Implications of declining government debt for financial markets and monetary operations in Australia

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1. Introduction

Like a number of countries, Australia has undergone a substantial fiscal consolidation in recent years and a consequent reduction in government debt. On a cash basis, the Commonwealth government moved into surplus in the 1997/98 fiscal year, and has since run an average surplus of around 1% of GDP. Official projections over the next three years are for surpluses of similar magnitude to be maintained, resulting in substantial further reductions in the government's net debt.

A declining level of government debt has a number of potential implications for financial markets and for monetary operations, which are the subject of this paper. Three areas in particular are explored:

- The size and liquidity of the government bond market;
- Growth and development of private sector bond markets;
- Implications for Reserve Bank of Australia monetary operations.

The paper argues that markets in Australia have so far coped smoothly with the reduced supply of government debt, although a further substantial reduction in gross debt would have implications for the viability of the government bond market and for the conduct of monetary operations.

2. Developments in government debt

Key indicators of the Commonwealth government's fiscal position are presented in Figure 1. The government's "underlying" budget balance (ie excluding the proceeds of asset sales) shifted substantially into surplus in the second half of the 1990s and has remained in surplus notwithstanding an expansionary package of tax reforms implemented last year. The move into surplus reflected both a structural fiscal consolidation and the cyclical effects of strong economic growth in the second half of the 1990s. At the same time, a continued programme of asset sales has added to the average surplus on a cash basis, and hence increased the rate at which government debt has been reduced.[2]

The net debt of the Commonwealth government peaked at 19.1% of GDP in 1997/98 and has since declined to stand at 5.8% of GDP in 2000/01. The debt position of Australian state governments has been much more stable than that of the Commonwealth, and hence the developments at the Commonwealth level have been the main driver of trends in the aggregate debt of the government sector as a whole.

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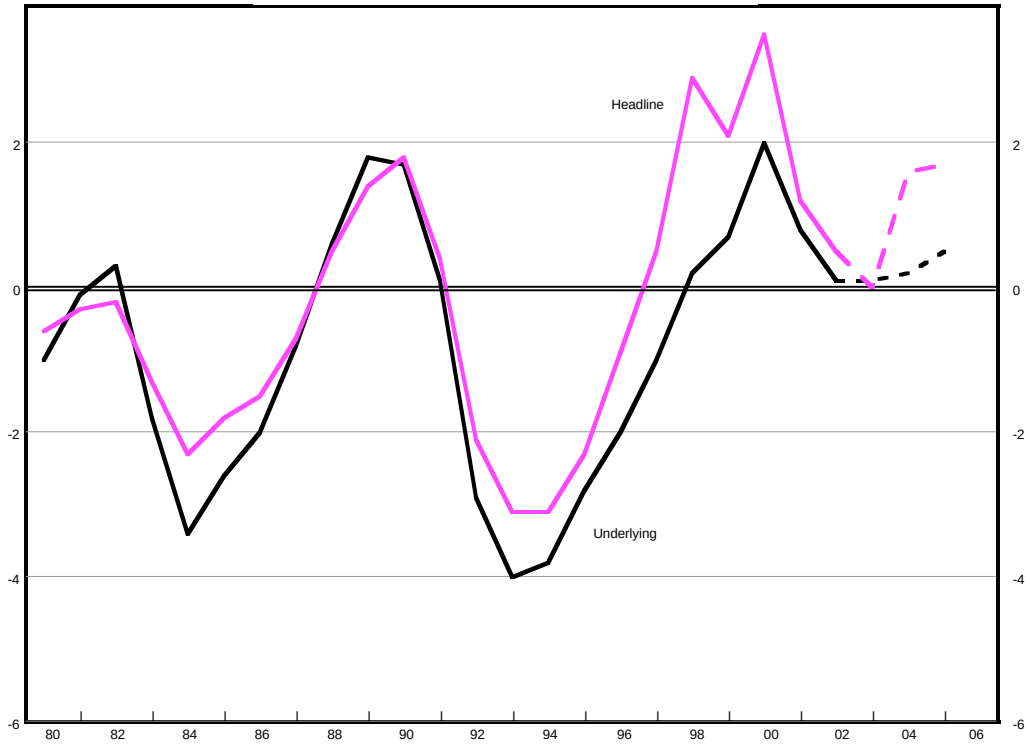
[2] Net debt in this context is defined as gross debt less the financial assets of the government, where the latter excludes ownership of public corporations. Hence, on this definition, government asset sales reduce debt on both a gross and a net basis.

Figure1

Commonwealth budget surplus

% to GDP



The latest official projections, made at the time of the May 2001 budget, are for further substantial reductions in net debt, to the point where the Commonwealth government's net debt is projected to decline to –0.6% of GDP by 2004/05. This projection is of course subject to a number of uncertainties. First, it is based on a technical assumption of no changes to expenditure programmes or tax rates. Second, it is subject to the usual uncertainties concerning the economic cycle, a point which may be particularly important at a time when expectations of growth in the global economy are being revised downwards. And third, the projections incorporate the sale of the final tranche of Telstra (the formerly publicly owned telephone utility), which has not yet been passed by the parliament; this is projected to contribute just under 3 percentage points of GDP to the reduction in debt over the period. But notwithstanding these uncertainties, the trend in net government indebtedness at present is clearly downward.

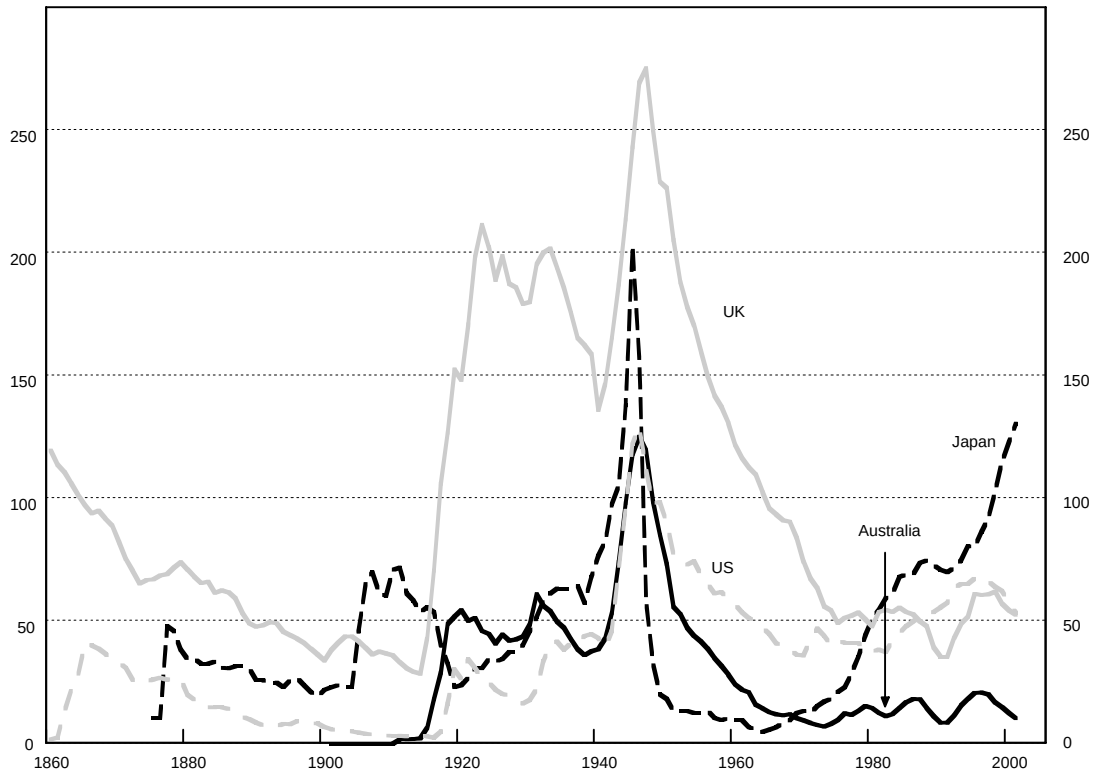
In international terms, Australia's level of central government debt is relatively low (Figure 2). It has been lower than in most major economies throughout the past decade and is also declining more quickly than elsewhere, including in the United States, where falling levels of government debt have similarly sparked debate on possible implications for financial markets and monetary operations (Reinhart and Sack 2000, Broaddus and Goodfriend 2001, Greenspan 2001).

