

IMPACT OF MACROECONOMIC SURPRISES ON CARRY TRADE ACTIVITY

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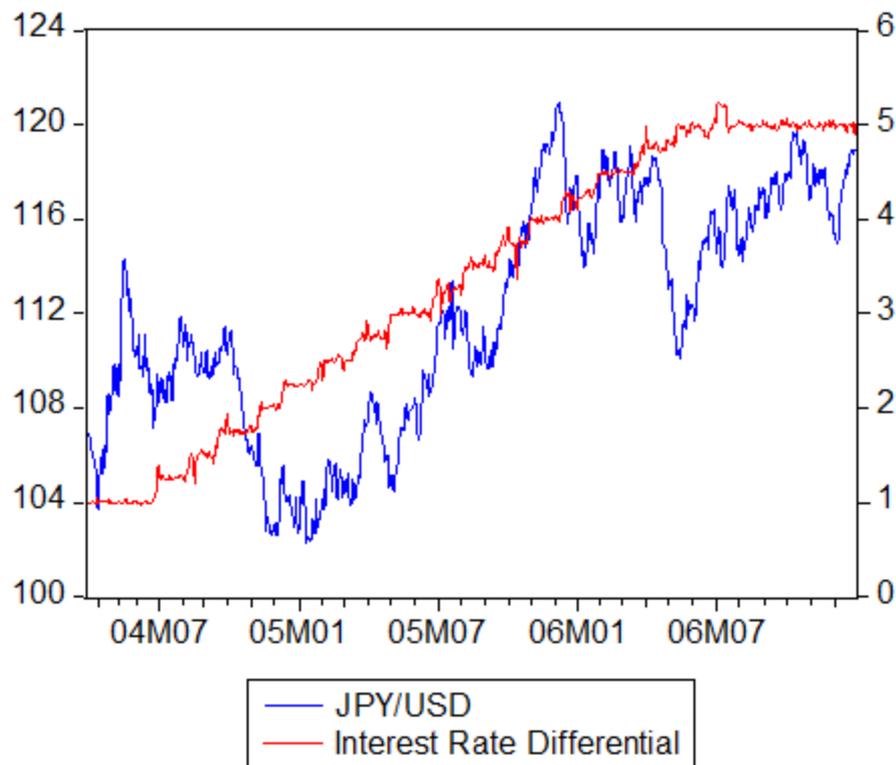
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*The views expressed herein are those of the authors and do not reflect the views of the Bank for the International Settlements.

BACKGROUND

- **Zero interest policy in Japan---** before it became the norm-created opportunities for massive “carry trade”
- **Carry trade is betting against UIP...borrowing in low interest currency, lending in high interest currency and hoping currency doesn't move against you**
- **Hugely profitable**
- **Could be a “peso” problem...but short-run deviations from UIP clearly evident (CIP holds, implies that forward rate is not a good predictor of future spot rate)**

