasing risks involved in the settlement system, capping overdraft limits met the Federal Reserve's risk reduction goals. This was achieved with little transitional disruption, no impact on monetary policy implementation or outcomes, and no need to alter banks' balance sheets.

A capped overdraft limit still involves credit risk. If a bank failed whilst in overdraft, then the Federal Reserve would be left being owed money. To compensate for this risk, banks in the United States since April 1994 have been required to pay the Federal Reserve an overdraft fee for using the intra-day overdraft facility. This is not a full intra-day interest rate but simply a fee for the credit risk component of an interest rate.[5] One of the Reserve Bank of New Zealand's objectives was to keep taxpayers' risks to a minimum, and not simply be remunerated for it. To introduce unsecured intra-day overdraft limits to provide liquidity for RTGS would have **increased** the explicit credit risks facing the taxpayer. Accordingly, this was not seriously considered as an option.

The Swiss Inter-bank Clearing (SIC) system was introduced in 1987. It is a solely cash-based RTGS system, with no distinction between inter-day and intra-day balances. Throughout the day and over the end of the day, banks hold sufficiently positive cash balances to settle payments individually. The Swiss choice of a method of providing liquidity has to be understood in the light of what had gone before. Prior to the introduction of SIC, Swiss banks had

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5   A typical lending rate can be thought of as a risk-free rate (say the Treasury bill rate) and a margin over that for the credit risk of lending to that specific borrower. This latter margin is all the Federal Reserve is seeking to recoup.

faced high required reserve ratios, and therefore already held large cash balances at the central bank. To free up some of these balances and to facilitate the additional demand for liquidity when RTGS was introduced, the reserve requirements were reduced. This allowed the transition to occur with little or no change to banks' balance sheets and little or no additional cost to banks of holding liquidity.

The SIC system is very simple technically, and its biggest advantage is that the central bank does not risk being left holding a claim on a failed bank. Because the settlement accounts are always in credit, a failing bank has some, however small, deposit at the central bank.

However, on other counts there were transitional problems that were factored into our own thinking. The Swiss National Bank (SNB) operated monetary policy by reference to an intermediate target for growth in the monetary base (the bulk of which was made up of settlement balances held at the central bank). Introducing RTGS altered the demand for settlement cash, and it took some time for the SNB to determine what was an appropriate level of settlement cash balances. This materially complicated the management of monetary policy in Switzerland in the late 1980s, inadvertently allowing an unwanted build-up of inflationary pressures.

In addition, the SNB does not pay any interest on positive settlement account balances, so that the cost to banks of holding liquidity is high. Consequently, banks try to economise on liquidity needs and keep their settlement cash balances to a minimum. To do this, banks tend to delay large payments until after they have received incoming payments to fund their account. Typically, this results in the bunching of settlements towards the end of each day – not something the Reserve Bank was looking for in our system.

When New Zealand changed to RTGS we too operated a quantity-based system for implementing monetary policy – centred on a target level of settlement cash balances. Against that background, moving to a largely or solely cash-based system would have exposed us to the potential for a period of unstable monetary conditions in the transition. We would have had to determine what level of cash balances to target, as banks themselves were only gradually discovering how much liquidity they needed. This had proved difficult and

costly when the cash target system was first introduced in the mid-1980s. And when decisions on the system were being made in the mid-1990s the Reserve Bank was still trying to bed in public confidence that price stability would prove enduring. In fact, to avoid inefficiently low demand for liquidity, moving to a cash-based system would probably have required material changes to the way we implemented monetary policy, especially regarding payment of interest on settlement balances.[6] It would have also involved significant change to the portfolio structures of both the banks and the Reserve Bank: banks would have had to decrease their holdings of tradeable securities significantly in exchange for an increase in their settlement cash balances.

In fact, the Reserve Bank chose to supply banks with intra-day liquidity via intra-day repurchase agreements[7] (the third option above). Although this system involved the greatest degree of technical complexity, it best satisfied our desired criteria. Using intra-day repos, fully reversed by the end of each day, involved least transitional risk to monetary policy because it was most unlikely to impact on demand for end-of-day settlement cash – the monetary policy instrument. Monetary policy formulation and implementation would, it was hoped, be able to proceed completely unaffected by the transition to RTGS. Choosing the repo option meant that any credit that was provided by the Reserve Bank would be fully secured. It was expected that using intra-day repos would limit the change in banks' liquid security requirements, because, to some extent at least, banks would be able to use securities they were already holding for other reasons.

