Australian dollar and Yen carry trade regimes and their determinants

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January 2015

Abstract:

This paper investigates the time varying carry trade regime probabilities of major currencies over the period 2 Jan 1999 to 31 Dec 2012. We find evidence for carry trades involving the Australian Dollar (AUD), Euro and Yen against the US Dollar during non-crisis periods. However, there is no evidence for cross currency carry trades. We also investigate the determinants of the AUD and JPY carry trades. For daily horizon, for both the AUD and JPY, carry trade probabilities are significantly higher when realized volatilities and trade volume are lower. In addition, for the AUD, carry trade probabilities are higher when 1) unexpectedly low inflation and unemployment rates, and unexpected interest rate hike from the RBA are announced in Australia, and 2) there are positive AUD order flows. For the JPY, carry trades are more likely when 1) unexpectedly low announcements of machine orders and Tanken in Japan and unexpectedly high US retail sale growth and Fed policy rate are announced, and 2) when there are negative JPY order flows. For weekly horizon, net long futures positions increase the AUD carry trade probabilities, but they lower the JPY probabilities. Furthermore, we find significant differences in the role of the determinants before and after the GFC period.

JEL: E44; F31; G15

Keywords: currency carry trade, Markov regime shifting, macroeconomic news, Order flows

Acknowledgement:
This research was funded by a faculty research grant of the University of Sydney Business School. I wish to thank Steve Satchel, Terry Walter, Ian Marsh and Masayuki Susai for useful comments and suggestions.

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1. Introduction

One of the building blocks of the theory of international finance is interest rate parity in both covered and uncovered forms. Interest rate parity suggests equilibrium relationships between movements in an exchange rate between two national currencies and their equivalent interest rates over their holding period. The currency that has a higher nominal interest rate, therefore a positive interest rate differential, is expected to fall in value against the other currency by roughly the same amount as the interest rate differential, in the absence of transaction costs. For instance, if a one year money market interest rate in the UK and the U.S. are 5% and 2% p.a., respectively, then the Pound (GBP) is expected to depreciate at an annual rate roughly equal to the interest rate differential of 3% p.a.. The GBP would then be traded at an annual discount of 3% in the forward market.

However, empirical evidence thus far suggests that interest rate differential (or forward premium) is a notoriously unreliable measure of the future spot exchange rate movements. 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 is most likely due to a combination of higher real interest rate and risk premium in the high yielding currency. This presents an opportunity for currency investors who are willing to take unhedged speculative positions – borrowing in low yielding currencies (funding currencies, e.g. the Japanese Yen) and investing in higher yielding currencies (investment currencies, e.g. most emerging market currencies and commodity currencies such as the Australian Dollar, the New Zealand Dollar, etc.). This strategy, known as a currency carry trade, has emerged as an alternative asset class in a portfolio of investments (e.g. Das, Kadapakkam and Tse, 2013, Lusig, Roussanov and Verdelhan, 2014). However, this is in direct violation of Uncovered Interest rate Parity (UIP). For instance, the Australian Dollar has been one of the more important investment currencies due to the persistent positive interest rate differential against the US Dollar and other major currencies, especially against the Japanese Yen, since the early 2000s. One of the motivations for risk takers is the speculation that *ex ante* risk premium thought to be included in the higher yielding currencies would not be completely offset by *ex post* exchange rate changes, leading to sufficient rewards for taking the risk. For instance, Coudert and Mignon (2013) report that sovereign default risk, as measured by sovereign Credit Default Swap spreads, contributes to carry trade gains during booms. The downside risk or crash risk of carry trade strategies relates to unexpectedly higher levels of exchange rate volatility leading to higher probabilities of significant losses from the exposed positions. The relevant literature reports 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%. Colavecchio (2008) reports significant carry trade opportunities involving Yen. Mollick and Assefa (2011) report evidence in support of carry trades involving Yen and Swiss Frac. Jurek (2014) reports profitable carry trades involving G10 currencies where crash risk premia is responsbile for one-third of the excess returns.

In addition, a number of researchers report spillover effects from carry trade activities. Cheung, Cheung and He (2012) find various measures of Yen carry trades have varying degrees of impact on stock market returns in Australia, Canada, UK, Mexico and New Zealand. Similarly, Fung, Tse and Zhao (2013) find that casality runs from carry trades to Asian stock markets. Lee, and Chang (2013) report similar results for USD carry trades. They find that G10 currency carry trade returns Granger cause stock market returns but not vice versa, and that the impact is larger during bull market. In contrast, Fong (2013) reports optimism in the stock market seems to lead to currency carry trades by hedge funds. Tse and Zhao (2012) find significant correlation but no causality between US stock returns and carry trades, however stock market volatility Granger causes carry trades.

This paper aims to investigate the existence and the time varying nature of carry trade relationships among major currencies, the Euro (EUR), the Japanese Yen (JPY), the Pound (GBP), and the Australian Dollar (AUD), both against the US Dollar (USD) and against each other at daily and weekly horizons over the period 2 Jan 1999 to 31 Dec 2012.

Secondly, we examine the carry trades against the AUD and JPY in detail in order to assess the empirical determinants of profitable carry trades and their reversals. In particular, the underlying market (financial markets in general and foreign exchange market in particular) conditions that foster (or trigger abrupt unwinding of) carry trades will be empirically determined. We concentrate on these two currencies because unlike the EUR where there is no clear and consistent carry trade directions during the sample, the combinations of exchange rate movements and interest rate differentials suggest that the AUD would have been used as an investment currency and the JPY as a funding currency during the sample period. In addition, only the AUD and JPY show evidence of significant carry trade for both daily and weekly horizons.

The important findings of this paper are summarized as follows. First, although we find strong evidence of carry trade activities involving the USD (against the AUD, EUR and JPY at the daily investment horizon, and the AUD and JPY at weekly horizon), there is no such relationship between cross currencies at either horizon. In general, carry trades are reversed during the various episodes of financial market turmoil such as the period surrounding 9/11 in 2001, the Global Financial Crisis (GFC) period of 2008-9 and the Eurozone crisis period of 2010-11. The carry trade probabilities for the JPY is less straight forward to interpret, however the GFC period shows a tendency of lower carry trade probabilities. Furthermore, the AUD has been more consistently in the carry trade regime than other currencies.

Second, there is a significant structural break around the outbreak of the GFC in relation to the impact of the determinants of both the AUD and JYP carry trades. For daily horizon, we find the determinants have time varying impact. In the pre-GFC period, carry trade probabilities are significantly higher in response to higher realized volatility of the USD/AUD exchange rate, number of trades, unexpected inflation and unexpected unemployment announcements in Australia. They are significantly higher when order flows are positive (more buyer than seller initialed trade of AUD) and when the RBA unexpectedly increased interest rates. For the JPY, the carry trade probabilities are significantly lower when realized volatility is high and the probabilities are lower when the US unexpectedly raises the Fed funds rate and when unexpected rise in retail sales growth in the US. In the post-GFC sample, almost all of the determinants are now insignificant for the AUD carry trades. For the JPY, The carry trade probabilities no longer respond to the JPY volatility, however, it reacts to trade volume and order flows. In addition, only the Japanese macroeconomic news matter.

Third, for weekly horizon, we find that for the AUD carry trades the market activity variables are also 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. For the JPY, speculative futures positions on the currency matters in both sample, however, different combinations of determinants are relevant for each subsample.

The outcome of the investigation provides significant insights into the time varying patterns of carry trade probabilities of major currencies and the reaction functions of the AUD and JPY carry traders. Knowledge gained from this investigation is useful for all types of participants in the AUD and JPY markets, in particular. These include fund managers who would benefit from day to day probabilities of the crash risk in order to implement an appropriate currency hedge. Furthermore, this information would be an important factor (i.e. as a signal of changes in systemic risk) in the respective central banks' policy formulation to achieve system stability.

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. Empirical methodologies

2.1 Markov regime shifting models for currency carry trades

The presence of currency carry trades can be approximated as deviations from *ex post* UIP conditions, and it is shown below in (1).

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

Where

S_t = The USD exchange rates defined as units of the USD per one unit of the AUD, EUR, JPY and GBP.

n = Investment horizon, daily and weekly

$i_{t,n}, i^*_{t,n}$ = n period interest rate in the U.S. and in Australia, the Eurozone, Japan and the UK at time t, respectively.

The USD exchange rates and London money market interest rates for each currency at daily (overnight) and weekly horizons are collected at 5pm GMT in London and they are obtained from Datastream.

A deviation from the UIP condition above implies a potentially profitable carry trade opportunity. Formally, the UIP condition in (1) is tested in a regression model of the form shown below:

$$\ln\left(\frac{S_{t+n}}{S_t}\right) = \alpha + \beta \cdot (i_{t,n} - i^*_{t,n}) + \varepsilon_{t+n} \qquad (2)$$

If UIP holds, the constant α would be insignificant and the slope coefficient β would be equal to positive one. This suggests, in general, that a positive interest rate differential in favor of the US is associated with a proportionate appreciation of the foreign currency over the relevant holding period leaving zero profit from the exercise. For $\beta>1$, carry trades are potentially unprofitable. On the other hand, if β is negative and statistically significant, there is a potential for carry trade profits. For the carry trades that use foreign currency as an investment currency, a one percentage point fall in the interest rate differential (e.g. due to an increase in the foreign 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 foreign currency as a funding currency, implies that a one percentage increase in the interest rate differential (representing a higher return in the USD is associated with a depreciation of the funding currency at t+1 reducing the amount necessary for repayment in the USD.

Under favorable market conditions currency speculators would invest in high yielding currencies financed by lower cost currencies. A necessary condition is an expectation of the investment currency continuing to appreciate (or at least not depreciate as much as what is predicted by the 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 a 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.