Gross debt of the Commonwealth government has declined more slowly than net debt, reflecting a significant accumulation of financial assets by the government in recent years. The government has stated that it aims to maintain a sufficient stock of bonds on issue to support the liquidity and efficiency of the market, although it has not publicly endorsed a particular estimate of the amount required. At this stage, the financial assets accumulated by the government have been short-term deposits with the RBA, which have increased from virtually zero in 1997/98 to between AUD 10 billion and AUD 15 billion at present. The counterpart to this growth in deposits on the RBA balance sheet has been a build-up in RBA repos and foreign exchange swaps.

Figure 2

Central government debt

% to GDP



The government debt ratio can decline even when the government is not deliberately reducing debt. Any government that keeps its budget in balance on average over the course of the business cycle will eventually eliminate its debt, if only during the stronger phases of the business cycle. Provided growth in nominal GDP is positive in the long run, the long-run average government debt ratio will asymptote to zero from whatever is its starting point. It will then oscillate around zero. Therefore, a government that tries to maintain fiscal balance on a cyclically adjusted basis will eventually find itself accumulating net assets during cyclical upturns, but seeking to issue debt during downturns. Unless some efforts are made to sustain a continued positive gross debt position, such a government would be forced to re-establish a market for government debt in every cyclical downturn. This is likely to be difficult at the very time investor confidence is weak.

The time it takes for the stock of government debt to hit zero depends on the initial level of debt, the average rate of growth in nominal GDP and the amplitude of the deficit cycle, that is, the size of the peak deficits and surpluses relative to GDP. The larger these cycles in the fiscal position are, the earlier peak surpluses will cause the (temporary) elimination of government debt. However, it should be noted that this is a very long-term phenomenon. If the business cycle has a period of, say, 10 years, then even with peak annual surpluses of 5% of GDP, it will take 30 years to eliminate a government debt stock of 40% of GDP, given an average nominal GDP growth rate of 6%, and nearly 20 years to eliminate a stock equal to 15% of initial GDP. Sustained periods of positive net government assets would only occur after 40 years, given a starting point for debt of 40% of GDP.[3]

[3] These time periods can be a little shorter if the deficit cycle is asymmetric, with deficits large but brief while surpluses are smaller but occur for more sustained periods. See Ramsey and Rothman (1996) for examples of functions that generate asymmetric cycles.

3. Liquidity of government bond markets

Liquidity is usually defined as the ability of participants in the market to trade significant volumes of a security without generating substantial adverse price movements by doing so. Gravelle (1999) defines a liquid market as one "…in which trading is immediate, and where large trades have little impact on current and subsequent prices or bid-ask spreads". Pagano (1989) links liquidity more closely to trading volume, defining it as the ability of the market to absorb large trades.

Given this, Gravelle (1999) presents a number of separate indicators of the liquidity and functioning of the market. These are related to the four dimensions of liquidity listed in that paper: immediacy (time taken to complete large trades), width (largest trade possible for a given bid-ask spread), depth (bid-ask spread) and resilience (price response to large trades).

The following sections examine the available evidence on these aspects of liquidity for both the physical bond market and the bond futures contracts traded on the Sydney Futures Exchange.

3.1 Physical bond market

The bottom panel of Figure 3 shows that trading activity in Australia's physical bond market has declined noticeably in recent years, even as derivatives associated with the bond market have experienced increasing activity.[4] In principle, this might be expected to indicate declining liquidity and to result in increased price volatility. However, the picture is complicated by changes in the liquidity of specific security issues. Figure 3 does not cover a fixed set of securities. Turnover and liquidity of individual issues decline markedly in the year prior to their maturity date (Figure 4). At this short end of the yield curve, the bulk of trading activity is focused on the markets for bank-accepted bills and other types of high-quality commercial paper. These markets are deep and liquid, and are generally seen as the main locus of price discovery for short-dated securities in Australia, rather than the market for longer-term government securities that happen to be close to maturity.

Although both the stock of government bonds outstanding and turnover have declined in recent years, turnover has fallen to a greater extent than the stock. Therefore, the *turnover ratio* declined a little over the 1990s (Figure 5). Once the trading of futures contracts is factored in, however, it appears that the total turnover ratio began to recover in the late 1990s. This is consistent with the idea that the futures market has been replacing liquidity that has disappeared from the physical market.

Gravelle (1999) argues that fragmentation, that is, low *average issue sizes*, can interfere with the ability of market-makers to maintain a sufficient inventory to offer their market-making service. Benchmark (on-the-run) issues are usually larger in size. In Australia, the Commonwealth government has concentrated debt buybacks on illiquid stocks and consolidated new issues into a limited number of benchmark stocks, in order to enhance the liquidity of markets in the remaining securities. Since 1996, the average size of each benchmark issue has increased from AUD 4 billion to AUD 4.7 billion.

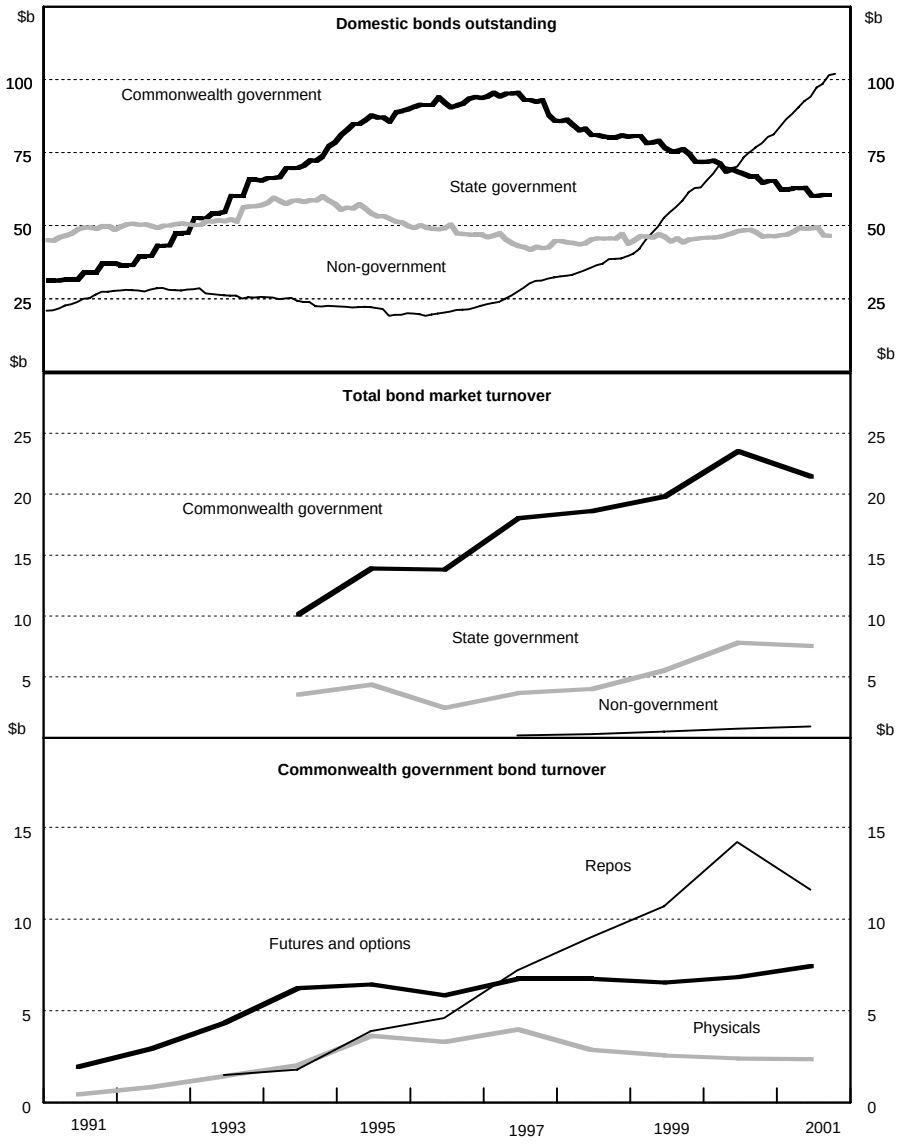
Bid-ask spreads are an important indicator of liquidity in many markets, and have been used to assess variations in bond market liquidity by a number of authors (Gravelle 1999). However, the physical bond market in Australia uses a fixed bid-ask spread of 2 basis points, by convention (note that this spread is based on the yield, not the price). The spread is unfortunately therefore not an indicator of the liquidity of this market, either through time or in comparison with other securities markets such as corporate bond, foreign bond or bond futures markets. The bid-ask spread on bond futures contracts is lower than the underlying physicals, as would be expected for this more liquid market, but beyond this, there is little we can say about movements in the liquidity of these markets relative to each other.

