The response of financial markets in Australia and New Zealand to news about the Asian crisis

Luci Ellis and Eleanor Lewis[1]

1. Introduction

As financial markets become more integrated, shocks can be transmitted quickly between them. In times of market turmoil, this implies that the effects of negative shocks might be felt in markets far removed from the originating market. In this paper, we investigate the spillover of financial-market volatility, specifically the impact of recent news from Asia (Korea, Thailand and Indonesia, as well as Malaysia and the Philippines), on financial markets in Australia and New Zealand. We examine the initial impact of key events and announcements in the Asian crisis period and the spillover of these effects, as measured by both financial prices and proxies of their volatility.

We find that realisations of news – both positive and negative – that came out of Asia during the crisis clearly had repercussions for financial markets that were not directly affected by these events. But these effects must be put in perspective: developments in the US market generally had a much greater influence on price movements and volatility than cross-market shocks originating in the Asian crisis economies. This result is in line with previous work on the importance of overseas returns in Australian markets (Kortian and O'Regan (1996)). We also find evidence indicating that stock markets reacted to developments in Asia with a lag, after the United States reacted, rather than reacting directly to the news itself.

Our results indicate that the volatility in Australian and New Zealand financial markets in late 1998 – which we term the "world crisis" period – was generally as great as or greater than in the 1997–98 period, when the main news events of the Asian financial crisis occurred. We also find that the apparent spillover of financial market returns from Asia to Australia and New Zealand was small and – for some asset classes – *smaller* in the Asian crisis period than previously. This implies that the shocks originating in Asia were less important for Australian and New Zealand markets than were the global "common" shocks affecting all of these markets simultaneously.

The evidence suggests that the *volatility* seen in Australian and New Zealand markets was not affected by the different stances of monetary policy, or the differing natures of the monetary policy regimes in the two countries. The effects of developments in Asia on volatility in Australian and New Zealand financial markets were remarkably similar, despite the distinctly different methods used to conduct monetary policy over that period. These results reflect the short-run measure of volatility that we adopt in this paper, however. The *levels* of the financial market variables in Australia and New Zealand display differing profiles: there were large divergences in stock and bond prices over the period. On the other hand, the exchange rates of the two currencies against the US dollar moved together, reflecting that these currencies are generally traded as a bloc.

This paper draws on the literature on contagion (Eichengreen et al. (1996) is a key empirical paper; see Dungey (1999) for a survey). Calvo and Mendoza (1999) show that contagion of financial market volatility might increase as world markets become more integrated. In certain circumstances, the costs of gathering and analysing information about unfamiliar foreign markets may outweigh the perceived benefits. This can result in investors choosing to act on the basis of rumours unrelated to market

---

[1] Luci Ellis is a member of the Economic Analysis Department and Eleanor Lewis of the International Department. We are indebted to colleagues at the Reserve Bank of Australia and to Mardi Dungey for invaluable comments and suggestions. We are also grateful to Adam Cagliarini for technical advice and Clare Padua for assistance with the data. Any errors are ours alone. The opinions expressed in this paper are those of the authors and should not be attributed to the Reserve Bank of Australia.

fundamentals, instead of on complete information. In addition, fund managers may face incentives that encourage herd behaviour in portfolio allocation decisions. Both of these effects can result in contagion of financial volatility from markets in one country to those in other countries.

Masson (1998) has defined contagion as the portion of financial market volatility that cannot be explained by normal factors such as domestic fundamentals and global common shocks. However, much of the contagion literature focuses on the propagation of exchange rate crises and does not deal explicitly with the transmission of volatility outside crisis periods (Dungey and Martin (1998) is an exception). In this sense, this paper has more in common with the literature on "meteor showers and heat waves", which studies geographic (time zone) patterns in the volatility of particular securities (Engle et al. (1990); Fleming and Lopez (1999) is a recent example). We seek to identify the effect of "meteors" – as measured by news events or volatility in one market – on returns and volatility in other markets.

Previous work on the effects of macroeconomic "news" on Australian financial market prices and volatility has focused on announcements made at pre-scheduled times, such as Australian CPI releases (Campbell and Lewis (1998) and Kim (1996)). In these cases, the content of an announcement may be a surprise, but its timing is not. Therefore, it is possible for market participants to plan their contingent trading strategies in advance. If the timing of an announcement is not known in advance, however, traders have less opportunity to plan for its effects. Previous empirical work for other countries has suggested that unscheduled announcements tend to have more persistent effects on financial returns than do scheduled announcements (Almeida et al. (1998)), although the difference can be measured in hours. In general, studies of this kind examine the impact of economic announcements on "own" financial markets. The present paper, however, focuses on the effects of unscheduled (though potentially anticipated) announcements relating to one group of countries on the financial markets of other countries.

The paper proceeds as follows. In Section 2, we discuss the reasons why financial markets in Australia and New Zealand might have been affected by the financial crisis in Asia. We also discuss our measure of news events and the financial market data to be analysed. Section 3 contains the empirical evidence on the response of financial markets in Australia and New Zealand to these news events, in terms of both volatility and price movements. In Section 4, we examine whether the spillover of financial market returns is greater in times of crisis than in more normal times, using results from vector autoregressions (VARs). Section 5 provides a brief conclusion.

2. Motivation and data

2.1 Why Australian and New Zealand financial markets might be affected

There are a number of reasons why negative events relating to the Asian financial crisis might be expected to have a negative effect on financial markets in countries such as Australia and New Zealand. Firstly, to the extent that financial crises in some countries result in a generalised increase in uncertainty in world financial markets, we should expect increased volatility in financial markets in non-crisis countries, which usually results in lower returns.

Secondly, the Asian crisis countries are important markets for Australian and New Zealand exports. As such, a pronounced recession in the crisis countries might be expected to have a negative effect on activity in Australia and New Zealand via the current account; these expectations would then flow through to financial market returns.[2]

Thirdly, some market participants might have factored in some possibility – however remote – that contagion of the crisis could have spread as far as Australia and New Zealand, perhaps relating to financial institutions' debt exposures to the crisis countries.

---

[2] This vector of contagion is essentially the economic linkages model of Lowell et al. (1998).

Finally, even if financial market participants do not expect that countries such as Australia and New Zealand will experience financial crises, they may expect that portfolio rebalancing behaviour could result in sharp declines in asset markets of countries with unrelated fundamentals. Kaminsky and Schmukler (1999) describe how market participants, in responding to a crisis in country A by selling country-A assets and buying country-B assets, may rebalance their portfolios by selling country-C assets, where country C is similar to country B. This ensures that the share of B and C assets in the portfolio remains at the desired level. This results in an apparent contagion of the crisis from country A to the unrelated country C. The effect is also consistent with the portfolio adjustment model of contagion in Lowell et al. (1998). In addition, the effect might be compounded if there is a significant number of uninformed traders in the market, as they may also sell country-C assets if they interpret the sell-off as reflecting a change in fundamentals.

The factors listed above could explain some co-movement between Asian financial markets and those in Australia and New Zealand. On the other hand, there may be reasons for Australian and New Zealand markets to move in the opposite direction to their Asian counterparts. If a financial crisis in one region caused overseas investors to repatriate or otherwise reallocate their funds, it is possible that markets such as Australia and New Zealand could have received them, putting upward pressure on asset prices in those countries. That is, Australia and New Zealand could have been country B, not country C, in the portfolio rebalancing scenario of Kaminsky and Schmukler (1999).

Further reactions to crisis events may occur, related to the actual or expected response by monetary policymakers. For example, if the authorities raise short-term interest rates in response to an exchange rate depreciation – or market participants expect that they will do so – this may result in a fall in stock prices and movements in long-term bond rates.

2.2 The impact of news on financial markets

A large literature exists on the impact of macroeconomic news on financial market prices sampled at high frequencies (Campbell and Lewis (1998), Fleming and Remolona (1997), Almeida et al. (1998), Kim and Sheen (1998) and Kim (1999) are some recent examples).

One distinction between most of this "event study" literature and the present paper is that the former generally examines the effects of news events on financial markets in the country in which the news originated. We focus on the effects of news on third-country markets. In addition, most of the previous literature examines the effect of official macroeconomic data releases, which generally have prescheduled release dates and times. Exceptions to this are releases of German macroeconomic data, which do not follow a predetermined schedule. In this case, market participants are less likely to be able to plan reaction strategies upon the release of the data. Almeida et al. (1998) find that the response of the US dollar/Deutsche mark bilateral exchange rate to German releases is somewhat more drawn out than the response to US releases, which are pre-scheduled (although the difference can be measured in hours).

The set of news events we consider goes even further than this, however. Although the precise timing of German macroeconomic releases is not known in advance, they are approximately regular. So although market participants may not know the exact timing of the German CPI release, they know that a release will occur each month. By contrast, news events during the Asian financial crisis were not always predictable. This would tend to increase the "surprise" value of news about the Asian crisis, relative to the surprise value embodied in regular releases of macroeconomic data.

Limitations of the available data, described in the next section, prevent us from examining the response of Australian and New Zealand financial markets to news at ultra-high frequencies of hours or minutes. Also, since we do not have information on the times that most of the news events occurred, we are restricted to examining news effects on a daily frequency.

Asian time zones largely overlap the Australian and New Zealand domestic trading zones. We would, therefore, expect that in most cases the reaction of Australian and New Zealand markets would begin on the same day that the Asian news events occurred. There will be some instances, however, in which

the news events in Asia occurred after the market closes in Australia and New Zealand, and so the reaction will have occurred on the following day.

2.3 Identifying the timing of news events

The first step in assessing how news about the Asian financial crisis affected other countries' financial markets is to identify the events that constitute news. We use a combination of two pre-existing chronologies, one from the BIS and the other from the IMF (BIS (1998) Table VII.6, page 131; IMF (1998) Box 2.12, page 49), as well as the RBA's daily market reports. A table listing the events from these sources is shown in the Appendix. It should be noted that in some cases the dates cited in the IMF chronology differ from other IMF papers (e.g. IMF (1999)). Where possible, we verified the dates using newswire stories and other sources. The IMF and BIS chronologies end in June and March 1998 respectively; we extended the chronology in this paper to end-August 1998 using the RBA's daily market reports.

Positive news will have the opposite effect on markets to negative news, suggesting that we should distinguish between events that are considered "good" or "bad" news. We classify events relating to agreements between international agencies and crisis countries, announcements of rollovers of debt and certain reforms as "good news"; all other news events listed in the Appendix are considered to be "bad news". The classification of events as positive or negative is shown in the right-most column in the table. Our listing is similar to the classification used by Kaminsky and Schmukler (1999), based on the chronology compiled by Roubini (1999), and to that of Baig and Goldfajn (1998), compiled from newswire stories.[3]

Kaminsky and Schmukler (1999) report that days on which some of the most volatile movements in Asian financial markets occurred were not necessarily associated with specific news events relating to the crisis. There are a number of possible explanations for this. Firstly, markets might react to cumulations of news, so that a seemingly "small" or unimportant news event can engender a greater response if it follows a series of news events (the "straw that broke the camel's back" effect). Secondly, there may be some herding behaviour by traders, so that sudden changes in financial prices can occur even in the absence of significant news. Thirdly, the news events considered may be less relevant to asset markets than the trading strategies used by market participants. To maximise returns from these trading strategies, it may be necessary to take advantage of particular market conditions, such as thin volume, which may not occur on news event days.

2.4 The financial market data, episodes and volatility

The data used to measure financial market returns and volatility for Australia and New Zealand in this study are: the broad indices of stock prices – the All Ordinaries Index (AOI) for Australia and the NZSE40 for New Zealand; bilateral exchange rates for the Australian and New Zealand dollars against the US dollar; and the prices on futures contracts for Australian and New Zealand 10-year bonds, which trade on the Sydney Futures Exchange (SFE) and the New Zealand Futures and Options Exchange (NZFOE).[4]

We use daily market-close data for stock prices and bond futures prices, and 4 pm (AEST) readings for the bilateral exchange rates. Given these data series, we need to derive an appropriate measure of volatility: for daily data, the usual approach is to take the absolute value of daily percentage changes in prices (returns), or squared percentage changes. To avoid introducing spurious autocorrelation into our measure of financial market volatility, we do not use measures such as rolling standard deviations of

---

[3] Although this classification is somewhat arbitrary, it did not seem to be crucial to our results.

[4] The bonds data are for the "next" contract to be delivered, which is a very close substitute for the underlying spot instrument, i.e. physical 10-year bonds. The markets in these instruments on the futures exchanges are deep and liquid and provide reliable price readings. These markets are generally considered to be more liquid than those for the corresponding physical securities.

daily returns. Although the daily series will be considerably noisier than series that incorporate information from a run of days, their time-series properties will be more informative.

An alternative approach would be to use the diffusion-theoretic measure of daily realised volatility, which can be calculated (to a close approximation) as the daily summation of squared *intra*day returns (Andersen et al. (1999)). It is not clear, however, that volatility within the day is the appropriate measure of interest to policymakers. In any case, one of the principal attractions of this alternative measure of realised volatility is that some transformations of it may be normally distributed; this did not seem to be the case for the intraday data available to us. This could, at least in part, reflect that this intraday data set had a large number of missing observations.[5]

We examine financial market behaviour in Australia and New Zealand from the beginning of 1994 to the end of August 1999. We compare times of crisis with other times by dividing our sample into four sub-periods or episodes: "pre-crisis" – from 1 January 1994 to 30 April 1997; "Asian crisis" – from 1 May 1997 to 31 August 1998; "world crisis" – from 1 September 1998 to 31 December 1998; and "post-crisis" – the first eight months of 1999.[6] The Asian crisis period spans 16 calendar months, starting at the beginning of the month in which the first major news event occurred (see the Appendix). We defined the end of the Asian crisis as being the onset of financial crises outside the Asian region; accordingly, we separately identify a "world crisis" period, which we take as ending at the end of 1998 when most markets had calmed down considerably. The post-crisis period is therefore limited to the first eight months of 1999.

We were constrained from beginning the pre-crisis period any earlier than January 1994 by the availability of the composite Asian financial indices described and used in Section 4. We also wanted to avoid selecting a sample for the pre-crisis period that was too short, as the exact beginning of the Asian crisis is not necessarily clear. As early as July 1996, there was notable pressure on the Thai baht, following the collapse of the Bangkok Bank of Commerce. There was also pressure in January 1997, following the release of poor export and fiscal data (IMF (1998)). Therefore, we chose to start the sample long before there was any indication of trouble in the region.

Another advantage of the 1994 starting date is that it captures the onset of the global bond bear market in February 1994. This period was characterised by falling bond prices and more volatile financial markets in general. It was followed by a substantial recovery in financial markets, which continued through to the beginning of the Asian crisis period. Capturing both market phases seemed a balanced approach, rather than constructing a sample period characterised by a bull or bear market alone. Moreover, differences between the pre-crisis and Asian crisis periods might then be reasonably attributed to the Asian crisis, rather than simply being due to the comparison between a turbulent period and a relatively calm period in financial markets.

2.4.1 Stock market volatility

Figure 1 plots the absolute daily percentage change in Australian and New Zealand stocks during the four periods described above. The standard pattern of financial market volatility is apparent: in both countries, stock market volatility fluctuates over time and tends to "cluster", i.e. particularly turbulent days tend to be followed by turbulent days and relatively calm days tend to be bunched together. Volatility of Australian stocks appears, on average, to be slightly lower than for New Zealand,

---

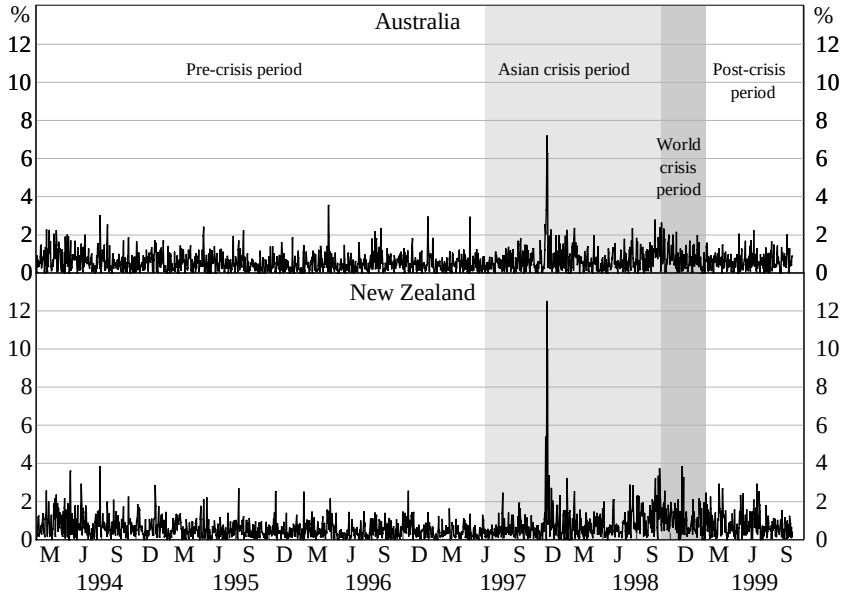
[5] We calculated a measure of daily realised volatility (the logarithm of the summation of log-intraday returns – see Andersen et al. (1999) for a derivation) using 10-minute observations of Australian stocks, Australian dollar/US dollar bilateral exchange rates and New Zealand dollar/US dollar bilateral exchange rates. We then estimated the density of these series using a standard kernel density estimation procedure, with an Epanechnikov kernel and Silverman (1986) bandwidth selection. We found a considerable degree of excess kurtosis relative to the corresponding normal (Gaussian) distribution. These results are available from the authors.

