Modelling the crash risk of the Australian Dollar carry trade

Suk-Joong Kim*

Discipline of Finance
The University of Sydney Business School
The University of Sydney
2006 NSW Australia

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Abstract:

This paper investigates the nature and the determinants of the Australian dollar (AUD) carry trades using a Markov regime shifting model over the period 2 Jan 1999 to 31 Dec 2013. We find that the AUD has been used, except for a number of short periods notably surrounding the outbreak of the GFC, as an investment currency in a carry trade regime. We also investigate the determinants of the AUD carry trade regime probabilities. For daily horizon, prior to September 2008, carry trade regime probabilities are significantly lower in response to higher realized volatility of the USD/AUD exchange rate, number of trades, unexpected inflation and unexpected unemployment announcements. They are significantly higher when order flows are positive (more buyer than seller initialed trades of AUD) and when RBA policy interest rate unexpectedly increase. At weekly horizon, realized skewness and net long futures position on the AUD contributed to the carry trade regime probabilities. On the other hand, post-September 2008 period shows a breakdown on the relationship between carry trade regime probabilities and the determinants.

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* Tel: +61 2 9114 0940, FAX: +61 2 9351 6461, Email: sukjoong.kim@sydney.edu.au

1. Introduction

One of the enduring puzzles in the field of international finance is the forward exchange rate premium puzzle. Forward exchange rates are determined by considering the interest rate differentials of two currencies involved over a corresponding holding period. The currency that has a higher nominal interest rate attracts a forward discount, and in general its value is expected to fall by roughly the same amount as the interest rate differential. For instance, if a one year money market interest rate in Australia and the US are 5% p.a. and 2% p.a., respectively, then the Australian dollar (AUD) is traded at an annual discount roughly equal to the interest rate differential of 3% p.a.. The implication is that the currency with a forward premium (discount) is expected rise in value over the relevant holding period as indicated by the premium (discount).

However, empirical evidence thus far suggests that forward premium is a notoriously unreliable measure of future spot exchange rate. Not only is the magnitude of forecast incorrect, even the actual direction of exchange rate movement is often opposite to what is predicted. That is, higher yielding currencies tend to appreciate over the relevant holding period rather than to depreciate (Burnside et al., 2006). This presents an opportunity for currency investors who are willing to take speculative positions – borrowing in low yielding currencies (funding currencies, e.g. Japanese Yen) and invest in higher yielding currencies (investment currencies, e.g. Australian dollar, New Zealand dollar, Brazilian Real, etc.). This strategy, known as a currency carry trade, is in direct violation of Uncovered Interest rate Parity (UIP). For instance, the AUD has been one of the more important investment currencies due to the persistent positive interest rate differentials with respect to the USD and other major currencies especially against the Japanese Yen since the early 2000s. One of the motivations for the risk takers is the speculation that the *ex ante* risk premia thought to be included in the higher yielding currencies would not be matched by *ex post* exchange rate changes leading to sufficient rewards for taking the risk. The downside risk or crash risk of carry trade strategies relates to unexpectedly higher level of exchange rate volatility leading to higher probabilities of a significant loss of the exposed positions. The relevant literature reports some evidence of profitable carry trade strategies. Burnside et al. (2008) report significant gains from carry trades where carry trades diversified over a number of currencies improve the typical Sharpe ratio of hedge funds by more than 50%. Mollick and Assefa (2011) report evidence in support of carry trades involving Yen and the Swiss Frac. Colavecchio (2008) report significant carry trade opportunists involving the Japanese Yen.

This research aims to investigate the empirical determinants of the Australian dollar (AUD) currency carry trades at both daily and weekly frequencies over the period 2 1999 to 31 Dec 2012. In particular, the thresholds of underlying market (financial markets in general and foreign exchange in particular) conditions that trigger the reversal of the carry trades (i.e. crash risk) will be empirically determined.

Since the early 2000s the movements of the AUD have been increasingly influenced by currency speculators known as carry traders. They take long positions on the AUD to take advantage of the relatively high Australian interest rates compared to the lower interest rates of major currencies over the corresponding maturities. This has resulted in persistent deviations of the AUD from its economic fundamentals and occasional abrupt reversals of the movements whenever the speculators reverse their long AUD positions. To the extent that Australia is a small open economy and its financial system is significantly influenced by international capital flows, understanding the underlying factors that determine the movements of the AUD is of paramount importance.

Despite the growing importance of the role played by carry traders in the AUD market, little is known about the determinants of the AUD carry trade reversals apart from the more vague assumption of AUD market volatility being a factor. There is no published research documenting the impact of the currency speculators in the AUD market. The significance of this paper is in providing important insights into the determinants of the market characteristics that invite carry traders and trigger the reversal of their positions.

The important findings of this paper is summarized as follows. First, there is strong evidence for AUD carry trades, except for the GFC periods. The AUD consistently deviated from the uncovered interest rate parity conditions at both daily and weekly horizons.

Second, there is a significant structural break around the outbreak of the GFC in relation to the impact of the determinants of carry trades. For daily horizon estimation, during the pre-GFC period, carry trade regime probabilities are significantly lower in response to higher realized volatility of the USD/AUD exchange rate, number of trades, unexpected inflation, unexpected unemployment announcements. The probabilities are significantly higher when order flows are positive (more buyer than seller initialed trade of AUD), and when unexpected RBA policy interest rate increase occurs. On the other hand, post-GFC period reposts a breakdown on the relationship between carry trade regime probabilities and the list of explanatory variables. Only the US unemployment news elicit significant response – unexpected increase raises the AUD carry trade probabilities.

Third, of the Australian and US macroeconomic variables used as determinants, only the Australian news matter. This suggests that carry traders only pay attention to Australian economic/financial conditions in their decision making process.

Fourth, for weekly horizon, we also find that realized skewness of the AUD and net long futures positions also contributed to the carry trade regime probabilities.

The outcome of the investigations provide significant insights into the reaction functions of the currency speculators that have dominated the movements of the AUD. Knowledge gained from the proposed research is useful for all types of participants in the AUD market. For example fund managers would benefit from knowing current probabilities of the AUD crash risk to effect an appropriate currency hedge. In addition, this information would be an important factor in the Reserve Bank of Australia's intervention activities in the AUD market.

The rest of this paper is organized as follows. Section 2 presents discussion on the data and empirical methodologies used in this paper, section 3 discusses the empirical results, and section 4 offers conclusions.

2. Data requirements and methodologies

Presence of currency carry trades can be approximated as deviations from UIP conditions. Using mid prices the UIP condition is shown in (1).

$$\frac{S_{t+n}}{S_t} = \frac{(1-i_{t,n})}{(1-i^*_{t,n})} \tag{1}$$

Where

S_t = USD/AUD exchange rate at time defined as units of USD per one AUD,
n = Investment horizon, daily and weekly
$i_{t,n}, i^*_{t,n}$ = n period interest rate in the U.S. and in Australia at time t, respectively.
The USD/AUD exchange rate and the AUD and USD London money market interest rates at daily (overnight) and weekly horizons are collected at 5pm GMT in London and they are sourced from Datastream.