[4] The annual turnover data presented in Figures 3 and 5, and Table 3 in Section 4, are compiled by AFMA. Like the higher-frequency turnover data, they do not suffer from double-counting of turnover, unlike the results presented in Inoue (1999). However, the annual AFMA data exclude repos, whereas the higher-frequency data include them.

Figure 3

Bond market indicators

Outstandings and daily turnover



Sources: AFMA; SFE; RBA.

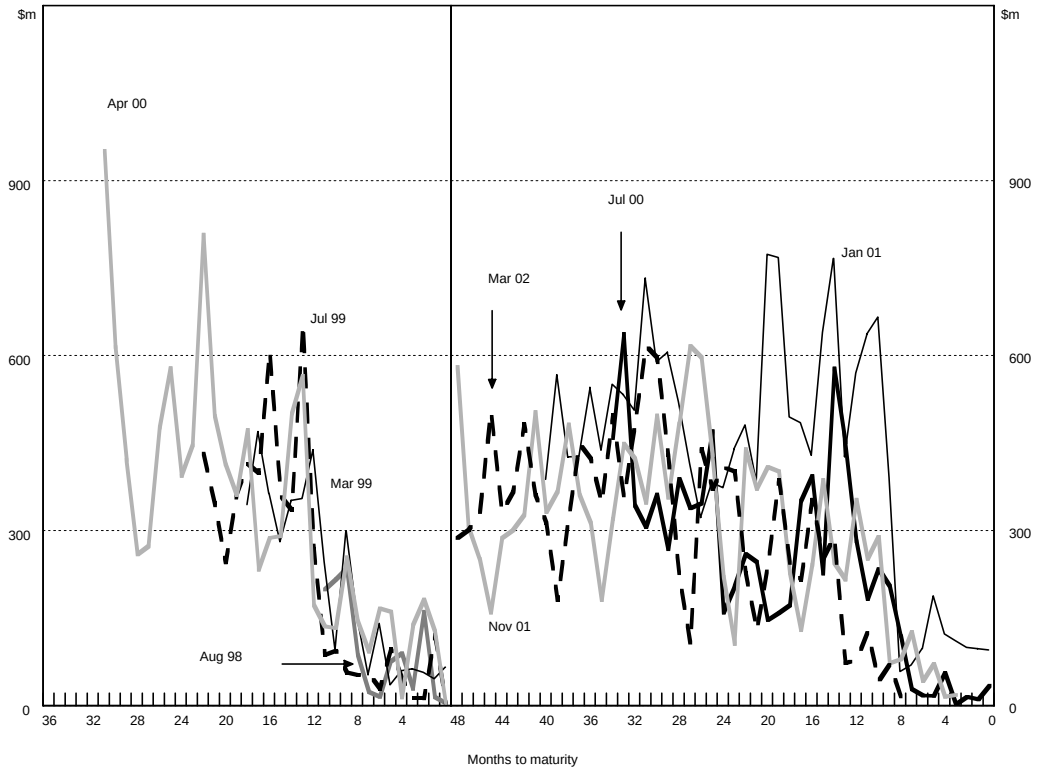
The *resilience* of the market depends on the relationship between trade size and price movements. Past theoretical and empirical work using a range of plausible models suggests that we should expect a positive relationship between trading volume or turnover, and the magnitude of price volatility in the market, for a given level of market liquidity. Copeland (1976) presented a model where trading volume had a positive relationship with the magnitude of price changes due to sequential arrival of information. The mixture of distributions model developed in Clark (1973), Tauchen and Pitts (1983) and related papers explains persistence in price volatility via the joint determination of price movements and trading volume; see Lamoureux and Lastrapes (1990) for an empirical application of this model using stock price indices and Watanabe (1996) for an investigation using Japanese government bonds. Karpoff (1986, 1987) provides surveys of this earlier literature. Dupont (1997) presents a theoretical result showing that price volatility and absolute movements in price are

necessarily positively correlated if traders' demands are symmetric.[5] If liquidity were falling, we would expect that a given level of turnover would be associated with greater price volatility than had been the case previously.

Figure 4

Turnover of government bonds by issue

Monthly average of daily turnover



Institutional factors make it difficult to assess the resilience of the market, that is, the extent to which the market can absorb a large transaction or large volume of trades without prices moving precipitously. The physical bond market frequently does not trade for periods within a trading day. At those times, the quoted price for physical bonds is generally derived in a mechanical way from the activity in the futures market, which is much more liquid than the underlying physical market. Therefore, the quoted prices will give misleading signals about the ability of the market to absorb a large trade.

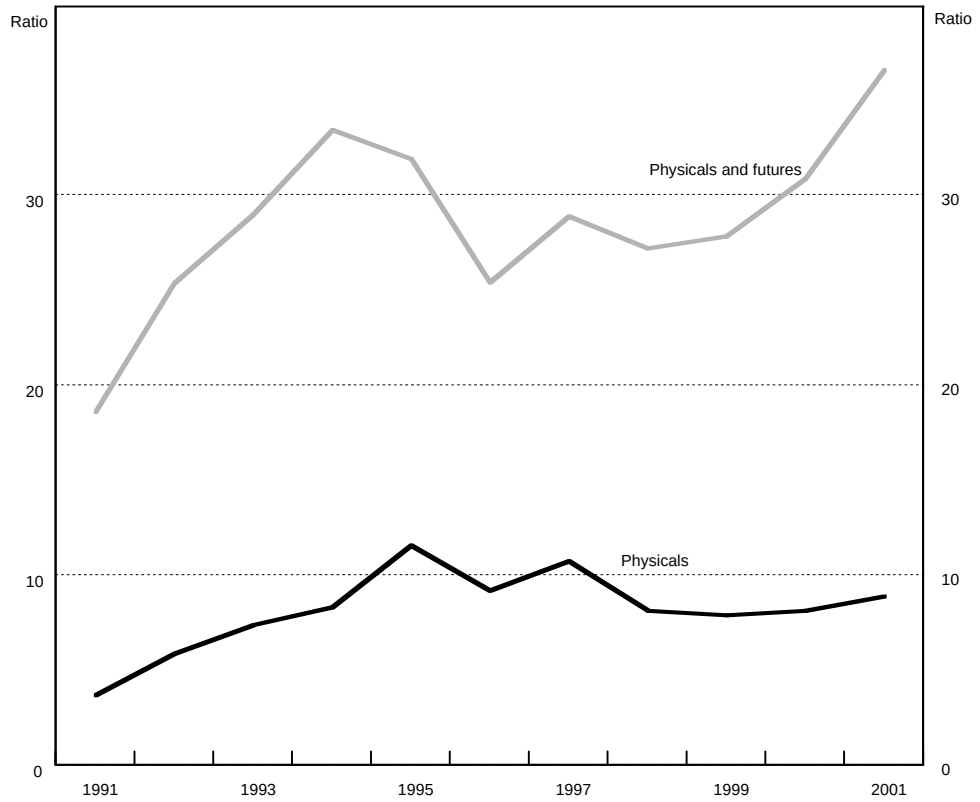
Another way of looking at the resilience of the market is to examine the response of prices in one market to an event relative to the price response in another market. In an illiquid market, we would expect the absolute change in price in response to a particular event to be greater than the price response in a related, more liquid market. Therefore, we could compare price changes across markets to obtain a sense of relative liquidity. Again, however, the quoting practices mentioned above prevent us from comparing the activity of the two markets; the quotes and yields recorded for the physical market will not differ from yields in the futures market, and it would be impossible to use price information to determine relative liquidity at those times.