[6] This rather arbitrary dating is not the only way to define periods of crisis. Eichengreen et al. (1995, 1996) define a crisis period by the occurrence of extreme values of an index of "exchange market pressure", defined as a weighted average of movements in exchange rates, interest rates and international reserves, relative to interest rate and reserves changes in a numeraire country.

although overall the patterns of fluctuations look very similar. This is evident throughout most of the sample, but most clearly during late October 1997 – where the large spikes represent the large stock market sell-off at that time – and subsequently in the world crisis period.[7] There does not appear to be much difference in volatility between the pre-crisis, Asian crisis and post-crisis periods (with the exception of the large spike in October 1997), whereas the world crisis period clearly exhibits a higher level of volatility for both countries.

Figure 1

Stock market volatility



2.4.2 Bond market volatility

It is clear that volatility in bond market returns – the absolute percentage change in the price on the futures contract – is much smaller than stock price volatility (Figure 2). However, there appears to be more evidence of volatility clustering in the bond market, with the 1994 period characterised by very volatile returns, followed by a period of relative calm in the second half of 1995. Again, these patterns are evident in both Australia and New Zealand, although, unlike the case for stock price volatility, bond price volatility is much higher for Australia and appears to be more persistent. Overall, however, volatility in the Australian and New Zealand bond markets seems highly correlated, with volatility in the pre-crisis period much higher for both countries than in the other periods. This is consistent with the global sell-off in bond markets throughout 1994 and early 1995, on fears of rising inflation, compounded by monetary policy tightenings in Australia and New Zealand at that time.

2.4.3 Foreign exchange market volatility

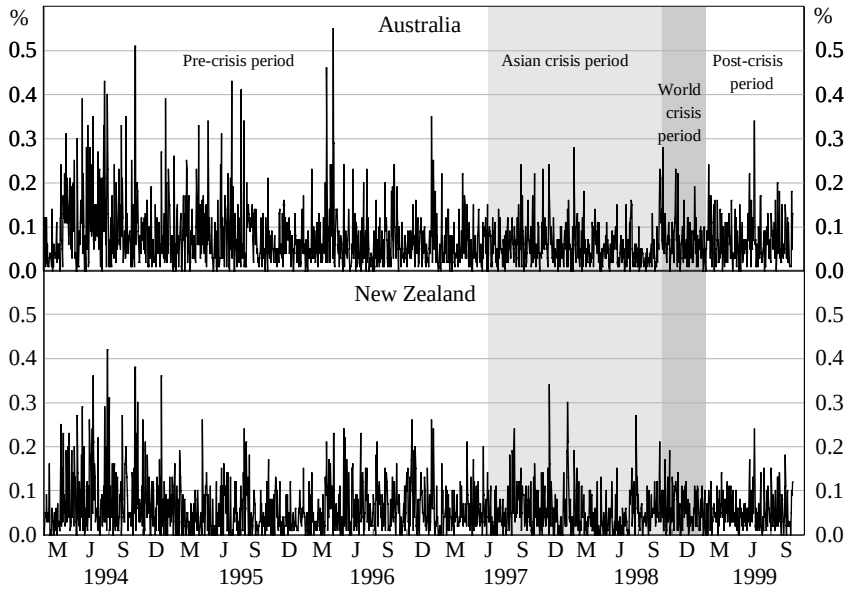
Volatility of both the Australian dollar and the New Zealand dollar exchange rates against the US dollar increased markedly during the Asian crisis, building towards the end of the period, and remained high into the world crisis period (Figure 3). This result suggests that the Asian and world crises had their largest impacts on the exchange rates of the two countries. The increased daily volatility during the later part of the Asian crisis period and in the world crisis period was associated with large depreciations in both bilateral exchange rates. By contrast, the bond and stock markets rallied during most of this period. In part, this may reflect a "flight to quality" by investors.

---

[7] Over the whole period, the average absolute daily percentage change in Australian stocks was 0.6%, compared to 0.7% for New Zealand. However, in the period since October 1997, average volatility has increased to 0.7% and 0.9%.

Figure 2

Bond market volatility



Although the volatility in the exchange rates of the two currencies against the US dollar varied considerably in the crisis periods, the volatility in the Australian dollar/new Zealand dollar cross rate was relatively stable (Figure 4), despite the differences in the operational regimes and stances of monetary policy between the two countries. During the Asian and world crises, the monetary policy instrument was the cash rate in Australia, whereas in New Zealand it was a monetary conditions index (MCI), based on the trade-weighted index for the New Zealand dollar and the three-month bank bill interest rate. The relatively constant volatility of the cross rate reflects that the two currencies are generally traded as a bloc.

Figure 3

Foreign exchange market volatility

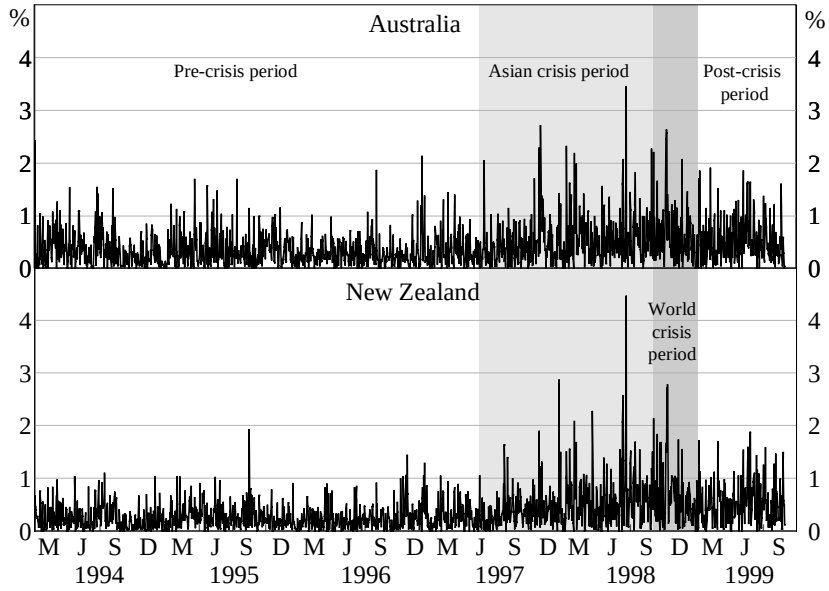
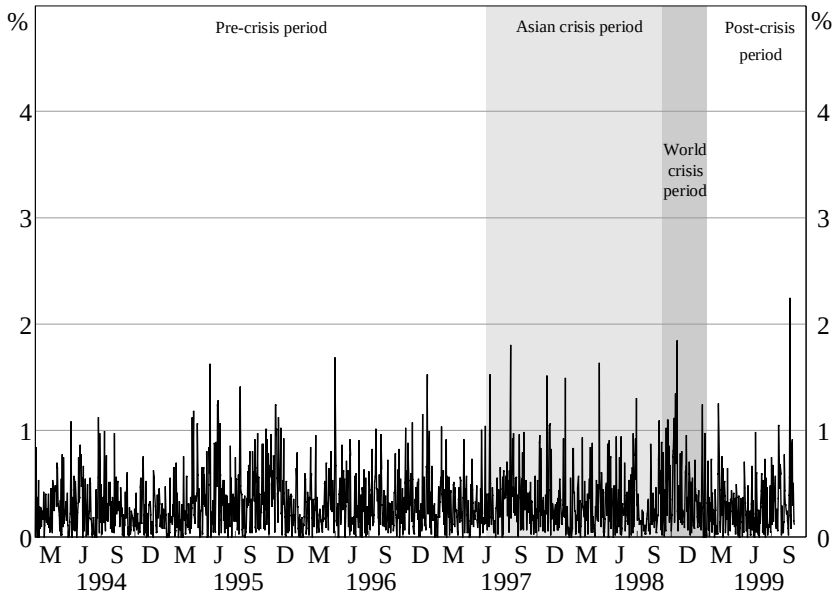


Figure 4

Volatility of the Australian dollar/New Zealand dollar cross rate



3. The response to news

In this section, we use some simple summary statistics and econometric techniques to measure the impact of news on financial market volatility and returns during the Asian crisis.

Within the Asian crisis period, we distinguish between "news" days and "no-news" days, defined as days on which a news event did not occur, and which neither preceded nor followed a news day. Days on which a news event did not occur, but which were adjacent to a news day, are identified separately as "pre-news" and "post-news" days.

3.1 Summary statistics

3.1.1 Stock prices

The first two rows of Table 1 summarise volatility in the Australian and New Zealand stock markets – as measured by the average absolute percentage change in Australian and New Zealand stocks – for all news event days (pre-news, news and post-news days) and no-news days during the Asian crisis period. The table also shows the corresponding measures for the world crisis, pre-crisis and post-crisis periods, as well as the Asian crisis period taken as a whole. Table 2 and Table 3 present mean difference tests of the significance of the differences between these measures.

Several facts stand out. Firstly, during the Asian crisis, all news event days were noticeably more volatile for both Australian and New Zealand stock indices than were days when news events did not occur. Secondly, volatility in both stock indices in the pre-crisis period was significantly lower (in a statistical sense) than during the Asian crisis, but similar to no-news days during the crisis. It was also lower than in both subsequent periods (world crisis and post-crisis). Thirdly, volatility in the world crisis period was similar to the Asian crisis for Australian stocks, but for New Zealand stocks the world crisis period exhibited significantly higher volatility.

3.1.2 Bond futures prices

The variation in bond market volatility was much smaller than for the other financial markets considered. For both Australia and New Zealand, there was seldom more than 0.01 percentage points

difference between the mean absolute movements in the bond futures prices across the sub-periods (Table 1). The mean difference tests shown in Table 2 and Table 3 do not indicate any significant news effects during the Asian crisis period for Australia or New Zealand. Pre-news days, news days and post-news days did not engender any greater volatility in Australian and New Zealand bond markets, on average, than days when news events did not occur. Reflecting the severe sell-off in bond markets in 1994, mean volatility in the pre-crisis period was significantly greater than for the Asian and post-crisis periods for both the Australian and New Zealand markets, but not greater than in the world crisis period. Although these are statistically significant differences, they are very small from an economic perspective.

Table 1
Daily financial market volatility:
average absolute daily percentage returns

	News days during Asian crisis				Pre-crisis	Asian crisis	World crisis	Post-crisis
	Pre-news	News	Post-news	No news				
Stock prices								
Australia	0.77	0.91	1.00	0.59	0.55	0.70	0.77	0.62
New Zealand	1.01	0.97	1.24	0.63	0.55	0.79	1.03	0.74
Bond prices								
Australia	0.06	0.06	0.06	0.06	0.08	0.06	0.07	0.07
New Zealand	0.05	0.05	0.07	0.05	0.06	0.05	0.06	0.05
Exchange rates								
Australia	0.59	0.67	0.66	0.46	0.33	0.52	0.62	0.52
New Zealand	0.56	0.63	0.62	0.44	0.26	0.51	0.65	0.52

Note: There are 868 pre-crisis days, 348 Asian crisis days, 88 world crisis days and 173 post-crisis days. During the crisis period, there are 65 news days, 196 no-news days, 65 pre-news and 64 post-news days. There are 42 days that fall into more than one category.

3.1.3 Exchange rates

The effect of the Asian crisis on Australian and New Zealand financial markets is particularly evident for exchange rates. There was an apparent news effect: the mean absolute returns on all news event days were significantly greater than for no-news days for both exchange rates. In the Asian crisis, world crisis and post-crisis periods, both exchange rates were significantly more volatile, on average, than in the pre-crisis period. This suggests that these differences reflected a generalised increase in volatility stemming from heightened uncertainty triggered by the crises. Moreover, the world crisis period exhibited greater volatility than the Asian crisis period in both countries, although not significantly so for Australia.

3.1.4 Comparing Australia and New Zealand

In Section 2.1 above, we discussed a number of reasons why financial markets in Australia and New Zealand might react to news events in Asia. The degree of the responses, however, may not be the same. For example, there may be differing degrees of macroeconomic integration with the crisis countries. There could be different expectations about the likelihood of the crisis spreading to these economies. The reactions could also reflect differences in markets' expectations of the potential responses by the monetary authorities in each country, or market reactions to different monetary policy actions that actually occurred. (Australia and New Zealand were conducting monetary policy using different operational regimes at the time of the crisis.) Finally, there is a possibility that financial markets in different countries react differently to policy actions that appear identical.

Table 2
Mean difference test statistics, Australia: differences between average absolute daily returns by type of day

	News days during Asian crisis				Pre-crisis	Asian crisis	World crisis	Post-crisis
	Pre-news	News	Post-news	No news				
Stock prices								
Pre-news	–	–0.96	–1.38	**1.88**	**2.46**	0.69	–0.04	1.58
News	0.96	–	–0.46	**2.43**	**2.81**	1.59	0.99	**2.22**
Post-news	1.38	0.46	–	**2.68**	**3.00**	**1.96**	1.43	**2.50**
No news	–1.88	–2.43	–2.68	–	1.01	–2.07	–2.35	–0.58
Pre-crisis	–2.46	–2.81	–3.00	–1.01	–	–3.51	–3.16	–1.79
Asian crisis	–0.69	–1.59	–1.96	**2.07**	**3.51**	–	–0.89	1.56
World crisis	0.04	–0.99	–1.43	**2.35**	**3.16**	0.89	–	**1.99**
Post-crisis	–1.58	–2.22	–2.50	0.58	**1.79**	–1.56	–1.99	–
Bond prices								
Pre-news	–	0.11	–0.32	0.68	–2.33	0.40	–0.86	–0.72
News	–0.11	–	–0.43	0.55	–2.53	0.26	–0.99	–0.87
Post-news	0.32	0.43	–	1.09	–1.90	0.82	–0.50	–0.33
No news	–0.68	–0.55	–1.09	–	–5.44	–0.54	–2.00	–2.11
Pre-crisis	**2.33**	**2.53**	**1.90**	**5.44**	–	**5.52**	1.58	**2.37**
Asian crisis	–0.40	–0.26	–0.82	0.54	–5.52	–	–1.72	–1.81
World crisis	0.86	0.99	0.50	**2.00**	–1.58	**1.72**	–	0.26
Post-crisis	0.72	0.87	0.33	**2.11**	–2.37	**1.81**	–0.26	–
Exchange rates								
Pre-news	–	–0.84	–0.78	**1.80**	**3.85**	0.93	–0.39	0.92
News	0.84	–	0.09	**2.69**	**4.61**	**1.92**	0.48	**1.87**
Post-news	0.78	–0.09	–	**2.79**	**4.93**	**1.96**	0.41	**1.90**
No news	–1.80	–2.69	–2.79	–	**3.74**	–1.59	–2.38	–1.37
Pre-crisis	–3.85	–4.61	–4.93	–3.74	–	–6.75	–4.60	–5.34
Asian crisis	–0.93	–1.92	–1.96	1.59	**6.75**	–	–1.50	0.05
World crisis	0.39	–0.48	–0.41	**2.38**	**4.60**	1.50	–	1.46
Post-crisis	–0.92	–1.87	–1.90	1.37	**5.34**	–0.05	–1.46	–

Note: Boldface indicates that the type of day listed in the row label was significantly more volatile, on average, than the type of day listed in the column.

In Table 4, we compare the average volatility of financial markets in Australia and New Zealand, using the same mean difference test statistic as in the previous subsections.[8] For the stock market, the results are unambiguous: in the crisis periods and the post-crisis period, the mean volatility is larger in New Zealand. However, this difference between countries is significant only during the world crisis and post-crisis periods. There could be a number of reasons for this, not least that the New Zealand stock price index, being relatively small, was more susceptible to being moved by large liquidity flows during the second half of 1998. In any case, this difference is unrelated to the Asian crisis period and therefore cannot be attributed to differences in the authorities' responses to the Asian crisis, or to different market expectations about the implications of the crisis. A similar pattern can be seen in the results for bonds and exchange rates: where differences between Australia and New Zealand exist, they occur in the pre-crisis or post-crisis periods. The crisis periods seem to have resulted in greater

[8] Using a two-tailed test, not a one-tailed test as in the previous section.

similarity between markets. A possible explanation for this is that both markets were driven by overseas events during the crises, and to about the same extent, while at other times they were driven by country-specific shocks.

Table 3
Mean difference test statistics, New Zealand: differences between average absolute daily returns by type of day

	News days during Asian crisis				Pre-crisis	Asian crisis	World crisis	Post-crisis
	Pre-news	News	Post-news	No news				
Stock prices								
Pre-news	–	0.19	–0.83	**2.98**	**3.69**	1.61	–0.10	**2.09**
News	–0.19	–	–0.86	**1.68**	**2.07**	0.84	–0.27	1.13
Post-news	0.83	0.86	–	**2.41**	**2.72**	**1.74**	0.81	**1.97**
No news	–2.98	–1.68	–2.41	–	**1.73**	–2.43	–4.32	–1.77
Pre-crisis	–3.69	–2.07	–2.72	–1.73	–	–4.06	–5.52	–3.59
Asian crisis	–1.61	–0.84	–1.74	**2.43**	**4.06**	–	–2.30	0.78
World crisis	0.10	0.27	–0.81	**4.32**	**5.52**	**2.30**	–	**3.01**
Post-crisis	–2.09	–1.13	–1.97	**1.77**	**3.59**	–0.78	–3.01	–
Bond prices								
Pre-news	–	0.11	–1.44	–0.10	–1.78	–0.21	–0.73	–0.40
News	–0.11	–	–1.41	–0.21	–1.57	–0.31	–0.74	–0.46
Post-news	1.44	1.41	–	1.50	0.43	1.49	0.95	1.33
No news	0.10	0.21	–1.50	–	–2.27	–0.13	–0.76	–0.37
Pre-crisis	**1.78**	1.57	–0.43	**2.27**	–	**2.56**	1.03	**2.05**
Asian crisis	0.21	0.31	–1.49	0.13	–2.56	–	–0.72	–0.28
World crisis	0.73	0.74	–0.95	0.76	–1.03	0.72	–	0.47
Post-crisis	0.40	0.46	–1.33	0.37	–2.05	0.28	–0.47	–
Exchange rates								
Pre-news	–	–0.74	–0.78	**1.80**	**5.41**	0.87	–1.04	0.66
News	0.74	–	0.05	**2.31**	**5.09**	1.57	–0.20	1.39
Post-news	0.78	–0.05	–	**2.64**	**6.13**	**1.80**	–0.28	1.57
No news	–1.80	–2.31	–2.64	–	**5.51**	–1.49	–2.89	–1.65
Pre-crisis	–5.41	–5.09	–6.13	–5.51	–	–9.09	–6.25	–8.27
Asian crisis	–0.87	–1.57	–1.80	1.49	**9.09**	–	–2.09	–0.29
World crisis	1.04	0.20	0.28	**2.89**	**6.25**	**2.09**	–	**1.86**
Post-crisis	–0.66	–1.39	–1.57	**1.65**	**8.27**	0.29	–1.86	–

Note: Boldface indicates that the type of day listed in the row label was significantly more volatile, on average, than the type of day listed in the column.

