This is the published version:


Available from Deakin Research Online:

http://hdl.handle.net/10536/DRO/DU:30017804

Reproduced with the kind permission of the copyright owner.

Copyright : 2008, Deakin University
Ups and Downs: Australian Trade Follows a Volatile $A

Terry Boulter and Ronny Marlina

If you thought that Australian exchange rate volatility and the volatility of Australia’s exports was affected during the Asian financial crisis, you were right. But what is the situation when things are normal – and how much difference does a crisis make?

Over the past thirty years, analysts have probed the relationship between the exchange rates and trade. It has been difficult to pin down a neat answer to the question of whether there was a relationship, and if there was, what kind of relationship it was\(^1\). Did trade go up, down or stay the same following a volatile exchange rate? Were all industries affected? Were imports as well as exports? And how long before the effects kicked in? Internationally, the jury has been out on whether there is a relationship between currency movements and trade volume – and whether there are opportunities for importers and exporters to take advantage of volatility, or whether excessive exchange changes require government intervention.

But whatever the relationship for the rest of the world, for a twenty five year period over the last quarter of the 20th century, for Australia, the relationship is now clear. For the first time in an Australian study, we looked at the volatility of exchange rates and trade volume during Australia’s three recent currency exchange ‘eras’. We looked at the overall trade figures, as well as breaking figures down sector by sector\(^2\) with data on Australia’s trade with its major partners – the US, Japan, UK and Korea\(^3\).

Australia is a good example because it had three distinct periods of exchange rate activity, moving from a stable exchange rate when the exchange rate was fixed; to a changing exchange rate when it was floated on December 12th 1983; and then to a volatile exchange rate during the Asian financial crisis which ran from 1996 to 2001\(^4\).

We used two models to work out whether there was any impact. One model – an international trade model, included an exchange rate volatility variable. The other model – a trade volume model, also used a volatility variable. These models are described and compared in more detail in the section on method.

---

\(^1\) A good survey of this literature is provided by McKenzie (1993).

\(^2\) Sector by sector analysis tables are available from the authors on request.

\(^3\) The study covers a twenty five year period from 1977 to 2002. During this period, China was not one of Australia’s major trading partners. This, of course, is not the case as at 2008.

\(^4\) Note that the study did not test whether these three periods in time represent structural breaks in an econometric sense. Instead, the periods were chosen subjectively and compared as periods representing distinct periods in the history of the Australian dollar.
Australia’s Three Recent Exchange Rate ‘Eras’

From 1977 to 2002, there were three exchange rate ‘eras’ for the Australian dollar. Between 1977 and 1983, the exchange rate for the Australian dollar was fixed. In 1983, the exchange rate was floated, creating the second exchange rate ‘era’ of modern times. In 1996, the third ‘era’ began with the Asian Financial Crisis, which continued until 2001.

Overall, the findings of the two models about the relationship between exchange rate volatility and trade volumes were consistent, and the results are summarised in Table 1. The relationship between exchange rate volatility and trade is most noticeable during periods of high exchange rate volatility.

TABLE 1: EXCHANGE VOLATILITY AND ITS IMPACT ON TRADE VOLUMES

<table>
<thead>
<tr>
<th>FIXED EXCHANGE RATE</th>
<th>FLOATING EXCHANGE RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable exchange rate</td>
<td>Normal exchange rate (not moderately volatile)</td>
</tr>
<tr>
<td>Exchange rate volatility had no impact on trade flow</td>
<td>Using the international trade model we found that a volatile exchange rate was linked to trade declining in 75 of cases covering imports and exports. The trade volume model found that a volatile exchange rate did affect trade, but it was more noticeable during the crisis (see next column). As the exchange rate becomes more volatile, the variance in trade volume goes down, i.e., traders reduce their business, so trade volume has lower variance. When the exchange rate becomes less variable, the trade volume volatility goes up, i.e., traders take on new, larger orders.</td>
</tr>
<tr>
<td>Both models found that there was no relationship between exchange rates and trade volume or variation</td>
<td>The international trade model found that for two sectors – manufacturing and capital goods – there is no relationship between exchange rates and trade. But for the others, there is a negative relationship. As volatility goes up, trade goes down; as volatility goes down, trade goes up. Both models showed that there is a time lag between a volatile exchange rate and the volume of trade, and there is a significant negative impact, i.e., trade goes down. Under the international trade model, exports to the US, Japan, UK and Korea go down four months after an increasingly volatile exchange rate, particularly for the resources sector. Rural exports go down after seven months. Imports, including consumption and intermediate goods, also go down after four months. As volatility increases, trade goes down. As volatility decreases, trade goes up.</td>
</tr>
</tbody>
</table>