As it happens, a number of other countries shifting to RTGS at much the same time also decided to adopt a collateralised credit approach to the provision of intra-day liquidity.[8]

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[6] Under the monetary policy implementation system being used at the time, below-market rates were paid, and only on the first $20 million of balances.

[7] These intra-day repos fall under a Master Intra-day Repurchase Agreement (MIDRA) signed with each of the settlement banks. Strictly, the decision to enter into a MIDRA is independent of the decision to grant an institution a settlement account. At present, however, all settlement banks are also MIDRA counterparties.

[8] The United Kingdom, Australia and Hong Kong used the repo form while many European central banks chose to provide liquidity via collateralised intra-day loans. The autorepo transactions are very similar, in economic effect, to secured loans, but they are not in fact, loans. They take a form that strengthens the legal position of the central bank, in the event of bank default. However, relevant case law on this subject is scant.

3   How the system works

Banks start the day with very low cash balances (usually less than $20 million between them) – just the same as in pre-RTGS days. Payment instructions generated by them and their customers via the payment "switches" (namely Austraclear, KITS, and – more recently – SCP) begin to build up in a queue in the settlement account system, ESAS.[9]

Once the bank has authorised the payments to be settled (normally automatically) the respective banks' settlement accounts are debited/credited provided the paying bank has sufficient cash in its settlement account to do so. These payments are settled within ESAS on a first-in first-out basis (FIFO).

If the paying bank has insufficient funds to make the payment it can obtain cash from the Reserve Bank via the intra-day repo facility using certain tradeable securities as collateral. Individual banks set the parameters to control the value of outstanding payments that must have built up in the queue of authorised payments before the repo facility is activated. They also determine how much they will borrow each time the facility is triggered, and which securities are used and in which order. Because the intra-day repos are generated automatically subject to these pre-set parameters, the facility is commonly known as "autorepo."[10]

Banks face a balancing act: they have to assess the costs of holding collateral and weigh that against the costs and risks of delaying payments. Bank customers, particularly those with direct Austraclear and SCP access, typically prefer to have their payments settled quickly. For example, a non-bank investment house settling a securities transaction is – under RTGS – dependent on its bank's liquidity management for the timely settlement of trades with its own counterparties. Banks therefore have a customer service incentive to settle

payments quickly. However, delaying a payment until a bank has received payments itself means they do not have to hold as much security for autorepo. In other words, there is a risk of individual banks seeking to "free-ride," delaying making payments until they are 'cashed up' by other banks.

Banks can repurchase the securities sold to the Reserve Bank in autorepo at any time. At 8:30 am the following day, ten minutes prior to the close of the banking day, an auto buy-back function is triggered. This reverses any outstanding autorepos not already reversed by the banks themselves.

Box 1 outlines a typical ESAS banking day.

The Reserve Bank decided not to charge interest on intra-day funds. We had no borrowing costs ourselves and we were concerned that charging intra-day interest might encourage banks to economise on liquid assets, and withhold payments through the day until they had received payments themselves to build up their balances. This could have led to payments bunching at the end of the day, and heightened the risk of gridlock. No one else in the market was expected to charge intra-day interest, and therefore the Reserve Bank doing so would have led the market – something we did not want to do. However, we indicated that if the market did start to charge intra-day interest rates then we would look to follow. Doing so would probably also involve paying intra-day interest on credit balances.

An obvious question is whether having Reserve Bank lending funds on demand intra-day at zero interest poses problems for monetary policy? The answer is no. Because the zero interest funds are only available intra-day, they cannot impinge on the prices or interest rates of any longer-term financial asset. If a bank has insufficient funds at the end of the day to repay its intra-day repos those transactions do roll over into a one-day loan. However, if that happens the funds are no longer interest-free. When the system was designed, controlling the end-of-day quantity of settlement cash was very important, and the Bank set the cost of converting zero interest intra-day liquidity into end-of-day liquidity at a level designed to ensure that no one would voluntarily do so.[11]

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[9]   Austraclear handles all of the New Zealand wholesale market security and cash transactions. KITS (Kiwi Interbank Transfer System) is used for the New Zealand dollar leg of foreign exchange transactions. SCP (Same day Clearance Payment) is a more recent "switch" designed to allow for real-time gross settlement of customer transactions, eg property settlements. To facilitate RTGS the Reserve Bank built a new computerised account system - the Exchange Settlement Account System (ESAS). Transactions generated by banks in the switches are sent to ESAS for settlement.