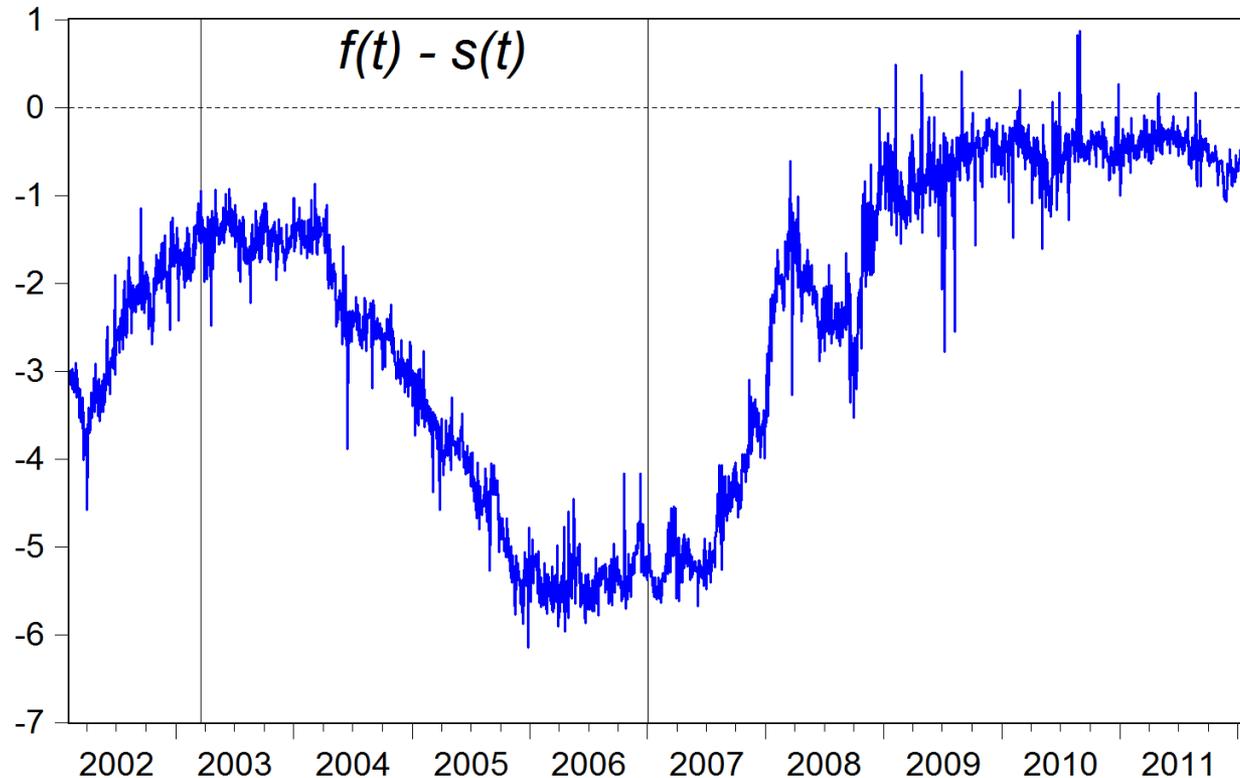
MOTIVATION: IMPACT OF FUNDAMENTALS NEWS VIA THE TAILS OF FX RETURN DIST.



UIP violations may compensate carry traders for exposing themselves to periodic crashes by taking the other side of commercial hedging (March 18 2004 – Dec 29 2006; start is end of Jpn intervention in fx; end date is before fin. crisis). Gyntelberg and Remolona (2007), Farhi and Gabaix (2008), and Brunnermeier et al(2009).

AN ERA OF CARRY TRADE IN JPY

Negative forward premium indicates carry trade opportunity



The chart plots JPY/USD forward premium, measured as the difference between forward and spot rates, $f(t) - s(t)$. JPY was the funding currency in carry trade using USD. JPN interest rates Less than US interest rates.

QUESTIONS

- How do carry-traders respond to “news”?
- How to measure the perceptions of risk that carry-traders will be caught on the wrong side a really big and sharp yen appreciation?
- How does risk perceptions influence carry-trade activity?
- And how do news announcements influence risk assessments and thereby carry-trade activity?

OUTLINE OF PAPER

- **Risk Reversals (buying deep OTM call, selling deep OTM put):**
 - Hedging against large yen appreciation...
 - A common measure of market assessment of risk of large movements
- **Macro news and risk: “normal news” and “big news” suitably matched with big changes in risk assessment**
- **Linking news to RR to carry trade (via futures positions of non-commercial traders)**

Related Literature:

News and FX spot and options markets:

- Andersen, Bollerslev, Diebold and Vega (2003), Disyatat and Galati (2007), Galati et al.(2007a), Evans and Lyons (2008), Fatum, Hutchison and Wu (2010)
- Crash Risk in Currency Mkts. / Carry Trade: Galati et al.(2007b), Farhi and Gabaix (2008), Gabaix et al.(2009), Brunnermeier, Nagel and Pedersen (2009)

Departure from existing literature:

- Focus on the height of carry trade in Japanese yen
- Use of risk reversals...measuring expected “big changes”