07 DEAKIN BUSINESS REVIEW
The Australian dollar has traded at a fixed exchange rate, at a floating exchange rate; and during the late 1990s, traded as a floating exchange rate, through a major financial crisis, the Asian financial crisis. During the fixed exchange rate period, as you might expect when the exchange rate is managed, risks are lower, and thus there is little or no impact on trade. However, when the dollar was floated and later when the Asian financial crisis hit, the exchange rate became volatile and it had an impact on Australian trade. In fact, when the exchange rate is most volatile during a crisis, the effect on trade is worst. When the Australian dollar is more volatile, Australian trade goes down. This is not a finding that other research has been able to confirm. In fact, Mckenzie (1999) who surveys the literature, finds mixed results. Some find a relationship, others do not. He does, however, point out that 'more recent papers appear to be having greater success in deriving a statistically significant relationship between volatility and trade' (p. 100). In this study of Australian trade and AUD volatility, this was found to be the case.

Data

Trade data: we used monthly bilateral trade volumes between Australia and the United States, Japan, Korea and the UK from July 1977 to December 2002. This imports and exports data is published by the Reserve Bank in its quarterly trade figures.

Exchange rate: we used the Australian real effective exchange rate (REER), an inflation adjusted, trade weighted index, for two reasons. This rate is adjusted for inflation, a factor that affects traders' decisions to trade. If we had used data which didn't take inflation into account, the relationship between trade and the Australian dollar could be distorted by inflation. In addition, when using REER, exchange rate fluctuations don't simply reflect a particular bilateral relationship, but the multilateral nature of trade. »

5 The Asian Financial Crisis began in 1997. The sample covers the period immediately before and after.
GDP: we used retail sales and industrial production index to approximate Gross Domestic Product (GDP) because it allowed us to track the data monthly, rather than quarterly. For exports we included rural goods; coal, coke and briquettes; metal ores and minerals; metals, excluding gold; other mineral fuels; machinery; transport equipment and manufacturing. For imports, we included consumption goods, capital goods and intermediate goods.

Aggregate export and import data: we divided this into rural, resources and manufacturing. We are interested in the volatility of trade, so we look at the changes in these variables, which are found to be stationary after first differencing.

Volatility: we used a definition of volatility based on the degree of unpredictability of an exchange rate. Broadly speaking, volatility can be defined in two ways, either as variation or uncertainty. Variation is how much an exchange rate changes – the larger the change, the greater the volatility. Or variation can be defined as dispersion – how far the exchange rate moves from a defined point (this is most often measured as standard deviation). Uncertainty is the unpredictability of the exchange rate. If it is harder to predict, the greater the risk, and the more volatile the currency.

Method\(^6\)

We used two models to look at monthly data over a 25 year period between July 1977 and December 2002. The models performed differently but supported our overall conclusions (as per our discussion on exchange rate ‘eras’).

\(^6\) Note that the method used within this study does not include Markov Switching models. For a good description of these see Longford (1993). These are good models when the regime changes are frequent and the time between changes is short. Estimating models of this type is onerous because of the nonlinearities inherent in the models and the long training periods required. In this study, we estimate a standard model of trade and include a volatility variable for the whole of the floating sample and then within that sample (the Asian Crisis). Other researchers often do this to check for parameter constancy.
We used two models to look at the exchange rate, one examined the relationship between exchange rate volatility and changes in trade volume; and the second between exchange rate volatility and the implied volatility in the volume of trade. The first model is:

For exports

\[
\Delta E_t = C + \sum_{i=1}^{p} \alpha_i \cdot \Delta E_{t-i} - \sum_{j=1}^{q} \beta_j \cdot \Delta \hat{e}_{t-j} + \sum_{t=1}^{T} \gamma_t \cdot \Delta A_t + \sum_{t=1}^{T} \phi_t \cdot \Delta F_t + \sum_{t=1}^{T} \theta_t \cdot \nu_t + \varepsilon_t
\]

For imports

\[
\Delta I_t = C + \sum_{i=1}^{p} \alpha_i \cdot \Delta I_{t-i} - \sum_{j=1}^{q} \beta_j \cdot \Delta \hat{e}_{t-j} + \sum_{t=1}^{T} \gamma_t \cdot \Delta A_t + \sum_{t=1}^{T} \phi_t \cdot \Delta F_t + \sum_{t=1}^{T} \theta_t \cdot \nu_t + \varepsilon_t
\]

where:

- \( \Delta E \) = changes in Australian export volume (aggregate and sectoral)
- \( \Delta I \) = changes in Australian import volume (aggregate and sectoral)
- \( \Delta A \) = changes in Australian income level
- \( \Delta F \) = changes in foreign income level (US, Japan, Korea, and UK)
- \( \Delta \hat{e} \) = changes in estimated error terms; and
- \( \nu \) = Australian exchange rate volatility.

The relationship between exchange rate volatility and trade volume was examined from two angles. The first angle examines the relationship between exchange rate volatility and changes in trade volume, while the second approach examines the relationship between exchange rate volatility and the implied volatility of trade volume. The first approach is a dynamic modelling of the relationship, while the second approach is time series analysis. The second approach models the volatility in trade volume as an autoregressive conditional heteroskedasticity (ARCH) process with the exchange rate volatility series included within the variance equation. The ARCH models for export and import volatility are:

For exports: (Eq. 1)

\[
\sigma^2_{xt} = C_0 + \sum_{i=1}^{q} \alpha_i \cdot \hat{e}^2_{x_{t-i}} + \sum_{t=1}^{T} \nu_t
\]

For imports: (Eq. 2)

\[
\sigma^2_{It} = C_0 + \sum_{i=1}^{q} \alpha_i \cdot \hat{e}^2_{I_{t-i}} + \sum_{t=1}^{T} \nu_t
\]
This approach examines whether exchange rate volatility helps to explain trade volatility. This is done by using an ARCH model of trade volatility without exchange rate volatility in the variance equation and then running the same model with exchange rate volatility within the variance equation. Comparison is then made between the two models. If the ARCH model with exchange rate volatility included in the variance equation is a superior model, then it is concluded that exchange rate volatility is an important determinant of trade volatility. This procedure is carried over each of the three sample periods. It is anticipated that exchange rate volatility will have its biggest influence during the Asian crisis.

Broadly speaking, the results from both models were consistent. The ARCH model found that exchange rate volatility is associated with trade volume variance, as did international trade regression modelling. Comparing the value of the two models, we concluded that when exchange rate volatility is included in the variance equation of the ARCH trade volume model, that the performance of that model based on the heteroskedasticity mean squared errors (HMSE) and the Akaike Information Criterion (AIC) statistics improve. The implication being that exchange rate volatility is associated with trade volume variance.

During a period of high volatility, like the Asian crisis, the International Trade model does not perform as well as it does in other periods. In times of high volatility, it is less able to predict than during normal periods. This is consistent with the intuition that periods of high volatility are associated with periods of higher risk, which are harder periods to predict.

In the period leading up to the Asian crisis it is possible to model the data using an ARCH process. However, during the Asian crisis it is much more difficult.

Where the model includes exchange rate volatility it is better than the model without it in the period leading up to the crisis. While modelling is more difficult, the findings are consistent with our others.

We also found that a time series model of trade volume variance, which includes an exchange rate volatility variable, is a better model of volatility of trade volume during periods of high volatility than it is during periods of normal volatility.

References


 Ups and Downs: Australian Trade Follows a Volatile $A -
 Dr Terry Boulter is a Senior Lecturer in Finance in the
 Deakin Business School, Ronny Marlina is a Financial
 Controller at Inter Linear Technology Pty Ltd