Figure 1, in graphs 1A-4A and 1B-4B's, shows the graphs of the USD exchange rate movements and the interest rate differentials in mid quotes between the US and foreign countries at daily horizon. The foreign currencies are presented in the order of the AUD, EUR, JPY and GBP. The corresponding weekly graphs are shown in Figure 2. There is a common feature in the interest rate differentials across the four cases whereby a pronounced down trend from 2001 is reversed in 2004. A sharper but shorter downtrend from 2007 is visible and continues until the end of 2008. These largely follow the U.S. monetary policy cycles of policy rate cutting surrounding the 9/11 and GFC events. It is noticeable that the interest rate differentials have been negative for the AUD and GBP for the most of the sample while the reverse is true for the JPY. This indicates that the first two currencies could have been used as investment currencies and the JPY as a funding currency for the US carry trades. On the other hand, both positive and negative interest rate differential periods exist for the EUR. To a similar extent there is a common trend in the USD exchange rates. The foreign currencies have been gaining on the USD since 2001 until an abrupt reversal in mid-2008 for all currencies except for the JPY. For the AUD and JPY, the uptrend has been restored from early 2009, however for the EUR and GBP, there is no clear up or downtrend for the recent period.

Furthermore, for all currencies there is a mix of positive and negative co-movements between interest differential and exchange rate. The UIP condition suggests that there would be a positive relationship between the two and the periods of negative co-movements imply a violation of this condition. For the most of the sample period a negative relationship is shown for most exchange rate-interest rate differential pairs. It is noticeable that an upward movement in interest rate differential coincides with a downward movement in exchange rate over the periods of early 1999 to mid-2001 and early 2005 to mid-2006 in all cases except for the JPY. The reverse relationship is shown for the periods of mid-2001 to mid-2004 and mid-2009 to late 2011 in all cases. There are also periods of positive co-movements and these are mostly surrounding the GFC periods of mid-2008 to late-2009.

This paper aims to investigate the existence and nature of carry trade relationships between the USD and other major currencies, the EUR, JPY, GBP and AUD as a first instance. The investigation is conducted via a Markov regime shifting model of the UIP and follows a similar approach taken by Colavecchio (2008).The estimating equations shown below are adopted from the UPI condition in (2).

$$\ln\left(\frac{S_{t+n}}{S_n}\right) = \alpha(ST_t) + \beta(ST_t)\cdot(i_{t,n} - i^*_{t,n}) + \varepsilon_{t+n} \qquad (3)$$

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

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

We specify two states (or regimes) and each state will have distinct values for each of the three parameters. The first state (ST_1) is a profitable carry trade regime and the second (ST_2) is the reversal of carry trade. We expect the slope coefficient $\beta(ST_1)$ to be negative and statistically significant while $\beta(ST_2)$ is positive, significant and greater than one or insignificant. Also, we expect the state one to have a lower volatility, i.e., $\sigma^2(ST_1) < \sigma^2(ST_2)$. The unobservable state variable ST_t is modelled to evolve according to the following time varying transition probabilities:

$$P_{11,t} = \Pr(ST_t = 1 \mid ST_{t-1} = 1) \quad (4)$$
$$P_{12,t} = \Pr(ST_t = 1 \mid ST_{t-1} = 2)$$
$$P_{21,t} = \Pr(ST_t = 2 \mid ST_{t-1} = 1)$$
$$P_{22,t} = \Pr(ST_t = 2 \mid ST_{t-1} = 2)$$

Where $P_{ij,t}$ are the probabilities of moving from state i in period $t-1$ to state j in period t. The Markov regime shifting model is then estimated by maximizing the likelihood function as discussed in Hamilton (1994). We then generate a time series of smoothed carry trade regime probabilities for each foreign currency and investigate the time varying nature of these probabilities.[1]

2.2 The determinants of carry trade regime probabilities for the AUD and JPY

The approach taken in the paper to model the AUD and JPY carry trades is in two steps. First, we estimate the AUD and JPY carry trade regime probabilities via the two-state Markov regime shifting model as highlighted in section 2.1 above. The second stage investigation is to model the time series of carry trade regime probabilities on a selection of market related variables that potentially influence carry trade decisions. We choose the AUD and JPY for detailed analyses because unlike the EUR, both currencies have provided opportunities for carry trade in one direction, the AUD as an investment and the JPY as a funding currency. In addition, both currencies show significant carry trade regimes for both daily and weekly horizons.

The literature has concentrated on exchange rate volatility as a determinant of the crash risk of carry trades. For example, Colavecchio (2008) uses the Yen/USD volatility as the lone determinant of the carry trade reversal risk, and Menkhoff et al. (2012) report a negative link between innovations from global foreign exchange volatility risk and high yielding currencies.

[1] 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.

Peltomäki (2011) reports that hedge funds' Yen carry trade strategies are conditional on its implied volatility. In a related research, Christiansen et al. (2012) employ the US equity market volatility index (VIX), and the US interest rate spreads over LIBOR and T-Bill rates to explain the transition from one carry trade state to the other in their Logistic Smooth Transition Regression model.. Bakshi and Panayotov (2013) find that in addition to currency volatilities a commodity index was useful in explaining USD carry trades. Cenedese, Sarno and Tsiakas (2014) report that a large future loss from carry trades results from higher foreign exchage market volatilities. Anzuini and Fornari (2012) report that longer term gains from carry trades can be originated from demand and confidence shocks in the economy as well as undexpected widening of interest rate differentials.

Although currency speculators consider currency return volatility as an important determinant of carry trade/crash risk probabilities, it is a coarse and aggregate measure of the underlying market conditions that directly influence carry trades. Direct measures of the underlying components of market conditions would yield better insights into the reaction functions of currency carry traders.

In this paper we use a number of market activity measures that more directly convey currency speculators' risk appetites. These are realized volatility, realized skewness, number of trades, and order flows of the AUD and JPY for each trading day. In addition, we include scheduled information arrival that injects tradable information to the market. We examine the news components of major macroeconomic announcements in Australian and the US for the AUD carry trade investigations, and the Japanese and the US news for the JPY carry trade investigations at daily horizon investigations. For the weekly horizon, we examine net long positions of the AUD and JPY futures contracts at the Chicago Mercantile Exchange in addition to aggregate news intensity variables. The regression model is shown below.

$$RP_t = \alpha + \sum_{i=1}^{p} \alpha_i^{RP} RP_{t-i} + \sum_{i=0}^{q} \alpha_i^{RV} RV_{t-i} + \sum_{i=0}^{r} \alpha_i^{NumTrade} NumTrade_{t-i} + \sum_{i=0}^{s} \alpha_i^{RS} RS_{t-i} + \sum_{i=0}^{u} \alpha_i^{OF} OF_{t-i}$$
$$+ \alpha^{\text{News\_Num}} \text{News\_Num}_t + \alpha^{\text{USNews\_Num}} \text{USNews\_Num}_t \quad (5)$$
$$\begin{cases} \text{for daily horizon} & + \sum_{i=1}^{u} \alpha_i^{News} News_{t-1}^{i} + \sum_{i=1}^{v} \alpha_i^{USNews} USNews_t^{i} + \varepsilon_t \\ \text{for weekly horizon} & + \alpha^{FP} \text{FutPos}_t + \varepsilon_t \end{cases}$$

RP =	Fisher transformed smoothed Carry trade regime probabilities of AUD or JPY .
RV =	Realized volatility calculated from tick by tick trades of the AUD or JPY against the USD
NumTrade =	Total number of trades within the relevant horizon – daily and weekly
RS =	Realized skewness
OF =	Order flow of calculated as the difference between buyer initiated trade minus seller initiated trades.
News_Num. USNews_Num =	News intensity variables for Australia or Japan and the US, respectively. They are the number of scheduled announcements within each investment horizon – daily and weekly
$News^i$, $USNews^i$ =	The news components in the scheduled macroeconomic announcements. They are standardized news calculated as the difference between actual and median expected figures divided by the standard error of the difference. Both actual and medial expectations data are sourced from Bloomberg.
FutPos =	Net long positions of the AUD or JPY futures contracts in the Chicago Mercantile Exchange.

The Fisher transformed carry trade regime (RP_t) probabilities is the dependent variable in (5). Compared to the untransformed regime probabilities which can take values between 0 (no carry trade or carry trade reversal) and 1 (carry trade regime), the Fisher transformed probability series can potentially have any numerical value. The raw and Fisher transformed carry trade probabilities for the AUD and JPY for the daily and weekly horizons are shown in Panel A and B of Figure 3, respectively. The transformed probabilities retain the same pattern as their raw counterparts but the range has been more than doubled in all cases.

We consider lags (up to *p*) of the dependent variable to account for potential autocorrelation structure. In addition, we examine the optimal lag structures for the realized exchange rate volatility, *RV*. As volatility increases the risk of AUD carry trade increases at the same time and this would increase the probability of a carry trade reversal - the probability of moving from state 1 (ST_1, carry trade regime) to state 2 (ST_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 exchange rate returns would also be useful in modeling asymmetric nature of exchange rate movements. For instance, Brunnermeier et al. (2008) find a negative relationship between carry trade crash risk and exchange rate return skewness. In the current case, negative skewness suggests a fat tail in the area of the AUD or JPY depreciation. Thus an increase in the magnitude of a negative skewness or a decrease in the magnitude of the positive skewness would indicate an increased likelihood of further future rise AUD or JPY depreciation leading to carry trade reversals for the AUD and profitable JPY carry trades, given stable interest rate differentials. In a similar vein, Dobrynskaya (2014) suggests a downside risk factor to explain carry trade returns. In our case, the coefficient α^{RS}, is expected to be positive for the AUD and negative for the JPY.

In addition, trade volume also conveys important information about the foreign exchange market conditions. Trade volume is proxied by number of executed trades, NumTrade within a given horizon, daily and weekly. The coefficient for the volume measure, $\alpha^{NumTrade}$, can potentially have both positive and negative signs depending on what movement sin trade volume is proxying for. If higher volume is due mostly to heterogeneous (informed) traders exploiting private information then higher volatility is likely, in which case a negative coefficient is expected. Conversely, if higher trade volume is due mostly to liquidity transactions, it may not be related to volatility and hence the coefficient may be either insignificant or positive. Order flows, OF, is also considered as a determinant. There has been a growing attention paid to foreign exchange order flow as a leading indicator of currency movements. A dominance of buyer initiated AUD trades would be an indication of a rising probability of carry trade implying a positive α^{OF}. On the other hand, for the JPY order flow, more buyer initiated JPY trades would lead to a lower carry trade probability implying a negative OF coefficient.