[10]   There are also contractual provisions for manually generated intra-day repos. This facility is largely a fallback provision and has not been used to date.

[11]   In fact, the cost of rolling an autorepo into inter-day liquidity was set higher than the cost of obtaining liquidity by discounting even the longest maturity Reserve Bank bills. The cost of discounting Reserve Bank bills was an increasing function of the days to maturity

4   Determining acceptable collateral

The shift to RTGS largely eliminated risk from the domestic inter-bank settlement process itself. Having decided to provide intra-day liquidity via autorepo the Reserve Bank had to decide which security would be suitable as acceptable collateral. The criteria for accepting autorepo security are outlined in table 1. Taking only government paper[12] would also have allowed the Reserve Bank to eliminate completely its credit risk on the domestic private sector. However, accepting only government paper as collateral in autorepo would have met considerable resistance from banks. To have done so would have forced big changes in banks' security holdings – they simply had not been holding very many government securities – and would have imposed larger costs on banks, because government securities earn much less than other paper. That in turn would have encouraged banks to economise severely on collateral holdings – which would have been entirely rational for the individual banks concerned, but not in the overall interests of the system.

Prior to RTGS, the Reserve Bank had provided some unsecured credit to banks in our regular market operations, and we had also been exposed to the ill-defined but huge systemic risks in the event of a bank failure. As repos were much less risky than unsecured lending, and we had already decided to eliminate the unsecured lending, there was considerable scope for us to take some privately issued paper in autorepo while still substantially reducing our total overall credit risks.

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[12] **Issuance of Reserve Bank bills ceased on 8 February 1999. Prior to the last of these maturing, the Reserve Bank accepted them as collateral. In this article, government paper refers to Government bonds, Treasury bills, and Reserve Bank bills prior to their demise.**

The Bank accepts an unlimited quantity of government paper in autorepo. In addition, we agreed to accept up to, normally, $200 million of each registered bank's short-dated paper (provided a bank other than the issuing bank repoed it to us). For largely technical reasons, all these limits would be available in autorepo only. There were around twenty banks registered at the time, so this could have provided for around $4,000 million of autorepos – although not all registered banks had material amounts of acceptable paper on issue.

The pure credit risk involved in doing intra-day repos in private bank paper is low (for us to lose money, the issuing bank and the bank doing the repo would have to fail on the same day). Legally, if a bank fails while it has an outstanding autorepo, then the Reserve Bank can sell the securities and recover the cash it had advanced. But, holding private bank paper in a repo may still pose particular risks for the Reserve Bank because of our role as banking supervisors. And, because of our supervisory responsibilities, a decision to make a bank's paper unacceptable for autorepo because of legitimate credit concerns would be difficult, risking worsening any problems that that bank already had.

Partly because of these concerns, but also to try to minimise artificial distinctions between banks and non-banks, rather than allow additional bank paper limits we agreed to take limited amounts (no more than $50 million) of short-term highly rated non-bank "private" paper. This included paper issued by major corporates, city councils etc. The corporate paper market in New Zealand is much less liquid than the private bank paper market – part of the reason for keeping the maximum term of acceptable paper to twelve months.

Overall, the Reserve Bank ended up allowing more private paper to be offered to us in autorepo than we had originally hoped. This was a pragmatic response to an inevitably uncertain transition – neither we nor the banks had very confidently-held views as to just how much liquidity would be required to make the system work. However, the Reserve Bank's unease about being locked into taking private credit exposures (especially to domestic banks) through autorepo led us to indicate that a review of the liquidity arrangements would be held after a year's live operation of RTGS.

The Reserve Bank monitors the level of autorepos done with individual banks, but there are no limits on either individual

Table 1
Acceptable securities for intra-day repos

	When RTGS began			By 1 July 2000		
	Minimum short-term domestic credit rating	Days to maturity	Maximum acceptable in autorepo	Minimum short-term domestic credit rating	Days to maturity	Maximum acceptable in autorepo
Government paper	No limit			No limit		
Reserve Bank bills	No limit			N/A	N/A	N/A
Bank paper		<366	50% of tier 1 capital with maximum of **$200** million	A1 (S&P) P1 (Moody's)	<366	50% of tier 1 capital with maximum of **$150** million
Non-bank private paper	A1 (S&P) P1 (Moody's)	<366	50% of total reserves and shareholder equity with maximum of $50 million	A1 (S&P) P1 (Moody's)	<366	50% of total reserves and shareholder equity with maximum of $50 million

banks or the banking system as a whole on the amount of intra-day liquidity that can be obtained from the Reserve Bank. Although there are risks associated with having a very large amount of repos outstanding with an individual bank, it was not regarded as credible for a central bank to turn away a bank seeking to use an on-demand facility, if that bank had acceptable securities. To do so would risk sending signals that the Reserve Bank had concerns about the bank in question, which would be likely to cause problems for that bank even if it had not had any previously.