A deviation from the UIP condition above implies a potentially profitable carry trade transaction, however it does not specify a direction of trade that may be potentially profitable. That is, the AUD can be either a funding currency or an investment currency in the carry trade that violate the UIP condition. Alternatively, a direction of trade can be specified as in (2) and (3) below.

$$\frac{S^b_{t+n}}{S^a_t} = \frac{(1-i^a_{t,n})}{(1-i^{b*}_{t,n})} \tag{2}$$

$$\frac{S_{t+n}^{a}}{S_{t}^{b}}=\frac{(1-i_{t}^{b})}{(1-i_{t}^{a*})} \tag{3}$$

Where a and b are bid and ask quotes on the USD/AUD exchange rate Australian and U.S. money market interest rates over the daily and weekly horizons. The equation (2) specifies a carry trade transaction where the AUD is the investment currency. The left hand side (LHS) represents income from the transaction whereas the right hand side (RHS) shows the cost, both denominated in the USD. The equation (3) outlines a carry trade transaction where the AUD is a funding currency. This time the LHS represents cost and the RHS measures income. A profitable carry trade occurs when LHS>RHS in (2) and LHS<RHS in (3).

Formally, the UIP condition, in both directions and in general, is tested in a regression model of the form shown below:

$$\ln\left(\frac{S_{t+n}}{S_{t}}\right)=\alpha+\beta\cdot(i_{t,n}-i_{t,n}^{*})+\varepsilon_{t+n} \tag{4}$$

For the carry trade where the AUD is a investment currency (capital movements from U.S. to Australia at t and the reversal at t+1), the LHS is $\ln\left(\frac{S_{t+n}^{b}}{S_{t}^{a}}\right)$ and the RHS is $(i_{t,n}^{a}-i_{t,n}^{b*})$. Whereas for the reverse carry trade where the AUD is a funding currency (capital movements from Australia to U.S. at t and the reversal at t+1) the LHS is $\ln\left(\frac{S_{t+n}^{a}}{S_{t}^{b}}\right)$ and the RHS $(i_{t,n}^{b}-i_{t,n}^{a*})$.

If UIP holds, we should see an insignificant α and a positive β in the above equation with the magnitude equal to unity. This suggests, in general, that a positive interest rate differential in favour of the U.S. is associated with a proportionate appreciation of the AUD over the relevant holding period leaving zero profit for the exercise. If $\beta>1$, carry trades become unprofitable. If, on the other hand, β is statistically significant and negative profits will result for both types of carry trades. For the carry trades that use AUD as an investment currency (equation (2)), a one percentage point fall in the interest rate differential (e.g. due to an increase in the Australian interest rate, $i_{t,n}^{*}$) leads to higher positive LHS which represents income from the trade, given constant USD cost. Similarly, a negative β for a trade using AUD as a funding currency, implies that a one percentage increase in the interest rate differential (representing a higher return in USD is associated with a depreciation of the funding currency at t+1 reducing the amount or repayment lower in USD.

The first two panels of Figure 1 show interest rate differentials and exchange rate using mid quotes at daily horizon. The UIP condition suggests that there would be a positive relationship between the two and the periods of negative comovement imply a violation of this condition. For the most of the sample period a negative relationship is shown. It is noticeable that an upward movement in the interest rate differential coincide with a downward movement in the exchange rate over the periods of early 1999 to mid-2001 and early 2005 to mid-2006. The reverse relationship is shown for the periods of mid-2001 to mid-2004 and mid-2009 to late 2011. There are also periods of positive comovements and these are mostly surrounding the Global Finance Crisis periods of mid-2008 to late-2009. The third and the fourth panels show AUD carry trade probabilities which represent departures from the UIP condition.[1] The periods of AUD carry trades as indicated by the regime probabilities largely coincide with the periods of negative comovements identified above. Figure 2 shows the weekly horizon equivalents. The patterns of movements in the variables under discussion are consistent with the daily horizon patents.

During the periods of market conditions conducive to carry trade (carry trade regime) currency speculators would invest in high yielding currencies financed by funding currencies.

[1] Detailed explanations of these probabilities are provided in the next section.

A necessary condition is an expectation of the higher yielding currency continuing to appreciate (or at least not depreciate as much as what is predicted by UIP) under a low volatility environment. A crash risk rises as the market environment becomes more volatile where a sudden reversal of the exchange rate movement caused by carry traders reversing their positions simultaneously becomes more likely. In general, we observe slow accumulation of carry trade positions under a low uncertainty environment which may lead to a sudden reversal as some threshold level of market uncertainty is reached.

This research aims to determine the empirical relevance of various measures of financial market characteristics that help explain the time varying probabilities of the AUD market being in and out of carry trade regime. This requires specifying two regimes for the AUD market, one in which the AUD carry trade (the AUD is the investment currency) is profitable leading to speculative capital inflows, and the other in which the reversal of the carry trade occurs leading to capital outflows.

The approach taken in the paper is in two steps. First, we estimate the carry trade regime probabilities via two-state Markov regime shifting model. The time series of smoothed regime probabilities is then modelled on a selection of potential determinants to identify the variables that carry traders pay attention to in the AUD market.

The first stage estimations of a Markov regime shifting model of UIP follows a similar approach taken by Colavecchio (2008) and is shown below for mid quotes (5A), investing in AUD (5B) and investing in USD (5C).

$$\ln\left(\frac{S_{t+n}}{S_n}\right) = \alpha(ST_t) + \beta(ST_t)\cdot(i_{t,n} - i^{*}_{t,n}) + \varepsilon_{t+n} \tag{5A}$$

$$\ln\left(\frac{S^{b}_{t+1}}{S^{a}_{t}}\right) = \alpha(ST_t) + \beta(ST_t)\cdot(i^{a}_{t,n} - i^{b*}_{t,n}) + \varepsilon_{t+n} \tag{5B}$$

$$\ln\left(\frac{S^{a}_{t+1}}{S^{b}_{t}}\right) = \alpha(ST_t) + \beta(ST_t)\cdot(i^{b}_{t,n} - i^{a*}_{t,n}) + \varepsilon_{t+n} \tag{5C}$$

$$\varepsilon_{t+n} \sim (0, \sigma^2(ST_t))$$

Where S_t is an unobserved state variable at time t, n is holding period – daily and weekly. The daily and weekly USD/AUD exchange rate and money market interest rates are observed at 5pm London time.

There are two states (or regimes) and each state will have distinct values for each of the three parameters. The first state (ST_1) will be the profitable carry trade regime (in either direction – (5A), investing in the AUD – (5B) and investing in the USD – (5C)) and the second (ST_2) will be the reversal of the carry trade. We expect $\beta(ST_1)$ to be statistically significant and negative while $\beta(ST_2)$ is greater than positive one or insignificant. In addition, we expect the carry trade regime to have a lower volatility, i.e. $\sigma^2(ST_1) < \sigma^2(ST_2)$.

The unobservable state variable ST_t is assumed to evolve according to the following time varying transition probabilities:

$$\begin{aligned} P_{11,t} &= \Pr(ST_t = 1 \mid ST_{t-1} = 1, x_{t-1}) \\ P_{12,t} &= \Pr(ST_t = 1 \mid ST_{t-1} = 2, x_{t-1}) \\ P_{21,t} &= \Pr(ST_t = 2 \mid ST_{t-1} = 1, x_{t-1}) \\ P_{22,t} &= \Pr(ST_t = 2 \mid ST_{t-1} = 2, x_{t-1}) \end{aligned} \tag{6}$$

Where $P_{ij,t}$ are the probabilities of moving from state i in period t-1 to state j in period t, x_{t-1} is a vector of fundamental variables that determine the state transition probabilities. For each period t, the regime sifting probabilities are assumed to be a function of these variables. That is, the time varying nature of the carry trade regime shifting probabilities are assumed to vary with how the fundamental variables change over time. The current specification of the Markov regime shifting model is estimated via maximizing the likelihood function as described in Hamilton (1994). From the Markov regime shifting model estimations, we generate a time series of smoothed carry trade regime probabilities. We then proceed to model the carry trade regime probabilities.[2]

The second stage investigation is to model the carry trade regime probabilities on a selection of market related variables that potentially influence carry trade decisions. The literature has concentrated on exchange rate volatility as a determinant of the crash risk of carry trades. For example, in a similar empirical framework where the Yen carry trade is investigated. Colavecchio (2008) use the Yen/USD volatility as a lone determinant of the carry trade reversal risk. In a related research Christiansen et al. (2012) use the US equity market volatility index (VIX), and the US interest rate spreads over LIBOR and T-Bill rates as the determinants of the transition between one state to the other in their Logistic Smooth Transition Regression model. Peltomäki (2011) reports that hedge funds carry trade strategies involving Yen/USD are conditional on its implied volatility.