The market activity related variables discussed above over the daily and weekly horizons are calculated from tick by tick trade data from Reuters' Deal 3000 trading platform which we obtained from the Thomson Reuters Tick History database via SIRCA. The daily horizon is from 5pm London time from day *t* to day *t+1*. The weekly horizon is from 5pm London close on Tuesday to 5pm on Tuesday one week later.[2]

For daily horizon, we also consider scheduled macroeconomic news from Australia and the US for the AUD carry trades and news from Japan and the US for the JPY carry trades. This is a similar approach to Hutchison and Sushko (2013) who use Japanese macroeconomic news to explain the risk reversals, proxied by option prices, of Yen carry trades. They find bilateral trade balance news is the most influenctial. Market participants' expectations on impending data releases are already priced in and as such they will respond only to announcements only if there is a significant deviation from the expected value, and they need to respond quickly to new information. At a broad level, the macroeconomic information arrival would provide tradable information potentially impacting various measures of market activities. In addition, the act of releasing information, regardless of news content, could also potentially have an impact on information heterogeneity in the market leading to an overall increase in market uncertainty. We proxy the information intensity by aggregating the number of macroeconomic announcements made in Australian, Japanese and the U.S in each trading and use the resulting daily sums (and weekly sums for weekly horizon) as a 'news intensity' variable for each of the three countries, respectively. If on average, more information arrival

[2] 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.

adds to information asymmetry, we would see a negative influence (a negative news intensity coefficient) on the carry trade regime probability. On the other hand, if more information helps resolve information asymmetry to some extent there would be either no impact on the current carry trade probabilities or a positive impact.[3]

We also consider the news contents of the scheduled macroeconomic announcements in the three countries involved in the analyses, Australia, Japan and the US. Instead of considering all economic variables that are announced, we concentrate on those announcements that have been shown to matter more in the literature. These are CPI inflation, Current account balance, GDP, RBA's cash rate, Retail sales growth and Unemployment rate for Australia; and national CPI, Current account balance, GDP, Trade balance, GDP, jobless rate, Merchandise order and Tankan index for Japan. For the US, we use Current account balance, CPI, FOMC rate decision, GDP, non-farm payroll, purchasing manager index, advanced retails sales and unemployment rate. Each news variable is constructed by taking a difference between actual and median survey expectations and then scaling it by its standard deviation, as first used in Balduzzi, Elton and Green (2001). Appendix A reports the details of the scheduled announcements used in this paper. Both the actual and median expectations of the announced variables are obtained from Bloomberg.[4] In general, those announcements that are knows to appreciate the AUD (e.g. higher economic activity variables and lower inflation) and unanticipated RBA's policy interest rate increases are likely to encourage the carry trade into the AUD. On the other hand, those news that are likely to lead to a depreciation of the JPY

[3] Huchison and Shshko (2013) have 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.

[4] The time stamp for the announcements from all three countries 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.

would be associated with profitable carry traded out of the JPY (e.g. unexpectedly bad news in Tanken survey). The corresponding US news are expected to have the opposite impact.

For weekly horizon, we only use weekly news intensity variables as macroeconomic news variables are not practical. In addition, we consider the position imbalance in the AUD and JPY futures contracts, FutPos, calculated from data obtained from the US futures exchanges. Currency futures are commonly used for speculative purposes and the 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 the AUD and JPY are 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 AUD and JPY futures positions will then be used as indications of the likely carry trades into the AUD and out of the JPY, respectively. The coefficient, α^{FP}, is then expected to be positive for the AUD and negative for the JPY.

Table 3 reports the summary statistics of the AUD and JPY carry trade regime probabilities and the regressors used in the analyses for both daily and weekly horizons. For all variables, significant deviations from normal distributional characteristics are evident. However, there is no evidence of a unit root in any of the series. The Fisher transformed regime probabilities have higher means and standard deviations compared to the untransformed ones as expected. In addition, they also have lower skewness and kurtosis.

3. Empirical results

3.1 Carry trade regime probabilities of foreign currencies against the USD

The estimation results of the Markov regime models of currency carry trades against the USD are reported in Table 1. Panel A shows the estimations for the daily horizon and Panel B shows the weekly horizon equivalents. The two regime probabilities, P11 and P22, are close to one, although the former is larger than the latter, in all cases. This suggests once either regime 1 (carry trade) or regime 2 (non-carry trade) is in place, it is likely that the same regime will continue to the next day (and next week), for example with a probability of 0.99 and 0.96 for the two regimes for the AUD, respectively. The standard error of estimation for regime 1, $\sigma(ST_1)$, is lower than that of regime 2, $\sigma(ST_2)$, in all cases. Regime 2 is thus identified as the high volatility regime where existing carry trades would reverse and new carry trades are prevented from taking place. This is verified by the UIP coefficient, $\beta(ST_2)$, being either insignificant (the AUD and EUR) or positive and significant (the JPY and GBP). The UIP coefficient for regime 1, $\beta(ST_1)$, is negative in all cases and significant for all but the GBP indicating potentially profitable carry trades in these three currencies against the USD. Panel B reports weekly horizon estimations. The qualitative results are similar to the daily horizon estimations. However, there are now only two currencies that show evidence for carry trades, the AUD and JPY. Moreover, the standard errors of the estimations are considerably larger (at least by a factor or two) for both regimes compared to the daily horizon estimations.

The time series of the smoothed carry trade probabilities are shown in graphs 1C-4C in Figure 1 for the daily horizon. The periods of carry trades, as indicated by the regime probabilities being close to one, largely coincide with the periods of negative co-movements identified in the previous section in all cases except for the JPY. For the AUD, until the outbreak of the GFC in 2007 carry trade regime probabilities stayed close to one except for a few occasions in 2001, 2003 and the first part of 2004. From mid-2007 to early-2008 carry trade regime probabilities have fluctuated between the two extremes and returned briefly to mostly near one until mid-2008. Between mid-2008 and mid-2009, the probabilities stayed near zero, but afterwards the carry trade regime returned once again, except for brief reversals in mid 2010 and late 2011. The pattern of EUR carry trade probabilities is qualitatively similar to that of the AUD although the periods of reversals are longer which also shows up in a higher P22 coefficient for the EUR (0.98 against 0.96 for the AUD). The JPY carry trade probabilities are less straight forward to interpret, however the GFC period shows a tendency of lower carry trade probabilities.

Figure 2 shows the weekly horizon equivalents. The patterns of movements in the exchange rate, interest rate differential and carry trade probabilities are consistent with the daily horizon patterns in all cases.

Since clear investment and funding currencies exist in our sample in terms of persistent interest rate differentials in one direction (e.g. the JPY being the funding currency and the AUD and the GBP being the investment currencies), it would be worthwhile investigating the likelihood of cross currency carry trades between appropriate currency pairs such as the JPY against the AUD and GBP. Although markets exist for the cross currencies they are considerably smaller and illiquid compared to the two relevant USD exchange rates.[5] This suggests that for immediacy of transactions the two USD exchange rates are likely to be used for carry trades rather than the considerably illiquid cross exchange rate. We construct six pairs of cross exchange rates using the four currencies we consider, and these are AUD&EUR, AUD&JPY, AUD&GBP, EUR&JPY, EUR&GBP and JPY&GBP. Table 2 reports the cross currency carry trade estimations. For daily horizon (Panel A), although the lower volatility regime 1 coefficient is negative in all cases, except for the AUD&JPY pair, there is no evidence

[5] For example, on 1 Dec 2011 the number of direct trades between the EUR and JPY was 2,520. Whereas the corresponding number of transactions for the EUR/USD and the JPY/USD were 20,466 and 6,873, respectively (Author's calculation using EBS's tick by tick transaction data).

of statistical significant in any cross exchange rates. Panel B of Table 2 reports the weekly horizon estimations. The UIP coefficient is now marginally significant at 10% for the AUD&EUR pair. However, there is no evidence for carry trades for the rest of the cross exchange rates. This suggests that even though there might be opportunities for direct pairing of consistent funding and investment currencies via cross exchange rate markets (e.g. the JPY and AUD), significant carry trades mostly go through the USD market where immediacy of transaction is assured.

3.2 The determinants of the AUD carry trade regimes

The investigation results for the determinants of daily AUD carry trade regime probabilities are reported in Tables 4A, 4B and 4C for whole sample, pre-GFC and post-GFC samples, respectively. Table 4A shows the whole sample, 2 Jan 1999 to 31 Dec 2012, estimation results. The first group of estimation results (column 2 and 3) show only the market activity variables and the Australian and US news intensity variables. We determined that only the first lag is required for the dependent variable and RV, and none is required for NumTrade and OF. Realized skewness, RS, is not significant in any of the estimation periods for daily horizon so it is dropped from the analyses. For weekly horizon, RS requires one lag in all three specifications (shown in Table 6).

The coefficient for the lagged dependent variable is positive and close to one which is not surprising considering the high state regime probabilities (P11) observed above. As per expectation, RV coefficient is negative suggesting that a high exchange rate volatility period is associated with carry trade reversals. This is consistent with the findings of Baillie and Chang (2011) where a low volatility regime is more conducive for a UIP, and Cenedese, Sarno and Tsiakas (2014) who report larger future losses of carry trade positions are associated with high foreign exchange volatility. Trade volume, NumTrade, also shows a negative relationship indicating that a higher volume is associated with potential carry trade reversals. Finally, the positive and significant order flow coefficient suggests that increasing buyer (seller) initiated trades signal impending appreciation of the AUD, leading to higher (lower) levels of profitability of the carry trade into the AUD for a given interest rate differential. When it is included, the Australian news intensity variable (ANews_Num), is significantly negative. This suggests that, on average, the days with large number of scheduled macroeconomic announcements are associated with a higher probability of carry trade reversal. That is, currency carry trades are sensitive to information arrivals. The arrival of US information, however, did not register any response in the AUD carry trades.

The second group of columns (4 and 5) report include the Australian macroeconomic news and the third group of columns (6 and 7) show the results also including the U.S. news. Only one each from six Australian macroeconomic news and eight US news shows a significant impact on the AUD carry trade probability. An unexpected Australian unemployment leads to a lower carry trade probability as the news would be associated with an impending AUD depreciation. The U.S. GDP news lowers the AUD carry trades probabilities as an appreciation of the USD is implied. Both of these news announcements suggest potential support for the AUD and hence higher likelihood of the AUD carry trade being sustained. However, in general, macroeconomic news tend not to have significant explanatory power for the whole sample estimations.