5   Characteristics of the system

Since the liberalisation of world financial markets in the 1970s and 1980s there has been ongoing very rapid growth in turnover in global financial markets, and hence in the volume and value of payments settled. New Zealand has been no exception to that trend.

There are more than 3,000 wholesale financial transactions settled in New Zealand through ESAS each day, totalling around $35 billion – an amount equivalent to one third of New Zealand's annual GDP. Of this $35 billion, $9 billion goes through Austraclear, and $26 billion through KITS, with only trivial amounts at present going through SCP. However, as the following figure 1 shows, these volumes fluctuate depending on other market factors at the time. For example, volumes have fallen back somewhat as world financial market activity slowed over the past year. This followed the very marked volatility – and big losses for a number of overseas institutions – in international financial market prices in mid-late 1998. At least one transaction for an amount over $500 million is settled on most days. The largest single transaction to date was $1,500 million.

Of course, not all payments are settled through ESAS – an **inter-bank** settlement system. For example, if a bank customer makes a payment to another customer at the same bank then it is settled internally, not via ESAS. Also, "retail" transactions including those generated by EFTPOS, cheques etc are still pooled together and only one net payment between each pair of banks is made in settlement through Austraclear at the end of each day. In total, there are probably

Figure 1
Total value of ESAS Transactions
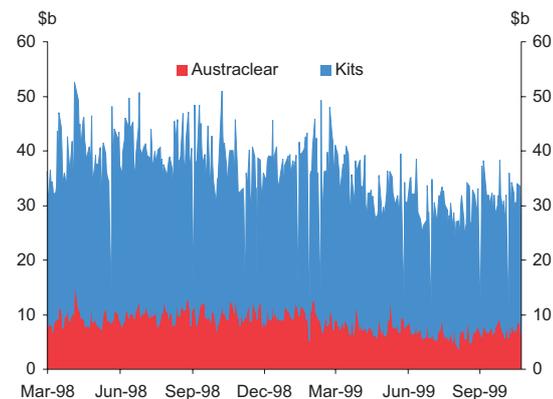
around $45-$50 billion of payments settling in New Zealand on a typical day.

So what accounts for the sheer volume of transactions? A majority of the ESAS payments are made through KITS and are therefore generated via the foreign exchange market. The volume of transactions reflects two things. First, in deep and liquid markets, market makers distribute risk and assets to investors who want to hold them, but to do this, an asset may be passed around the market many times until it reaches a final investor who wants to hold it.[13] Secondly, in both the money and foreign exchange markets many transactions have two legs (including all inter-bank loans, repos etc) and are done for very short terms. Short-term foreign exchange swaps account for the largest component of all foreign exchange market activity, and the KITS turnover numbers includes both New Zealand dollar legs of these swaps transactions.[14]

When RTGS started up no one knew, with any degree of certainty, just how much liquidity would be required. Although a number of other countries had by then introduced RTGS systems, none of them quite mirrored the characteristics of the New Zealand system – number of banks, liquidity provision arrangements etc. What has the experience here been?

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[13]   **For further information regarding New Zealand financial market turnover see Lucas and Rosborough (1999).**

[14]   **See Hawkesby (1999) for details on foreign exchange swaps.**

Although RTGS requires considerably more liquidity than an end-of-day settlement system, the value of daily autorepos is still only a small proportion of total daily transactions settling through ESAS. In fact, settling the $35 billion of daily ESAS trades has required an average of around $2.8 billion of cash (and autorepos) each day – around 8 percent of the value of the payments being settled. This is because the same liquidity may be used many times over during the day as settlements are made back and forwards between banks. The ratio has been very stable since RTGS began, without even initial hiccups, and was in line with our own rather loosely-held expectations. The largest liquidity ratios shown on the graph below are a little artificial. They occur either on United States holidays when there are few foreign exchange settlements (the other side of most New Zealand foreign exchange transactions is a US dollar transaction), or on Wellington and Auckland Anniversary Days, which are not official settlement days for wholesale trading activity, although the systems are open. However, they help highlight that when there are relatively few payments a relatively greater amount of liquidity is required to support the business.