[5] Dupont's theoretical results also require that changes in prices be jointly normally distributed with traders' demands, but her simulation results indicate that the volatility-volume relationship also appears to be robust to more general, non-normal specifications.

Figure 5

Liquidity of Commonwealth government bonds

Ratio of turnover to bonds outstanding



Source: AFMA; SFE.

The difficulties of attributing price developments in the physical bond market to liquidity considerations are exemplified by the lack of connection between price volatility and trading volume across different government bond issues. Ordinarily, we would expect to see a positive relationship between price volatility and trading volume in a given securities market. As shown in the next section, this is clearly true for bond futures. However, the relationship between price changes and trading volume in the physical bond market is very weak for most issues, indicating that pricing in the bond market is not closely related to the flow of orders in that market. Table 1 shows that regressions of trading volume for bonds of different maturities have little relationship with volatility in their own yield. Although there is almost certainly some simultaneity bias in regressions of this kind, the results presented here are at least indicative of a pricing process that bears little relation to turnover in that market.[6] There is, however, some noise in these data; daily volumes data for the physical market are somewhat distorted by the difficulty of separating repurchase agreements from outright sales, since these are generally entered through the same trading systems. This does not apply to the annual turnover data compiled by AFMA and presented in Figures 3 and 5.

[6] The regressions presented in Table 1 differ from the results presented for bond futures in the next section on a number of counts, due to limitations in the available data. First, the estimation period is much shorter - around half the length of the data available for futures. Second, we were constrained by data limitations to using the (absolute) difference between consecutive closes as our measure of price volatility for the physicals data, compared with intraday (close-open) variation used for the futures data. Third, these data are for specific bond issues, rather than being benchmark contracts for debt of a specific maturity. Finally, the turnover data are measured in millions of AUD for the physicals data, whereas the futures trading volume data presented below are measured as the number of contracts traded.

Table 1

Government securities (physicals) turnover and volatility

Regressions of daily data

Maturity date	Average daily turnover ($ million)	Own turnover			Total turnover		
		Coefficient on yield volatility	Coefficient on time trend	Adjusted R^2	Coefficient on yield volatility	Coefficient on time trend	Adjusted R^2
Apr 2000	353.0	135.7 (0.598)	– 0.244 (0.001)	0.344	2,622.6 (0.204)	– 0.288 (0.502)	0.271
Jul 2000	280.7	125.1 (0.533)	– 0.129 (0.007)	0.349	2,911.2 (0.132)	– 0.448 (0.254)	0.300
Jan 2001	440.6	234.6 (0.298)	– 0.142 (0.003)	0.298	1,552.5 (0.355)	– 0.514 (0.089)	0.286
Nov 2001	306.0	73.7 0.632)	– 0.069 (0.005)	0.315	2,523.9 (0.073)	– 0.318 (0.139)	0.278
Mar 2002	457.6	48.0 (0.807)	– 0.003 (0.936)	0.108	2,309.6 (0.096)	– 0.336 (0.116)	0.277
Oct 2002	359.1	– 2.4 (0.990)	0.035 (0.243)	0.140	2,405.5 (0.727)	– 0.342 (0.107)	0.278
Aug 2003	549.9	– 55.0 (0.810)	0.068 (0.049)	0.158	1,977.5 (0.126)	– 0.356 (0.091)	0.277
Sep 2004	455.2	451.8 (0.016)	0.100 (0.009)	0.175	2,218.5 (0.077)	– 0.353 (0.092)	0.277
Jul 2005	446.9	247.5 (0.195)	0.061 (0.052)	0.143	1,731.4 (0.181)	– 0.356 (0.090)	0.276
Feb 2006	311.0	– 35.5 (0.822)	– 0.101 (0.000)	0.348	1,114.6 (0.385)	– 0.359 (0.088)	0.275
Nov 2006	462.9	298.2 (0.291)	– 0.002 (0.949)	0.189	984.1 (0.454)	– 0.358 (0.089)	0.275
Oct 2007	448.3	– 221.5 (0.219)	– 0.132 (0.000)	0.153	609.1 (0.645)	– 0.362 (0.086)	0.275
Aug 2008	606.7	– 317.1 (0.318)	– 0.052 (0.159)	0.262	483.3 (0.719)	– 0.363 (0.085)	0.275
Sep 2009	635.8	508.8 (0.067)	0.109 (0.002)	0.180	301.8 (0.820)	– 0.365 (0.083)	0.275
Jun 2011	483.6	296.1 (0.257)	0.333 (0.000)	0.280	– 345.1 (0.000)	– 0.181 (0.546)	0.231

Notes: Average daily turnover excludes final month before maturity, when issues trade infrequently. Estimation period is from the beginning of September 1997 to the end of August 2001 (910 observations after excluding lags and holidays), except where the security had already matured. Figures in parentheses are *p*-values. Regressions also include a constant, a time trend and eight lags of the dependent variable, accounting for the equations' explanatory power and eliminating serial correlation in the residuals that would otherwise be present. The time trend is scaled as one unit per day.

The two exceptions to this seem to be the issues with September 2004 and September 2009 maturity dates. While this could simply be coincidence, these issues would have been the physical bonds closest to the benchmark three- and 10-year maturities for most of the estimation period. Therefore, the prices and yields recorded for these securities may reflect the greater interest and liquidity for benchmark maturities, partly associated with activity in the futures market, than applies for bonds with maturities that are not associated with the main futures contracts.

There seems to be a closer relationship between the turnover of government bonds at *all* maturities (shown in the fourth to sixth data columns of Table 2) and yield volatility for each of the securities than there is between the turnover of a given security and its own yield volatility. This is particularly true for

securities currently around the middle of the yield curve. One possible interpretation of this is that activity in the bond market generally is related to yield or price volatility generally, but that the relationship is less strong at the level of the individual security. The statistically significant relationship between yield volatility and total turnover occurs because movements in yields are highly correlated across the yield curve. Still, the explanatory power of this equation is largely unrelated to the volatility term, indicating that other forces drive both turnover and pricing in this market.

A final consideration in assessing the liquidity of the market for a particular security is the concentration of the market. If there are only a few active players in the market, participants may find it difficult to find a counterparty that wishes to trade at the same time as they do. The number of market-makers actively trading Commonwealth government securities has declined in recent years, due to mergers between some investment banks.