Table 4B and 4C report pre- and post-GFC period estimations, respectively. We break the sample on the date of Lehman brothers collapse, 13th Sep 2008, as it wasn't until after the collapse that markets were convinced of the crisis.[6] There is no qualitative difference compared to the whole sample results in the market activity variables; all have the same sign

[6] We also used earlier and later dates for the break point. However, the qualitative results are the same.

and significance, except for NumTrade and OF where the coefficients are somewhat larger and statistically significant compared to the whole sample. The most notable difference is in the Australian news. There are now a total of three significant news variables. These are unexpected CPI inflation, RBA cash rate adjustments as well as the unemployment rate news. An unexpected CPI inflation lowers the carry trade probability via an expectation of an AUD depreciation leading to a lower AUD carry trade profit. On the other hand, an unexpected change in the RBA's cash rate decisions have a positive impact. An unexpected rate hike (cut) is associated with a higher probability of carry trade as the returns from the carry trades into the AUD are expected to be higher. As in the whole sample, the U.S. news again fail to elicit any significant responses except for the GDP news which retains the negative coefficient.

Table 4C reports the post-GFC estimation results. There is no longer any significant relationship between the determinants and the carry trade regime probabilities. None of the market activity variables are significant except for the marginally significant first lag of RV at 10%. The relevance of the scheduled news variables have been substantially reduced as well. The only significant news remaining is the Australian current account news which is barely significant at 10%. The negative coefficient indicates an unexpected improvement leads to a fall in the probability, which is counter intuitive.

Table 5 reports the weekly horizon estimation results. For the whole sample, there is still a negative relationship between RV and NumTrade on the one hand and the AUD carry trade probabilities on the other hand. Order flows matters only in the pre-GFC subsample and only at 10%. The first lag of RS is significant and positive in the whole sample and both contemporaneous and first lag are significant in the pre-GFC sample. The positive sign suggests that as market participants observe higher frequencies of the AUD appreciations in weekly trading patterns they become less concerned about carry trade reversals. In support of this view, we also report the positive and significant order flow coefficient in the pre-GFC sample. In addition, futures market speculative positions have significant impact on the probabilities. As per expectation, more speculative buy than sell AUD futures positions contributed to the expectation of the AUD appreciation leading to higher carry trade probabilities.[7] As in the daily investigations, the news intensity variables is associated with a higher likelihood of carry trade reversal. This suggests that tranquil market conditions are important for the continuation of speculative carry trades. The market did not react to the U.S. news intensity variable, however. The Post-GFC period shows a lack of any role played by the determinants as in the daily horizon estimations.

In sum, we find that for both daily and weekly horizons, realized volatility, trade volume and the number of scheduled news released decreased carry trade probabilities. On the other hand, positive order flow and macroeconomic news that are associated with an AUD appreciation (unexpected RBA policy rate increase and US unemployment) increase the AUD carry trade probabilities, whereas those that suggest worsening Australian economic conditions (unexpected higher inflation and unemployment rates) lower the probabilities. For weekly horizon, we find realized skewness and net long futures positions on the AUD tend to raise the carry trade probabilities. Furthermore, we find that there is a significant structural break around the GFC period. Specifically, most of the explanatory power of the determinants are shown only in the pre-GRC period. Finally, only Australian macroeconomic news, in general, matter for the AUD regime probabilities.

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

3.3 The determinants of the JPY carry trade regimes

The investigation results for the determinants of daily JPY carry trade regime probabilities are reported in Tables 6A, 6B and 6C for whole sample, pre-GFC and post-GFC samples, respectively. In the whole sample results shown in Table 6A, RV and NumTrade are negative and significant, as in the AUD carry trade case, suggesting that high trading volume and volatility discourage carry trade speculations. Unlike the AUD case, however, OF is insignificant in all three specifications. The Japanese macroeconomic news does not have any impact on the carry trade probabilities. However, two US news show significant responses. The US retails sales and the FED's interest rate decisions have significant positive influence suggesting that unexpectedly high retails sales growth and unexpected FED rate hikes lower the carry trade probabilities. This is consistent with the expectations that the new information that is likely to lead to an appreciation of the USD against the JPY will increase returns from current carry trade positions where the JPY is a funding currency.

The pre-GFC sample estimations are reported in Table 6B. RV is still negative and significant, however, NumTrade is no longer significant in any of the specification. As in the full sample, none of the Japanese news is significant and the two US news, Retail sales growth and FOMC decisions are positive and significant. The post-GFC sample estimations show somewhat different results. The carry trade regime probabilities did not respond to RV, however, NumTrade and OF are negative and significant. The negative OF coefficient suggests that as there are more buy than sell JPY trades (hence an upward pressure on the JPY), the resulting expectation of the JPY appreciation would render the JPY carry trades (JPY as a funding currency) less profitable and hence lower carry trade probabilities. This is opposite to the role OF plays for the AUD as an investment currency. Unlike the pre-GFC sample, we now have some Japanese macroeconomic news that are significant. The unexpected increase in merchandise orders and Tanken improvements lower the probabilities. Since these news are likely to appreciate the JPY against the USD the attractiveness of the JPY as a funding currency diminishes. In addition the Japanese news intensity variable is negative and significant suggesting that the scheduled information arrival in Japan, regardless of news contents, lowered carry trade probabilities. This is similar to the AUD news intensity variable that shows a significant negative influence in all three samples.

The weekly estimations results are presented in Table 7. RV is not significant in any of the sample which is a departure from the daily results. NumTrade is negative and significant in the whole and the pre-GFC samples, whereas OF is significant only in the post-GFC sample. FutPos, which measures the amount of speculation in the JPY futures market, is negative and significant in all samples considered. The negative sign is in line with expectation that net long position being associated with lower carry trade probabilities as a future JPY appreciation is expected. The Japanese news intensity variable is now significant and positive which is opposite to the result found for daily horizon. The accumulation of scheduled announcement events over a week apparently contributed to the JPY carry trades.

In sum, there are significant time varying impact of the determinants of the JPY carry trades. A direct measure of the JPY volatility, RV, is significant only during the pre-GFC sample, whereas NumTrade, as a measure of trade volume, has a significant impact only during the post-GFC sample. In addition, OF is significant only in the later subsample. There is also a shift in the importance of macroeconomic news. In general, those macroeconomic news that point to a future appreciation of the USD against JPY (unexpectedly higher retail sales growth and unexpected Fed rates increase in the US, and lower than expected machine orders and worse than expected Tanken survey results in Japan) increase the JPY carry trade probabilities. However, the US news is significant only in the pre-GFC sample and the Japanese news matter only in the post-GFC sample.

4. Conclusion

In this paper we investigated the time series characteristics of carry trade regime probabilities of major currencies over a period 2 Jan 1999 to 31 Dec 2013 at daily and weekly investment horizons. As a first step we investigated the carry trades that involve the USD and also cross currencies with a Markov regime shifting methodology. We find that there is strong evidence for carry trades for the AUD, EUR and JPY at daily horizon. Although both the AUD and EUR show similar patterns of time variations in carry trade regime probabilities, the AUD was more likely to stay in a carry trade regime than the EUR. In general, carry trades are revered during the various episodes of financial market turmoil such as the period surrounding 9/11 in 2001, the GFC period of 2008-9 and the Eurozone crisis period of 2010-11. The carry trade probabilities for the JPY is less straight forward to interpret, however the GFC period shows a tendency of lower carry trade probabilities.

In the second stage of analyses, we conducted detailed investigations on the determinants of the AUD and JPY carry trades. For determinants, we considered a list of foreign exchange 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 the AUD carry trade investigations, and from Japan and the US for the JPY for daily horizons. For weekly horizon investigations we examined the role of net long futures positions on the AUD and JPY, which act as a proxy for the market's assessment on the future movements of the currencies.

For daily horizon, we find that there is a significant difference in responses of the regime probabilities to these determinants between the pre- and post GFC periods for both AUD and JPY carry trades. 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 and unexpected unemployment announcements in

Australia. The carry trade probabilities are significantly higher when order flows are positive (more buyer than seller initialed trade of AUD) and when the RBA unexpectedly increased interest rates. For the JPY, the carry trade probabilities are significantly lower when realized volatility is high and the probabilities are lower when the US unexpectedly raises the Fed funds rate and when unexpectedly high retail sales growth is announced in the US.

On the other hand, the post-GFC period reports a significant departure from the pre-GFC relationships we report. For the AUD carry trades, almost all of the determinants are insignificant. For the JPY, the carry trade probabilities no longer responds to the JPY volatility, however, it reacts to trade volume and order flows. In addition, only the Japanese macroeconomic news matter.

For weekly horizon, we find that for the AUD carry trades the market activity variables are also 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. For the JPY, speculative futures positions on the currency matters in both samples, however, different combinations of determinants are relevant for each subsample.

The investigation results have significant implications for market participants and policy makers who need to better understand the factors that explain the time varying nature of currency carry trade probabilities.

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Figure 1: Daily carry trade variables