Figure 2
Daily liquidity ratio
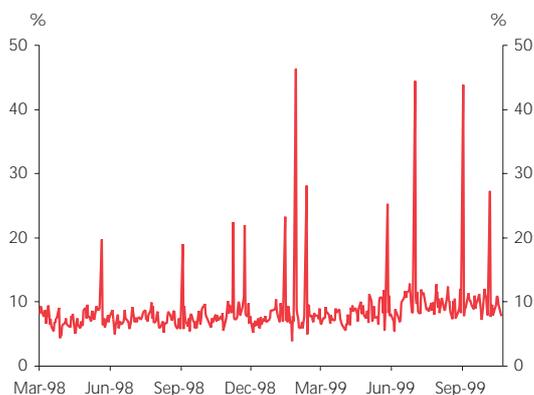
There is no private market in intra-day cash, and because different banks face different liquidity needs each day and do not want to be caught short, each bank needs a reserve buffer of liquid assets. Looking at each bank's peak usage of autorepo during a full week, it probably takes a total of around $3.5 to 4 billion of securities in the banking system to keep the RTGS system ticking over smoothly. Strong economies of scale also exist when it comes to intra-day

liquidity needs, ie banks that make fewer transactions require relatively more liquidity during the day, and hence have higher liquidity ratios. At the limit if a bank had only one payment to make, and they were not receiving any payments that day, then they would require enough cash to make the entire payment.

Patterns of usage of the various classes of securities have been relatively stable since the system began. On average around 60 percent of autorepos are performed using settlement bank paper, around 25 percent using Treasury bills, and 10 percent using government bonds. Only a small amount of other securities are used. Banks prefer to hold (and use) private paper rather than government paper for autorepo because government paper generates a lower return than private paper. Part of this reduced return represents the credit risk associated with holding non-government assets. However, banks appear typically to take the view that the margin between the returns more than compensates for this increased credit risk. Banks also tend not to hold large portfolios of long-dated securities, including government bonds, and so short-dated securities dominate in autorepo.

Early in the trading day most autorepos are done using settlement bank paper as collateral. This is because each bank aims to satisfy as much of their daily autorepo requirements as possible before the major private paper limits are filled up. Most of the main settlement bank limits are filled within the first hour of the day. Only once these limits are full do banks typically start using government paper. However, not all private paper limits are filled as quickly as those on settlement bank paper. In fact, some securities that the Reserve Bank would accept as collateral in autorepo, including paper issued by corporates and non-settlement banks, are never used in autorepo. The settlement bank paper market is the most liquid (traded) security market in New Zealand, and banks therefore hold these as a large proportion of their portfolio.

To date, payments are spread throughout the day, and we appear to have successfully avoided payments being bunched towards the end of the day. The average time of settlement is around 1pm. Market convention, the relatively generous approach to determining which securities we will take in

autorepo, and – perhaps paradoxically – the binding nature of the bank paper limits have all contributed to this very satisfactory outcome.

There is a strong relationship between a bank's overnight "cash" position and their use of autorepo the following day. The amount of settlement cash left in the banking system at the end of each day is very small (currently around $20 million). This means it is quite likely that some banks will be short of cash at the end of the banking day. If this happens they typically borrow the shortfall overnight from another bank. Market convention is that the overnight loan is repaid first thing the following morning. The bank that lends the cash overnight will therefore be less likely to need cash from the autorepo facility the next day. To repay its debt the bank that was short of cash must, in effect, use the autorepo facility to obtain intra-day cash from the Reserve Bank – if they had cash from other sources they would not have needed to borrow in the first place. Thus, for example, if a bank were $1,000 million short overnight it would probably have to generate around $1,000 million of autorepos at the start of the new day – a large proportion of any day's total autorepo.

Much of the overnight inter-bank lending is done unsecured (currently around sixty five percent). However, the more a bank has to borrow the more likely it is that they would have to provide collateral for the overnight loan. To do the autorepo the following day the bank that was short of cash must, of course, provide security to the Reserve Bank. This is on top of any security that they may have already supplied to the bank they borrowed the cash from overnight. Hence, in some circumstances there can be a 'doubling up' of the amount of security required because of the separation maintained between intra-day and end-of-day cash.