Consider a broader set of news than previous work

- Focus on “big” news surprises (concerned with large exchange rate changes)
- Focus on longer hedging horizon (1-year vs. 1-month)

Measure the effect of news on the yen carry trade (through the “value “of risk”)

RISK REVERSALS

The cost of buying insurance against large foreign currency appreciation (yen appreciation) e.g. European call option

where,
$$C(X, \sigma) = \frac{1}{(1+i)T} (F \cdot \Phi(d_1(X, \sigma)) - X \cdot \Phi(d_2(X, \sigma)))$$

$$d_1 = \frac{\ln(F / X) + (\sigma^2 / 2)T}{\sigma \sqrt{T}}, d_2 = d_1 - \sigma \sqrt{T}$$

for 25-delta risk reversals:

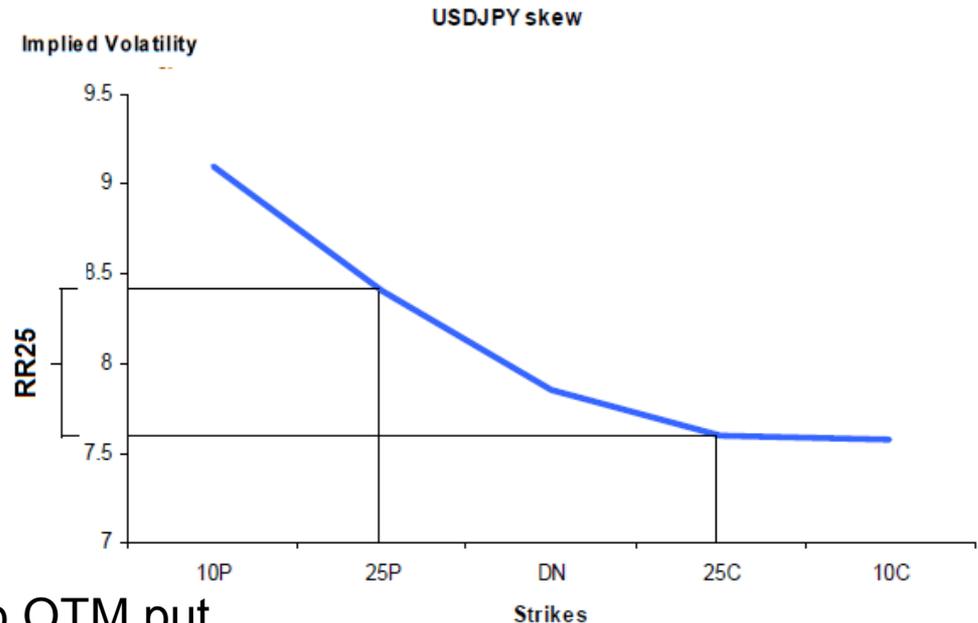
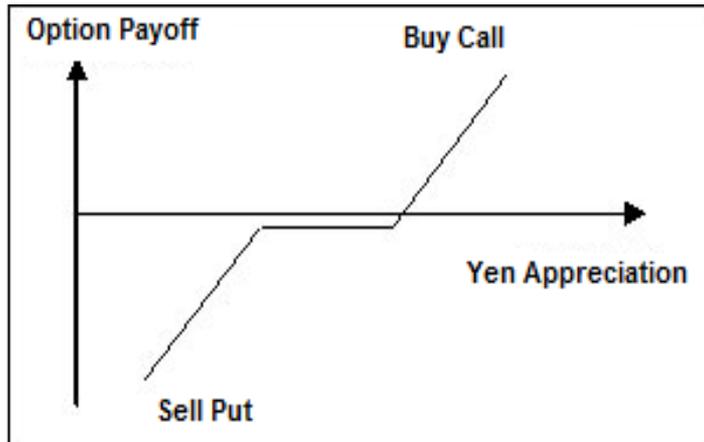
$$\frac{\partial C(X, \sigma)}{\partial X} = 0.25$$

$$RR25 = \sigma_c^{25\delta} - \sigma_p^{25\delta}$$

Quotes are for USD calls and puts (Yen puts and calls), so negative values mean risk of large yen appreciation dominates

RISK REVERSALS

Value conveys expected skewness and skewness risk premium



RR: Buy deep OTM Call, sell deep OTM put...