Table 4
Mean difference tests between Australia and New Zealand

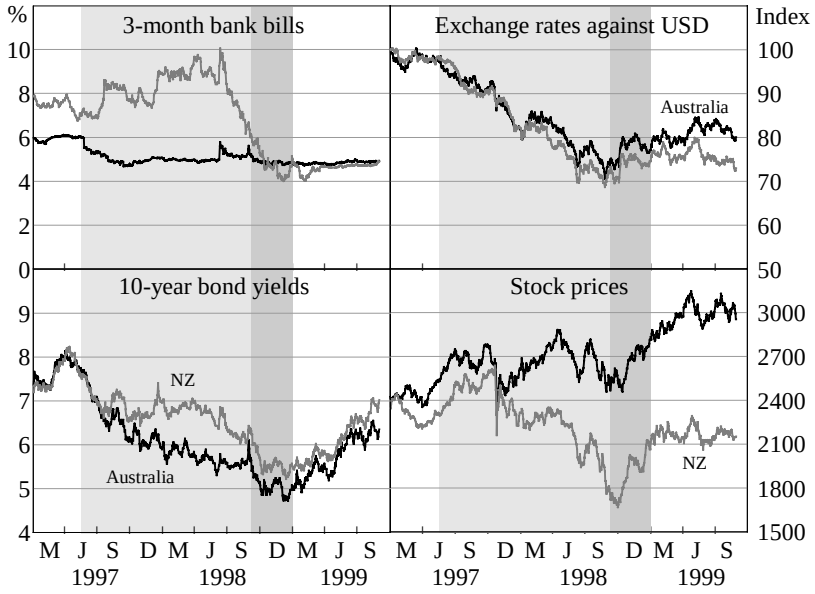
	News days during Asian crisis				Pre-crisis	Asian crisis	World crisis	Post-crisis
	Pre-news	News	Post-news	No news				
Stock prices								
Australia								
– Mean volatility	0.77	0.91	1.00	0.59	0.55	0.70	0.77	0.62
– Sample variance	0.47	1.05	1.42	0.25	0.24	0.52	0.39	0.20
New Zealand								
– Mean volatility	1.01	0.97	1.24	0.63	0.55	0.79	1.03	0.74
– Sample variance	0.97	2.57	4.05	0.29	0.26	1.11	0.61	0.39
Test statistic	–1.64	–0.23	–0.82	–0.67	–0.07	–1.35	–2.39	–1.97
Decision	Same	Same	Same	Same	Same	Same	Aust<NZ	Aust<NZ
Bond prices								
Australia								
– Mean volatility	0.06	0.06	0.06	0.06	0.08	0.06	0.07	0.07
– Sample variance	0.003	0.003	0.003	0.002	0.006	0.002	0.003	0.003
New Zealand								
– Mean volatility	0.05	0.05	0.07	0.05	0.06	0.05	0.06	0.05
– Sample variance	0.002	0.003	0.004	0.003	0.004	0.003	0.002	0.002
Test statistic	1.12	1.01	–0.07	0.80	5.11	1.46	1.73	2.56
Decision	Same	Same	Same	Same	Aust>NZ	Same	Same	Aust>NZ
Exchange rates								
Australia								
– Mean volatility	0.59	0.67	0.66	0.46	0.33	0.52	0.62	0.52
– Sample variance	0.27	0.33	0.27	0.19	0.10	0.23	0.33	0.19
New Zealand								
– Mean volatility	0.56	0.63	0.62	0.44	0.26	0.51	0.65	0.52
– Sample variance	0.20	0.34	0.23	0.22	0.06	0.24	0.34	0.16
Test statistic	0.31	0.39	0.39	0.30	5.87	0.41	–0.29	0.04
Decision	Same	Same	Same	Same	Aust>NZ	Same	Same	Same

Note: The null hypothesis is that the mean volatility in the two markets is the same on that category of day. The two-sided alternative is that they are different.

While the volatility in the two countries' financial markets was very similar during the Asian crisis, the *levels* of the financial-market variables suggest that conditions in Australian and New Zealand stock and bond markets were rather different during this period (Figure 5).

Figure 5

Australian and New Zealand financial markets



3.2 Econometric evidence

In this section, we seek to further quantify the effect of news on financial markets using econometric methods. Based on our chronology, we constructed a news event "dummy" series which took the value +1 for good news, –1 for bad news, and zero otherwise. We then estimated vector autoregressions (VARs) of the daily returns on Australian and New Zealand assets and on a benchmark US financial asset (the S&P 500 stock price index and the futures contract on the 30-year benchmark Treasury bond) for the pre-crisis, world crisis and post-crisis periods. For the Asian crisis period, we augmented the VAR with the current and lagged values of the news event dummy series. This is similar to the methodology used by Baig and Goldfajn (1999).

Since bilateral exchange rates are relative prices – in this case to the US dollar – it is not possible to use this exact approach for the exchange rates. Instead, we estimated VARs of the Australian dollar and New Zealand dollar rates against the US dollar with the CRB Commodity Price Index, which is intended to proxy for the effects of global shocks on commodity-exporting countries.[9] For each of the VAR systems, we used two lags of the endogenous variables, which was the preferred number of lags according to the Schwartz Information Criterion. We included the current-dated and first lag of the news variable for the Asian crisis period.

The results from these models should be taken as indicative rather than decisive, not least because linear VARs are hardly the best available model of financial asset returns. In particular, the residuals from most of these models are non-normal; specifically, they have marked ARCH properties. However, when we estimated single-equation models incorporating the same variables and lag structure as these VARs, allowing for GARCH residuals, the qualitative results on the importance of the news events in Asia and US developments were unchanged. It is also not feasible to estimate multivariate GARCH models using our data set. Because non-trading days are not identical across markets, there are missing values, which can distort estimation of the process for the error variance.

---

[9] Westpac Banking Corporation produces a real-time commodity price index that better reflects the composition of Australia's exports. Although back-data is available, this index was not available to traders until 1999. In any case, estimation of the exchange rate VAR using the WBC index instead of the CRB index gives similar results.

Table 5
VAR estimates for daily stock returns

	Pre-crisis			Asian crisis			World crisis			Post-crisis		
	AOI	**NZSE40**	**S&P**	**AOI**	**NZSE40**	**S&P**	**AOI**	**NZSE40**	**S&P**	**AOI**	**NZSE40**	**S&P**
Constant	–0.02	–0.03	0.06**	–0.02	–0.08	0.05	0.04	0.04	0.38**	–0.03	–0.01	–0.03
	(–0.72)	(–1.31)	(2.21)	(–0.48)	(–1.52)	(0.67)	(0.45)	(0.28)	(2.15)	(-0.63)	(–0.23)	(–0.25)
AOI_{-1}	0.07	0.17***	0.01	0.00	0.33***	–0.08	–0.17	0.07	–0.21	–0.12	0.13	0.03
	(1.59)	(3.76)	(0.30)	(0.08)	(4.29)	(–0.83)	(–1.45)	(0.45)	(–0.97)	(–1.35)	(1.18)	(0.20)
AOI_{-2}	–0.06	0.00	–0.03	0.07	0.14*	0.02	–0.05	–0.02	–0.16	–0.05	0.20***	0.04
	(–1.64)	(0.06)	(–0.74)	(1.21)	(1.80)	(0.24)	(–0.49)	(–0.13)	(–0.85)	(–0.69)	(1.97)	(0.30)
$NZSE40_{-1}$	–0.04	0.02	0.04	–0.06	–0.08	0.05	–0.04	–0.04	0.12	–0.03	0.12	–0.20
	(–0.95)	(0.45)	(1.07)	(–1.16)	(–1.26)	(0.62)	(–0.48)	(–0.35)	(0.74)	(–0.46)	(1.41)	(–1.61)
$NZSE40_{-2}$	0.03	0.04	0.01	–0.01	–0.02	0.08	–0.08	0.14	–0.02	0.07	–0.16**	0.03
	(0.83)	(0.88)	(0.32)	(–0.20)	(–0.27)	(1.11)	(–1.01)	(1.36)	(–0.16)	(1.19)	(–1.97)	(0.28)
$S\&P_{-1}$	0.57***	0.43***	0.09**	0.45***	0.45***	0.09	0.38***	0.46***	–0.09	0.38***	0.35***	–0.02
	(15.27)	(10.66)	(2.27)	(10.63)	(8.54)	(1.45)	(6.61)	(5.88)	(–0.83)	(8.27)	(5.77)	(–0.23)
$S\&P_{-2}$	–0.14***	–0.11**	–0.01	0.08	–0.04	–0.04	0.05	0.03	–0.08	0.02	–0.17**	0.15
	(–3.15)	(–2.38)	(–0.33)	(1.57)	(–0.72)	(–0.55)	(0.72)	(0.29)	(–0.59)	(0.42)	(–2.24)	(1.40)
"News"	–	–	–	0.14	0.21	0.03*	–	–	–	–	–	–
				(1.29)	(1.60)	(1.87)						
"News"$_{-1}$	–	–	–	0.01	–0.06	–0.13	–	–	–	–	–	–
				(0.14)	(–0.42)	(–0.81)						
R-bar squared	0.26	0.17	0.00	0.28	0.27	0.01	0.36	0.33	–0.02	0.31	0.22	–0.01
S.E. regression	0.65	0.70	0.66	0.73	0.90	1.10	0.80	1.10	1.48	0.64	0.83	1.18
F-statistic	42.15	24.54	1.29	15.13	14.18	1.24	7.81	7.19	0.74	11.92	7.69	0.65
Jarque-Bera stat.	22.77	32.14	98.75	0.51	48.32	238.24	0.50	9.04	1.10	1.73	1.73	2.39

Notes: ***, ** and * indicate significant at the 1, 5 and 10% levels. t-statistics are in parentheses. The residuals do not display significant serial correlation.

Table 6
VAR estimates for daily bond returns

	Pre-crisis			Asian crisis			World crisis			Post-crisis		
	Australia	**NZ**	**US**	**Australia**	**NZ**	**US**	**Australia**	**NZ**	**US**	**Australia**	**NZ**	**US**
Constant	0.00	0.00	0.00	0.02	0.00	0.04	0.01	0.01*	–0.07	–0.01	–0.01**	–0.09*
	(0.55)	(–0.43)	(–0.18)	(0.52)	(0.91)	(1.34)	(1.47)	(1.75)	(–0.86)	(–1.15)	(–2.02)	(–1.94)
Australia$_{-1}$	–0.14***	0.06	0.24	–0.02	0.04	–0.12	–0.41***	–0.02	–1.18	–0.25**	–0.02	–0.08
	(–3.31)	(1.40)	(0.80)	(–0.32)	(0.58)	(–0.25)	(–2.74)	(–0.19)	(–0.85)	(–2.50)	(–0.24)	(–0.07)
Australia$_{-2}$	0.00	0.21	0.03	–0.10	0.01	–0.51	–0.13	–0.05	–0.82	0.19**	0.19***	0.62
	(–0.02)	(0.58)	(0.12)	(–1.61)	(0.18)	(–1.18)	(–0.96)	(–0.45)	(–0.65)	(2.02)	(2.63)	(0.61)
NZ$_{-1}$	–0.11**	–0.19***	0.45	0.05	–0.10	0.15	0.14	–0.13	0.34	–0.16	–0.18*	0.13
	(–2.31)	(–4.20)	(1.34)	(0.79)	(–1.52)	(0.34)	(0.79)	(–0.84)	(0.21)	(–1.19)	(–1.75)	(0.08)
NZ$_{-2}$	–0.04	–0.04	0.12	0.01	–0.03	0.01	0.04	0.00	0.32	–0.44***	–0.31***	–1.69
	(–0.76)	(–0.79)	(0.37)	(0.16)	(–0.54)	(0.02)	(0.28)	(0.01)	(0.21)	(–3.72)	(–3.32)	(–1.29)
US$_{-1}$	0.12***	0.08***	–0.04	0.09***	0.07**	0.06	0.06***	0.06***	0.28**	0.14***	0.11***	–0.02
	(19.21)	(14.03)	(–0.87)	(10.67)	(6.96)	(0.99)	(4.53)	(5.42)	(2.27)	(16.96)	(17.17)	(–0.32)
US$_{-2}$	0.01*	0.00	–0.08	–0.01	–0.02	–0.01	0.03	0.03**	0.23	0.04***	0.02*	0.02
	(1.68)	(0.48)	(–1.40)	(–1.02)	(–1.57)	(–0.09)	(1.51)	(2.19)	(1.38)	(2.98)	(1.73)	(0.15)
"News"	–	–	–	–0.01	0.01	0.00	–	–	–	–	–	–
				(–1.27)	(0.53)	(0.01)						
"News"$_{-1}$	–	–	–	0.01	0.01	–0.04	–	–	–	–	–	–
				(0.57)	(0.71)	(–0.66)						
R-bar squared	0.39	0.26	0.00	0.29	0.14	–0.02	0.24	0.30	0.03	0.67	0.67	–0.02
SE regression	0.09	0.08	0.60	0.06	0.07	0.45	0.07	0.06	0.65	0.05	0.04	0.56
F-statistic	64.20	36.14	0.72	15.38	6.86	0.44	4.57	5.95	1.30	49.92	50.96	0.47
Jarque-Bera stat.	189.44	32.58	29.98	37.42	103.58	30.18	8.31	1.30	0.64	1.03	1.42	6.02

Notes: ***, ** and * indicate significant at the 1, 5 and 10% levels. t-statistics are in parentheses. The residuals do not display significant serial correlation.

Table 7
VAR estimates for daily exchange rate returns

	Pre-crisis			Asian crisis			World crisis			Post-crisis		
	A$	**NZ$**	**CRB**	**A$**	**NZ$**	**CRB**	**A$**	**NZ$**	**CRB**	**A$**	**NZ$**	**CRB**
Constant	0.02	0.03**	0.02	–0.05	–0.08*	–0.05	0.10	0.04	–0.06	0.02	–0.01	0.04
	(0.99)	(2.47)	(1.00)	(–1.17)	(–1.89)	(–1.52)	(1.26)	(0.45)	(–0.78)	(0.39)	(–0.19)	(0.74)
$A\$_{-1}$	–0.03	0.04	–0.07	0.00	0.07	0.12	0.30*	0.29	0.09	–0.05	–0.08	–0.08
	(–0.70)	(1.31)	(–1.50)	(0.02)	(0.74)	(1.60)	(1.81)	(1.53)	(0.61)	(–0.33)	(–0.61)	(–0.57)
$A\$_{-2}$	0.00	0.00	0.01	–0.04	–0.05	0.12*	–0.12	0.16	–0.12	0.01	–0.09	–0.14
	(0.06)	(0.10)	(0.22)	(–0.43)	(–0.58)	(1.66)	(–0.72)	(0.86)	(–0.82)	(0.15)	(–0.73)	(–1.09)
$NZ\$_{-1}$	0.03	0.00	0.02	0.00	–0.08	0.00	–0.12	–0.10	–0.02	–0.06	0.01	0.12
	(0.57)	(–0.04)	(0.37)	(–0.04)	(–0.80)	(–0.05)	(–0.85)	(–0.62)	(–0.19)	(–0.45)	(0.04)	(0.85)
$NZ\$_{-2}$	–0.04	–0.11**	–0.05	–0.10	–0.13	–0.06	0.13	0.05	0.18	0.04	0.04	0.05
	(–0.69)	(–2.49)	(–0.83)	(–1.19)	(–1.43)	(–0.92)	(0.94)	(0.29)	(1.36)	(0.31)	(0.34)	(0.41)
CRB_{-1}	0.06*	0.02	0.05	0.25***	0.27***	0.01	0.56***	0.46***	–0.07	0.42***	0.43***	0.08
	(1.65)	(0.64)	(1.39)	(3.40)	(3.52)	(0.23)	(4.66)	(3.25)	(–0.63)	(4.74)	(5.13)	(0.89)
CRB_{-2}	0.04	0.02	0.00	–0.06	–0.07	–0.07	–0.08	–0.09	0.08	0.05	0.07	–0.04
	(1.08)	(0.57)	(–0.01)	(–0.86)	(–1.03)	(–1.27)	(–0.62)	(–0.58)	(0.66)	(0.56)	(0.83)	(–0.45)
"News"	–	–	–	0.06	0.02	0.00	–	–	–	–	–	–
				(0.65)	(0.19)	(0.04)						
"News"$_{-1}$	–	–	–	0.17*	0.17*	–0.07	–	–	–	–	–	–
				(1.85)	(1.77)	(–0.87)						
R-bar squared	0.00	0.01	0.00	0.04	0.05	0.01	0.21	0.14	–0.02	0.12	0.14	–0.02
SE regression	0.47	0.36	0.49	0.67	0.68	0.53	0.69	0.80	0.65	0.64	0.62	0.63
F-statistic	0.84	1.82	0.81	2.58	3.08	1.47	4.50	3.15	0.69	4.30	4.85	0.59
Jarque-Bera stat.	86.90	108.37	35.62	37.39	278.11	8.95	0.33	0.30	4.50	1.41	0.43	3.78

Notes: ***, ** and * indicate significant at the 1, 5 and 10% levels. t-statistics are in parentheses. The residuals do not display significant serial correlation.