It was difficult to determine exactly what impact the introduction of RTGS and the associated autorepo facility was going to have on banks' portfolios of tradeable assets. Banks already held a lot of securities for a range of reasons including prudential requirements adopted by their own management or imposed by their parent banks, trading, or hedging. But questions remained about the extent to which these securities would be able to be used for multiple purposes, and about just how large the demand for liquidity would prove to be. It was generally expected that the

introduction of RTGS would require banks to hold at least some additional securities, and probably with a bias towards increased holdings of government paper (with attendant costs to banks as they substituted out of other assets) because of the limited amount of private paper we were willing to take.

Bank holdings of government securities have increased quite substantially since the introduction of RTGS (roughly $6 billion now compared with around $3 billion in mid-1997). Holdings of acceptable private securities have also increased, but as a proportion of total bank assets these holdings have not changed markedly.

But is RTGS the reason for the increase in government paper holdings? Since RTGS was introduced offshore holdings of New Zealand government assets – especially Treasury bills – have fallen significantly. Lower New Zealand interest rates have been a factor: Treasury bills were a popular asset with foreign investors wanting a high-yield New Zealand instrument with low credit risk. The increase in New Zealand settlement banks' holdings of government paper may merely be a consequence of the domestic banks absorbing the excess supply generated by the fall in offshore demand. However, if this were the case, with the local banks reluctant buyers, the price of the government paper should have fallen relative to other assets. Whereas if the increase in settlement bank holdings was due to increased bank demand generated by factors including RTGS, then the relative price of government paper would have risen – in effect the local banks would have to "shake loose" some of the other holders.

A typical measure of the relative price of government paper is the spread in yield between a Treasury bill and a bank bill – the T-Bill spread. A wider spread represents an increase in the relative price of government paper, while a contraction represents a fall in price. Figure 3 shows that despite the marked reduction in offshore holdings, the T-Bill spread has remained high. In fact, the last time offshore holdings were this low the T-Bill spread was much lower at around 10 basis points, rather than the 35-40 points at present. This suggests that the introduction of RTGS is likely to have been a factor behind the increase in settlement bank holdings of government paper. In addition, our discussions with individual banks and analysis of their holdings patterns

around the time RTGS was introduced was strongly suggestive of an RTGS-linked increase in demand. Such an increase is not surprising: if anything, the rise in holdings has been surprisingly modest, enabling banks to keep in check the additional costs of RTGS.

Figure 3
T-Bill spread and offshore holdings of Treasury bills

Costs and returns were always going to be key influences on how much liquidity banks chose to hold. Partly because of the uncertainty that existed going into RTGS banks worried that a combination of large individual payments through ESAS combined with insufficient acceptable security holdings created the potential for ESAS to jam. For example, if a single bank were receiving all of the payments early in the day then they would be removing large amounts of settlement cash from the system. This would reduce the liquidity available to other banks and the system may jam. Alternatively, if two banks each had a very large payment to make to the other bank, and they did not have sufficient security to perform an autorepo, then the system would also jam – especially with a FIFO queue system in which no payments were made if the payment at the head of the queue could not be made.

"Gridlock" was – and is – a risk. Keeping that risk to a minimum was part of the motivation for our relatively generous approach to liquidity provision – the more liquid assets banks voluntarily held the less the risk of the system gumming up. To help manage "gridlock" if it did occur, the Reserve Bank introduced a routine in ESAS called Freeze Frame. Freeze Frame will settle **simultaneously** all of the

payments in bank queues, **provided** all settlement accounts would be left in credit once Freeze Frame is completed. In a simplified example, with only two banks in the system, if two banks each had to pay the other $1,000 million, the two payments would be settled simultaneously without either party having to generate $1,000 million of cash to lubricate the system. It was not designed as a guaranteed fix, but instead as one of a number of tools for dealing with the unlikely event of "gridlock." To date, however, we have not seen an episode of system-wide "gridlock."

As a matter of course, the Freeze Frame routine is also run each hour at quarter past the hour. In principle, this allows banks the possibility of economising on liquidity by waiting to settle simultaneously each hour. The Reserve Bank did not expect regular running of Freeze Frame to have much effect, and this has indeed been the case. In a review of each run of Freeze Frame over a couple of months very few, low value, transactions had ever been settled by it, and then probably by chance (they were in the queues unsettled just as Freeze Frame happened to run).