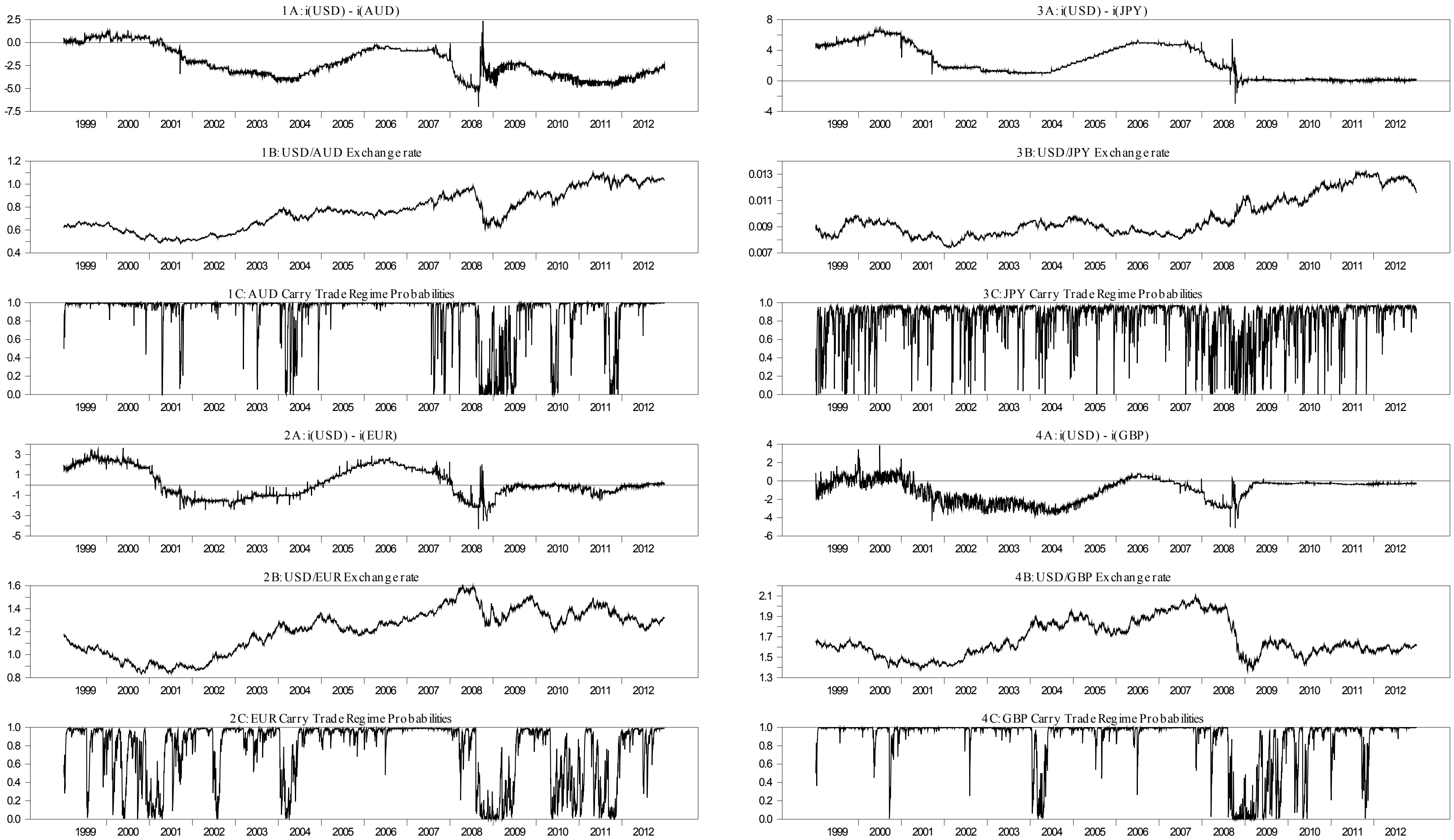


Figure 2: Weekly carry trade variables

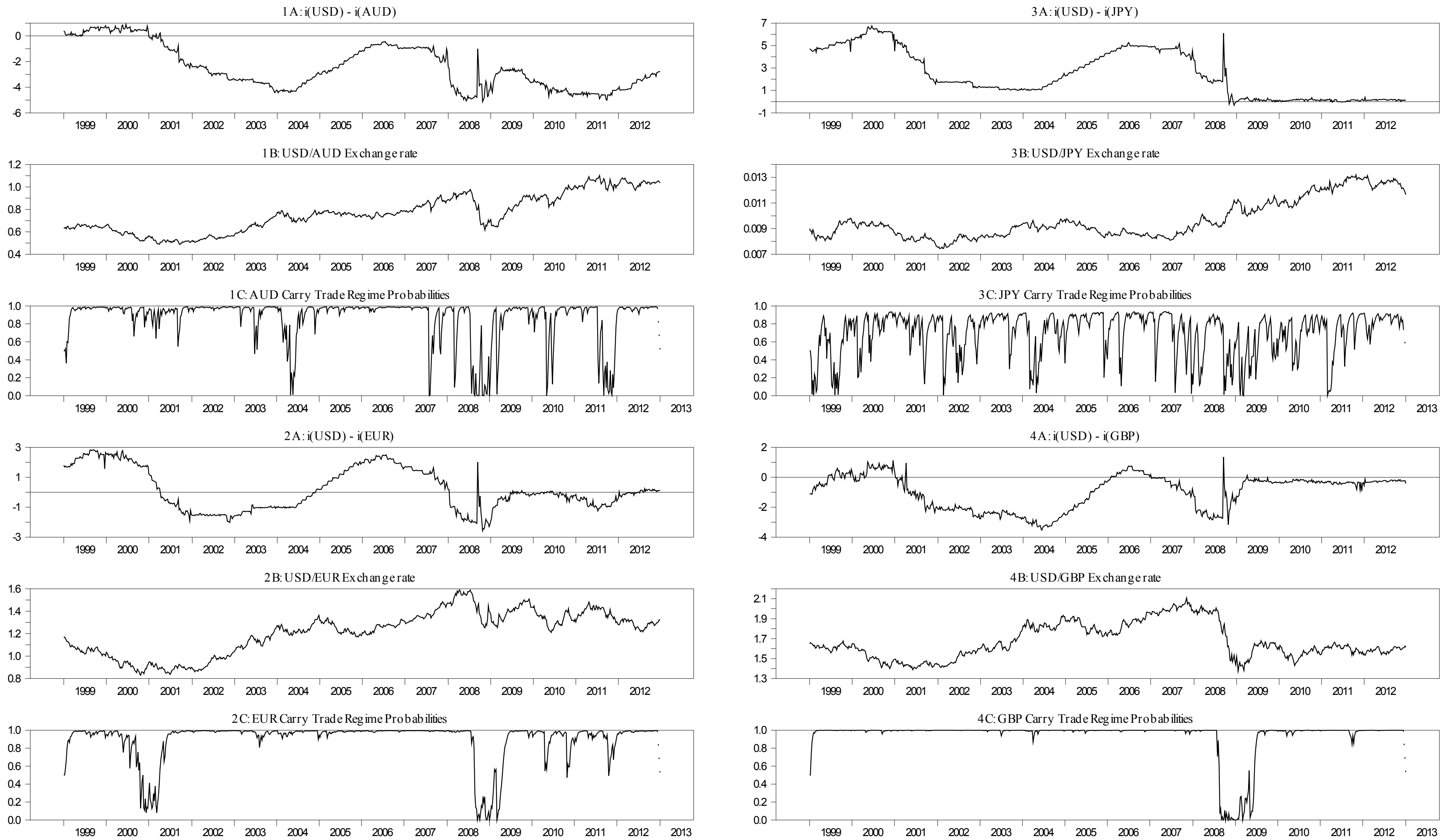
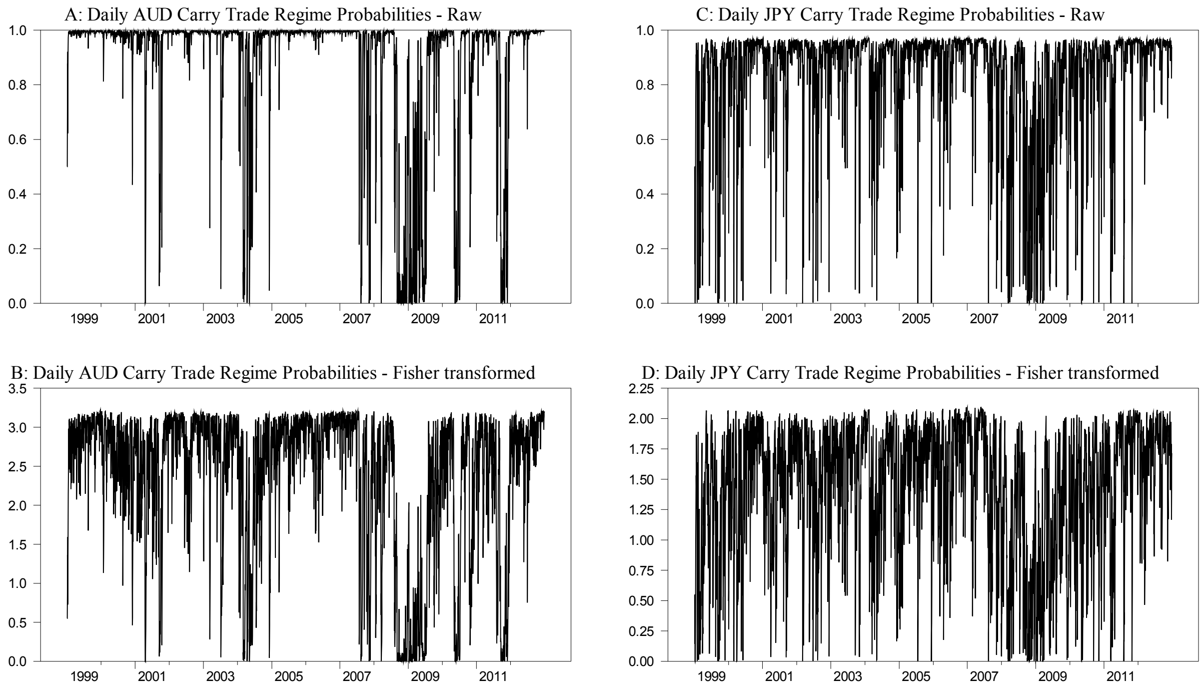


Figure 3: Raw and Fisher transformed AUD carry trade regime probabilities

Panel A: Daily regime probabilities



Panel B: Weekly regime probabilities

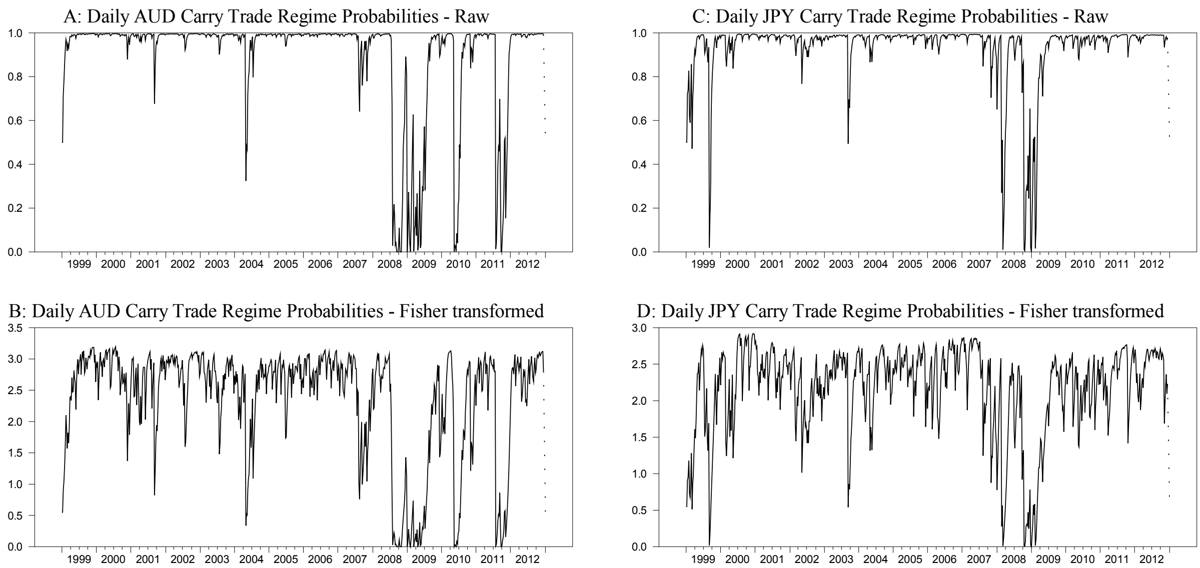


Table 1: Carry trade probabilities between involving the USD

The table below reports the Markov regime shifting model estimations of equations (5A) and (6) for the USD exchange rates against the AUD, EUR, JPY and GBP for the period Jan 1999 to Dec 2012.