3.2 Futures market

The preceding discussion shows that, although there are good reasons to suspect that liquidity has declined in the Australian bond market, institutional factors make it very difficult to find definitive evidence of this decline. What does seem apparent, however, is that liquidity in the bond futures market increased through the 1990s. Figure 6 shows that volume increased noticeably in the three-year market, while for the 10-year market, it was in most periods about 50% higher after 1994 than in the late 1980s and early 1990s. We focus on the contract for next delivery, since this is the contract accounting for almost all bond futures trading activity. Contracts expire around 15 March, June, September and December.

At the same time, price volatility (equivalently, yield volatility) declined noticeably, as shown in Figure 7. In particular, intraday volatility declined relative to the fairly small decline in volatility as measured by the change between consecutive market closes. Since it is the price movements within the trading session that indicate the market's ability to withstand large trades, we interpret this development as indicating increased liquidity in the market, at the same time as responses to overnight developments became more important, particularly movements in the US Treasury market.[7]

Table 2

Daily bond futures trading volume

Dependent variable	Constant	Yield volatility	Lagged yield volatility	Time trend	Adjusted R^2 and SIC
10-year	270.1 (0.674)	32,978.2 (10.633)	49,453.0 (11.216)	1.681 (9.910)	0.40892 0.425
3-year	2,347.0 (2.32)	138,172.2 (13.84)	–	5.917 (12.23)	0.4058 21.839

Notes: Sample size is 2,910 for 10-year contract regression (January 1988 to end-August 2001) and 2,450 for three-year contract regression (January 1992 to end-August 2001). Figures in parentheses are t-statistics, showing that all estimated coefficients shown other than constants are significant at the 1% level. Standard errors calculated using the Newey-West heteroskedasticity consistent covariance matrix. Coefficients on lags of the dependent variable are not shown; the first and some later lags were generally statistically significant at the 1% level.

Table 2 shows the results from regressions of volume on intraday yield volatility for the three- and 10-year benchmark bond futures contracts, similar to those in Gravelle (1999). We focus on intraday volatility on the grounds that it is the intraday price movements that would be affected by any lack of liquidity to enable transactions; differences between opening price and the previous close can occur almost regardless of liquidity during the day trading session, as quoted prices adjust to overnight

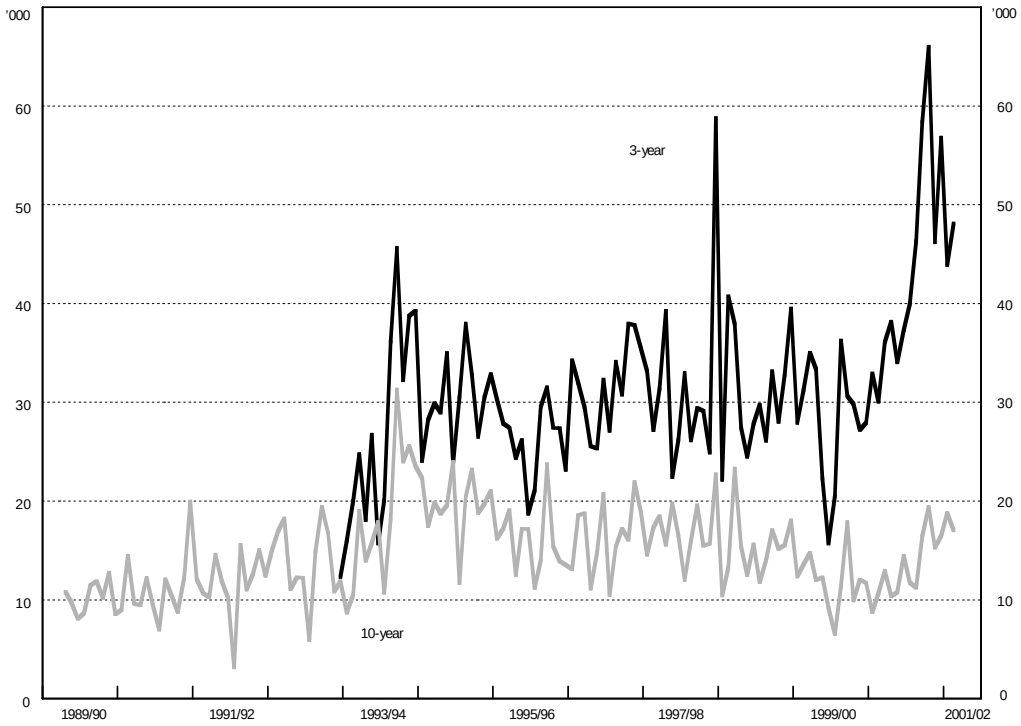
[7] Ellis and Lewis (2001) presented evidence that overnight developments in the US Treasury market accounted for an increasing fraction of the volatility in yields on Australian and New Zealand bond futures during the late 1990s.

movements in offshore markets. We obtained similar results for alternative regressions using absolute yield changes between consecutive closes rather than between the open and close on the same day. We also allowed for an asymmetric effect of volatility on volume by including the yield change as well as the absolute yield change, as suggested by Karpoff (1987). The sign on the estimated coefficient was not statistically significant and therefore the results in Table 2 do not include this term.

Figure 6

Bond futures trading volume

Monthly average of number of contracts traded daily



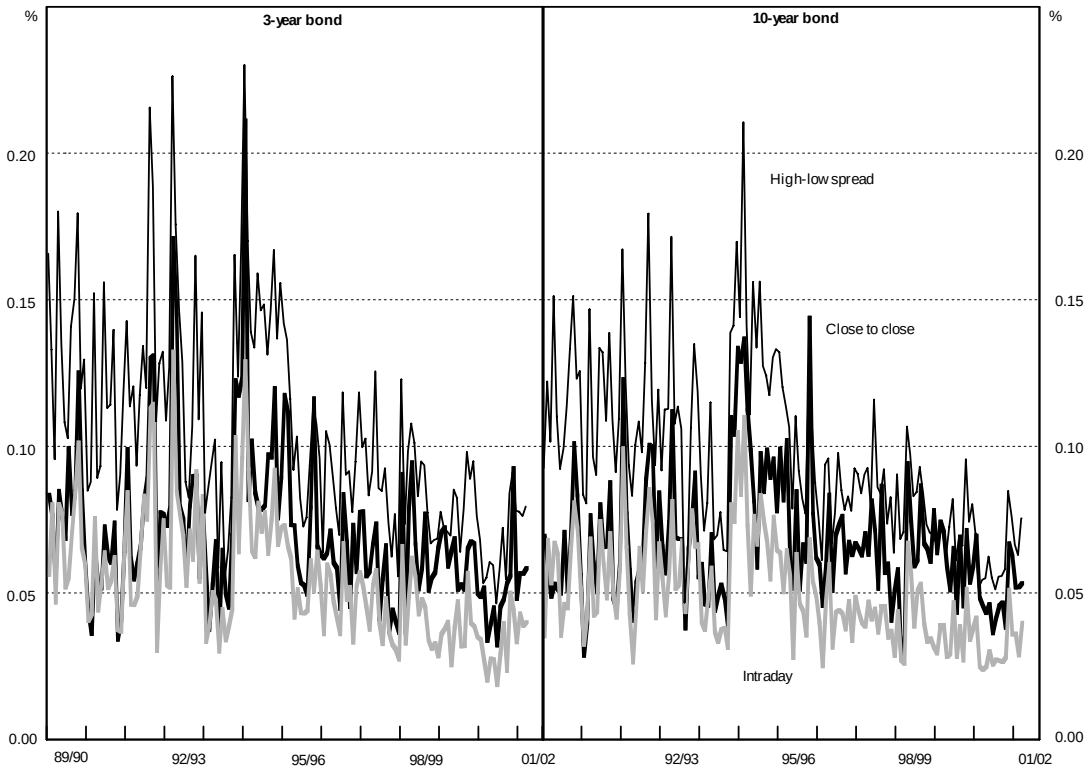
The regression results show that price volatility clearly results in increased trading volume. Since bond futures in the Australian market are priced as 100 minus the yield, we can interpret these coefficients as indicating that a 1 basis point movement in interest rates requires an additional 330 10-year contracts to be traded on the day (824 over two days), or 1,381 three-year contracts. Of greater interest is the significant positive time trend identified in these results. This implies that in the 10-year contract market, the mean number of contracts exchanged when yields did not move increased by around 5,000 contracts from 1988 to the end of August 2001. The surge in trading volume in 2001 has resulted in an even higher estimate for the time trend in the three-year contract regression, suggesting that base daily trading volume - the trading volume that should be expected when yields are constant - has increased markedly over the past eight years.