6 The intra-day liquidity review

As already noted, when RTGS was first introduced the Reserve Bank took on more credit risk than was initially intended. We were willing to do this to get the new system up and running, and to ease potential concerns about the cost of the change away from an end-of-day settlement system. Any transition of this nature inevitably involved considerable uncertainty, and at the time there was only a limited international track record with introducing such systems. Part of the quid pro quo for the relatively generous private paper limits was that there would be a review of the system after RTGS had been fully operational for one year.

The review concluded that the transition from the old netting-based system to RTGS had gone very smoothly and that the system was working well. In reassessing a number of issues addressed when the initial choice was made to move to RTGS, the review showed that there were some areas that could be changed to reduce further the risk facing the Reserve Bank, as well as improve the way the system operated. Some of this was made possible, or easier, by the coincidental (in

timing) move to the OCR which reduced some of the restrictions that had previously been imposed by the need to separate intra-day and inter-day liquidity.[15]

Shifting to the OCR system meant that the Reserve Bank would in future regulate monetary conditions by managing the overnight interest rate directly, rather than by relying on (statements and) a fixed target level of settlement cash. Indeed, we made overnight liquidity available on demand, at 25 basis points above the OCR, and began paying a full market interest rate, 25 basis points below the OCR on unlimited settlement account balances. With end-of-day settlement cash available on-demand there was no need to maintain an economic distinction between intra-day and inter-day repos. Accordingly, the first change was to reduce the cost of rolling over autorepos to just five basis points above the cost of obtaining inter-day cash via the Overnight Repo Facility (ORF). Reducing the rollover costs also means that in periods when government paper was scarce the 'doubling up' problem from using the ORF would be eliminated. The small premium above the ORF rate simply recognises the modest additional credit risk the Reserve Bank faces when accepting private paper in autorepo, compared to government paper used in the ORF.

In fact, despite the change, the rollover facility has been only rarely used; when two banks have accidentally failed to get a transaction through before the close of trade, or during periods of cash market friction. These periods of cash market friction have occurred when there has been a shortage of government paper in circulation and/or when one bank has held a large amount of the remaining government paper. This has meant that if the remaining banks wanted to obtain cash from the Reserve Bank they could not do so via the ORF because this required government paper as collateral. Rolling over autorepos gave them access to cash using only non-government paper. The extra five basis points cost of rolling over autorepo compared to using the ORF is one reason why banks prefer the ORF. History probably also matters: in designing the original scheme, not only were rollovers made very expensive, but they were also looked on rather dubiously by the Reserve Bank.

The review also concluded that a move towards a more cash-based system, similar to the SIC approach, was now appropriate. A system with less dependence on the legal robustness of repo agreements had attractions. Such a system was likely to be much more transparent: at present large proportions of banks' balance sheets are transferred to the Reserve Bank for 95 percent of the day, only to revert back for the five percent that spans the end-of-day, and the public reporting period. Once the quantity of settlement cash created no monetary policy issues and we had a clearer idea of effective liquidity demand, it would be considerably easier to adopt such a system than when RTGS was originally designed in the mid-1990s. However, there were a number of reasons why making an immediate move to a fully cash-based system was not seriously considered. First, the present system in its current form is operating effectively. Secondly, a slow transition would give the Reserve Bank an opportunity to assess the impact of the shift. And finally, a more modest transition allowed the Reserve Bank gradually to become less exposed to settlement bank and repo risk without lurching dramatically from regime to regime.

Previously only non-bank private paper was required to have a sufficiently high credit rating to be accepted in autorepo. Effective from the time of the intra-day liquidity review the Reserve Bank imposed the same credit rating requirements on to private bank paper as had previously been on non-bank paper.[16] This was consistent with our goal of treating banks and non-banks equally. In addition, our supervisory responsibilities could make it near impossible to drop a bank from the list of acceptable issuers, without reference to an outside standard such as the judgement of a rating agency.

Recognising the risks associated with bank paper (outlined earlier), the Reserve Bank moved to lower the limits on private bank paper from the current $200 million to $150 million per bank, effective from 1 July 2000.[17] With the (binding) limits on the private bank paper being reduced, if at the same volume, banks will be forced to substitute the use of settlement bank paper in autorepo for other types of acceptable paper. In reality, the most likely option would be

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[15]   For further details regarding the change to the OCR see Archer, Brookes and Reddell (1999).