While it is true that currency speculators look to currency return volatilities to judge the crash risk probability, it is a coarse and aggregate measure of the underlying market conditions that directly influence the crash risk. It can be argued that investigations of the underlying components of market conditions that lead to the observed volatility measure would yield better insights into the reaction functions of the currency carry traders. In this research we propose to use a number of market activity measures that more directly convey currency speculators' risk incentives. These variables are realized volatility, realized skewness, number of trades, order flow of the USD/AUD exchange rate for each trading day. In addition, we examine the role of scheduled information arrival in aggregate and also individually the surprise components of major macroeconomic announcements in Australian and the US for daily horizon. For the

[2] Ichiue and Koyama (2011) use a four-state regime shifting model with high/low mean and high/low volatility states in the UIP equation. However, this level of breakdown in the regimes is unnecessary in the current case of investigating one currency where the direction of carry trade has always been in one way.

weekly horizon we examine net long positions of the AUD futures contracts in the Chicago Mercantile Exchange. The regression model is shown below.

$$
\begin{aligned}
RP_t = \alpha + \sum_{i=1}^{p} \alpha_i^{RP} RP_{t-i} + \sum_{i=0}^{q} \alpha_i^{RV} RV_{t-i} + \sum_{i=0}^{r} \alpha_i^{NoTrade} NoTrade_{t-i} + \sum_{i=0}^{s} \alpha_i^{RS} RS_{t-i} + \sum_{i=0}^{u} \alpha_i^{OF} OF_{t-i} \\
+ \alpha^{\mathrm{ANews\_Num}} \mathrm{ANews\_Num}_{\mathrm{t}} + \alpha^{\mathrm{USNews\_Num}} \mathrm{USNews\_Num}_{\mathrm{t}} \\
\left[\begin{array}{ll} \text{for daily horizon} & + \sum_{i=1}^{u} \alpha_i^{ANews} ANews_{t-1}^{i} + \sum_{i=1}^{v} \alpha_i^{USNews} USNews_t^i + \varepsilon_t \\ \text{for weekly horizon} & + \alpha^{FP} \mathrm{FutPos}_{\mathrm{t}} + \varepsilon_t \end{array} \right.
\end{aligned} \tag{7}
$$

The Fisher transformed smoothed probability time series of carry trade regime is shown in RP_t. The regime probabilities range between 0 (no carry trade or carry trade reversal) and 1 (carry trade regime), and when Fisher transformed it is not bounded and can potentially have any value. Lags (up to p) of the regime probabilities are included to account for potential autocorrelation structure.

The realized USD/AUD exchange rate volatility, RV, in various lags (up to q) is included. As volatility rises the risk of AUD carry trade rises at the same time and this would increase the probability of a carry trade reversal - the probability of moving from state 1 (S_1, carry trade regime) to state 2 (S_2, non-carry trade regime), $P_{12,t}$ and the probability of staying in state 2, $P_{22,t}$ would also rise as the higher crash risk more than offsets potential carry trade opportunities. The coefficient, α^{RV}, is expected to be negative.

Time varying skewness measure of the USD/AUD returns would also provide some indication of likely future movements of the currency. For instance Brunnermeier et al. (2008) report that there is a negative relationship between the crash risk and skewness. In the current case, a negative skewness suggests a fat tail in the area of AUD depreciation and so a rise in the magnitude of a negative skewness or a decrease in the magnitude of the positive skewness would indicate a future rise in the probability of carry trade reversals. Conversely, a decrease in negative skewness or a rise in positive skewness would foster carry trades. The coefficient α^{RS}, is expected to be positive.

In addition, volume of trade also conveys important information about the market conditions. Trade volume is proxied by number of trades executed, NoTrade. Both positive and negative coefficient, $\alpha^{NoTrade}$, is possible depending on what higher volume of trade is proxying for. If higher volume is due mostly to heterogeneous (informed) traders exploiting private information then higher volume would be associated with higher volatility in which case a negative coefficient is expected. On the other hand a higher level of trade is due mostly to liquidity trade, it may have no relationship with volatility and hence the coefficient may be either insignificant or positive. Order flows, OF, is also included to explain the regime probabilities. There has been a growing importance of foreign exchange order flow as a leading indicator of currency market movements. Dominance of buyer (seller) initiated AUD trades would be an indication of a rising probability of a carry trade (carry trade reversal, i.e. increasing $P_{12,t}$). The coefficient α^{OF}, is expected to be positive.

The market activity related variables over the daily and weekly horizons are generated from tick by tick trade data of the USD/AUD exchange rate from the Reuters' Deal2000 trading platform which is sourced from Thomson Reuters Tick History database via SIRCA. The daily horizon is from 5pm London time at day t to day t+1 to coincide with the collection time for the money market interest rates. The weekly horizon is from 5pm London time on Tuesday to 5pm on Tuesday one week later.[3]

[3] Tuesday to Tuesday weekly horizon is selected to coincide with the observation frequency of one of the determinants at the weekly horizon. The speculative positioning data on the AUD from the US Commodity Futures Trading Commission reports are released on Tuesdays. However, the regime shifting estimation results are robust to the choice of starting day for weekly horizon.

In addition to the market activity related variables discussed above, for the daily horizon investigations we also include scheduled macroeconomic news from Australia and the US. Market participants price in their expectations of the impending announcements of macroeconomic variables and as such when there is a significant deviations from the expected values they need to respond quickly to the new information. At a broad level, the release of macroeconomic data would provide tradable information potentially influencing various measures of market activities. In general, the act of releasing information could potentially have an impact on the information heterogeneity in the market leading to an overall increase in the level of uncertainty in the market. We proxy the information intensity by the number of Australian and the U.S. macroeconomic announcements made in each trading day. If on average aggregate information releases add to the information asymmetry, we would observe a negative influence (a negative news coefficient) in the carry trade regime probability. On the other hand, if macroeconomic releases resolve information asymmetry to some extent would have no impact on the current carry trade probabilities if not have a positive influence.[4]

We also consider the news contents of major announcement form each country. We select those macroeconomic announcements that have shown to be influential in the literature. These are CPI inflation, Current account balance, GDP, RBA's cash rate, Retail sales growth and Unemployment rate for Australia and Advanced Retail sales, Nonfarm payroll, Purchasing Manager Index, CPI inflation, Current Account, FOMC rate announcement, GDP growth rate and Unemployment for the US. Each of the macroeconomic news variable is generated from taking a difference between actual and median survey expectations and then scaled by standard deviation of the news. Appendix A reports the details of the macroeconomic announcements used in this research. Both the actual and media expectations of the announced variables are

[4] Huchison and Shshko (2013) has a similar approach in terms of using macroeconomic news to explain carry trade activities. They report that trade balance news is important in explaining Japanese Yen carry trade, as approximated by the pricing of downside risk in the Yen option.

sourced from Bloomberg.[5] In general, unexpectedly good Australian news (higher economic activity variables, lower inflation) and RBA's policy interest rate hikes are likely to boost the likelihood of carry trade. The US news would be expected to have the opposite impact.