These estimates should be treated with some caution. Our approach of fitting a simple time trend to the available data points implies that days that are missing due to gaps in the data, public holidays or other reasons do not contribute to the rising trend. Given Sarig and Warga's (1989) finding that errors in recorded bond prices were more prevalent for illiquid securities, data issues may have non-trivial effects on our results. Our data on price volatility are not adjusted for the small price movements that occur when futures contracts expire and trading activity switches to the next contract, but this is unlikely to affect our results much. Volume also tends to increase a little in these changeover periods. On the other hand, there is no evidence of non-stationarity in the data; standard augmented Dickey-Fuller tests strongly reject the null of a unit root.

Figure 7

Bond futures volatility

Monthly average of daily absolute change in yield



The 10-year contract regression included six lags of the dependent variable, while the three-year contract regression included seven lags of the dependent variable. This minimised the Schwartz information criterion as well as eliminating serial correlation. Elimination of serial correlation in the 10-year regression also required the inclusion of the lag of the price volatility variable. Some ARCH characteristics remain in the residuals, but estimation of a standard GARCH model does not seem to make much difference to the estimated coefficients or the qualitative conclusions to be drawn from the results.

4. Implications for financial markets

4.1 Functioning of the debt market

The effect of declining supply on government bond yields is ambiguous in principle. If one market were to become less liquid relative to another, we might expect it to start displaying a *scarcity premium* relative to the other market. That is, its price would rise (yield fall) relative to the other security. This seems to have explained the falls in US bond yields in early 2000 when expectations of continued fiscal surpluses generated an expectation that the supply of US Treasury securities would become constrained (Reinhart and Sack 2000).

On the other hand, declining supply may imply a declining *liquidity premium*; investors will accept a lower return on liquid securities because of the confidence that liquidity brings, that future trades can occur without engendering adverse price movements. That is, highly liquid securities trade at a premium to less liquid alternative securities, so as supply declines we would expect yields to increase relative to other markets where supply and liquidity are not falling. The net effect of declining supply on yields may therefore be ambiguous and hard to discern. We would expect that the liquidity premium is more important for corporate bonds. However, if there are institutional factors generating underlying or

exogenous demand for a particular security, the scarcity premium may be relatively more important. This seems to be an important consideration for benchmark securities such as government bonds, which are more likely to be affected by regulatory requirements inducing market participants to hold these securities rather than alternatives. Examples of these requirements include the past restrictions that required Australian banks to hold a certain percentage of their assets in liquid and government securities, and the choices made by central banks about the securities they will trade in as part of their liquidity management operations.

Whatever the direction of the net effect of declining supply on government bond yields, these premia imply a possible change in the spread between interest rates on government bonds and interest rates on other fixed interest securities such as corporate bonds. However, measuring the effect of declining liquidity on spreads is difficult because risk spreads change for other reasons, unrelated to the supply of government debt.

Similarly, it is not obvious that there should be a sustained liquidity premium between a less liquid physicals market and a highly liquid futures market. A premium for scarcity or illiquidity in the physical market would presumably be arbitraged away. We would nonetheless expect that the short-run effects of yield-moving events could be different, or the effect on trading volume could be different, were the Australian market's convention of quoting prices for physicals based on futures trading outcomes not distorting that signal.

If a declining volume of bonds outstanding ultimately results in a highly illiquid bond market, its importance to markets for other securities would diminish. The physical bond market would cease to be the locus of price discovery and be replaced by the futures market; this transition is essentially already complete in Australia. This is essentially the result of the very high transactional efficiency of the futures market rather than any shortage of supply of physical bonds. Similarly, the yields paid on longer-term government bonds would become less representative of overall financial conditions, and thus less relevant for pricing other forms of debt, whether in securities or retail lending markets.

We should expect the consequences of illiquidity to be most acute at times when news events such as monetary policy changes occur. Chen et al (1999) found that equity markets experienced excess volatility and trading volume on the days when unexpected changes in the discount rate occurred. If this follows through to the bond market, then any problems of illiquidity would be particularly acute on those days. However, there is no evidence of this occurring in Australia.

4.2 Effect on private bond markets

Shrinkage of the government bond market might be conjectured to affect private bond markets in two opposing ways. First, to the extent that government borrowing crowds out borrowing by the private sector, reduced levels of government debt could be expected to "make room" for growth of the private bond market. On the other hand, the existence of a viable market for government bonds could be expected to provide valuable benchmarks for highly liquid and essentially risk-free securities from which private sector bonds can be priced. Hence, a significant loss of liquidity in government bond markets might make it more difficult for markets in private debt securities to grow and develop.

At this stage, there is no evidence of this latter effect occurring in Australia, and it is the first effect that seems to have predominated. Markets for private sector debt securities have grown strongly in recent years, and particularly in the period since around 1996 (see Figure 3 above). As in other countries, the largest segment of the market is in asset-backed securities, mainly securitised mortgages. However, the other segments of the market have been faster growing in recent years, with the outstanding stock of corporate bonds, for example, increasing by a factor of about four since 1996. Security issuance by the financial sector and by non-residents into the Australian market has also been expanding rapidly. In part, the growth of these markets has been a reflection of a global trend, but it also appears to have been hastened in Australia by strong demand for fixed income securities from an expanding funds management industry, as well as the falling supply of government bonds.

Another development that has assisted the growth of these markets has been the increasing use of credit enhancements ("credit wrapping") provided by highly rated financial institutions. While demand for fixed interest securities has been mainly concentrated in highly rated paper (A or better), the use of credit wrapping has enabled a number of less highly rated borrowers to gain access to the market in recent years, particularly in the corporate sector.

Notwithstanding their rapid growth in recent years, these markets remain less liquid than those for government bonds, as indicated by the comparisons in Table 3. There are nonetheless now a number of market-makers in this sector, and prices have provided a useful source of additional information on financial conditions. In general, the yield spread between corporate and government bonds has tended to follow the movements in the corresponding spreads in the United States (Figure 8). On occasions, there have been quite sharp increases in these spreads in response to shocks that diminished the market's appetite for risk (for example the Russian debt default in 1998). However, the two markets have not invariably moved together. For example, in early 2000 Australian corporate bonds began to trade at consistently narrower spreads to government paper than their counterparts in the United States. This appeared consistent with other indicators of relatively robust conditions in the Australian corporate sector, and helped support assessments at the time that credit conditions were less likely to constrain activity in Australia than seemed the case in the United States.