[16]   The Reserve Bank also indicated that at some time in the future we would consider moving to charge a credit risk fee for the use of private paper in autorepo.

[17]   The implementation of this change was delayed to avoid any possible year 2000 concerns.

for the banks to increase their holdings of government paper. However, as mentioned above, this generates a lower return than private bank paper. Taken in isolation, reducing the limits will tend to increase the costs of intra-day liquidity faced by the banks.

However, the change is not occurring in isolation. The Reserve Bank has indicated that it is willing to work with banks to explore more sophisticated arrangements for economising on liquidity needs. Options might include allowing individual pairs of banks to run Freeze Frame bilaterally at their own initiative. Alternatively, different queue ordering techniques within ESAS other than the current FIFO could be considered that might settle payments with a more efficient use of collateral. Algorithms could also be developed to enable matching sequences of securities trades to be identified and settled simultaneously within Austraclear.

Another global trend is towards the use of sophisticated netting arrangements to complement RTGS settlement systems. In a deep market, such as that in foreign exchange, individual pairs of banks may have numerous offsetting transactions in a single day in any product. Netting these down to one trade reduces the credit risk and eases liquidity pressures associated with settlement. This is because when the payments are netted together they partially offset each other, and only the net payment needs to be made, hence less liquidity is needed to make the payments

Recent changes to New Zealand law are designed to ensure that netting arrangements can be made legally robust here.[18] These changes helped eliminate uncertainties that previously existed with regard to the enforceability of netting agreements, and in particular to multilateral netting agreements, in the event of the insolvency of one of the parties to the agreement. With these uncertainties now removed, banks may be more willing to establish their own bilateral and multilateral netting agreements with other banks. The development of such agreements with frequent netting has the potential to reduce collateral demand, while still maintaining timely settlement of payments.

To offset the reduction in private paper limits, the Reserve Bank may increase the supply of settlement cash left in the system each night. Currently the Reserve Bank aims to leave around only $20 million – although this number is responsive to indications of changing market demand. Reducing the limits on the bank paper by $50 million for each of the banks is likely to reduce the effective level of autorepos current holdings can support by around $500 million of liquidity (because not all bank limits are heavily utilised). If demand is there, the Reserve Bank will consider increasing the daily settlement balances by a similar amount. To achieve this cash injection, however, the Reserve Bank would have to purchase assets from the banks. Increasing the Reserve Bank's portfolio of government paper is the most likely avenue for increasing the supply of cash left in the banking system. Higher end-of-day settlement balances may warrant some narrowing in the band around the OCR, increasing the return on end-of-day balances relative to the OCR. However, no final decisions have yet been made on these points.

Raising the cash settlement target to around $500 million from the current $20 million may also have some consequences for the Reserve Bank's daily Open Market Operations (OMO). Presently an OMO is performed if the actual forecast amount of cash left in the system is $10 million or more away from target. If the target were increased banks could absorb more fluctuations around the target, and so the Reserve Bank may be able to reduce the number of OMOs performed.

The move to the OCR has made the quantity of settlement cash left in the system effectively demand-determined. So why continue with OMOs at all? From the point of view of the Reserve Bank, we are managing the Crown's cash portfolio. Like any corporate treasury we try to have funds coming into the account at times when payments need to be made, and lend out funds when they are not needed. Banks would also like to see the OMO continue because it is generally cheaper for them to borrow through the OMO than from the overnight repo facility.

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[18]   For a full description of the legislation changes see DeSourdy (1999).

6   Conclusion

The transition from the end of day settlement system to RTGS went very well and the system has settled down very effectively. The new system has provided sufficient incentives to banks to hold liquidity to ensure that payments flow smoothly, and the shift to RTGS triggered no disruption to financial market prices or monetary policy. This has been achieved with much reduced risk to the Reserve Bank and to the banking system, and limited added costs to the banks. The additional costs that are faced by the banks effectively internalise the real costs of participating in the payments system business.

The recent intra-day liquidity review noted the success of the new system, while still initiating opportunities for further improvement. The changes will allow a reduction in the legal and credit risks faced by the Reserve Bank, as well as a gradual movement towards a more cash-based settlement system. Further movements in this direction may occur over time, but despite the simple elegance of such a system, the Reserve Bank has not made any commitment to a fully-fledged shift away from repos to an entirely cash-based system.

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