For the weekly horizon, macroeconomic news variables are not suitable. We instead consider position imbalance in the USD/AUD futures contracts, FutPos, in the US futures exchanges. Currency futures are commonly used for speculative purposes and net positions of total open interests of traders can be used as a proxy for carry trade activities. Commodity Futures Trading Commission (CFTC) in the U.S. compiles a weekly positions report on the futures contracts traded in the Chicago Mercantile Exchange where USD/AUD is one of the traded contracts. Net long position on a currency by noncommercial traders can be a proxy for a carry trade position where the foreign currency is the investment currency (Brunnermeier et al. (2008)). A weekly change in the net long position of the USD/AUD, Yen/USD and the EUR/USD futures positions will then be used as indications of the likely spot market carry trade positions. The coefficient, α^{FP}, is then expected to be positive. The Fisher transformation of the regime probabilities raised the mean but lowered skewness and kurtosis which is as expected.

Table 1 reports the summary statistics of the regime probabilities and the regressors used in the analyses for both daily and weekly horizons. For all variables, significant deviations for normal distributional characteristics. However, there is no evidence of a unit root in any of the series.

[5] The time stamps for each announcements for both Australian and the U.S. announcements are in the US Eastern Standard Time (GMT-4 or -5 depending on the summer time period in the U.S. in the Bloomberg database. The daily horizon is from 5pm GMT on day t-1 to 5pm GMT on day t so all of the announcements except for the U.S. CPI and FOMC announcements occur within this period, as a result the news variables are examined contemporaneously. For the two U.S. variables, the announcements are made after 5pm GMT (see Appendix A) and so these are used with a lag of one day.

The investigation results of the Markov Regime Shifting regressions will reveal the relative importance of the above explanatory variables in explaining and predicting the crash risk probabilities. In particular, we will be able to quantify the thresholds of these variables that trigger carry trade reversals.

3. Empirical results

3.1 Carry trade regime probabilities

The Markov regime shifting estimation results for both daily and weekly horizons are summarized in Panel A and B of Table 2, respectively. All three carry trade regime investigation results are reported. The first section in Panel A (columns 2 and 3) report the carry trade using mid quotes. Both regime probabilities (P11 and P22) are close to one suggesting that from one day to the next the same regime is likely to continue with probability of 0.99 and 0.96 for carry trade and non-carry trade regimes, respectively. The corresponding probabilities are in similar magnitudes for the other two carry trade regimes. The UIP coefficient significantly deviates from negative unity for regime one and insignificant for regime two. Furthermore, regime two variance is considerably higher than the one for regime one. In all, there is enough evidence to suggest that the AUD carry trade regime exists which is associated with a low volatility state. Whereas, during periods of high volatility carry trade reversals are noticeable. Similar results are shown for the weekly estimation results shown in Panel B.

The second group of columns (4 and 5) report the carry trade into the AUD. That, is the carry trade with the capital flows into the Australian money market instruments (borrow in the USD and invest in the AUD). The regime 1 UIP coefficient of -11.21 is much larger than before and negative whereas the regime 2 coefficient is insignificant. The regime 1 variance is much lower as before. The third group of columns (6 and 7) report the carry trade into the USD, that is the capital flows into the USD (borrow in the AUD and invest in the USD). Neither of the UIP coefficient is significant suggesting that there is no evidence of a carry trade using the AUD as a funding currency. Therefore the evidence suggest that the significant carry trade regime shown using the mid quote prices are due to the significant carry trades into the AUD.

The third and fourth panels of Figure 1 shows the raw (ranges between 0 and 1) and Fisher transformed (potentially infinite in range) daily smoothed probability of the carry trade into the AUD, respectively (Figure 2 shows weekly horizon equivalents). It is noticeable that during the pre-GFC period the AUD had mostly been in carry trade state with occasional reversals most noticeably in late 2001, in early mid-2004 and during the second half of 2007. With the onslaught of the GFC and the accompanying higher levels of volatility in the markets, carry trade reversal is clearly visible from mid-2008 until late in that year. A tentative return to carry trade regime is visible form mid-2009 except for the period of mid-2010 and late-2011. In short, the AUD had been in carry trade state for the most of the sample period with interruptions shown during the GFC period.

3.2 The determinants of the carry trade regimes

The investigation results for the determinants of daily AUD carry trade regime probabilities (carry trade into the AUD) are reported in Tables 3A, 3B and 3C. Table 3A shows the whole sample estimation results. The first group of estimation results (column 2 and 3) include only the market activity variables and the news intensity variables. The dependent variable is the Fisher transformed AUD carry trade (into the AUD) probabilities (shown in the fourth panel of Figure 1). We experimented with up to 5 lags of each variables and determined the optimal lag length by examining the significance of the lag coefficients. We determined that only the first lag is required for the dependent variable and the RV, and for NoTrade and OF lags are not required. RS is not significant in any of the estimation periods for the daily horizon but one lag is appropriate for the weekly horizon, so it is dropped in the former and up to lag 1 is used in the latter (shown in Table 4). The coefficient for the lagged dependent variable is fairly close to one and positive. This is not surprising considering the high state regime probabilities as discussed above. As expected RV has a negative effect on the regime probabilities. A high exchange rate volatility period is associated with carry trade reversals. Trade volume, as proxied by NoTrade also shows a negative relationship suggesting that a larger number of trade is associated potential carry trade reversals. Finally, the order flow coefficient is positive and significant. Apparently, increasing buyer (seller) initiated trades signal impending appreciation of the AUD leading to higher (lower) levels of profitability of the AUD carry trade with a given an interest rate differential.

The Australian news intensity variable (ANews_Num) when it is included is significantly negative suggesting that on average the days with scheduled macroeconomic announcements are associated with higher probability of carry trade reversal suggesting that currency carry trades are sensitive to information arrivals. The arrival of US information, however, failed to elicit any response. The second group of columns report the selected Australian macroeconomic news and the third group of columns show the results for the U.S. news as well. Out of the 6 Australian macroeconomic news and 8 US news, only one each show a significant impact on the carry trade probability. Australian unemployment news has a negative relation suggesting that an unexpectedly higher unemployment leads to a lower carry trade probability since worsening economic conditions imply an impending depreciation of the AUD reducing carry trade profits. In short, macroeconomic news tend not to have significant explanatory power for the whole sample estimation. In addition, U.S. GDP news lowers the AUD carry trades suggesting a likely depreciation (appreciation) of the AUD in relation to a better (worse) than expected GDP news. Both of these news suggest potential support for the AUD and hence the higher likelihood of the AUD carry trade being sustained.