The VAR results for the stock market are shown in Table 5. The estimated coefficients on the news dummy series are positive but insignificant for Australian and New Zealand stocks. The coefficients on the lagged S&P 500, however, are large and highly significant for both countries in all periods. This suggests that the news dummies do not appear to have much independent effect on Australian and New Zealand stock markets, once overnight events in US markets are controlled for; these markets are dominated by overnight developments in the United States.[10] However, there is some evidence that Australian and New Zealand market participants react to events in Asia *indirectly* via the United States. The contemporaneous news dummies are just significant in the equation for the S&P 500, and they are of the expected sign. This might explain why the post-news days exhibited greater average volatility in both countries' stock markets than did news days (Table 1). It also suggests possible inefficient information processing. If Asian news had systematically moved the S&P 500, which then systematically moved Australian and New Zealand stock markets, it begs the question why the Australian and New Zealand markets did not react on the day of the news event. One answer may be that timing issues prevented these markets from reacting contemporaneously, for example if the event occurred after the markets closed.

The results for bonds indicate an even smaller response to the news events, once the overnight movements in the US Treasury market are controlled for (Table 6). The estimated coefficients are broadly similar across the four sub-periods, with the inclusion of the news event dummies making little difference to the estimation results for the Asian crisis. Again, overnight movements in the US long bond mattered more for Australian and New Zealand bond returns than did the Asian-crisis news events.

The picture for the exchange rates is somewhat different in that the contemporaneous news dummies are of the right sign but are insignificant, while the lags of the dummies are significant in both the Australian dollar and New Zealand dollar equations (Table 7). The significance of the lagged dummies and not the contemporaneous dummies could possibly be attributed to the timing of the news announcements. The estimated coefficients on the news dummies are positive, implying that bad news in Asia resulted in a depreciation of the Australian and New Zealand dollars against the US dollar.

Interestingly, the CRB index became more significant in later periods. This suggests that market participants looked more closely at commodity price series, such as the CRB index, when assessing the fundamentals underlying these exchange rates.

4. Comparing spillover in crises and at other times

An important question relating to financial stability is whether the spillover of shocks and volatility is greater when the originating markets are in crisis than in more normal times. At first glance, it might be thought that this is true: turbulent markets indicate greater uncertainty about the future, and so uncertainty about the effects of news events on third markets is also likely to be greater during these times.

It is not feasible to answer this question using the news event data described in Section 2.3, however. By construction, there were no news events before or after the Asian crisis period (May 1997–August 1998), so we cannot test whether markets responded more to news events in the Asian crisis period compared with other periods. Instead, we estimate an expanded version of the VARs presented in Section 3.2, with an additional equation in the system to measure movements in Asian financial markets. We present results for returns, rather than volatility (absolute returns), as these were more robust to small specification changes, and allow us to examine the direction as well as the magnitude of the reaction to movements in other markets.

For each market, we present selected impulse responses and variance decompositions, using a recursive-ordering identification scheme with the ordering (Asia, Australia, New Zealand, United

[10] The US market's day t occurs after Asian, Australian and New Zealand day t, but before their day t+1.

States). In general, alternative orderings made little difference to our results on the effect of the Asian variable on returns in Australia and New Zealand, although the relative ordering of Australia and New Zealand can affect the estimates of their effects on each other. The US market generally had no contemporaneous effect on the Australian and New Zealand markets, even when the system was ordered to permit this. We attribute this result to the time zone differences, with the US trading day starting after the close in Asian, Australian and New Zealand markets.

To capture movements in Asian financial markets, we use regional indices. For stock markets, we use the MSCI Far East Free (excluding Japan) index compiled by Morgan Stanley. This index is a market capitalisation-weighted stock price index covering at least 60% of the market capitalisation of each industry group. Only the portion of each country's stock market that is freely available to overseas investors is included. We use these "Free" series on the basis that contagion reflects movements in markets that foreigners can invest in, rather than those which only domestic investors can access. The countries included are listed in column 1 of Table 8, the data are presented in Figure 6.[11] Although we have elected to use a series that incorporates countries other than those most affected by the crisis (i.e. Indonesia, Korea, Thailand, Malaysia and the Philippines), this does not appear to distort our results. We obtained very similar results for the impulse responses and variance decompositions using the MSCI Emerging Markets Far East Index, the MSCI Emerging Markets Asia Index and the first principal component of a data set of stock market returns for the five countries most affected by the Asian crisis.[12]

Analysis of an equivalent VAR system for bond returns is precluded by the lack of long-maturity sovereign debt securities in the crisis-affected countries, equivalent to the benchmark bonds used for Australia, New Zealand and the United States. Instead, we use the JP Morgan EMBI (Emerging Markets Bond Index) Global Constrained Asia sub-index series as a proxy (Figure 7). This series is constructed using US dollar-denominated eurobonds for countries without a well-developed domestic market for sovereign debt.[13] For the exchange rate, we constructed a GDP-weighted fixed-weight exchange rate index based on the spot exchange rates of the four countries listed in the right-most column of Table 8 against the US dollar (Figure 8). The GDP weights were based on 1996 data from the World Bank Atlas, which converts the local currency GDP levels to US dollars using three-year-average exchange rates. A fall in this index represents depreciations of these countries' currencies against the US dollar.

One rationale for using a regional index is that it summarises groups of explanatory variables that are not of interest individually. With multiple individual series (plus lags) in the system, estimated coefficients for the crisis periods compared with non-crisis periods could be higher for some series and lower for others. In that case, it is not clear whether "spillover" in a general sense is greater or smaller during periods of financial crisis. By summarising the data using a regional index (or a principal component), we can get a better sense of the net difference between crisis periods and non-crisis periods.

Furthermore, and not surprisingly, the returns in individual Asian countries are correlated (individual stock market returns have correlation coefficients as high as 0.36). We are less interested in identifying the separate effects of movements in each market than in determining the reaction in Australia and New Zealand to some broadly defined notion of movements in Asian markets. Using the regional index instead of the country-specific data allows us to capture movements in Asian financial markets, while avoiding the problems inherent in estimating systems with multicolinear explanatory variables.

---

[11] Detailed documentation for the MSCI indices is available from Morgan Stanley's website (www.msci.com).

[12] These results are available from the authors. The principal components of a data set are simply a linear transformation of the data into mutually orthogonal components. These components are then ordered so that the first component captures the largest portion of the total information in the data set, the second captures the second largest share, and so on. For an introduction to principal component analysis (PCA), see Cooley and Lohnes (1971) or Chatfield and Collins (1980).

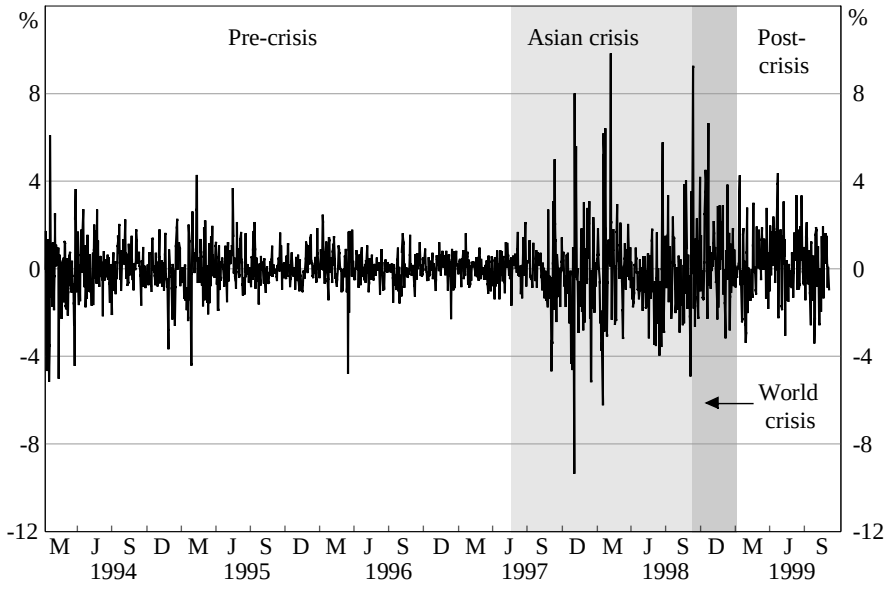
[13] The EMBI Global Constrained Index is a market capitalisation-weighted index, which includes emerging market issues by sovereign and quasi-sovereign entities denominated in US dollars. It only considers issues with a current face value amount outstanding of US$ 500 million or more, with at least two and a half years until maturity. More detailed information on the construction of EMBI Global is available on JP Morgan's website.

Table 8
Countries included in alternative Asian region financial indices

MSCI Far East Free (ex. Japan)	MSCI Emerging Markets Far East	MSCI Emerging Markets Asia	EMBI Global Constrained (Asia sub-index)	Troubled Asia Exchange Rate Index
China	China	China	China	
Hong Kong				
		India		
Indonesia	Indonesia	Indonesia		Indonesia (JCI)
Korea	Korea	Korea	Korea	Korea (KOSPI)
Malaysia	Malaysia	Malaysia	Malaysia	Malaysia (KLCI)
		Pakistan		
Philippines	Philippines	Philippines	Philippines	
Singapore				
		Sri Lanka		
Taiwan	Taiwan	Taiwan		
Thailand	Thailand	Thailand	Thailand	Thailand (SET)

Sources: MSCI indices: Morgan Stanley and Bloomberg. EMBI Global: JP Morgan. Exchange rate index compiled by the authors.

Figure 6
Morgan Stanley Far East Asia Free index: daily returns



Another consideration that suggests some sort of data summarisation technique may be more appropriate is the loss of observations due to public holidays and other non-trading days falling on different days in different countries. For the VARs presented in Section 3.2 above, there is enough overlap between non-trading days in the different countries so that the number of observations lost is small. However, when Asian markets are added, around half the total number of observations can be lost due to missing data on non-trading days. This wastage of data points is clearly undesirable. By contrast, the regional indices record price movements for days when some (but not all) of those markets are closed, although possibly at the expense of some measurement error.

Figure 7

EMBI Global Constrained Asia sub-index: daily returns

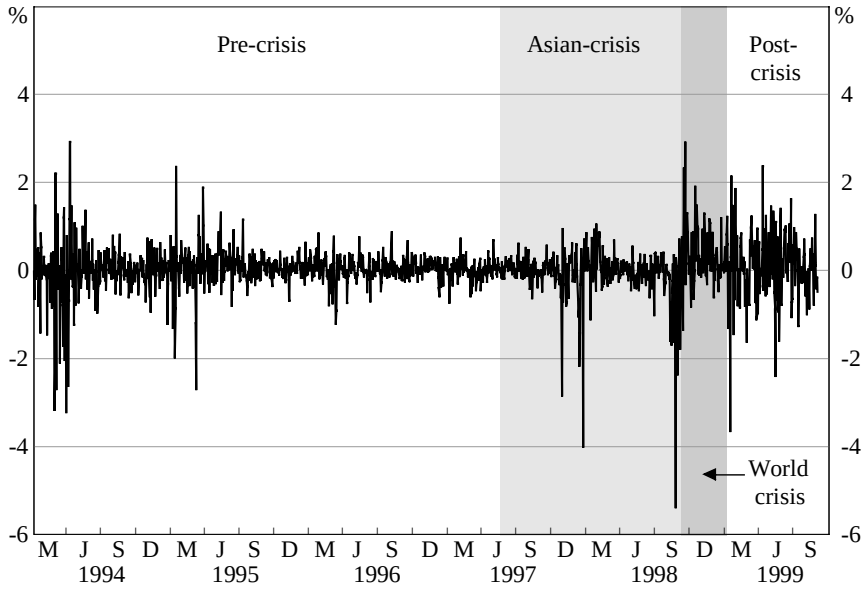
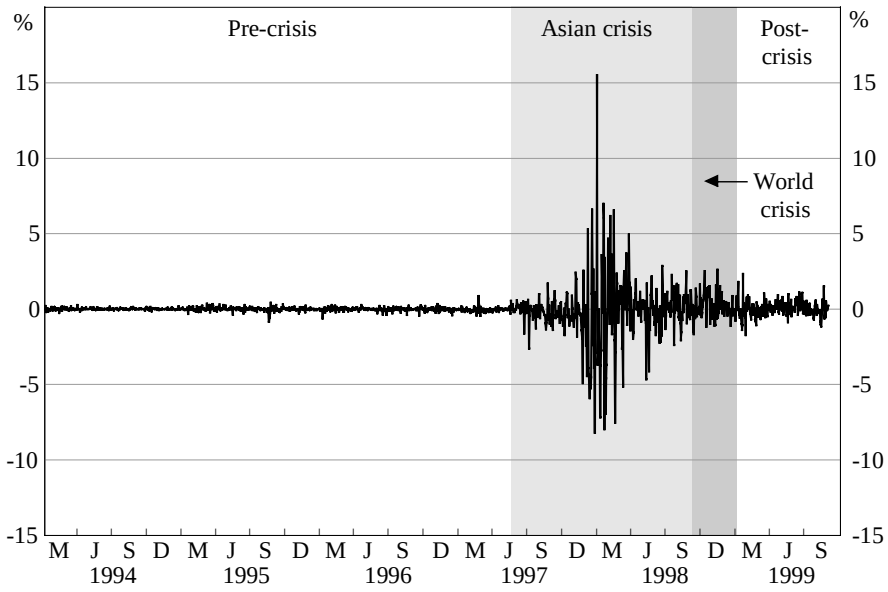


Figure 8

Troubled Asia Exchange Rate Index: daily returns



4.1 Stock markets

Within each sub-period (pre-crisis, Asian crisis, world crisis and post-crisis), our VAR results for stock returns were largely as expected. Much of the variation in Australian and New Zealand returns was driven by overnight developments in US markets. Movements in the Australian and New Zealand markets did not have an independent effect on US markets. There was some minor persistence in Australasian markets, with lagged own price changes being significant in some cases. The previous day's return in the Australian market also had a significant positive effect on the New Zealand market; we attribute this to time zone differences.[14]

[14] We do not present the estimation results in the paper; they are available from the authors. To save space, we also show only the first, second and fifth days in the variance decompositions.

Figure 9

Impulse responses for pre-crisis stock returns VAR

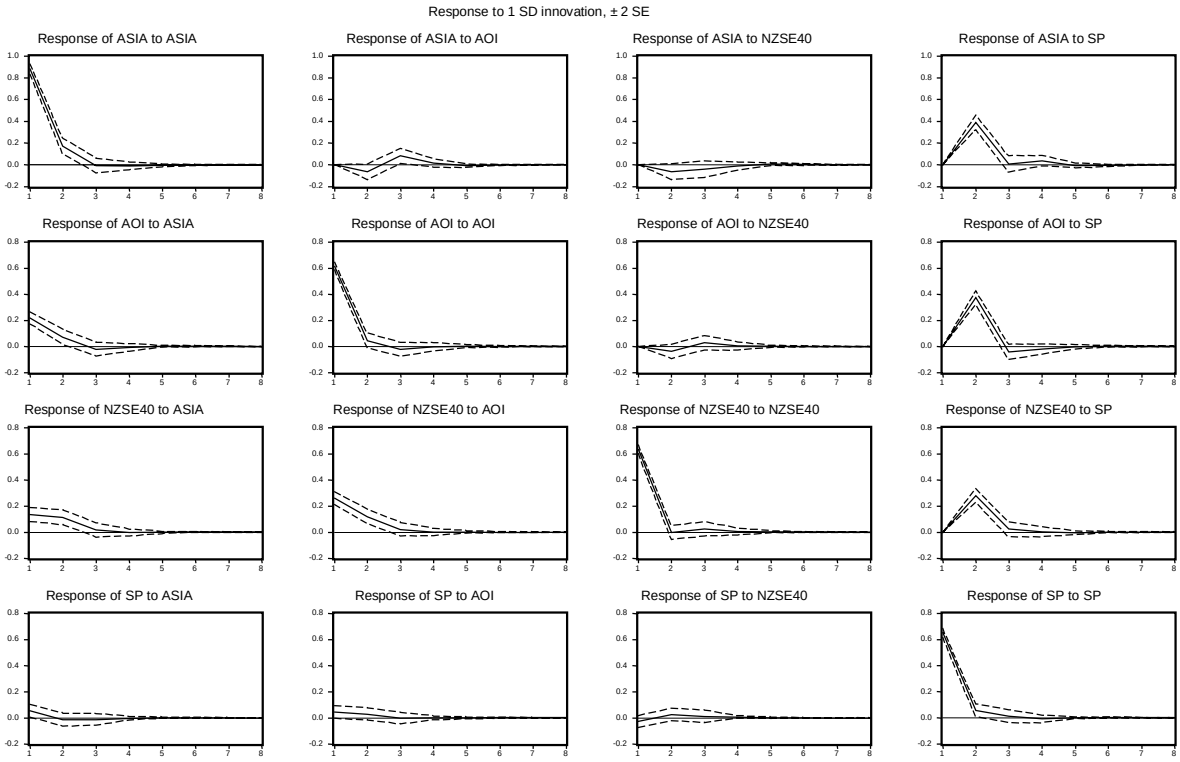


Table 9

Stock returns variance decompositions, pre-crisis

Period	SE	Asia	AOI	NZSE40	SP
Asia: MSCI Far East Free excluding Japan					
1	0.878509	100.0000	0.000000	0.000000	0.000000
2	0.980516	83.29571	0.431031	0.436179	15.83708
5	0.985841	82.42261	1.145628	0.619652	15.81211
All Ordinaries Index					
1	0.652259	11.22335	88.77665	0.000000	0.000000
2	0.757196	9.231658	66.20873	0.265550	24.29406
5	0.759975	9.268215	65.81962	0.401995	24.51017
NZSE40					
1	0.697813	3.729639	13.80512	82.46524	0.000000
2	0.769523	5.196051	13.70929	67.81368	13.28098
5	0.770694	5.219660	13.74559	67.70387	13.33088
S&P 500					
1	0.653492	0.708081	0.475811	0.188500	98.62761
2	0.657131	0.748842	0.656160	0.339144	98.25585
5	0.657529	0.786385	0.657852	0.371244	98.18452

Ordering: Asia AOI NZSE40 SP.