	USD&AUD			USD&EUR			USD&JPY			USD&GBP		
A: Daily Horizon												
P11	0.9942	***	{0.0000}	0.9945	***	{0.0000}	0.9636	***	{0.0000}	0.9967	***	{0.0000}
P22	0.9570	***	{0.0000}	0.9832	***	{0.0000}	0.8425	***	{0.0000}	0.9775	***	{0.0000}
$\alpha(ST_1)$	0.0000		{0.6955}	0.0002		{0.1361}	-0.0002	**	{0.0316}	0.0000		{0.7225}
$\alpha(ST_2)$	-0.0026	***	{0.0007}	-0.0001		{0.8029}	0.0001		{0.8039}	0.0003		{0.5623}
$\beta(ST_1)$	-5.2216	***	{0.0002}	-7.2564	***	{0.0092}	-4.4182	***	{0.0002}	-1.9096		{0.3293}
$\beta(ST_2)$	-14.6487		{0.1074}	10.7730		{0.1688}	13.4753	**	{0.0152}	26.1093	***	{0.0061}
$\sigma(ST_1)$	0.0064	***	{0.0000}	0.0054	***	{0.0000}	0.0051	***	{0.0000}	0.0049	***	{0.0000}
$\sigma(ST_2)$	0.0175	***	{0.0000}	0.0088	***	{0.0000}	0.0106	***	{0.0000}	0.0103	***	{0.0000}
No. Obs	3650			3650			3650			3650		
LogL	12216			13380			13362			13835		
B: Weekly Horizon												
	AUD			EUR			JPY			GBP		
P11	0.9888	***	{0.0000}	0.9955	***	{0.0000}	0.8582	***	{0.0000}	0.9984	***	{0.0000}
P22	0.8902	***	{0.0000}	0.9624	***	{0.0000}	0.9406	***	{0.0000}	0.9735	***	{0.0000}
$\alpha(ST_1)$	0.0000		{0.9777}	0.0006		{0.1721}	0.0012		{0.3989}	0.0000		{0.9401}
$\alpha(ST_2)$	-0.0062		{0.1473}	-0.0025		{0.3914}	0.0006		{0.3132}	0.0036		{0.2761}
$\beta(ST_1)$	-3.7305	***	{0.0004}	-3.1557		{0.1360}	-2.7172	***	{0.0032}	-1.4172		{0.3795}
$\beta(ST_2)$	3.3079		{0.5855}	6.0260		{0.5116}	3.9032		{0.1583}	36.7811	***	{0.0003}
$\sigma(ST_1)$	0.0143	***	{0.0000}	0.0126	***	{0.0000}	0.0109	***	{0.0000}	0.0112	***	{0.0000}
$\sigma(ST_2)$	0.0414	***	{0.0000}	0.0240	***	{0.0000}	0.0184	***	{0.0000}	0.0301	***	{0.0000}
No. Obs	729			729			729			729		
LogL	1885			2085			2092			2118		

***, ** and * represent significance at 1, 5 and 10% level

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

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

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

Table 2: Cross currency carry trade probabilities

The table below summarizes the Markov regime estimations for carry trades between two non-USD currencies.

	AUD&EUR			AUD&JPY			AUD&GBP			EUR&JPY			EUR&GBP			JPY&GBP		
A: Daily Horizon																		
P11	0.9739	***	{0.0000}	0.9764	***	{0.0000}	0.9853	***	{0.0000}	0.9741	***	{0.0000}	0.9884	***	{0.0000}	0.9797	***	{0.0000}
P22	0.8036	***	{0.0000}	0.8861	***	{0.0000}	0.8903	***	{0.0000}	0.9348	***	{0.0000}	0.9855	***	{0.0000}	0.9012	***	{0.0000}
$\alpha(ST_1)$	-0.0003	**	{0.0101}	-0.0019	***	{0.0000}	-0.0002	*	{0.0908}	-0.0002	*	{0.0630}	-0.0001		{0.4782}	0.0000		{0.6788}
$\alpha(ST_2)$	0.0017	**	{0.0212}	-0.0020	**	{0.0166}	0.0006		{0.3791}	0.0007	*	{0.0634}	-0.0001		{0.3938}	-0.0001		{0.8968}
$\beta(ST_1)$	-1.4572		{0.3160}	10.1991	***	{0.0000}	-2.3509		{0.2217}	-1.1651		{0.4817}	-1.8607		{0.2664}	-1.0396		{0.3259}
$\beta(ST_2)$	1.8565		{0.8999}	39.5984	***	{0.0000}	2.2354		{0.8580}	3.1770		{0.5258}	-1.5392		{0.7508}	16.2922	**	{0.0145}
$\sigma(ST_1)$	0.0053	***	{0.0000}	0.0067	***	{0.0000}	0.0056	***	{0.0000}	0.0056	***	{0.0000}	0.0034	***	{0.0000}	0.0059	***	{0.0000}
$\sigma(ST_2)$	0.0149	***	{0.0000}	0.0211	***	{0.0000}	0.0143	***	{0.0000}	0.0120	***	{0.0000}	0.0064	***	{0.0000}	0.0150	***	{0.0000}
No. Obs	3650			3650			3650			3650			3650			3650		
LogL	12822			12100			13165			12777			14181			12342		
B: Weekly Horizon																		
	AUD&EUR			AUD&JPY			AUD&GBP			EUR&JPY			EUR&GBP			JPY&GBP		
P11	0.9903	***	{0.0000}	0.9870	***	{0.0000}	0.9889	***	{0.0000}	0.9918	***	{0.0000}	0.9943	***	{0.0000}	0.9977	***	{0.0000}
P22	0.8574	***	{0.0000}	0.9070	***	{0.0000}	0.8892	***	{0.0000}	0.9435	***	{0.0000}	0.9844	***	{0.0000}	0.9836	***	{0.0000}
$\alpha(ST_1)$	0.0000		{0.9576}	-0.0047	***	{0.0000}	-0.0003		{0.5128}	0.0001		{0.8216}	-0.0002		{0.6335}	0.0007		{0.2302}
$\alpha(ST_2)$	0.0048		{0.2407}	-0.0326	***	{0.0000}	0.0009		{0.7796}	-0.0000		{0.9875}	-0.0010		{0.3488}	0.0019		{0.5049}
$\beta(ST_1)$	-1.7698	*	{0.0944}	3.5402	***	{0.0000}	-2.2310		{0.1257}	-1.5208		{0.1851}	-0.4810		{0.6856}	0.7118		{0.3191}
$\beta(ST_2)$	-0.5129		{0.9504}	45.9239	***	{0.0000}	1.4468		{0.8297}	13.0014	**	{0.0192}	-3.7028		{0.6298}	29.4796	***	{0.0000}
$\sigma(ST_1)$	0.0134	***	{0.0000}	0.0165	***	{0.0000}	0.0129	***	{0.0000}	0.0143	***	{0.0000}	0.0082	***	{0.0000}	0.0141	***	{0.0000}
$\sigma(ST_2)$	0.0322	***	{0.0000}	0.0453	***	{0.0000}	0.0288	***	{0.0000}	0.0300	***	{0.0000}	0.0150	***	{0.0000}	0.0309	***	{0.0000}
No. Obs	729			729			729			729			729			729		
LogL	2038			1826			2050			1968			2325			1983		

***, ** and * represent significance at 1, 5 and 10% level

Table 3: Summary statistics of market activity variables for the AUD and JPY carry trades at daily and weekly holding periods

The table below provides summary statistics of the AUD and JPY carry trade regime probabilities (both raw and Fisher transformed), realized volatility, number of trades and order flows of the AUD and JPY over daily and weekly horizons.

	Mean	Std. Dev	Max	Min	Skewness	Kurtosis	Normality	I(1)[a]
Panel A: AUD 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: AUD 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
Panel C: JPY Daily Holding Period								
RP_Raw	0.8144	0.2281	0.9702	0	-2.0135	3.3324	4155	-14.5410
RP_Z	1.4116	0.5601	2.0957	0	-0.8943	-0.2536	496	-13.8993
RV	0.0001	0.0001	0.0037	1.0E-06	14.3954	314.00	15120938	-15.9120
NoTrade	9584	4091.8	43270	177	1.6035	5.9612	6969	-10.8850
OF	-92.57	199.54	4287	-1037	3.1919	64.2657	634315	-18.8016
Panel D: JPY Weekly Holding Period								
RP_Raw	0.9300	0.1601	0.9942	0.000312	-4.0064	16.6539	10389	-5.7035
RP_Z	2.1570	0.6214	2.9191	0.000312	-1.5342	2.0687	417	-5.5636
RV	0.0004	0.0007	0.0152	6.88E-05	14.2394	275.0302	2325435	-7.9059
RS	-0.2097	1.1467	12.9505	-11.8155	1.3852	61.4079	114932	-10.0135
NoTrade	48690	17189.8	149359	6899	1.7299	5.0383	1136	-5.1026
OF	-467.90	659.90	4662	-2323	0.8626	4.6254	741	-6.3183
FutPos	-5225.55	42056.2	65920	-188077	-1.0724	1.8090	239	-5.3309

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

***, ** and * represent significance at 1, 5 and 10% level

Where RP_Raw is smoothed Markov regime probabilities of being in AUD or JPY 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, NumTrade 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 the AUD and JPY futures contracts held by non-commercial traders in the Chicago Mercantile Exchange.