Table 3B and 3C report pre- and post-GFC period estimations, respectively. Although the signs of impending crash were shown from as early as mid-2007, it wasn't until the bankruptcy of Lehman brothers on 13th Sep 2008 that convinced that market of the crisis. As such we divide the sample on this date. There is no qualitative difference compared to the whole sample results in the market activity variables, all have the same sign and significance, except for the coefficients for NoTrade and OF which are somewhat larger and statistically significant in the first subsample. The most significant difference is in the Australian news. There are now three news variables that are significant. These are unexpected CPI inflation, RBA cash rate adjustments and unemployment rate. The CPI news lowers the carry trade probability and this suggests that the unexpected inflation leads to an expectation of AUD depreciation leading to lower an AUD carry trade profit. On the other hand, unexpected news on the RBA's cash rate decisions have a positive impact. An unexpected rate increase (decrease) leads to higher probability of carry trade since the Australian and U.S. interest differential would increase and AUD expected to appreciate. As in the whole sample, the U.S. news once again failed to elicit any significant responses except for the GDP news which has retains the negative coefficient.

Table 3C reports the post-GFC estimation results. In general, neither the market activity variables nor the economic news variables explain the carry trade regime probabilities. None of the market activity variables included are significant except for the marginally significant first lag of RV at 10%. As for the news variables, Australian Current account news are barely significant at 10%. The negative coefficient suggests a fall in the probability in response to an improvement in the balance which is counter intuitive.

The weekly horizon estimation results are reported in Table 4. For the whole sample, RV and NoTrade are still negative and significant as in the daily estimations. OF is still relevant in explaining the carry trades although significant only at 10% for the whole sample and in the pre-GFC subsample. The first lag of RS is significant and positive in the whole sample and both contemporaneous and first lag are significant in the first subsample. The positive sign suggests a higher likelihood of sustaining carry trade regime in response to more positive (or less negative) skewness in the AUD returns. That is, as market participants observe higher frequencies of AUD appreciations in weekly trading patterns they are less concerned about carry trade reversals. This interpretation is also supported by the positive and significant order flow coefficient in the pre-GFC and the whole sample. In addition, net long futures position in the AUD has a positive impact on the carry trade probabilities. As expected, more speculative buy than sell AUD futures positions contributed to the expectation of AUD appreciation and hence higher carry trade probabilities.[6] As in the daily investigations, the number of scheduled announcements during the week is associated with higher likelihood of carry trade reversal suggesting that a tranquil market condition is important for carry trades. The market did not react to the U.S. news, however. The Post-GFC period shows none of the included explanatory variables is significant as in the daily horizon estimations.

In sum, we find that for both daily and weekly horizons, realized volatility, trade volume and the overall scheduled news events lowered carry trade probabilities. On the other hand, a positive order flow and macroeconomic news that point to imminent AUD appreciation (RBA policy rate increase and US unemployment) increase the carry trade probabilities,

[6] Huchison and Shshko (2013) report similar close link between Japanese Yen carry trade risk reversal and Yen speculative futures position.

whereas those that suggest worsening Australian economic conditions (higher inflation and unemployment) lower them. In addition, we find that for weekly horizon, realized skewness and net long futures positions on the AUD have a positive influence on the carry trade probabilities. Moreover, we find that there is a significant structural break around the breakout of the GFC and the most of the explanatory powers of the determinants are shown in the pre-GRC period. Finally, only the Australian macroeconomic news matter for the regime probabilities.

4. Conclusion

In this paper we investigated the nature and the determinants of the Australian dollar (AUD) carry trades at daily and weekly horizons. Markov regime shifting model is utilized to empirically determine the probabilities of the AUD carry trade regime over the period 2 Jan 1999 to 31 Dec 2013. We find that the AUD consistently deviated from the uncovered interest rate parity conditions for both horizons. In fact, except for a number of periods, specially surrounding the GFC periods, the AUD is shown to have been used as an investment currency in a carry trade strategy. That is, a positive differential between Australian and US interest rates was associated with an AUD appreciation which is contrary to the prediction of the UIP condition.

We also investigated the determinants of the AUD carry trade regime probabilities by modelling smoothed regime probabilities from Markov regime shifting model with a list of market activity related variables for both daily and weekly horizons. In addition we examined the role of macroeconomic news variables from Australia and the US for daily horizons and net long futures positions on the AUD which is a proxy for the market's assessment on the future movements of the currency. For daily horizon, we find that there is a significant difference in responses of the regime probabilities to these determinants between pre- and post

GFC periods. During the pre-GFC period, carry trade regime probabilities are significantly lower in response to higher realized volatility of the USD/AUD exchange rate, number of trades, unexpected inflation, unexpected unemployment announcements. The carry trade probabilities are significantly higher when order flows are positive (more buyer than seller initialed trade of AUD), unexpected RBA policy interest rate increase. On the other hand, post-GFC period reposts a breakdown on the relationship between carry trade regime probabilities and the list of explanatory variables. Only the US unemployment news elicit significant response – unexpected increase raises the AUD carry trade probabilities.

For weekly horizon, we also find the market activity variables being more influential in the Pre-GFC period. In addition, realized skewness, order flow and net long futures positions on the AUD have a positive influence on the carry trade probabilities.

The investigation results have significant implication for market participants and policy makers who need to better understand the driving factors of the currency carry trades.

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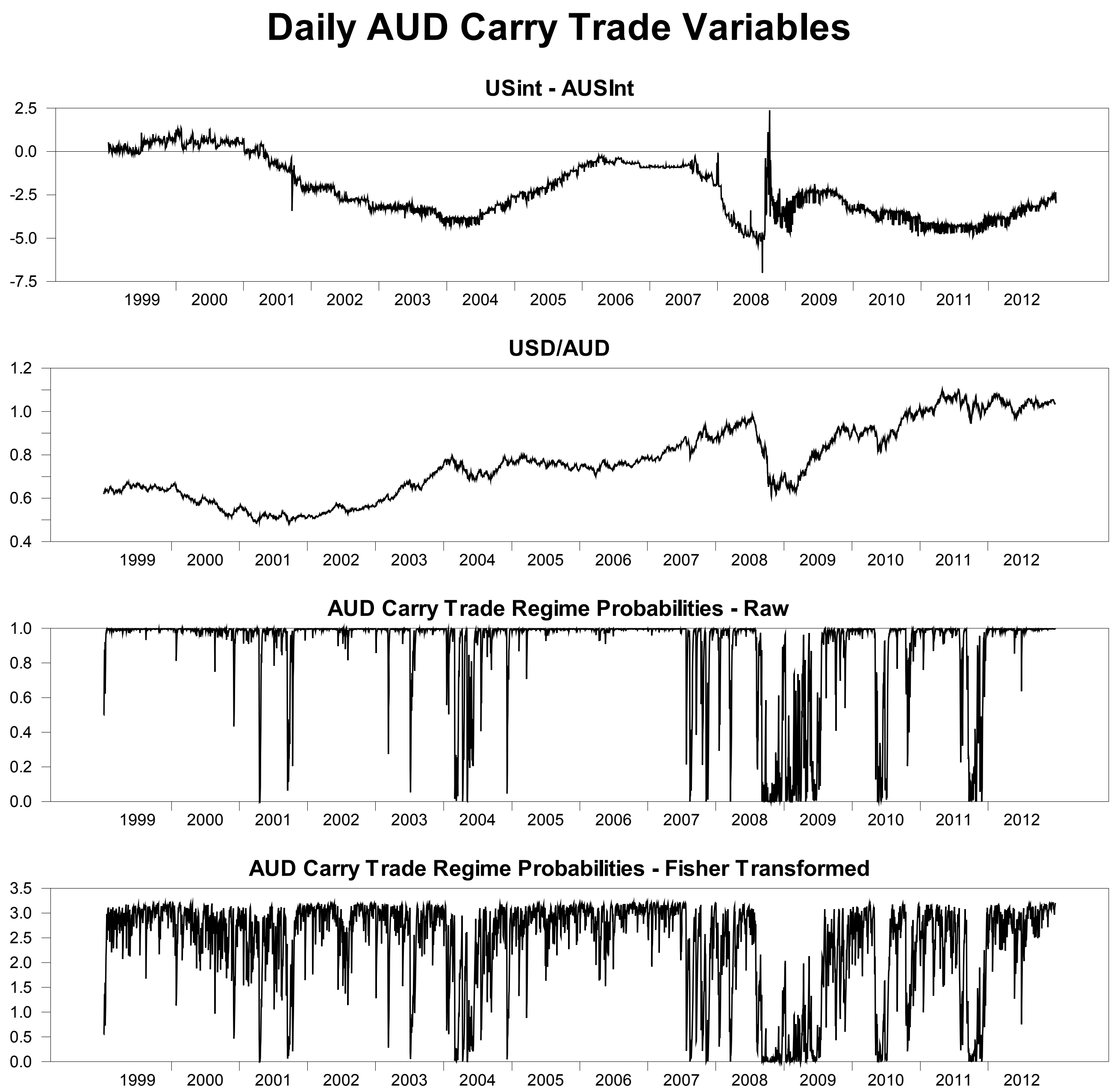
Figures 1