Table 3

Bond market liquidity

Ratio of turnover to stock outstanding, 1999/2000

Sector	Turnover ratio
Commonwealth	8.2
State	7.4
Corporate (corporate, financial, non-resident)	3.6
Asset-backed	2.1

Figure 8

Spread between yields on corporate and government debt

Falling government debt may not only have an effect on interest rates via liquidity or scarcity premia on government securities. The effect of the underlying fiscal policy stance responsible for the reduction in debt may also be important, influencing interest rates other than those in the government bond market. Expanding government deficits in the United States in the 1980s were thought potentially contractionary. Because higher deficits in the near future meant higher taxes later, the long-run interest rates would rise now, before the spending had even taken place. By the same argument, increasing surpluses would be expansionary because of the downward pressure they would put on (long) interest rates, even if the fiscal tightening were common across the world and therefore there was no exchange rate channel. Reinhart and Sack (2000) show that a permanent tightening in fiscal policy should lead to lower real interest rates. Therefore, although the quantity of private sector debt could rise as government debt falls - the effect mentioned earlier - this adjustment might be less than one for one, abstracting from other effects such as economic growth and increasing financial sophistication. Lower interest rates in the long run will also reduce total demand for debt securities, so the size of the net effect on issuance of private sector debt depends on the elasticities of supply of and demand for these securities with respect to the interest rate.

As mentioned earlier, the government debt market may become less important as a benchmark for pricing other types of debt if the stock on issue continues to diminish. However, since long-term fixed rate loans are uncommon in Australia, this would be of less importance to the retail market than is likely in the United States. Most corporate debt securities are at the shorter end of the maturity spectrum, which remains very liquid, and there is relatively little consumer or mortgage debt with fixed interest rates. Most mortgages in Australia are floating rate, and those with fixed interest rates are usually only fixed for one to three years. Unlike the United States, where there is a large retail market for loans with fixed rates for very long periods, there is little retail demand in Australia for the pricing benchmarks provided by long-term government securities, though with markets increasing in diversity and sophistication, the demand for such benchmarks may increase in the future.

4.3 Portfolio choice without government debt

The qualitative effects of the complete elimination of the government bond market are likely to be quite different to the effects of a declining stock of debt in a market that still exists. The elimination of this market would effectively remove the risk-free asset from the spectrum of available assets. Although the literature on incomplete markets is extensive (see Laffont (1989) and Saito (1999) for surveys), there has been surprisingly little theoretical work on the consequences for markets of this particular kind of incompleteness. Most academic studies of incomplete markets still assume that a riskless asset is available (Telmer 1993; Heaton and Lucas 1996), or that sovereign bonds are the only asset that is traded (Devereux and Saito 1996; Kim et al 2001).

In principle, the absence of government bonds may not have much effect on the workings of the economy. We know from the theory of the second best that adding a new asset into an incomplete market is not necessarily welfare-improving (Laffont 1989). By the same logic, removing an asset might not be welfare-reducing. Indeed, in some models, opening a new market in an incomplete markets setting can make all agents worse off (Hart 1975; Newbery and Stiglitz 1984). On the other hand, government securities are the closest available proxy to a risk-free asset in developed country financial markets, other than currency, so their absence may have non-trivial implications that do not apply for other securities.

Heaton and Lucas (1996) showed that the presence of an outside supply of government bonds dampened the effect of transactions costs in preventing consumption smoothing and generating a large equity premium. On the basis of this argument, elimination of the supply of government bonds would tend to increase the equity premium and reduce the rate on remaining risk-free bonds. Borrowing constraints would become more binding, because of the requirement that private sector bonds be in zero net supply. However, this result assumes that there is still a risk-free bond available, issued by a private sector entity. Although highly rated institutions such as large international banks and supranational institutions do issue securities into the Australian market, it is usually the case that only sovereign debt is considered close enough to being risk-free.

Nielsen (1990) developed a model where, without a riskless asset, investors could become satiated; more of the remaining assets is not better because the additional income cannot compensate them for the additional risk. The result is a potential for non-existence of general equilibrium in financial markets, negative prices for some assets and other degenerate outcomes. However, this is probably not an issue in practice. There are empirical precedents of markets lacking government debt; many

emerging markets have never had well developed domestic government bond markets. Although financial market instability occurs on occasion in these markets and those in developed countries, satiation of demand for certain types of asset does not appear to be the cause of this instability.

In summary, theory has to date contributed little to our understanding of the workings of an economy without sovereign debt or some other proxy for a risk-free asset. Moreover, given that governments in modern economies have generally retained a continuous presence in the bond market, it is difficult to assess how markets would function in a world where that was no longer the case.

5. Developments in monetary policy operations

A declining stock of government securities also raises issues for the conduct of monetary policy operations. Domestic monetary operations in Australia were, until 1997, conducted only in Commonwealth government securities (CGS), bought and sold either on an outright basis or through repurchase agreements (repos). It has been evident for some time, however, that the declining stock of CGS would make it increasingly difficult to confine operations to these securities, and this has prompted a number of decisions to expand the range of eligible securities for RBA operations. Key decisions to accept additional securities have been:

- securities of Australian state and territory central borrowing authorities ("semi-government securities", or "semis"), June 1997;
- Australian dollar securities of supranational organisations of which Australia is a member, October 2000 (this was extended to a broader range of AAA-rated supranationals in June 2001); and
- Australian semi-government securities lodged offshore and traded in Australia in a form known as euroentitlements, June 2001.

Of these decisions, much the most important in quantitative terms was the first. It added around $40 billion to the pool of eligible securities (on a stock of $110 billion in CGS at that time). The other elements have so far had a relatively minor impact. The available stock of supranational securities issued in Australia is small, although this market can be expected to develop over time. Euroentitlements potentially add a significant volume to the available stock, amounting to $15 billion on issue in June 2001, though at this stage there has been little activity in these instruments as they are relatively expensive to trade (Table 4).

Table 4

Domestic securities outstanding

as at 30 June 2001 ($ billion)

	RBA holdings (outright or under repo)	Total outstandings
CGS	11.8	65.4
State authorities	5.9	52.8
Supranationals	0.4	3.5
Euroentitlements	0.4	15.0

A further decision that had an important bearing in this area was the removal of the prime assets ratio (PAR), which had required banks to hold a minimum percentage of assets in the form of government securities. This was reduced from 6 to 3% in June 1997 and removed in June 1999.[8] The combined

[8] Previously, the ratio had been reduced from 12 to 6% in the late 1980s, a time of similar concerns about the consequences of a reduced stock of government securities.

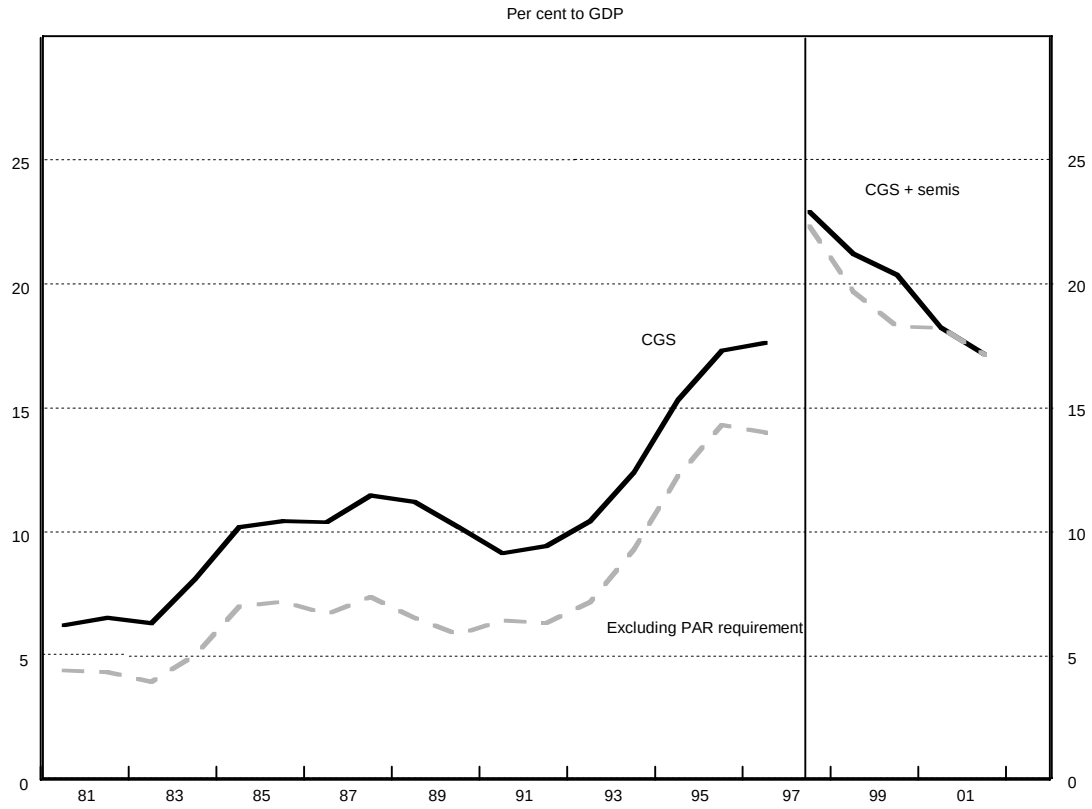
effects of the removal of PAR and the decision to accept semis in RBA operations are illustrated in Figure 9. It can be seen that, despite recent declines, the stock of eligible securities available to be traded remains well above the average of the past two decades in relation to GDP. On the other hand, with the financial system continuing to expand more rapidly than GDP, the demand for these securities has also been increasing.