Table 4A: 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 (7) below at daily horizon:

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

Variable	Coeff		P-Value	Coeff		P-Value	Coeff		P-Value
Constant	0.3050	***	{0.0000}	0.2983	***	{0.0000}	0.2972	***	{0.0000}
RP_{t-1}	0.8959	***	{0.0000}	0.8950	***	{0.0000}	0.8951	***	{0.0000}
RV	-0.0711	***	{0.0040}	-0.0658	***	{0.0062}	-0.0654	***	{0.0062}
RV_{t-1}	-0.0322	*	{0.0598}	-0.0330	*	{0.0535}	-0.0329	*	{0.0529}
NumTrade	-0.0061	***	{0.0034}	-0.0079	***	{0.0001}	-0.0079	***	{0.0000}
OF	0.0849	**	{0.0263}	0.0770	**	{0.0448}	0.0785	**	{0.0402}
A_News_Num	-0.0134	***	{0.0012}						
ANews_CAB				0.1586		{0.2233}	0.1644		{0.1902}
ANews_CPI				-0.0478		{0.1484}	-0.0487		{0.1407}
ANews_GDP				0.0276		{0.5768}	0.0278		{0.5760}
ANews_RBACR				0.0204		{0.6120}	0.0203		{0.6129}
ANews_RET				0.0182		{0.7350}	0.0183		{0.7337}
ANews_UE				-0.0573	***	{0.0034}	-0.0597	***	{0.0028}
USNews_Num	-0.0001		{0.9446}	-0.0001		{0.9766}			
USNews_CAB							0.0492		{0.1295}
USNews_CPI							0.0022		{0.9303}
USNews_FOMC							0.0158		{0.2994}
USNews_GDP							-0.0458	*	{0.0990}
USNews_NFP							0.0090		{0.7682}
USNews_PMI							0.0125		{0.7261}
USNews_RET							0.0289		{0.5728}
USNews_UE							-0.0483		{0.1224}
No. Obs.	3649			3649			3649		
R^2-Bar	0.85			0.85			0.98		
LogL	-1528			-1527			-1524		
DW	2.12			2.12			2.13		

***, ** and * represent significance at 1, 5 and 10% level

Table 4B: Determinants of AUD carry trade regime probabilities: Pre-GFC sample: 2 Jan 1999 – 12 Sep 2008

The table below provides estimation results for the determinants of the AUD carry trade regime probabilities of the equation (7) at daily horizon:

Variable	Coeff		P-Value	Coeff		P-Value	Coeff		P-Value
Constant	0.3479	***	{0.0000}	0.3438	***	{0.0000}	0.3432	***	{0.0000}
RP_{t-1}	0.8846	***	{0.0000}	0.8837	***	{0.0000}	0.8833	***	{0.0000}
RV	-0.0536	**	{0.0283}	-0.0472	**	{0.0455}	-0.0468	**	{0.0457}
RV_{t-1}	-0.0241		{0.1516}	-0.0249		{0.1372}	-0.0243		{0.1452}
NumTrade	-0.0136	***	{0.0003}	-0.0159	***	{0.0000}	-0.0162	***	{0.0000}
OF	0.1266	***	{0.0063}	0.1186	**	{0.0110}	0.1210	***	{0.0091}
ANews_Num	-0.0133	**	{0.0166}						
ANews_CAB				0.1844		{0.1690}	0.1881		{0.1391}
ANews_CPI				-0.0644	**	{0.0291}	-0.0657	**	{0.0264}
ANews_GDP				0.0171		{0.7423}	0.0175		{0.7392}
ANews_RBACR				0.0788	***	{0.0000}	0.0777	***	{0.0000}
ANews_RET				-0.0359		{0.4977}	-0.0357		{0.5017}
ANews_UE				-0.0577	***	{0.0039}	-0.0602	***	{0.0033}
USNews_Num	-0.0005		{0.8383}	-0.0006		{0.8198}			
USNews_CAB							0.0555		{0.1287}
USNews_CPI							-0.0086		{0.7122}
USNews_FOMC							0.0150		{0.3148}
USNews_GDP							-0.0522	*	{0.0799}
USNews_NFP							0.0066		{0.8705}
USNews_PMI							0.0258		{0.5027}
USNews_RET							0.0303		{0.5905}
USNews_UE							-0.0483		{0.1294}
No. Obs.	2529			2529			2529		
R2-Bar	0.85			0.85			0.85		
LogL	-1160			-1156			-1152		
DW	2.11			2.11			2.11		

***, ** and * represent significance at 1, 5 and 10% level

Table 4C: Determinants of daily AUD carry trade regime probabilities: Post-GFC sample: 13 Sep 2008 – 31 Dec 2012

The table below provides estimation results for the determinants of the AUD carry trade regime probabilities of the equation (7) at daily horizon:

	Coeff		P-Value	Coeff		P-Value	Coeff		P-Value
Constant	0.4076	***	{0.0000}	0.3826	***	{0.0000}	0.3834	***	{0.0000}
RP_{t-1}	0.8775	***	{0.0000}	0.8790	***	{0.0000}	0.8805	***	{0.0000}
RV	-0.4414	*	{0.0976}	-0.3785		{0.1498}	-0.3450		{0.1755}
RV_{t-1}	-0.3555	*	{0.0638}	-0.2886		{0.1343}	-0.3103		{0.1008}
NumTrade	-0.0031		{0.5898}	-0.0053		{0.3483}	-0.0049		{0.3537}
OF	0.1170		{0.1365}	0.0978		{0.1862}	0.1060		{0.1577}
ANews_Num	-0.0139	**	{0.0314}						
ANews_CAB				-0.9911	*	{0.0977}	-0.9946	*	{0.0907}
ANews_CPI				-0.0064		{0.9455}	-0.0072		{0.9392}
ANews_GDP				0.1652		{0.3311}	0.1623		{0.3354}
ANews_RBACR				0.0011		{0.9786}	-0.0000		{0.9996}
ANews_RET				0.0890		{0.3896}	0.0932		{0.3553}
ANews_UE				-0.0509		{0.3324}	-0.0520		{0.3264}
USNews_Num	0.0006		{0.8510}	0.0016		{0.6237}			
USNews_RET							0.0172		{0.8724}
USNews_CAB							0.0301		{0.6384}
USNews_CPI							0.0678		{0.5459}
USNews_FOMC							-		-
USNews_GDP							0.0156		{0.8006}
USNews_NFP							0.0100		{0.8224}
USNews_PMI							-0.0595		{0.4720}
USNews_UE							-0.0392		{0.7139}
No. Obs.	1120			1120			1120		
R2-Bar	0.85			0.85			0.85		
LogL	-358			-355			-354		
DW	2.17			2.18			2.18		

***, ** and * represent significance at 1, 5 and 10% level

Table 5: Determinants of weekly AUD carry trade regime probabilities

The table below provides estimation results for the determinants of the AUD carry trade regime probabilities of the equation (7) at weekly horizon:

$$RP_t = \alpha + \sum_{i=1}^{p} \alpha_i^{RP} RP_{t-i} + \sum_{i=0}^{q} \alpha_i^{RV} RV_{t-i} + \sum_{i=0}^{r} \alpha_i^{NumTrade} NumTrade_{t-i} + \sum_{i=0}^{s} \alpha_i^{RS} RS_{t-i} + \sum_{i=0}^{u} \alpha_i^{OF} OF_{t-i} + \alpha^{\text{ANews\_Num}} \text{ANews\_Num}_t + \alpha^{\text{USNews\_Num}} \text{USNews\_Num}_t + \alpha^{FP} \text{FutPos}_t + \varepsilon_t \qquad (7)$$

	Whole sample			**Pre-GFC**			**Post-GFC**		
Variable	Coeff		P-Value	Coeff		P-Value	Coeff		P-Value
Constant	0.3864	***	{0.0000}	0.5397	***	{0.0000}	0.1807		{0.2582}
RP_{t-1}	0.8776	***	{0.0000}	0.8262	***	{0.0000}	0.9154	***	{0.0000}
RV	-0.0158	**	{0.0368}	0.0116		{0.5626}	-0.0124		{0.2399}
RS	0.0100		{0.3725}	0.0244	**	{0.0407}	-0.0250		{0.2072}
RS_{t-1}	0.0140	**	{0.0227}	0.0219	***	{0.0012}	-0.0011		{0.9053}
NumTrade	-0.0019	*	{0.0756}	-0.0016		{0.3231}	-0.0017		{0.3904}
OF	0.0518	*	{0.0968}	0.0845	*	{0.0591}	0.0358		{0.4344}
FutPos	0.0016	***	{0.0065}	0.0018	**	{0.0188}	0.0011		{0.3496}
ANews_Num	-0.0121	***	{0.0010}	-0.0165	***	{0.0004}	-0.0039		{0.5033}
USNews_Nun	0.0001		{0.9413}	-0.0010		{0.6824}	0.0015		{0.5197}
No. Obs.	729			505			224		
R^2-Bar	0.87			0.73			0.90		
LogL	-215			-105			-91		
DW	2.10			2.14			1.97		

***, ** and * represent significance at 1, 5 and 10% level

Table 6A: Determinants of JPY 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 (7) below at daily horizon:

$$RP_t = \alpha + \sum_{i=1}^{p} \alpha_i^{RP} RP_{t-i} + \sum_{i=0}^{q}\alpha_i^{RV} RV_{t-i} + \sum_{i=0}^{r}\alpha_i^{NumTrade} NumTrade_{t-i} + \sum_{i=0}^{s}\alpha_i^{RS} RS_{t-i} + \sum_{i=0}^{u}\alpha_i^{OF} OF_{t-i}$$
$$+ \alpha^{\text{JNews\_Num}}\text{JNews\_Num}_t + \alpha^{\text{USNews\_Num}}\text{USNews\_Num}_t$$
$$+ \sum_{i=1}^{u}\alpha_i^{JNews} JNews_{t-1}^{i} + \sum_{i=1}^{v}\alpha_i^{USNews} USNews_t^{i} + \varepsilon_t \qquad (7)$$