Daily AUD Carry Trade Variables
USint - AUSInt
2.5
0.0
-2.5
-5.0
-7.5
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
USD/AUD
1.2
1.0
0.8
0.6
0.4
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
AUD Carry Trade Regime Probabilities - Raw
1.0
0.8
0.6
0.4
0.2
0.0
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
AUD Carry Trade Regime Probabilities - Fisher Transformed
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012

Figures 2

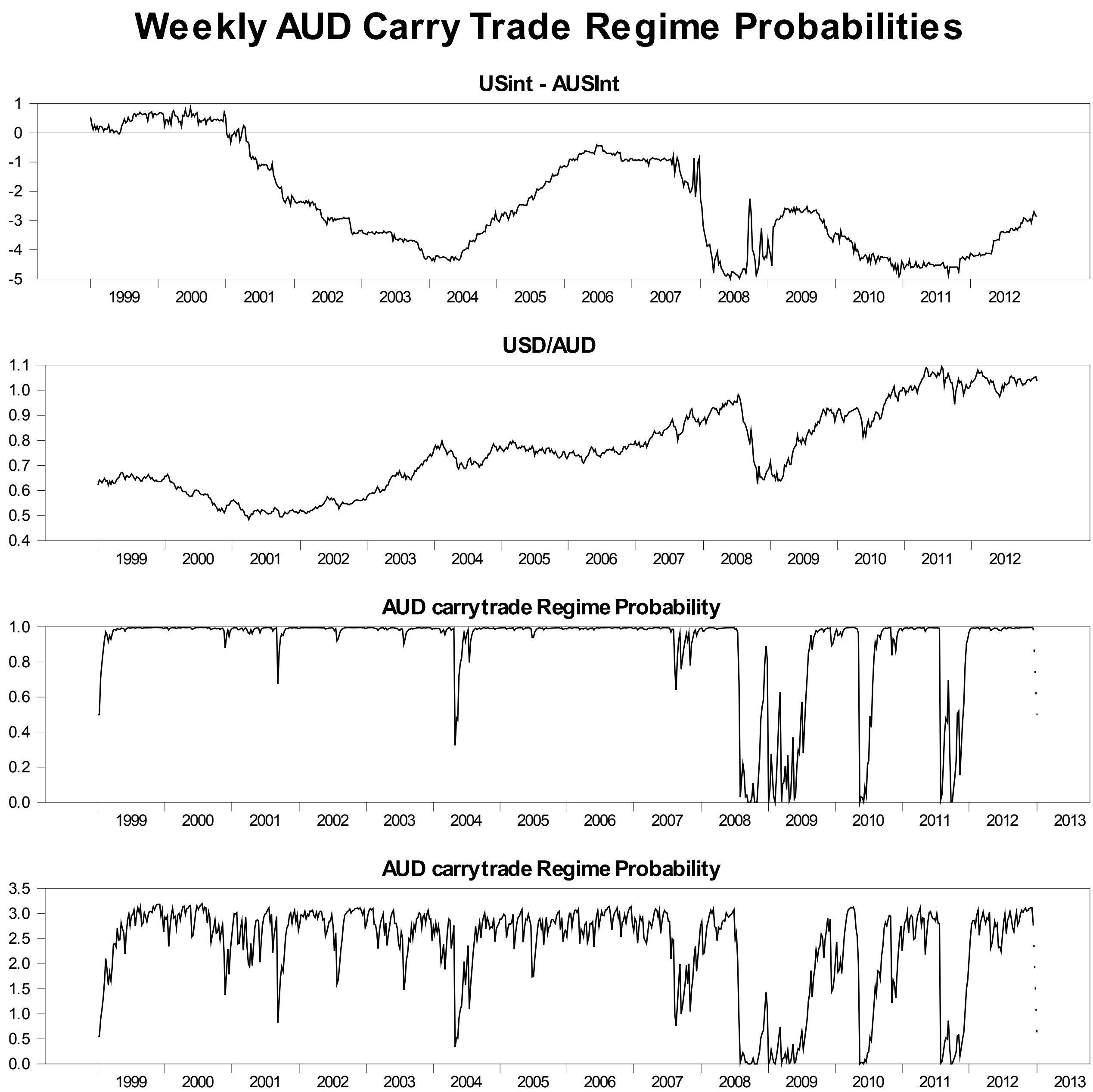

Weekly AUD Carry Trade Regime Probabilities
USint - AUSInt
1
0
-1
-2
-3
-4
-5
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
USD/AUD
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
AUD carrytrade Regime Probability
1.0
0.8
0.6
0.4
0.2
0.0
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
AUD carrytrade Regime Probability
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

Table 1:

Summary statistics of market activity variables for USD/AUD exchange rate at daily and weekly holding periods

	Mean	Std. Dev	Max	Min	Skewness	Kurtosis	Normality	I(1)[a]
Panel A: Daily Holding Period								
RP_Raw	0.8848	0.2612	0.9968	0	-2.4867	4.7574	7204	-9.0671
RP_Z	2.3691	0.9522	3.2113	0	-1.3669	0.5774	1187	-9.1285
RV	0.0001	0.0003	0.0059	4.9E-07	10.9552	162.31	4080535	-11.7154
NoTrade	5456	4025.7	28614	11	1.1471	1.4485	1120	-11.0835
OF	81.90	154.12	1018	-735	0.2304	1.5669	406	-18.7360
Panel B: Weekly Holding Period								
RP_Raw	0.8911	0.2527	0.9967	0	-2.6015	5.3978	1710	-4.6087
RP_Z	2.3426	0.8996	3.1963	0	-1.4820	0.9652	296	-4.8849
RV	0.0007	0.0011	0.0156	9.79E-05	7.5037	78.2328	193012	-6.4678
RS	-0.7830	1.8045	7.7251	-21.6234	-4.7168	41.4055	54854	-11.2481
NoTrade	27721	19076.5	105750	1965	0.8973	0.2299	100	-5.4112
OF	419.72	415.19	1927	-827	0.4457	1.0351	57	-5.7247
FutPos	23563.47	26274.51	103376	-51172	0.6748	-0.3701	60	-5.7337

[a]Augmended DF test with ctitical value of -3.9961 at 1%.