While the decisions outlined above have helped to alleviate pressure on the supply of eligible securities, the RBA has also responded by adjusting the structure of its monetary operations in recent years. The most important change has been an increasing use of foreign exchange swaps to supplement operations in domestic securities. Average annual turnover in foreign exchange swaps now stands at around a quarter of the volume of operations in domestic securities. The average stock of foreign exchange swaps outstanding has also increased substantially, to a level currently equivalent to around 40% of the stock of Commonwealth and state government bonds on issue. Clearly, if these operations had had to be replaced by domestic repos this would have represented a major source of additional pressure on the stock of available securities.

Figure 9

Government securities on issue

% to GDP



6. Conclusions

While issues associated with declining public debt have been raised in a number of countries, the process is more advanced in Australia than elsewhere. This paper has argued that financial markets and policy operations in Australia have so far coped smoothly with this process.

In terms of the impact on RBA monetary operations, the pressures that might have been expected to arise from a diminishing stock of government debt have been alleviated by policy decisions in three main areas; a run-up in government financial assets, which has absorbed part of the decline in net debt; an expansion of the range of eligible securities for RBA operations; and increased use of foreign exchange swaps for domestic liquidity management.

In terms of the impact on financial markets, there is little evidence at this stage of declining overall liquidity in government bond markets, although it does appear that liquidity has shifted from the physical to the futures markets in recent years. Nonetheless, this shift has had little effect on market-determined interest rates, and there is as yet little evidence of declining trading volume resulting in significant market disruption. Were the stock of government bonds to decline substantially further, this would clearly raise issues as to the viability of the domestic bond market and would require further changes in the composition of RBA operations. However, existing literature does not give much guidance as to how important the wider consequences for financial markets might be. In any case, the government remains committed to maintaining a viable stock of gross debt on issue even as its net debt declines.

References

Broaddus, J A and M Goodfriend (2001): "What assets should the Federal Reserve buy?", Federal Reserve Bank of Richmond, *Economic Quarterly*, vol 87, no 1, pp 7-22.

Chen, C R, N J Mohan and T L Steiner (1999): "Discount rate changes, stock market returns, volatility, and trading volume: evidence from intraday data and implications for market efficiency", *Journal of Banking and Finance*, vol 23, no 6, pp 897-924.

Clark, P K (1973): "A subordinated stochastic process model with finite variance for speculative prices", *Econometrica*, vol 41, no 1, pp 135-55.

Copeland, T E (1976): "A model of asset trading under the assumption of sequential information arrival", *Journal of Finance*, vol 31, no 4, pp 1149-68.

Devereux, M B and M Saito (1996): "Growth and risk-sharing with incomplete international assets markets", *Journal of International Economics*, vol 43, no 3/4, pp 453-81.

Dupont, D (1997): "Extracting information from trading volume", *Federal Reserve System Finance and Economics Discussion Series* no 1997/20.

Ellis, L and E Lewis (2001): "The effect of news about the Asian crisis on financial markets in Australia and New Zealand", Reserve Bank of Australia, *Research Discussion Paper* 2001-04.

Gravelle, T (1999): "Liquidity of the Government of Canada securities market: stylized facts and some market microstructure comparisons to the United States Treasury market", Bank of Canada, *Working Paper* no 99-11.

Greenspan, A (2001): "The paydown of Federal debt", remarks before the Bond Market Association, White Sulphur Springs, 27 April 2001, available at URL:http://www.federalreserve.gov/boarddocs/speeches/2001/20010427/.

Hart, O D (1975): "On the optimality of equilibrium when the market structure is incomplete", *Journal of Economic Theory*, vol 11, no 3, pp 418-43.

Heaton, J and D J Lucas (1996): "Evaluating the effects of incomplete markets on risk sharing and asset pricing", *Journal of Political Economy*, vol 104, no 3, pp 443-87.

Inoue, H (1999): "The structure of government securities markets in G10 countries: summary of questionnaire results", Bank for International Settlements Committee on the Global Financial System Publication no 11.

Karpoff, J M (1986): "A theory of trading volume", *Journal of Finance*, vol 41, no 5, pp 1069-87.

——— (1987): "The relation between price changes and trading volume: a survey", *Journal of Financial and Quantitative Analysis*, vol 22, no 1, pp 109-26.

Kim, J, S H Kim and A Levin (2001): "Patience, persistence and welfare costs of incomplete markets in open economies", Federal Reserve Board of Governors, *International Finance Discussion Papers* no 696, March.

Laffont, J J (1989): "A brief overview of the economics of incomplete markets", *Economic Record*, vol 65, no 188, pp 54-65.

Lamoureux, C G and W D Lastrapes (1990): “Heteroskedasticity in stock return data: volume versus GARCH effects”, *Journal of Finance*, vol 45, no 1, pp 221-29.

Newbery, D M G and J E Stiglitz (1984): “Pareto inferior trade”, *Review of Economic Studies*, vol 51, no 1, pp 1-12.

Nielsen, L T (1990): “Equilibrium in CAPM without a riskless asset”, *Review of Economic Studies*, vol 57, no 2, pp 315-24.

Pagano, M (1989): “Trading volume and asset liquidity”, *Quarterly Journal of Economics*, vol 104, no 2, pp 255-74.

Ramsey, J B and P Rothman (1996): “Time irreversibility and business cycle asymmetry”, *Journal of Money, Credit and Banking*, vol 28, no 1, pp 1-21.

Reinhart, V and B Sack (2000): “The economic consequences of disappearing government debt”, *Brookings Papers on Economic Activity*, no 2, pp 163-220.

Saito, M (1999): “Dynamic allocation and pricing in incomplete markets: a survey”, Bank of Japan, *Monetary and Economic Studies*, vol 17, no 1, pp 45-76.

Sarig, O and A Warga (1989): “Bond price data and bond market liquidity”, *Journal of Financial and Quantitative Analysis*, vol 24, no 3, pp 367-78.

Tauchen, G E and M Pitts (1983): “The price variability-volume relationship on speculative markets”, *Econometrica*, vol 51, no 2, pp 485-505.

Telmer, C I (1993): “Asset-pricing puzzles and incomplete markets”, *Journal of Finance*, vol 48, no 5, pp 1803-32.

Watanabe, T (1996): “Intraday price volatility and trading volume: a case of the Japanese government bond futures”, Bank of Japan, Institute for Monetary and Economic Studies, *Discussion Paper* 96-E-5.