Variable	Coeff		P-Value	Coeff		P-Value	Coeff		P-Value
Constant	0.3592	***	{0.0000}	0.3561	***	{0.0000}	0.3540	***	{0.0000}
RP_{t-1}	0.7866	***	{0.0000}	0.7861	***	{0.0000}	0.7865	***	{0.0000}
RV	-0.1540	***	{0.0023}	-0.1484	***	{0.0028}	-0.1497	***	{0.0018}
RV_{t-1}	-0.1316	**	{0.0280}	-0.1312	**	{0.0287}	-0.1272	**	{0.0349}
NumTrade	-0.0028		{0.1194}	-0.0031	*	{0.0852}	-0.0030	*	{0.0891}
OF	-0.0274		{0.2881}	-0.0224		{0.3865}	-0.0225		{0.3776}
JPNews_Num	-0.0023		{0.1652}						
JPNews_CAB				-0.0027		{0.9483}	0.0017		{0.9682}
JPNews_CPI				-0.0350		{0.2295}	-0.0352		{0.2274}
JPNews_GDP				0.0156		{0.8058}	0.0157		{0.8048}
JPNews_JobLess				0.0043		{0.8575}	-0.0003		{0.9910}
JPNews_MachOrd				0.0093		{0.6300}	0.0090		{0.6421}
JPNews_MercTB				-0.0032		{0.8993}	-0.0033		{0.8965}
JPNews_Tanken				-0.0837		{0.3867}	-0.0839		{0.3867}
USNews_Num	-0.0000		{0.9922}	-0.0001		{0.9470}			
USNews_CAB							-0.0653		{0.1540}
USNews_CPI							-0.0260		{0.2149}
USNews_FOMC							0.1036	***	{0.0079}
USNews_GDP							-0.0681		{0.1419}
USNews_NFP							-0.0014		{0.9458}
USNews_PMI							-0.0006		{0.9713}
USNews_RET							0.0247	*	{0.0893}
USNews_UE							-0.0059		{0.8086}
No. Obs.	3649			3649			3649		
R^2-Bar	0.68			0.68			0.68		
LogL	-989			-988			-976		
DW	2.06			2.06			2.06		

***, ** and * represent significance at 1, 5 and 10% level

Table 6B: Determinants of JPY carry trade regime probabilities: Pre-GFC sample: 2 Jan 1999 – 12 Sep 2008

The table below provides estimation results for the determinants of the JPY carry trade regime probabilities of the equation (7) at daily horizon:

Variable	Coeff		P-Value	Coeff		P-Value	Coeff		P-Value
Constant	0.3413	***	{0.0000}	0.3394	***	{0.0000}	0.3368	***	{0.0000}
RP_{t-1}	0.7812	***	{0.0000}	0.7810	***	{0.0000}	0.7807	***	{0.0000}
RV	-0.2168	**	{0.0452}	-0.2170	**	{0.0439}	-0.2084	**	{0.0499}
RV_{t-1}	-0.2933	***	{0.0000}	-0.2951	***	{0.0000}	-0.2911	***	{0.0000}
NumTrade	0.0004		{0.8633}	0.0004		{0.8388}	0.0000		{0.9908}
OF	0.0355		{0.3155}	0.0374		{0.2926}	0.0373		{0.2930}
JPNews_Num	-0.0010		{0.6454}						
JPNews_CAB				-0.0240		{0.6704}	-0.0207		{0.7200}
JPNews_CPI				-0.0600		{0.1029}	-0.0608		{0.1017}
JPNews_GDP				0.0179		{0.7824}	0.0182		{0.7798}
JPNews_JobLess				0.0011		{0.9709}	-0.0048		{0.8802}
JPNews_MachOrd				-0.0072		{0.7263}	-0.0076		{0.7159}
JPNews_MercTB				0.0385		{0.2571}	0.0364		{0.2832}
JPNews_Tanken				-0.0005		{0.9958}	0.0003		{0.9976}
USNews_Num	-0.0017		{0.4287}	-0.0019		{0.4007}			
USNews_CAB							-0.0857		{0.1506}
USNews_CPI							-0.0305		{0.2160}
USNews_FOMC							0.1016	**	{0.0109}
USNews_GDP							-0.0725		{0.1360}
USNews_NFP							-0.0117		{0.6100}
USNews_PMI							-0.0071		{0.6838}
USNews_RET							0.0265	*	{0.0749}
USNews_UE							-0.0076		{0.8236}
No. Obs.	2529			2529			2529		
R2-Bar	0.68			0.68			0.68		
LogL	-808			-806			-794		
DW	2.06			2.06			2.06		

***, ** and * represent significance at 1, 5 and 10% level

Table 6C: Determinants of daily JPY carry trade regime probabilities: Post-GFC sample: 13 Sep 2008 – 31 Dec 2012

The table below provides estimation results for the determinants of the JPY carry trade regime probabilities of the equation (7) at daily horizon:

	Coeff		P-Value	Coeff		P-Value	Coeff		P-Value
Constant	0.4692	***	{0.0000}	0.4667	***	{0.0000}	0.4690	***	{0.0000}
RP_{t-1}	0.7684	***	{0.0000}	0.7622	***	{0.0000}	0.7635	***	{0.0000}
RV	-0.0533		{0.2121}	-0.0315		{0.4477}	-0.0295		{0.4839}
RV_{t-1}	0.0056		{0.8487}	0.0097		{0.7321}	0.0082		{0.7924}
NumTrade	-0.0118	***	{0.0095}	-0.0132	***	{0.0030}	-0.0129	***	{0.0035}
OF	-0.0720	**	{0.0492}	-0.0597	*	{0.0986}	-0.0586		{0.1054}
JPNews_Num	-0.0056	**	{0.0401}						
JPNews_CAB				0.0426		{0.4183}	0.0487		{0.3307}
JPNews_CPI				0.0309		{0.3267}	0.0318		{0.3135}
JPNews_GDP				0.0783		{0.4471}	0.0773		{0.4578}
JPNews_JobLess				0.0253		{0.4981}	0.0246		{0.5095}
JPNews_MachOrd				0.0698		{0.2017}	0.0701		{0.2003}
JPNews_MercTB				-0.0767	**	{0.0181}	-0.0761	**	{0.0186}
JPNews_Tanken				-0.6583	***	{0.0000}	-0.6599	***	{0.0000}
USNews_Num	0.0009		{0.7097}	0.0012		{0.6160}			
USNews_CAB							0.0073		{0.8823}
USNews_CPI							-0.0307		{0.3183}
USNews_FOMC							-		-
USNews_GDP							0.0819		{0.1141}
USNews_NFP							0.0295		{0.5452}
USNews_PMI							-0.0001		{0.9986}
USNews_RET							0.0213		{0.7008}
USNews_UE							0.0113		{0.6435}
No. Obs.	1120			1120			1120		
R2-Bar	0.66			0.67			0.67		
LogL	-161			-150			-149		
DW	1.99			2.00			2.00		

***, ** and * represent significance at 1, 5 and 10% level

Table 7: Determinants of weekly JPY carry trade regime probabilities

The table below provides estimation results for the determinants of the JPY carry trade regime probabilities of the equation (7) at weekly horizon:

$$RP_t = \alpha + \sum_{i=1}^{p} \alpha_i^{RP} RP_{t-i} + \sum_{i=0}^{q} \alpha_i^{RV} RV_{t-i} + \sum_{i=0}^{r} \alpha_i^{NumTrade} NumTrade_{t-i} + \sum_{i=0}^{s} \alpha_i^{RS} RS_{t-i} + \sum_{i=0}^{u} \alpha_i^{OF} OF_{t-i}$$
$$+ \alpha^{\text{JNews\_Num}} \text{JNews\_Num}_t + \alpha^{\text{USNews\_Num}} \text{USNews\_Num}_t + \alpha^{FP} \text{FutPos}_t + \varepsilon_t \quad (7)$$

	Whole sample			**Pre-GFC**			**Post-GFC**		
Variable	Coeff		P-Value	Coeff		P-Value	Coeff		P-Value
Constant	0.6383	***	{0.0000}	0.8401	***	{0.0000}	0.4588	**	{0.0104}
RP_{t-1}	0.7869	***	{0.0000}	0.7052	***	{0.0000}	0.8632	***	{0.0000}
RV	-0.0270		{0.1953}	-0.0253		{0.1998}	0.0042		{0.9563}
NumTrade	-0.0044	***	{0.0003}	-0.0067	***	{0.0000}	-0.0040		{0.1775}
OF	-0.0093		{0.6619}	-0.0223		{0.5011}	-0.0764	**	{0.0328}
FutPos	-0.0008	***	{0.0053}	-0.0010	**	{0.0167}	-0.0011	**	{0.0307}
JPNews_Num	0.0036	**	{0.0171}	0.0063	***	{0.0012}	0.0032		{0.2241}
USNews_Nun	-0.0000		{0.9811}	0.0048		{0.1032}	-0.0018		{0.4892}
No. Obs.	729			505			224		
R^2-Bar	0.77			0.72			0.85		
LogL	-145			-108			-22		
DW	2.13			2.04			2.23		

***, ** and * represent significance at 1, 5 and 10% level

AppendixA: Australian and the US Macroeconomic news

The table below shows information on the macroeconomic announcement news from Australia, Japan and the US used in the analyses.

	No. Obs.	Frequency	Unit of measurement	Release time (local time)
Australia				**AEST**
CPI	168	QoQ	% Change	11:30
Current Account	56	Quarterly	AUD mil.	11:30
GDP	56	QoQ	% Change	11:30
RBA Cash Rate	45	Monthly	%	11:30
Retail sales	39	MoM	% Change	11:30
Unemployment	168	Monthly	%	11:30
Japan				
Tanken	58	Quarterly	0	8:50
Merchandise Order	155	Monthly	%	8:50
Current Account	148	Monthly	Yen b.	8:50
Trade Balance	155	Monthly	Yen b.	8:50
GDP	46	Quarterly	%	8:50
CPI	135	Monthly	%	8:50
Jobless	155	Monthly	%	8:50
US				**EST**
Advance Retail Sales	139	MoM	% Change	8:30
NonFarm Payroll	168	MoM	in '000s	8:30
Purchasing Manager Inde	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	% Change	8:30
Unemployment	168	Monthly	%	8:30

Source: Bloomberg