Where RP_Raw is smoothed Markov regime probabilities of being in AUD carry trade regime, RP_Z is Fisher trans formed regime probabilities, RV and RS are realized volatility and realized skenewss, respectively, calculated from tick by tick trade data, NoTrade is the number of trades, and OF is order flow calculated as the difference between number of buyer initiated trades and seller initiated trades in a trading day. FutPos is weekly net long position on USD/AUD futures contracts held by non-commercial traders in the Chicago Mercantile Exchange.

Table 2:

Markov regime estimation

Variable	Mid Quotes Coeff		Mid Quotes P-Value	AUD as Investment Currency Coeff		AUD as Investment Currency P-Value	AUD as Funding Currency Coeff		AUD as Funding Currency P-Value
A: Daily Horizon									
P11	0.9942	***	{0.0000}	0.9942	***	{0.0000}	0.9942	***	{0.0000}
P22	0.9570	***	{0.0000}	0.9581	***	{0.0000}	0.9562	***	{0.0000}
$\alpha(S_1)$	0.0000		{0.6955}	-0.0008	***	{0.0000}	0.0010	***	{0.0000}
$\alpha(S_2)$	-0.0026	***	{0.0007}	-0.0030	***	{0.0001}	-0.0023		{0.4582}
$\beta(S_1)$	-5.2216	***	{0.0002}	-11.2102	***	{0.0000}	0.5891		{0.8559}
$\beta(S_2)$	-14.6487		{0.1074}	-13.2798		{0.1743}	-16.5109		{0.5849}
$\sigma^2(S_1)$	0.0064	***	{0.0000}	0.0064	***	{0.0000}	0.0064	***	{0.0000}
$\sigma^2(S_2)$	0.0175	***	{0.0000}	0.0174	***	{0.0000}	0.0176	***	{0.0000}
No. Obs.	3648			3648			3648		
LogL	12736			12729			12739		
B: Weekly Horizon									
P11	0.9888	***	{0.0000}	0.9887	***	{0.0000}	0.9888	***	{0.0000}
P22	0.8902	***	{0.0000}	0.8899	***	{0.0000}	0.8905	***	{0.0000}
$\alpha(S_1)$	0.0000		{0.9777}	-0.0009		{0.1358}	0.0010		{0.2654}
$\alpha(S_2)$	-0.0062		{0.1473}	-0.0067		{0.1162}	-0.0058		{0.6668}
$\beta(S_1)$	-3.7305	***	{0.0004}	-4.6714	***	{0.0000}	-2.8383		{0.1075}
$\beta(S_2)$	3.3079		{0.5855}	3.6433		{0.5959}	2.8373		{0.8442}
$\sigma^2(S_1)$	0.0143	***	{0.0000}	0.0143	***	{0.0000}	0.0143	***	{0.0000}
$\sigma^2(S_2)$	0.0414	***	{0.0000}	0.0414	***	{0.0000}	0.0415	***	{0.0000}
No. Obs.	729			729			729		
LogL	1951			1950			1951		

$$\ln\left(\frac{S_{t+n}}{S_n}\right) = \alpha(ST_t) + \beta(ST_t)\cdot(i_{t,n} - i^*_{t,n}) + \varepsilon_{t+n} \tag{5A}$$

$$\ln\left(\frac{S^b_{t+1}}{S^a_t}\right) = \alpha(ST_t) + \beta(ST_t)\cdot(i^a_{t,n} - i^{b*}_{t,n}) + \varepsilon_{t+n} \tag{5B}$$

$$\ln\left(\frac{S^a_{t+1}}{S^b_t}\right) = \alpha(ST_t) + \beta(ST_t)\cdot(i^b_{t,n} - i^{a*}_{t,n}) + \varepsilon_{t+n} \tag{5C}$$

$$\varepsilon_{t+n} \sim (0, \sigma^2(ST_t))$$

$$P_{11,t} = \Pr(S_t = 1 \mid S_{t-1} = 1, x_{t-1})$$

$$P_{12,t} = \Pr(S_t = 1 \mid S_{t-1} = 2, x_{t-1})$$

$$P_{21,t} = \Pr(S_t = 2 \mid S_{t-1} = 1, x_{t-1})$$

$$P_{22,t} = \Pr(S_t = 2 \mid S_{t-1} = 2, x_{t-1})$$

Table 3A:

Determinants of AUD carry trade regime probabilities
Whole sample: 2 Jan 1999 – 31 Dec 2012

The table below provides estimation results for the determinants of the AUD carry trade regime probabilities of the equation (3) below:

$$RP_t = \alpha + \sum_{i=1}^{p} \alpha_i^{RP} RP_{t-i} + \sum_{i=0}^{q} \alpha_i^{RV} RV_{t-i} + \sum_{i=0}^{r} \alpha_i^{NoTrade} NoTrade_{t-i} + \sum_{i=0}^{s} \alpha_i^{RS} RS_{t-i} + \sum_{i=0}^{u} \alpha_i^{OF} OF_{t-i}$$
$$+ \alpha^{\text{ANews\_Num}} \text{ANews\_Num}_t + \alpha^{\text{USNews\_Num}} \text{USNews\_Num}_t$$
$$+ \sum_{i=1}^{u} \alpha_i^{ANews} ANews_{t-1}^{i} + \sum_{i=1}^{v} \alpha_i^{USNews} USNews_t^{i} + \varepsilon_t \tag{7}$$

Variable	Coeff		P-Value	Coeff		P-Value	Coeff		P-Value
Constant	0.2993	***	{0.0000}	0.2929	***	{0.0000}	0.2918	***	{0.0000}
RP_{t-1}	0.8977	***	{0.0000}	0.8967	***	{0.0000}	0.8967	***	{0.0000}
RV	-0.0691	***	{0.0041}	-0.0639	***	{0.0063}	-0.0635	***	{0.0064}
RV_{t-1}	-0.0317	*	{0.0586}	-0.0325	*	{0.0520}	-0.0325	*	{0.0514}
NoTrade	-0.0060	***	{0.0037}	-0.0078	***	{0.0001}	-0.0078	***	{0.0000}
OF	0.0856	**	{0.0245}	0.0778	**	{0.0418}	0.0793	**	{0.0376}
A_News_Num	-0.0133	***	{0.0012}						
ANews_CPI				-0.0472		{0.1480}	-0.0481		{0.1405}
ANews_CA				0.1602		{0.2186}	0.1658		{0.1881}
ANews_GDP				0.0245		{0.6195}	0.0248		{0.6179}
ANews_RBACR				0.0189		{0.6361}	0.0189		{0.6367}
ANews_Ret				0.0164		{0.7560}	0.0167		{0.7528}
ANews_UE				-0.0572	***	{0.0033}	-0.0597	***	{0.0027}
USNews_Num	-0.0002		{0.9036}	-0.0002		{0.9350}			
USNews_AdvRet							0.0298		{0.5620}
USNews_NFP							0.0078		{0.7983}
USNews_PMI							0.0103		{0.7789}
USNews_CPI							0.0019		{0.9368}
USNews_CA							0.0498		{0.1341}
USNews_FOMC							0.0191		{0.2452}
USNews_GDP							-0.0465	*	{0.0989}
USNews_UE							-0.0452		{0.1415}
No. Obs.	3649			3649			3649		
R^2-Bar	0.85			0.85			0.85		
LogL	-1517			-1516			-1513		
DW	2.12			2.12			2.12		

Table 3B:

Determinants of AUD carry trade regime probabilities
Pre-GFC sample: 2 Jan 1999 – 12 Sep 2008

Variable	Coeff		P-Value	Coeff		P-Value	Coeff		P-Value
Constant	0.3429	***	{0.0000}	0.3390	***	{0.0000}	0.3384	***	{0.0000}
RP_{t-1}	0.8862	***	{0.0000}	0.8853	***	{0.0000}	0.8849	***	{0.0000}
RV	-0.0516	**	{0.0299}	-0.0454	**	{0.0481}	-0.0450	**	{0.0487}
RV_{t-1}	-0.0235		{0.1524}	-0.0245		{0.1367}	-0.0239		{0.1445}
NoTrade	-0.0136	***	{0.0003}	-0.0158	***	{0.0000}	-0.0162	***	{0.0000}
OF	0.1263	***	{0.0062}	0.1185	**	{0.0108}	0.1208	***	{0.0090}
ANews_Num	-0.0130	**	{0.0187}						
ANews_CPI				-0.0633	**	{0.0322}	-0.0646	**	{0.0294}
ANews_CA				0.1859		{0.1657}	0.1897		{0.1379}
ANews_GDP				0.0149		{0.7748}	0.0153		{0.7710}
ANews_RBACR				0.0778	***	{0.0000}	0.0766	***	{0.0000}
ANews_Ret				-0.0366		{0.4848}	-0.0363		{0.4901}
ANews_UE				-0.0570	***	{0.0038}	-0.0598	***	{0.0031}
USNews_Num	-0.0007		{0.7996}	-0.0007		{0.7810}			
USNews_AdvRet							0.0317		{0.5746}
USNews_NFP							0.0056		{0.8892}
USNews_PMI							0.0220		{0.5833}
USNews_CPI							-0.0090		{0.6885}
USNews_CA							0.0560		{0.1303}
USNews_FOMC							0.0183		{0.2577}
USNews_GDP							-0.0526	*	{0.0825}
USNews_UE							-0.0458		{0.1456}
No. Obs.	2529			2529			2529		
R2-Bar	0.85			0.85			0.85		
LogL	-1150			-1146			-1142		
DW	2.11			2.11			2.11		

Table 3C:

Determinants of daily AUD carry trade regime probabilities
Post-GFC sample: 13 Sep 2008 – 31 Dec 2012

	Coeff		P-Value	Coeff		P-Value	Coeff		P-Value
Constant	0.3974	***	{0.0000}	0.3727	***	{0.0000}	0.3735	***	{0.0000}
RP_{t-1}	0.8803	***	{0.0000}	0.8816	***	{0.0000}	0.8831	***	{0.0000}
RV	-0.4206		{0.1050}	-0.3586		{0.1610}	-0.3288		{0.1889}
RV_{t-1}	-0.3548	*	{0.0614}	-0.2879		{0.1314}	-0.3073		{0.1015}
NoTrade	-0.0030		{0.5992}	-0.0052		{0.3532}	-0.0048		{0.3597}
OF	0.1202		{0.1266}	0.1014		{0.1723}	0.1091		{0.1471}
ANews_Num	-0.0140	**	{0.0304}						
ANews_CPI				-0.0072		{0.9375}	-0.0079		{0.9309}
ANews_CA				-0.9814	*	{0.0911}	-0.9843	*	{0.0847}
ANews_GDP				0.1542		{0.3734}	0.1514		{0.3784}
ANews_RBACR				-0.0001		{0.9982}	-0.0012		{0.9767}
ANews_Ret				0.0860		{0.4010}	0.0899		{0.3685}
ANews_UE				-0.0528		{0.3205}	-0.0538		{0.3165}
USNews_Num	0.0006		{0.8599}	0.0015		{0.6341}			
USNews_AdvRet							0.0139		{0.8976}
USNews_NFP							0.0087		{0.8447}
USNews_PMI							-0.0544		{0.4958}
USNews_CPI							0.0684		{0.5374}
USNews_CA							0.0302		{0.6518}
USNews_FOMC							-		-
USNews_GDP							0.0111		{0.8563}
USNews_UE							-0.0313		{0.7546}
No. Obs.	1120			1120			1120		
R2-Bar	0.85			0.85			0.85		
LogL	-356			-354			-353		
DW	2.17			2.17			2.17		

Table 4:

Determinants of weekly AUD carry trade regime probabilities

$$RP_t = \alpha + \sum_{i=1}^{p} \alpha_i^{RP} RP_{t-i} + \sum_{i=0}^{q} \alpha_i^{RV} RV_{t-i} + \sum_{i=0}^{r} \alpha_i^{NoTrade} NoTrade_{t-i} + \sum_{i=0}^{s} \alpha_i^{RS} RS_{t-i} + \sum_{i=0}^{u} \alpha_i^{OF} OF_{t-i}$$
$$+ \alpha^{\mathrm{ANews\_Num}} \mathrm{ANews\_Num}_{\mathrm{t}} + \alpha^{\mathrm{USNews\_Num}} \mathrm{USNews\_Num}_{\mathrm{t}} + \alpha^{FP} \mathrm{FutPos}_{\mathrm{t}} + \varepsilon_t \quad (7)$$

	Whole sample			**Pre-GFC**			**Post-GFC**		
Variable	Coeff		P-Value	Coeff		P-Value	Coeff		P-Value
Constant	0.3793	***	{0.0000}	0.5212	***	{0.0000}	0.1847		{0.2464}
RP_{t-1}	0.8784	***	{0.0000}	0.8296	***	{0.0000}	0.9156	***	{0.0000}
RV	-0.0159	**	{0.0353}	0.0097		{0.6205}	-0.0122		{0.2500}
RS	0.0099		{0.3866}	0.0243	**	{0.0490}	-0.0250		{0.2059}
RS_{t-1}	0.0139	**	{0.0234}	0.0217	***	{0.0015}	-0.0007		{0.9347}
NoTrade	-0.0017	*	{0.0935}	-0.0012		{0.4467}	-0.0017		{0.3854}
OF	0.0493		{0.1151}	0.0815	*	{0.0673}	0.0342		{0.4562}
FutPos	0.0016	***	{0.0089}	0.0017	**	{0.0298}	0.0011		{0.3602}
ANews_Num	-0.0121	***	{0.0009}	-0.0167	***	{0.0004}	-0.0039		{0.4939}
USNews_Num	0.0003		{0.8789}	-0.0008		{0.7636}	0.0015		{0.5322}
No. Obs.	729			505			224		
R^2-Bar	0.86			0.73			0.90		
LogL	-215			-106			-90		
DW	2.10			2.14			1.97		

Appendix A: Australian and the US Macroeconomic news

	No. Obs.	Frequency	Unit of measurement	Release time (local time)
Australia				**AEST**
CPI	168	QoQ	%	11:30
Current Account	56	Quarterly	AUD mil.	11:30
GDP	56	QoQ	%	11:30
RBA Cash Rate	45	Monthly	%	11:30
Retail sales	39	MoM	%	11:30
Unemployment	168	Monthly	%	11:30
US				**EST**
Advance Retail Sales	139	MoM	%	8:30
NonFarm Payroll	168	MoM	'000	8:30
Purchasing Manager I	168	Monthly	0	10:00
CPI	168	MoM	%	13:30
Current Account	56	QoQ	USD b.	10:00
FOMC Poliy Rate	112	Monthly	%	14:15
GDP	56	QoQ	%	8:30
Unemployment	168	Monthly	%	8:30