Figure 10
Impulse responses for Asian crisis stock returns VAR

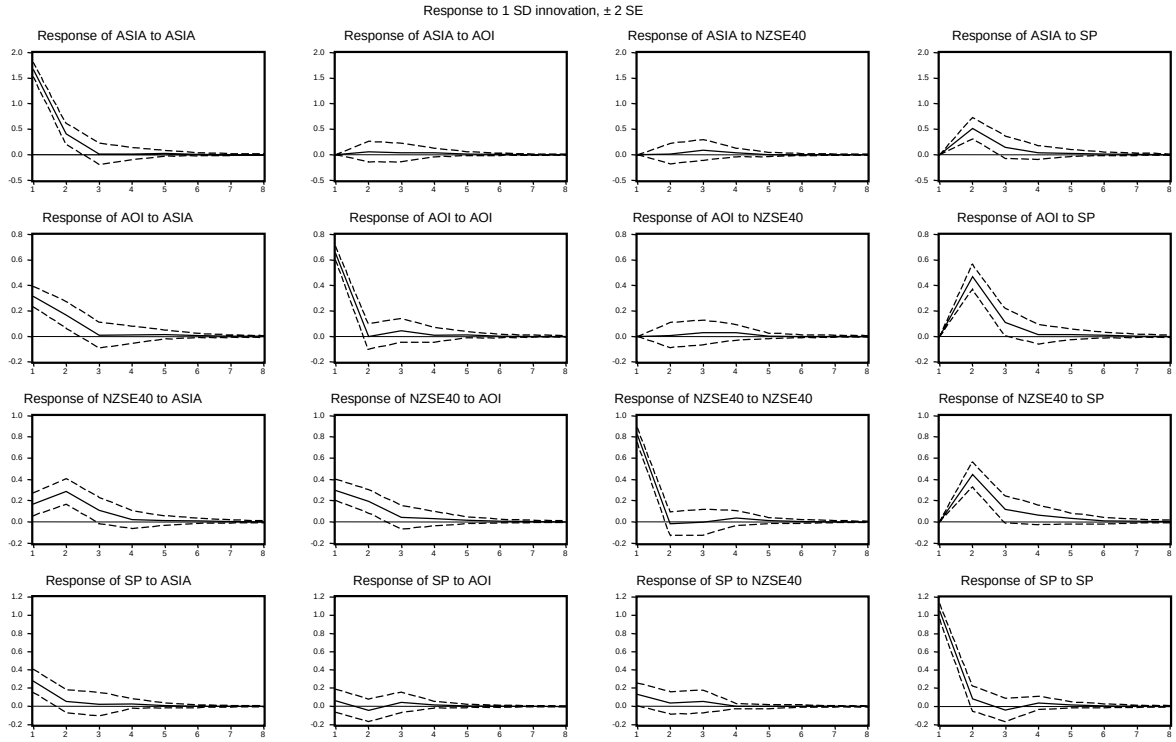


Table 10
Stock returns variance decompositions, Asian crisis

Period	SE	Asia	AOI	NZSE40	S&P 500
Asia: MSCI Far East Free excluding Japan					
1	1.663163	100.0000	0.000000	0.000000	0.000000
2	1.788953	91.58451	0.102682	0.008993	8.303816
5	1.799454	90.55363	0.216412	0.312136	8.917818
All Ordinaries Index					
1	0.719485	18.65428	81.34572	0.000000	0.000000
2	0.873748	16.27916	55.15806	0.007574	28.55521
5	0.883768	15.96006	54.22948	0.237500	29.57297
NZSE40					
1	0.882700	3.579450	11.56667	84.85388	0.000000
2	1.049160	9.988225	11.59553	60.09029	18.32595
5	1.065953	10.74370	11.47999	58.34329	19.43302
S&P 500					
1	1.085633	6.496993	0.331497	1.459383	91.71213
2	1.091870	6.663517	0.485786	1.559626	91.29107
5	1.085633	6.496993	0.331497	1.459383	91.71213

Figure 11

Impulse responses for world crisis stock returns VAR

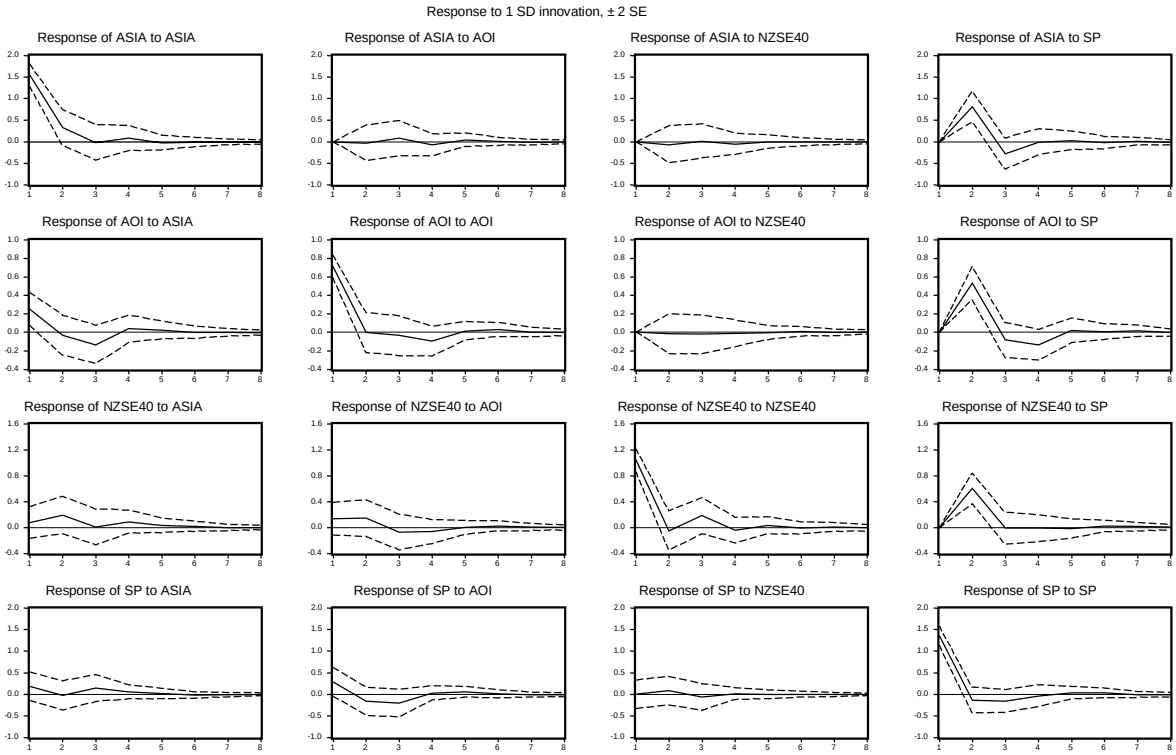


Table 11

Stock returns variance decompositions, world crisis

Period	SE	Asia	AOI	NZSE40	S&P 500
Asia: MSCI Far East Free excluding Japan					
1	1.534870	100.0000	0.000000	0.000000	0.000000
2	1.768751	78.67906	0.027567	0.130425	21.16295
5	1.797566	76.41886	0.488140	0.210869	22.88213
All Ordinaries Index					
1	0.750888	10.94246	89.05754	0.000000	0.000000
2	0.920059	7.408600	59.31890	0.027421	33.24508
5	0.950736	9.129159	56.74683	0.098782	34.02523
NZSE40					
1	1.046186	0.528573	1.626280	97.84515	0.000000
2	1.232038	2.760748	2.523090	70.71275	24.00342
5	1.254200	3.209581	3.057576	70.51633	23.21651
S&P 500					
1	1.389697	1.732727	4.244640	0.000487	94.02215
2	1.408422	1.721199	5.481639	0.360270	92.43689
5	1.444319	2.812388	7.475059	0.546025	89.16653

Figure 12

Impulse responses for post-crisis stock returns VAR

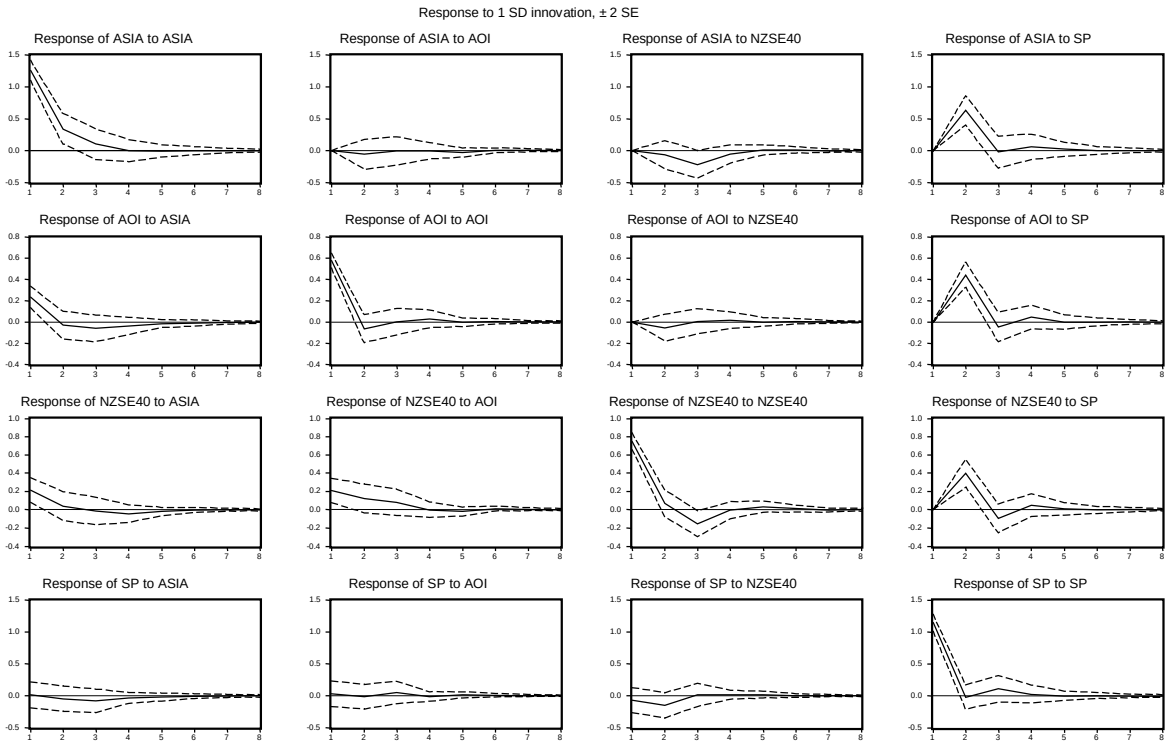


Table 12

Stock returns variance decompositions, post-crisis

Period	SE	Asia	AOI	NZSE40	S&P 500
Asia: MSCI Far East Free excluding Japan					
1	1.255178	100.0000	0.000000	0.000000	0.000000
2	1.449960	80.50739	0.143763	0.203534	19.14531
5	1.472692	78.52142	0.186564	2.505483	18.78654
All Ordinaries Index					
1	0.621094	14.28146	85.71854	0.000000	0.000000
2	0.767114	9.491655	56.85340	0.477399	33.17755
5	0.773912	10.18582	56.00659	0.523479	33.28412
NZSE40					
1	0.807679	7.041972	6.734723	86.22330	0.000000
2	0.911771	5.691949	7.033684	68.24758	19.02679
5	0.936746	5.708620	7.430989	67.55056	19.30983
S&P 500					
1	1.146743	0.013412	0.067533	0.349749	99.56931
2	1.157855	0.176475	0.087614	2.041724	97.69419
5	1.168442	0.773487	0.299874	2.054634	96.87200

The impulse responses shown in Figures 9–12, and the variance decompositions in Tables 9–12, are based on the recursive identification scheme discussed above. We cannot be completely certain that we have identified true structural innovations using this scheme. However, we are confident that a different ordering within a recursive scheme would not appreciably affect the results. The impulse responses and variance decompositions derived using other possible orderings are very similar to those presented here.[15] In particular, even when the US variable (S&P 500) was ordered before the other variables, allowing it to affect all other variables contemporaneously, the impulse responses of the other variables to an innovation in the S&P 500 were still tent-shaped, with the contemporaneous responses being close to (and almost always insignificantly different from) zero. A similar result applied for the bond and foreign exchange market results presented in the following sections.

The variance decompositions for the four periods show that own market innovations are the most important, although the S&P 500 has a significant impact on the Australian and New Zealand indices in all periods. The effect of the Asian market variable on Australian and New Zealand stocks was also fairly important, particularly during the Asian crisis period. There was some apparent cross-determination between the Australian and New Zealand markets, although this was not robust to different relative orderings. As expected, the S&P 500 was virtually entirely driven by own market innovations, although the contribution of the Asian variable in the crisis period was higher than at other times.[16]

When we examine each of the sub-periods individually, however, we obtain results that conflict with the usual intuition about the spillover of financial market volatility, i.e. that transmission of volatility from one market to another should be greater in times of crisis than in more normal times. The implied response of Australian and New Zealand stocks to an innovation from the Asian series was *proportionately smaller* in both the Asian and world crisis periods than in the pre-crisis period. The impulse response peaked at around 0.2 percentage points in both the pre-crisis and Asian crisis periods, even though the size of a one-standard-deviation innovation in the Asian series was substantially larger in the Asian crisis period than the pre-crisis period. Moreover, the reaction in the post-crisis period was similar to the reaction in the Asian crisis, and greater than in the world crisis period.

4.2 Bond markets

Figure 14 suggests that EMBI Global Constrained had a small and marginally significant impact on Australian and New Zealand bond returns during the Asian crisis period. However, the greatest reaction of Australian and New Zealand bond returns to the Asian series was in the pre-crisis period.[17] This result may be due to the EMBI series picking up the effects of the Japanese and European markets on Australian and New Zealand bond yields. Previous work has suggested some role for these other markets, independent of the US market, in explaining bond market movements in Australia (Kortian and O'Regan (1996)). Since these markets are omitted from our estimates, it may be that the EMBI series is picking up innovations from those markets during the 1994 bond market sell-off. If the Japanese and European market had affected Asian markets as well as the Australian and New Zealand markets, then our identification approach will capture this as Australian and New Zealand returns being affected by Asian returns.

There does not appear to be an indirect response to Asia via the US market. Overnight developments in US bond markets had a strong effect on Australian and New Zealand bond returns, accounting for

---

[15] There are 4!=24 possible orderings for a four-variable VAR; if Australia and New Zealand are treated as a block (i.e., kept together but with potentially different ordering within the block) there are twelve. The results for the other orderings are available from the authors.

[16] We have omitted the responses of the S&P 500 to other variables from the impulse response graphs as they are very close to zero.

[17] In both the pre-crisis and the Asian crisis period, the point estimate is around 0.01, although the size of a one-standard-deviation EMBI shock in the Asian crisis period was somewhat larger.