Protects against sharp appreciation, take risk of sharp yen depreciation

Deep OTM— only big yen changes;

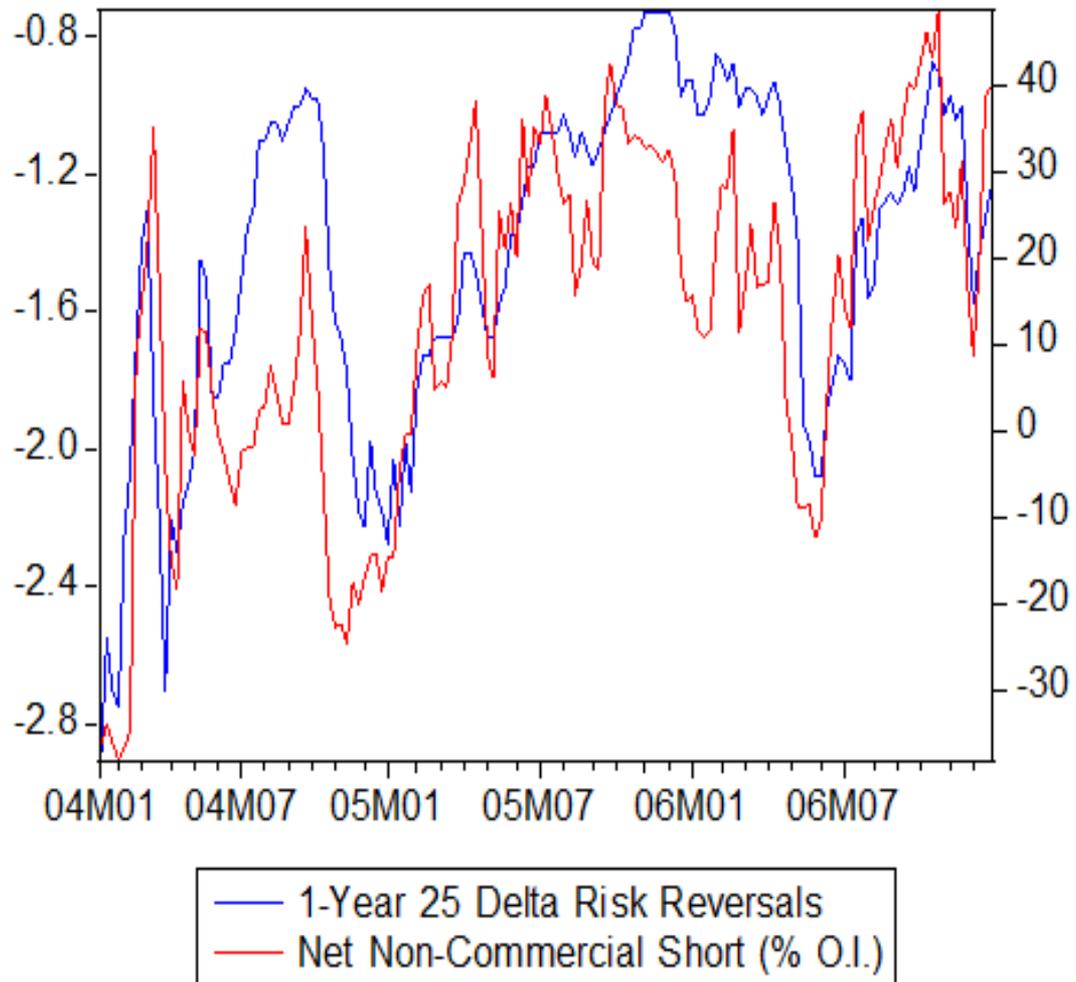
Why sell put? Helps finance call (and you already have a long USD position)

Delta25: OTM (rate of change in price for change in spot price/strike price)

Smirk: implied volatility of dollar put (yen call) is high, risk is higher of dollar

depreciation (yen appreciation), so value of RR is high

RISK REVERSALS



DATA: 03/18/2004 THROUGH 12/31/2006 SAMPLE PERIOD

Period of heavy carry trade. Start: Jpn intervention ceases; End: Beginning of financial crisis

Risk Reversals: Daily data (excluding weekends) 1-year options (sources: Bloomberg).