15–30% of their variability in the Asian crisis period, 40% in the world crisis period and 66% in the post-crisis period. However, during the Asian crisis (and the world crisis), bond market volatility in

Figure 13

Impulse responses for pre-crisis bond returns VAR

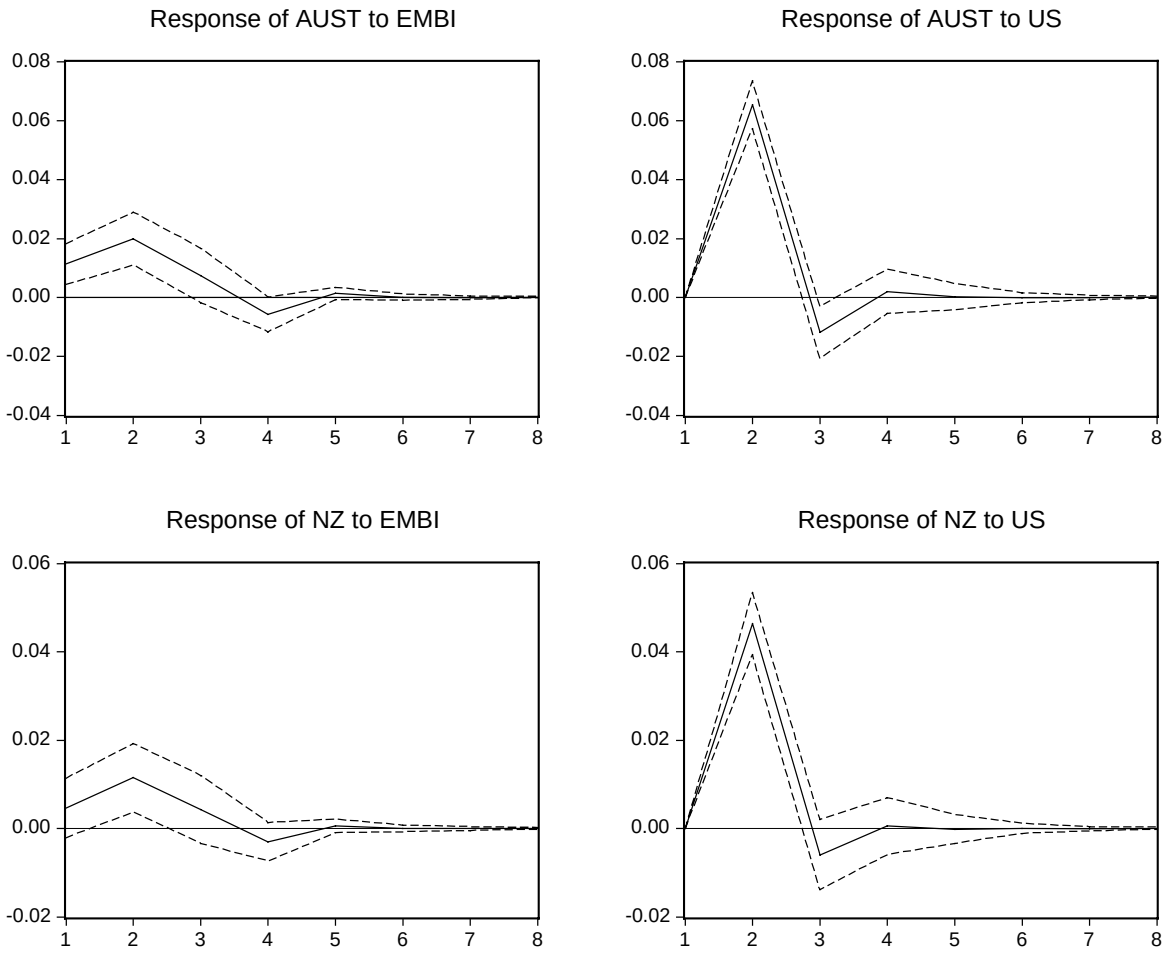


Table 13

Bonds variance decompositions, pre-crisis

Period	SE	AUST	NZ	US	EMBI
Australian bond futures					
1	0.085200	98.22205	0.000000	0.000000	1.777947
2	0.109599	59.72717	0.232840	35.65331	4.386683
5	0.110739	58.56773	0.303433	36.10057	5.028259
New Zealand bond futures					
1	0.080857	18.26934	81.40192	0.000000	0.328740
2	0.094819	13.60097	60.79360	23.90294	1.702492
5	0.095185	13.52368	60.36892	24.11231	1.995087

Figure 14

Impulse responses for Asian crisis bond returns VAR

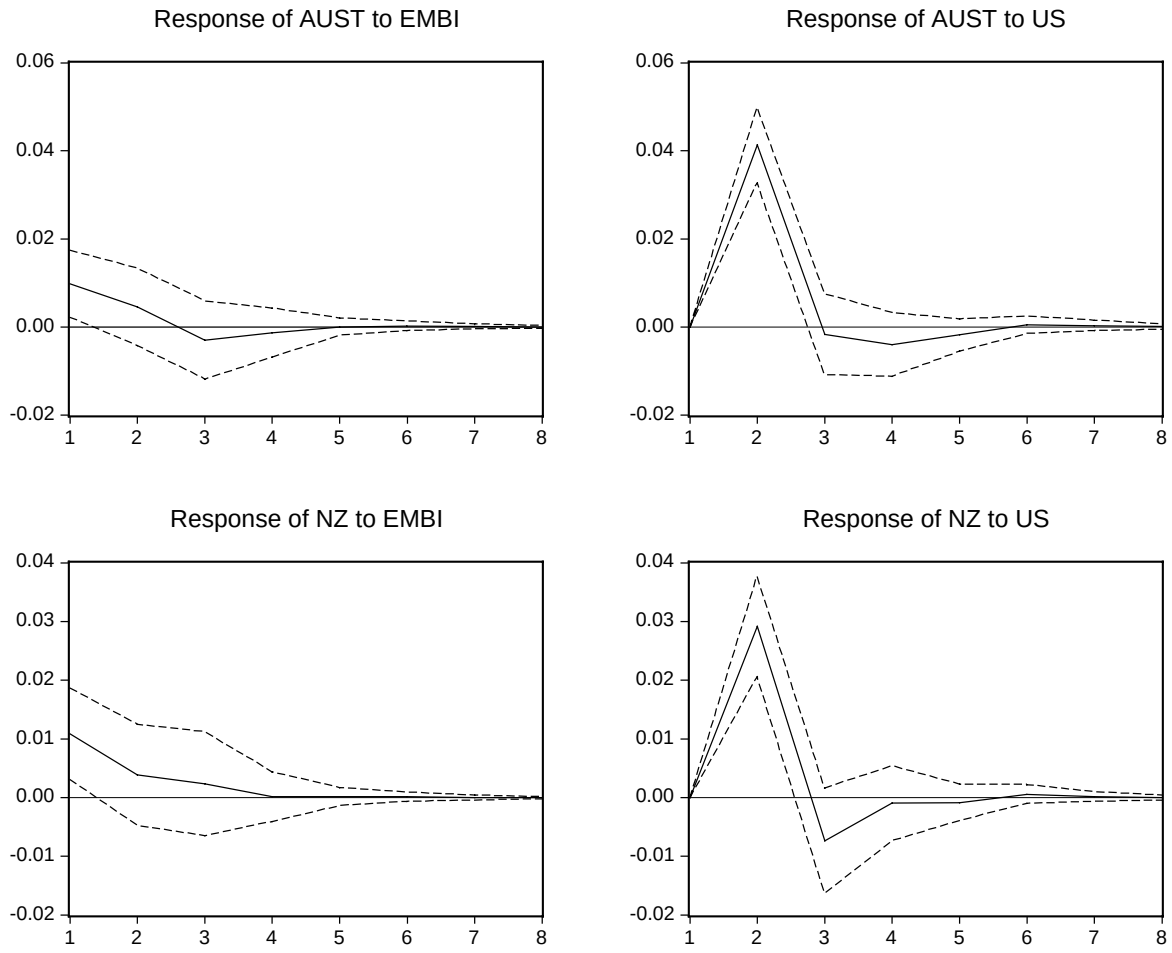


Table 14

Bonds variance decompositions, Asian crisis

Period	SE	AUST	NZ	US	EMBI
Australian bond futures					
1	0.062261	97.52979	0.000000	0.000000	2.470210
2	0.075049	67.28687	0.383318	30.26396	2.065851
5	0.075528	67.09444	0.408975	30.26936	2.227224
New Zealand bond futures					
1	0.066856	15.32406	82.04628	0.000000	2.629657
2	0.073199	12.83317	68.86906	15.82690	2.470865
5	0.073665	12.76430	68.03889	16.65592	2.540887

Figure 15

Impulse responses for world crisis bond returns VAR

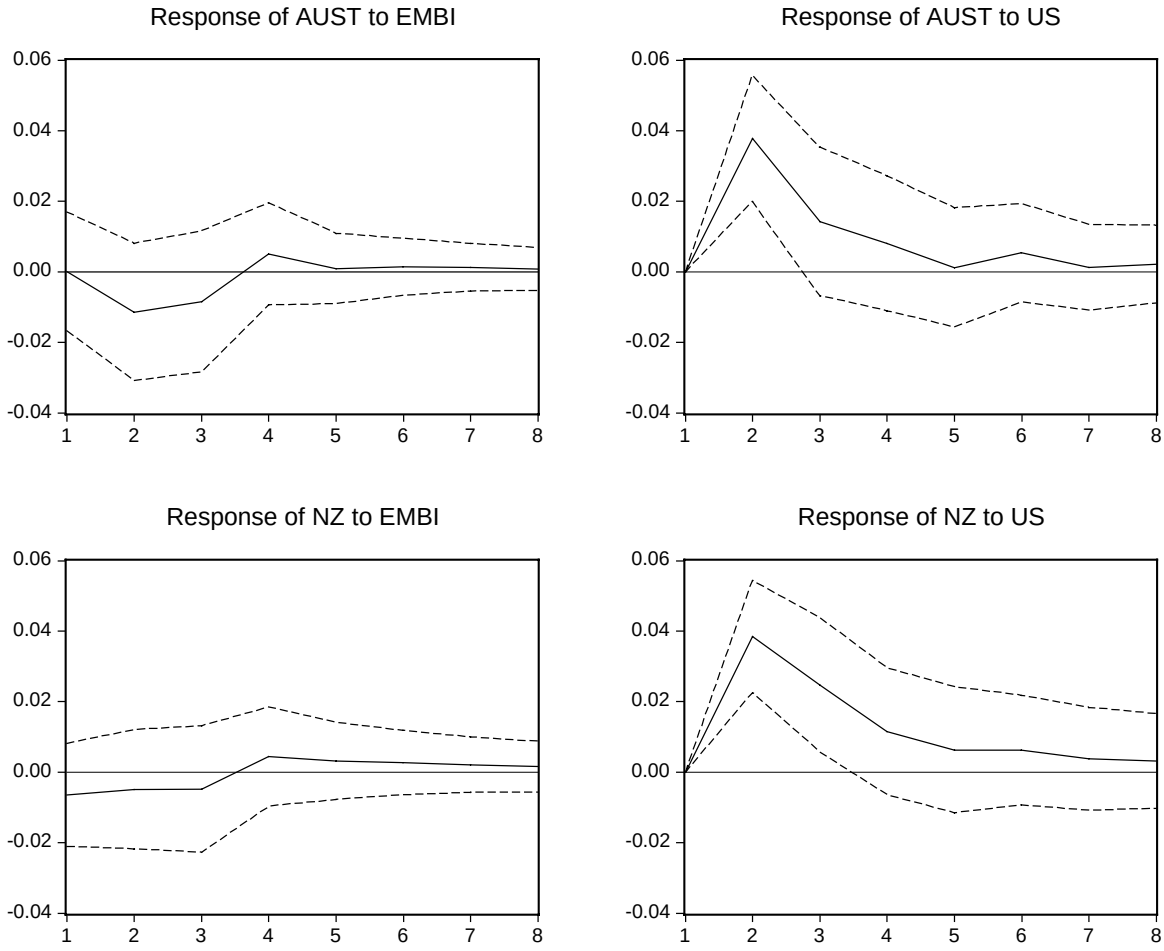


Table 15

Bonds variance decompositions, world crisis

Period	SE	AUST	NZ	US	EMBI
Australian bond futures					
1	0.064735	99.99992	0.000000	0.000000	7.96E-05
2	0.078880	74.58906	0.275470	23.01557	2.119898
5	0.081283	70.27160	0.514577	25.74554	3.468275
New Zealand bond futures					
1	0.056596	34.44071	64.26665	0.000000	1.292638
2	0.069234	23.40149	44.42332	30.81652	1.358669
5	0.075197	20.23925	37.71642	39.95933	2.084998

Figure 16

Impulse responses for post-crisis bond returns VAR

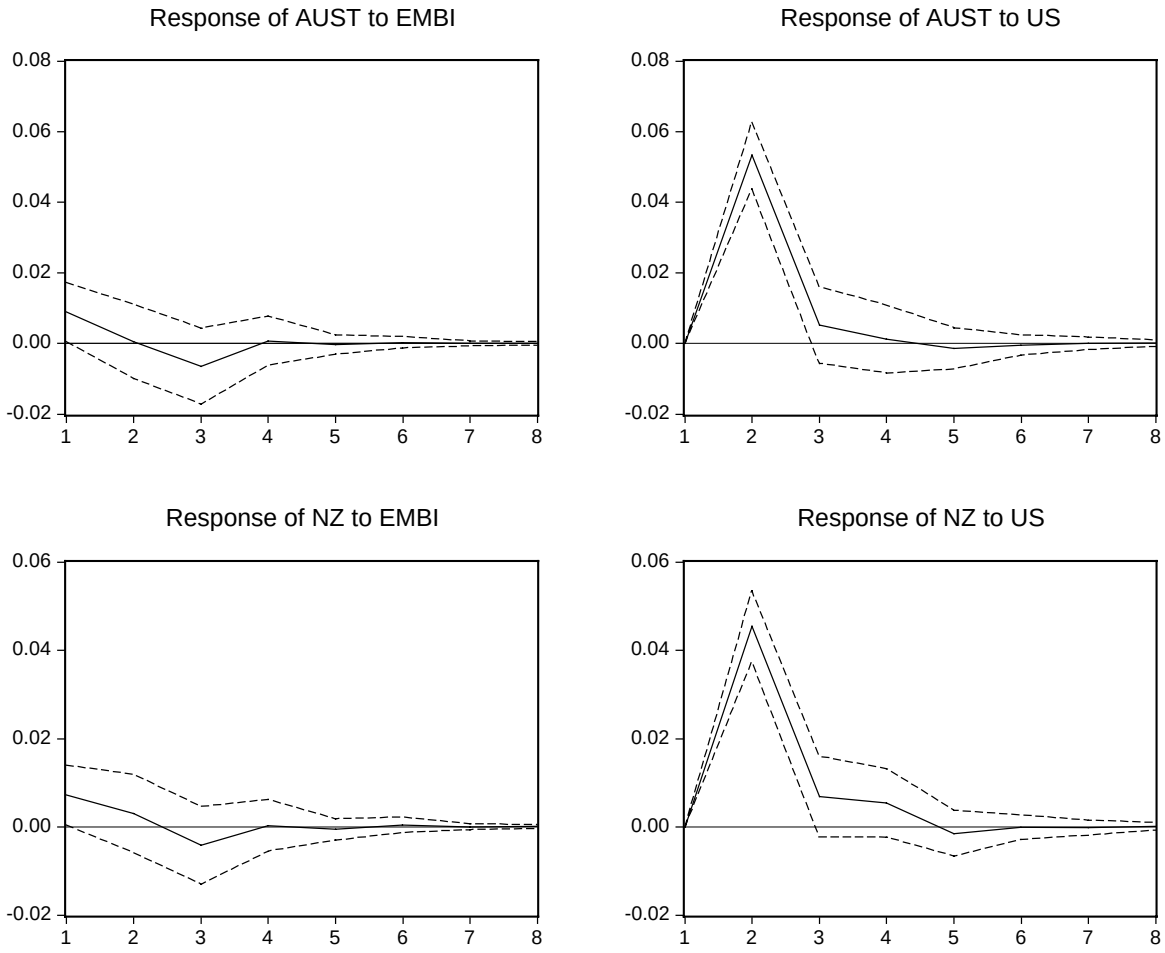


Table 16

Bonds variance decompositions, post-crisis

Period	SE	AUST	NZ	US	EMBI
Australian bond futures					
1	0.049935	99.16257	0.000000	0.000000	0.837429
2	0.090021	31.04368	0.838819	67.54907	0.568431
5	0.091860	30.09983	2.325278	66.23066	1.344231
New Zealand bond futures					
1	0.038648	33.54632	66.44916	0.000000	0.004515
2	0.069849	10.40950	21.72016	67.35815	0.512196
5	0.071256	10.30448	22.30867	65.30996	2.076893

Asia, as proxied by EMBI, accounted for an insignificant part of the variation in the US market (less than 1%).[18]

[18] In this section and the section presenting results for the bilateral exchange rates, we omit the impulse responses and variance decompositions for the US and Asian variables from the graphs and tables. These results are available from the authors (but see also Figures and Tables 13–20).

There are a number of possible reasons for this smaller response to Asian crisis events than is the case for stocks. In particular, bond yields are determined primarily by expectations of inflation and (domestic) real interest rates. Therefore, bond returns should be less affected by corporate sector and trade developments than are other markets, and so the economic linkages rationale for contagion between asset markets (Lowell et al. (1998)) is not as important. This would tend to result in a more muted reaction in bond markets than for stocks and, particularly, exchange rates.

4.3 Exchange rates

There was a clear reaction of the Australian dollar/US dollar and New Zealand dollar/US dollar to movements in Asian markets during the Asian crisis (Figure 18). This response was much more obvious than in the other two markets. Exchange market movements in Asia were significant during the Asian crisis, accounting for just under 8% of the variation in the Australian dollar/US dollar rate, and around 5.5% of the New Zealand dollar/US dollar.[19] There was also a significant impact on the New Zealand dollar/US dollar rate in the pre-crisis period. In the other periods, the impulse responses were not more than two standard deviations from zero (although nearly so for the Australian dollar/US dollar in the world crisis; see also Figures and Tables 17–20). While this might partly reflect the poor fit of the linear model – evidenced by the large error bands in most periods – it makes the contrast with the Asian crisis period even more striking.

As might be expected from the results in Section 3.2, another feature of these results is the increasing importance of the CRB index in explaining daily movements in both the Australian dollar/US dollar and New Zealand dollar/US dollar exchange rates. Since Australia's and New Zealand's exports have tended to become more diverse over time, rather than more concentrated in commodities, this result cannot reflect changing fundamentals. In any case, the extent of the change in exchange rate behaviour is probably too dramatic to be explained by a shift in the composition of exports. Moreover, the composition of the CRB index is not a particularly good match with the commodities exported by Australia and New Zealand, perhaps suggesting that short-term movements in these exchange rates have become *less* aligned with genuine fundamentals over time. This type of development may be evidence that financial market integration brings an increased proportion of less-informed traders to regional markets, who may look to indicator variables with little information content – but high-frequency availability – in forming their views and trading strategies. In this context, the theoretical findings of Calvo and Mendoza (1999) seem particularly pertinent. On the other hand, the increasing importance of the CRB index may simply reflect that the shocks to commodity prices were concentrated in the components of the index most relevant to Australian and New Zealand exports, despite the index as a whole being an imperfect measure of prices of these exports.

4.4 Interpretation

Our results indicate that responses to crises can vary between asset classes. There is not a uniform notion of increased uncertainty driving a uniform result: rather, each asset class is influenced by both common and market-specific factors. In addition, there are differences between the results in the Asian crisis and world crisis periods, which may reflect the different nature of shocks hitting Australian and New Zealand financial markets in the two periods. The Asian crisis countries are largely commodity importers and significant trading partners of Australia and New Zealand; the countries in financial distress in the world crisis period – primarily Russia and Brazil – are commodity exporters with little bilateral trade with Australia and New Zealand, although they are competitors in third markets.

The VAR estimates imply that Australian and New Zealand stock and (to a lesser extent) bond markets were *less* affected by movements in Asian markets during the crises than at other times. That is, spillover from these markets in crisis to unrelated markets appears to be weaker than it is between

[19] The large fraction of New Zealand dollar/US dollar variability accounted for by the Australian dollar/US dollar rate is an artefact of our recursive ordering identification scheme, and may reflect that the Australian and New Zealand dollars tend to be traded as a bloc.

markets that are already in similar environments. Put (very loosely) in the language of the "heat wave" versus "meteor showers" literature (Engle et al. (1990)), these markets do not react more to "meteors" during crises – they are simply being hit by bigger meteors then. However, these results could partly reflect the type of information captured by a regional market index. Financial market returns depend on common – or "global" – shocks, regional shocks and country or "country-specific" (idiosyncratic)

Figure 17

Impulse responses for four-variable exchange rate returns VAR, pre-crisis

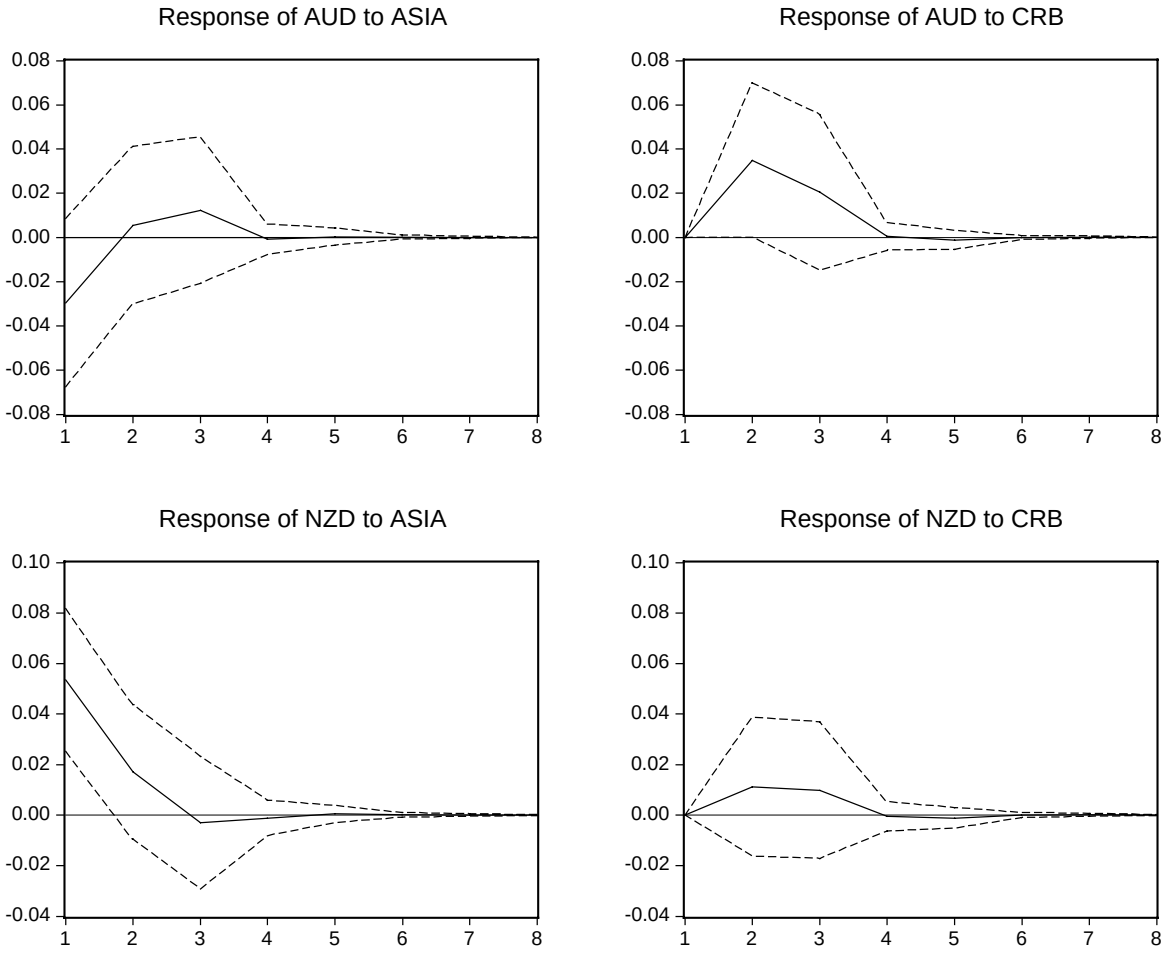


Table 17

Exchange rate variance decompositions, pre-crisis

Period	SE	A$	NZ$	CRB	ASIA
A$/US$					
1	0.467578	99.60259	0.000000	0.000000	0.397409
2	0.469042	99.03066	0.005615	0.555170	0.408558
5	0.470090	98.59864	0.184398	0.740829	0.476135
NZ$/US$					
1	0.359507	21.97531	75.80229	0.000000	2.222405
2	0.360846	22.20538	75.26712	0.096069	2.431432
5	0.363045	22.13094	75.28926	0.169456	2.410339

Figure 18

Impulse responses for four-variable exchange rate returns VAR, Asian crisis

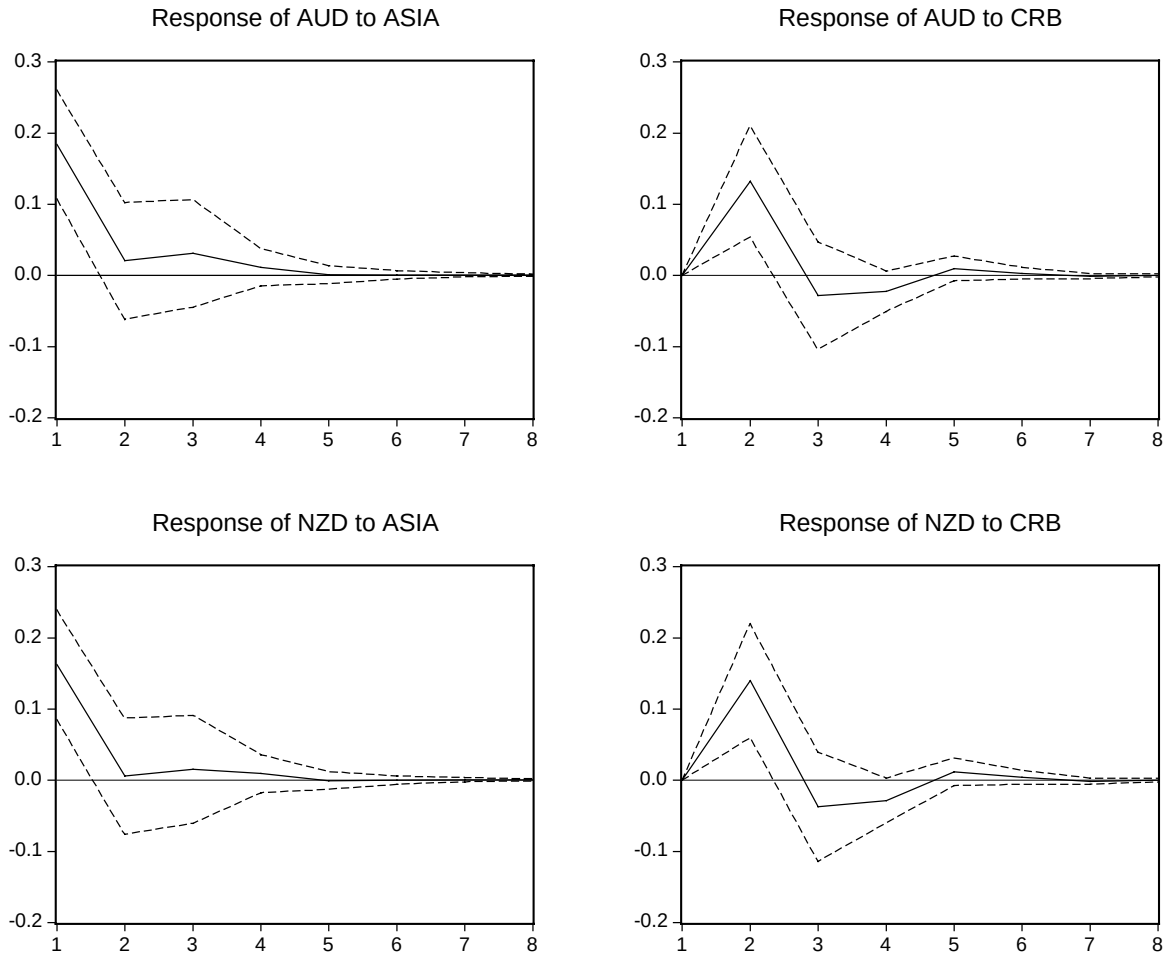


Table 18

Exchange rate variance decompositions, Asian crisis

Period	SE	A$	NZ$	CRB	ASIA
A$/US$					
1	0.659907	92.22623	0.000000	0.000000	7.773767
2	0.673344	88.59132	0.002285	3.851255	7.555144
5	0.680216	87.78647	0.500349	4.081009	7.632175
NZ$/US$					
1	0.671578	54.82092	39.36661	0.000000	5.812462
2	0.687084	52.45903	37.85542	4.126116	5.559432
5	0.696805	52.63966	37.39013	4.501398	5.468811

Figure 19

Impulse responses for four-variable exchange rate returns VAR, world crisis

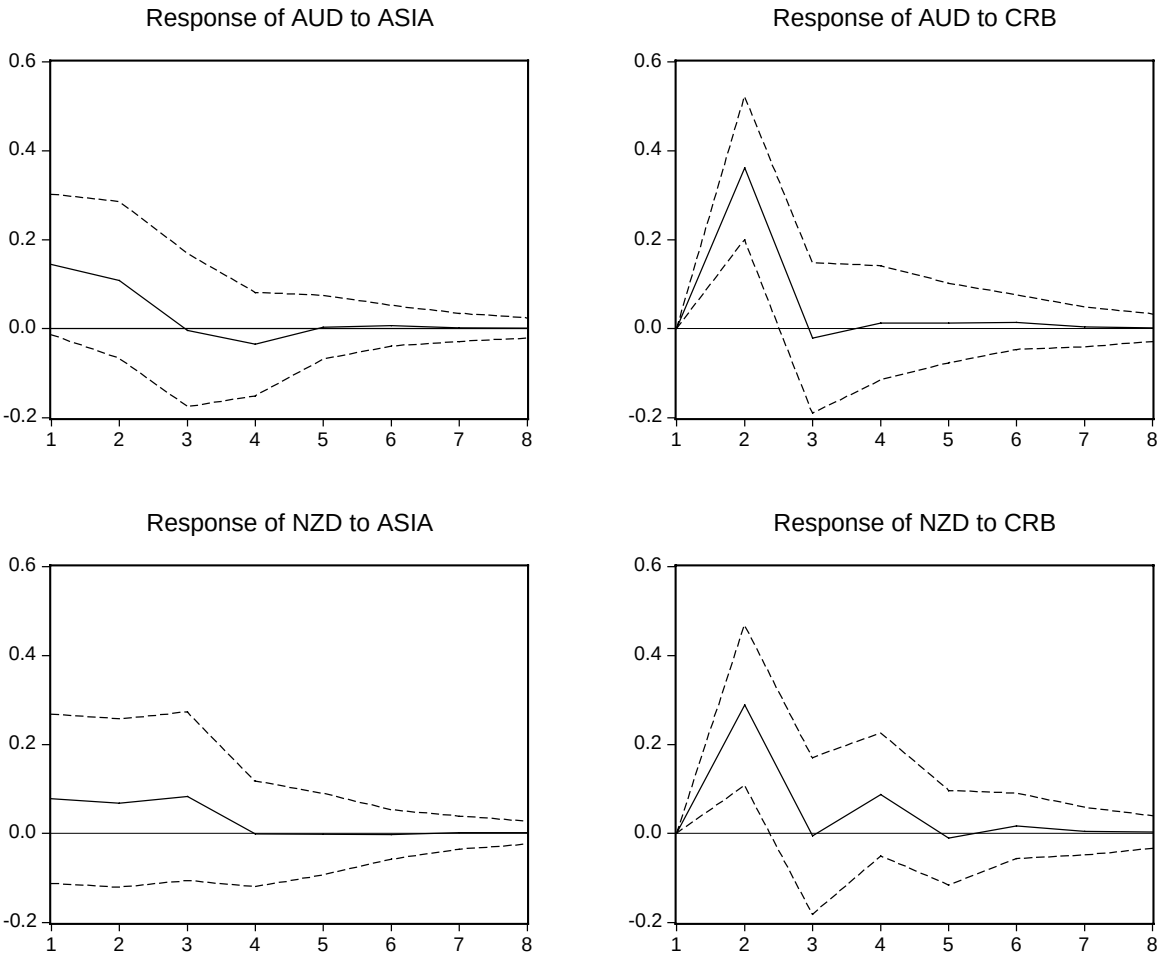


Table 19

Exchange rate variance decompositions, world crisis

Period	SE	A$	NZ$	CRB	ASIA
A$/US$					
1	0.645511	95.02422	0.000000	0.000000	4.975782
2	0.753993	70.71614	0.618036	22.94515	5.720675
5	0.761877	70.34418	1.233740	22.60467	5.817406
NZ$/US$					
1	0.759300	58.14465	40.80457	0.000000	1.050773
2	0.821129	50.83597	35.23830	12.35003	1.575700
5	0.850081	52.00823	32.95247	12.61087	2.428423

Figure 20

Impulse responses for four-variable exchange rate returns VAR, post-crisis

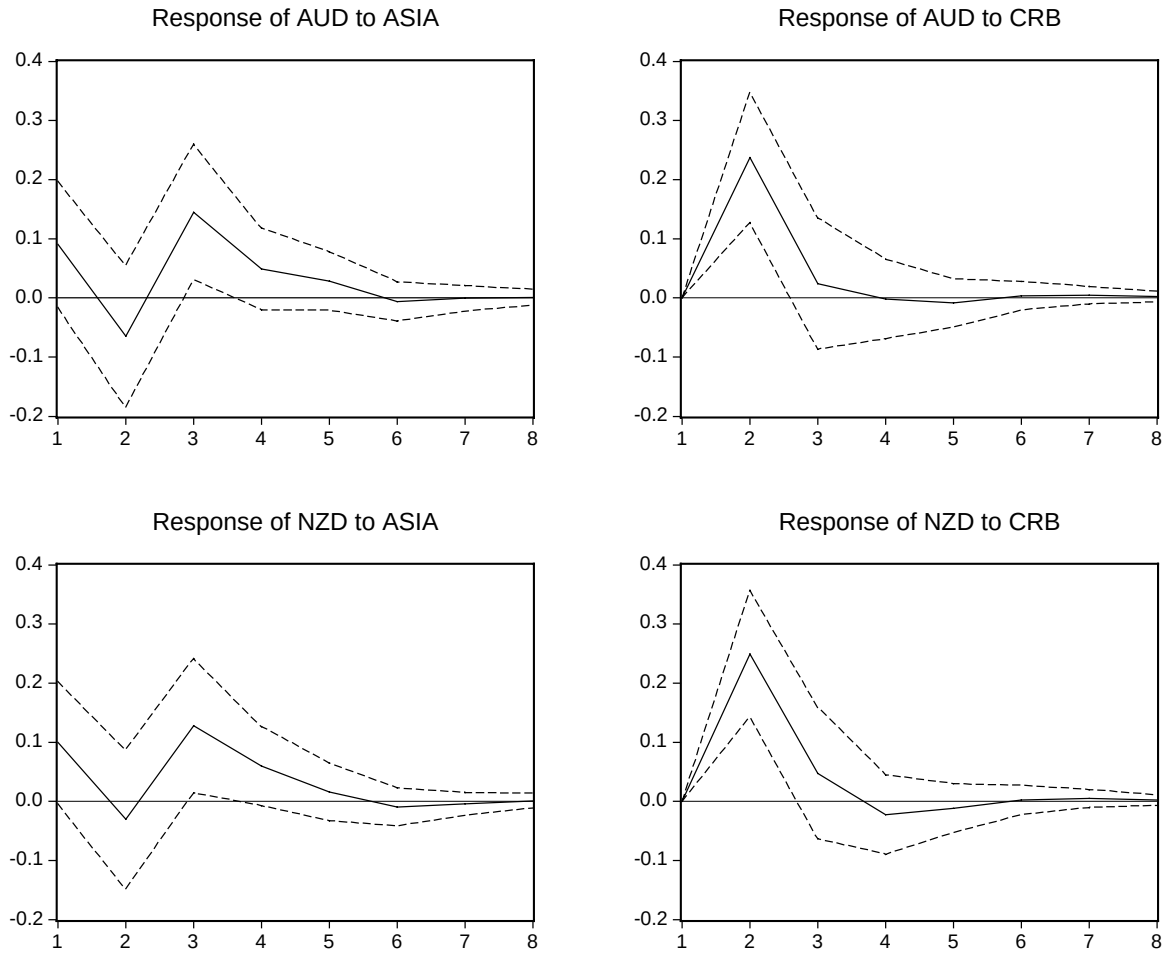


Table 20

Exchange rate variance decompositions, post-crisis

Period	SE	A$	NZ$	CRB	ASIA
A$/US$					
1	0.608434	97.79013	0.000000	0.000000	2.209869
2	0.656944	84.05403	0.025924	13.04857	2.871475
5	0.678600	79.40476	0.259016	12.37287	7.963361
NZ$/US$					
1	0.588463	57.72139	39.42747	0.000000	2.851140
2	0.640428	48.84315	33.33962	15.18252	2.634709
5	0.661120	46.46302	31.55317	14.91386	7.069949

shocks. By using a regional index, we are effectively averaging across country-specific shocks, so that most of the information in the series will reflect regional and global shocks. The global shocks are important for Australia and New Zealand, but this should be interpreted as all markets being affected by a common (global) shock, rather than spillover of an Asian region shock to Australia and New Zealand.

During the crisis periods, however, the Asian market variables incorporate idiosyncratic (country-specific) and regional shocks that were much larger than in non-crisis periods. Also, although country-specific shocks would ordinarily tend to average out and thus not show up in a regional index, this may not have been the case during the Asian crisis, as shocks were disproportionately negative in that period. These Asia-specific shocks may be less important to Australian and New Zealand markets than the global shocks also captured in the Asian data. Therefore, the estimated coefficients on the stock price indices during the Asian crisis period might have been smaller because the series contained *proportionally less* information relevant to markets in Australia and New Zealand.

By contrast, spillover of financial market volatility to *exchange rates* was greater during the crises than at other times. This difference is an example of the tendency for the asset class to matter more in determining spillover than did the country where the market was located. Indeed, the importance of Asian export markets for Australia and New Zealand may imply that Asia-specific shocks are *more* important than other shocks for exchange rates.

These results are not necessarily conclusive, as they might have some limitations. In particular, by using linear VAR econometric models, we have ignored the well-documented ARCH characteristics seen in most financial data sets, including the ones used in this paper. On the other hand, our investigations suggest that accounting for these characteristics does not affect the essential results.

5. Conclusion

Our results represent a first pass at examining the spillover of financial returns across markets, specifically the reactions by Australian and New Zealand markets to news about financial crises in other countries. We find that news events and movements in Asian financial markets had noticeable effects on financial markets in Australia and New Zealand. These events were not the *primary* determinant of Australian and New Zealand financial returns during the crises, however. During the Asian crisis, domestic developments generally accounted for more than half of the variation in Australian and New Zealand returns. The few cases where domestic shocks accounted for less than half of the total variation in daily returns reflected the apparent common shock affecting both the Australian dollar and New Zealand dollar exchange rates. In the post-crisis period, the US bond market also had a strong influence on its Australian and New Zealand counterparts.

Developments in US markets were more important than Asian market returns for Australian and New Zealand stocks and bonds. This result may be another example of the close relationship between US and Australian economic variables seen in other studies (Gruen and Shuetrim (1994), de Roos and Russell (1996) and Kortian and O'Regan (1996)). Moreover, the results from Section 3 suggest that stock markets in Australia and New Zealand seem to have reacted to Asian news with a lag. This may indicate that market participants wait until they observe the reaction in the United States before responding to the news. If true, this finding suggests that participants in financial markets do not process information efficiently. On the other hand, the reactions to movements in Asian financial markets, shown in Section 4, did indicate a contemporaneous relationship.

The results show that different asset classes can react differently to the same events. The bond markets were little affected by developments in Asia, while the stock markets displayed a (sometimes delayed) clear reaction; exchange rates were the most affected by events in Asia. These differences probably reflect that, even though financial markets react to the same set of information about fundamentals, the relative importance of particular aspects of fundamentals can vary greatly across asset classes. For example, returns on bonds are largely driven by expectations of future developments in inflation and monetary policy. The implications of the Asian news events for Australian and New Zealand inflation (via exchange rate depreciations) may have been offset by a "flight to quality", and by expectations that the world real interest rate had fallen in response to the contraction in Asian demand. In addition to expected inflation and interest rates, stock market returns reflect corporate profitability and indicators of world demand such as commodity prices. Therefore, a downturn in Asia and elsewhere would reduce expected returns on Australian and New Zealand stocks.

The currencies of the two countries were the asset class most affected by Asian news events. This supports the idea that trade developments, such as recessions in trading partner nations, affect exchange rates more than they affect returns on other assets. The economic contractions in Asia would have reduced demand for differentiated products exported to Asia, and also tended to reduce commodity prices. Consequently the bilateral exchange rates of the Australian dollar and New Zealand dollar against the US dollar depreciated through the Asian crisis period.

The world crisis period, on the other hand, was characterised by small appreciations in the currencies. These were despite the large falls at the end of August 1998, which largely reflected developments in global financial markets and the positions of highly leveraged traders. This seems in line with the different implications of the world crisis for commodity prices, given that the countries newly affected then tended to be commodity exporters. We would therefore expect smaller depreciations in other commodity exporters' currencies, since depreciation of a competitor's currency will only affect commodity prices in US dollar or own currency terms if the competitor responds by increasing its supply of commodities onto the world market. This effect was offset by the effects of market participants unwinding the short positions in the Australian dollar and New Zealand dollar built up towards the end of the Asian crisis period, resulting in a net appreciation.

We did not find any evidence of significant differences between the reactions of Australian and New Zealand markets, despite the differences in the monetary policy stances and operational regimes in those countries. This may reflect the similarities in their other fundamentals and in particular that the two currencies tend to be traded as a bloc.

In essence, our results suggest that financial markets may be buffeted by shocks spilling over from other markets in crisis. Even when markets are not dragged into crises, some spillover of shocks clearly occurs for at least some asset classes. This can sometimes occur regardless of domestic fundamentals, as evidenced by the exchange rate volatility in the world crisis period being at least as high as – if not higher than – in the Asian crisis period. This occurred even though the Asian crisis countries are more important trade partners for Australia and New Zealand than the countries dragged into the world financial crisis of late 1998, and, again, probably reflects the turmoil in markets generally, rather than reactions to crises in specific countries.

Appendix: Chronology of major events in the Asian crisis

Date	Event	Type of news
1997		
15 May	Thailand, after a week of selling pressure and massive intervention in the forward markets, announces wide-ranging capital controls aimed at segmenting the onshore and offshore markets.	bad
27 June	The BoT suspends the operations of 16 troubled finance companies and orders them to submit merger or consolidation plans.	bad
2 July	Floating of the Thai baht (baht devalues by 15% in onshore markets, 20% in offshore markets). Pressure spreads to the Philippine peso, Malaysian ringgit and Indonesian rupiah.	bad
11 July	BSP announces the peso will float in a wider range, abandoning the de facto peg. BI widens the rupiah trading band from 8% to 12%.	bad
14 July	BNM is reported as abandoning the defence of the ringgit.	bad
28 July	Thai government requests IMF assistance.	bad
5 August	Thailand suspends a further 42 troubled finance companies.	bad
14 August	Indonesia abandons the rupiah trading band. The rupiah depreciates by 4%.	bad
20 August	Thailand and the IMF agree on a US$ 17 billion financial stabilisation package.	good
27 August	Malaysia imposes trading restrictions on the stock market including an effective ban on short selling.	bad
29 August	BI introduces selective credit controls on rupiah trading.	bad
8 October	Indonesia announces it will seek IMF assistance.	bad
17 October	Malaysia announces an austerity budget. Authorities stop supporting the new Taiwan dollar, which falls by 6%. Pressure on Hong Kong dollar and equity markets intensifies. Review of Thai emergency funding.	bad
20–23 October	Financial turbulence in Hong Kong. Hang Seng index falls by 23% in four days. Overnight interest rates rise from 7% to around 250%. S&P downgrades Korea's and Thailand's sovereign ratings.	bad
27 October	The Dow Jones loses 554 points, following the crash in the Hang Seng. Equity markets in Brazil, Argentina and Mexico see their biggest single-day losses, as the crisis ripples across the globe.	bad
28 October	Russian equity prices decline by 23%.	bad
31 October	Bank resolution package announced in Indonesia, resulting in the closure of 16 troubled private banks. Leads to a depositor run on others. After intense pressure on the real, the Central Bank of Brazil doubles the central bank intervention rate to 43%.	bad
5 November	IMF standby credit for Indonesia of US$ 10.1 billion approved; US$ 3 billion made available immediately.	good
10 November	In Thailand, opposition leader Chuan Leekpai takes over as Prime Minister. In Russia, interest rates raised by 7 percentage points and authorities announce that the intervention band for the rouble will be widened from ±5% to ±15%.	bad
17 November	Korea abandons defence of the won.	bad
18 November	Korean finance minister resigns. Authorities announce a reform package.	bad
20 November	Daily fluctuation band for the Korean won widened from ±2¼% to ±10%.	bad
21 November	Korea requests IMF assistance.	bad
3 December	Korea and the IMF agree on a US$ 57 billion financial assistance package.	good
8 December	Thai authorities close 56 of the suspended finance companies.	bad
16 December	Floating of the Korean won.	bad
23 December	Rating agencies downgrade Korea's sovereign rating to speculative grade. The won falls to nearly 2,000 to the US dollar.	bad

24 December	IMF and other lenders announce speeding-up of disbursement of financial assistance and that international commercial banks will roll over short-term debts owed by Korean financial institutions.	good
30 December	Foreign banks agree to roll over Korean debt.	good
1998		
2 January	Indonesia announces plans to merge four out of seven state-owned banks. Malaysia announces plans for mergers of finance companies.	good
6 January	Indonesian budget introduced: badly received by financial markets.	bad
13 January	Thailand amends law for foreign investors in banks to be reclassified as domestic companies, allowing them to hold property.	good
15 January	Indonesia and the IMF announce agreement on revised economic programme aimed at strengthening and reinforcing the ongoing IMF-supported programme.	good
16 January	International lenders officially agree to roll over Korean short-term bank debt.	good
20 January	Thailand allows full foreign ownership of securities firms.	good
27 January	Indonesia guarantees commercial bank obligations, allows overseas investments in local banks and announces a freeze on debt payments.	good
29 January	Agreement between Korea and its external creditors to exchange $US 24 billion of short-term debt for government-guaranteed loans at 2¼–2¾ percentage points over six-month LIBOR.	good
30 January	Thailand lifts currency restrictions, reunifying the spot market.	good
9–10 February	Indonesia's plan to create a currency board is opposed by the IMF and several creditor governments, which threaten to withdraw financial assistance.	bad
13 February	IMF Managing Director Camdessus expresses further concern over Indonesia's move to a currency board. He is of the "strong view" that the time for a currency board in Indonesia has "not yet come" because of a number of preconditions.	bad
4 March	In a second review of Thailand's economic programme, the IMF relaxes certain macroeconomic policy targets and approves disbursement of second tranche.	good
10 April	Indonesia signs new letter of intent on economic programme with IMF.	good
21 May	Indonesia's president Suharto resigns.	bad
25 May	The Korean stock market falls to an 11-year low.	bad
1 June	The Thai stock market index, continuing its slide from early March, falls to a 10-year low.	bad
4 June	Indonesian authorities reach an agreement to restructure the external debt of Indonesia's banking and corporate sectors.	good
10 June	Third Quarterly Review of Thailand's assistance programme: indicated restructuring on track.	good
2 July	World Bank approves a US$ 1 billion loan to Indonesia. Loan is part of US$ 4.5 billion pledged by the World Bank in 1997.	good
8 July	S&P affirms its CCC+ rating on the Republic of Indonesia's US$ 400 million yankee bond due in 2006, and the CCC+ long-term foreign currency and B– long-term local currency issuer credit ratings. Outlook is now described as negative.	bad
10 July	Malaysian stock index hits nine-year low.	bad
16 July	IMF approves US$ 1 billion payment and promises another US$ 6 billion to Indonesia.	good
24 July	Moody's cuts Malaysia's foreign currency debt rating to Baa2 from A2. Reasons cited are: the country's recession, its growing debt and lack of clear policy direction in response to the Asian crisis.	bad
4 August	Philippines benchmark stock index slides to its lowest level since April 1993 on continuing loss of confidence in the region.	bad
6 August	Malaysia's sovereign risk rating cut to BBB from A by Thomson BankWatch.	bad
7 August	Singapore stock index reaches a 9.5-year low.	bad
11 August	Agence France-Presse (AFP) reports that the Indonesian government is in default on some of its sovereign debt. The government denies this.	bad
13 August	Moody's and S&P cut ratings for Russian sovereign debt.	bad

14 August	Hong Kong government intervenes in the stock market, purchasing an estimated HK$3 billion in stocks and futures, in an attempt to stop the speculation against the currency.	bad
17 August	Russia allows the rouble to float freely within a corridor between 6.00/9.50 to the US dollar and makes some other changes to Russian financial markets. S&P cuts Russia's long-term foreign currency debt rating to CCC from B–.	bad
25 August	IMF Executive Board approves extended funding arrangement for Indonesia.	good
31 August	S&P downgrades Hong Kong's sovereign credit rating to A, with a negative outlook. The rating agency also cites a decline in Hong Kong's financial strength because of the Asian crisis.	bad

Sources: BIS (1998), Table VII.6, p. 131 and IMF (1998), Box 2.12, p. 49.

Bibliography

Almeida, A, C A E Goodhart and R Payne (1998): "The Effects of Macroeconomic News on High Frequency Exchange Rate Behaviour". *Journal of Financial and Quantitative Analysis*, 33(3), pp. 383–408.

Andersen, T G, T Bollerslev, F X Diebold and P Labys (1999): "The Distribution of Exchange Rate Volatility". Wharton Financial Institutions Center, *Working Paper*, No. 99–08, University of Pennsylvania.

Bank for International Settlements (1998): *68th Annual Report*.

Baig, T and I Goldfajn (1998): "Financial Market Contagion in the Asian Crisis". *IMF Working Paper*, WP/98/155, November.

Baig, T and I Goldfajn (1999): "Financial Market Contagion in the Asian Crisis". *IMF Staff Papers*, 46(2) pp. 167–95.

Calvo, G A and E G Mendoza (1999): "Rational Contagion and the Globalisation of Securities Markets". *NBER Working Paper*, No. 7153.

Campbell, F and E Lewis (1998): "What Moves Yields in Australia?" Reserve Bank of Australia, *Research Discussion Paper*, No. 9808.

Chatfield, C and A J Collins (1980): *Introduction to Multivariate Analysis*. London, Chapman and Hall Ltd.

Cooley, W W and P R Lohnes (1971): *Multivariate Data Analysis.* New York, John Wiley and Sons.

De Roos, N and W Russell (1996): "Towards an Understanding of Australia's Co-movement with Foreign Business Cycles". Reserve Bank of Australia, *Research Discussion Paper*, No. 9607.

Dungey, M (1999): "Contagion in Currency Crises: What do We Mean?" La Trobe University, *mimeo*. Available from http://www.business.latrobe.edu.au/staffhp/mardihp/mardi3~1.htm (accessed 7 September 1999).

Dungey, M and V Martin (1998): "Contagion in the East Asian Currency Crisis". La Trobe University, *mimeo*. Available from http://www.business.latrobe.edu.au/staffhp/mardihp/mardi3~1.htm (accessed 7 September 1999).

Eichengreen, B, A Rose and C Wyplosz (1995): "Exchange Market Mayhem: The Antecedents and Aftermath of Speculative Attacks". *Economic Policy: A European Forum*, 21, pp. 251–312.

Eichengreen, B, A Rose and C Wyplosz (1996): "Contagious Currency Crises: First Tests". *Scandinavian Journal of Economics*, 98(4), pp. 463–84.

Engle, R F, T Ito and W Lin (1990): "Meteor Showers or Heat Waves? Heteroskedastic Intra-Daily Volatility in the Foreign Exchange Market". *Econometrica*, 58(3), pp 525–42.

Fleming, M and J A Lopez (1999): "Heat Waves, Meteor Showers and Trading Volume: An Analysis of Volatility Spillovers in the U.S. Treasury Market". Federal Reserve Bank of San Francisco *Working Papers in Applied Economic Theory*, 99–09.

Fleming, M and E Remolona (1997): "What Moves the Bond Market?" *Federal Reserve Bank of New York Economic Policy Review*, 3(4) pp. 31–50.

Gruen, D W R and G Shuetrim, (1994): "Internationalisation and the Macroeconomy", in P Lowe and J Dwyer (eds.), *International Integration of the Australian Economy*, Proceedings of a Conference, Reserve Bank of Australia, Sydney, pp. 309–63.

International Monetary Fund (1998): "The Asian Crisis: Capital Markets Dynamics and Spillover, Chronology of Major Events in the Asian Crisis and its Spillover". *IMF World Economic Outlook*, September.

International Monetary Fund (1999): "IMF-Supported Programs in Indonesia, Korea and Thailand: A Preliminary Assessment". Prepared by T Lane and others, January.

Kaminsky, G L and S L Schmukler (1999): "What triggers market jitters? A chronicle of the Asian Crisis". *Journal of International Money and Finance*, 18(4), pp. 537–60.

Kim, S-J (1996): "Inflation News in Australia: Its Effects on Exchange Rates and Interest Rates". *Applied Financial Economics*, 6, pp. 225–31.

Kim, S-J and J Sheen (1998): "International Linkages and Macroeconomic News Effects on Interest Rate Volatility – Australia and the US". University of Sydney, *Working Papers in Economics*, No. 98–11.

Kim, S-J (1999): "The Short-Term Dynamics of Bond Futures Market Response to New Information: Australian Evidence". University of New South Wales School of Banking and Finance, *Working Paper*, 1999–03.

Kortian, T and J O'Regan (1996): "Australian Financial Market Volatility: An Exploration of Cross-Country and Cross-Market Linkages". Reserve Bank of Australia, *Research Discussion Paper*, No. 9609.

Lowell, J, C R Neu and D Tong (1998): "Financial Crisis and Contagion in Emerging Market Countries". RAND MR–962, available from: http://ftp.rand.org/publications/MR/MR962/MR962.pdf/ (accessed 13 September 1999).

Masson, P (1998): "Contagion: Monsoonal Effects, Spillovers, and Jumps between Multiple Equilibria". *IMF Working Paper*, WP-98/142.

Roubini, N (1999): "Asia Chronology: Chronology of the Asian Currency Crisis and its Global Contagion". Available from http://www.stern.nyu.edu/~nroubini/asia/AsiaChronology1.html and http://www.stern.nyu.edu/~nroubini/asia/AsiaChronology1998.html (accessed 20 August 1999).

Silverman, B W (1986): *Density Estimation for Statistics and Data Analysis.* London, Chapman and Hall Ltd.

World Bank (1998): *World Bank Atlas.* Washington DC.