News: Daily data on 15 types of Japanese and 18 types of U.S. macro news (sources: Bloomberg News Service, Bank of Japan, Japanese Cabinet Office)

standardized surprise of macroeconomic fundamental q announced at

time t :
$$S_{q,t} = (A_{q,t} - E_{q,t}) / \hat{\sigma}_q$$

Futures Positions: from the Commodity Futures Trading Commission (CFTC)'s Weekly Commitment of Traders (COT) report

NCMS (% O.I.) = (non-commercial short - non-commercial long) / total open interest

Interest Rates: CIP implied interest rate differential using spot rates 1-year currency futures (source: Datastream)



Table 1: Descriptive statistics for risk reversal series

Summary statistics

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewnes	Kurtosis
Levels	-1.375	-1.250	-0.725	-2.750	0.440	-0.595	2.439
1st Differences	0.000	0.000	0.250	-0.900	0.071	-3.169	41.925

Unit root tests

	Aug. Dickey-Fuller	Phillips-Perron
Levels	-2.159	-2.216
1st Differences	-26.808***	-26.815***

Note: 3/18/2004 to 12/29/2006 sample period. Unit root test 10%, 5%, and 1% critical values for 1-year are -2.568864, -2.865366, and -3.439268. *, **, and *** indicate coefficients significant at 10%, 5%, and 1% level respectively.

JPY/USD NEWS REGRESSIONS

- The signs are consistent with the trade balance/flow model of exchange rate determination.
- **GDP growth** and stronger U.S. **consumer credit**, lead to a lower value of risk reversals—the perceived risk of sharp dollar depreciation against the yen rises—
- **Why? U.S.** trade deficits are associated with more robust demand
- News of improvement in the **Japanese trade balance** reduces the value of risk reversals, increasing the perceived likelihood of sharp yen appreciation, while rising Japanese **Consumer Confidence Index** and **Overall Household Spending** (increasing demand for imports) reduces the Japanese trade balance, in turn increasing the value of risk reversals and leading to less risk of major yen appreciation.

Table 2: Regression results for significant macroeconomic announcement surprises on risk reversals

ALL Macro Surprises	Baseline(1)		Baseline(2)	
	Coef.	S.E.	Coef.	S.E.
U.S. Announcements				
GDP	-5.517 **	(2.653)	-4.259 **	(1.768)
Nonfarm payroll employment	4.679 *	(2.468)	0.616	(2.314)
Consumer credit	-4.293 *	(2.550)	-4.858 *	(2.619)
Japanese Announcements	Coef.	S.E.	Coef.	S.E.
Trade balance	-5.553 *	(2.857)	-5.452 **	(2.796)
Consumer confidence index	3.660 **	(1.865)	3.517 *	(1.859)
Overall household spending	5.738 **	(2.485)	5.558 ***	(1.530)
Exchange rate			5.239 ***	(1.256)
Interest rate differential			-0.067 *	(0.041)
Lag dependent variable	0.008	(0.052)	0.003	(0.044)
R-squared	0.033		0.211	
Durbin-Watson	1.814		2.085	
Akaike info criterion	-2.402		-2.600	

Note: 3/18/2004 12/29/2006 sample, 715 observations. Standard errors in parentheses; *, **, and *** indicate coefficients significant at 10%, 5%, and 1% level respectively. Constant and day of the week omitted because of insignificant coefficient. Only coefficient on significant macroeconomic surprise announcements reported.

SIZE MATTERS

- Investigate effects of “large” news announcements, to match up with RR (risk of large yen appreciation)
- “narrow bounds”: 1SD
- “wide bounds”: 1SD but calculate SD dropping zero change observations
- Calculate OLS and ARMA(4,4)...based on AIC

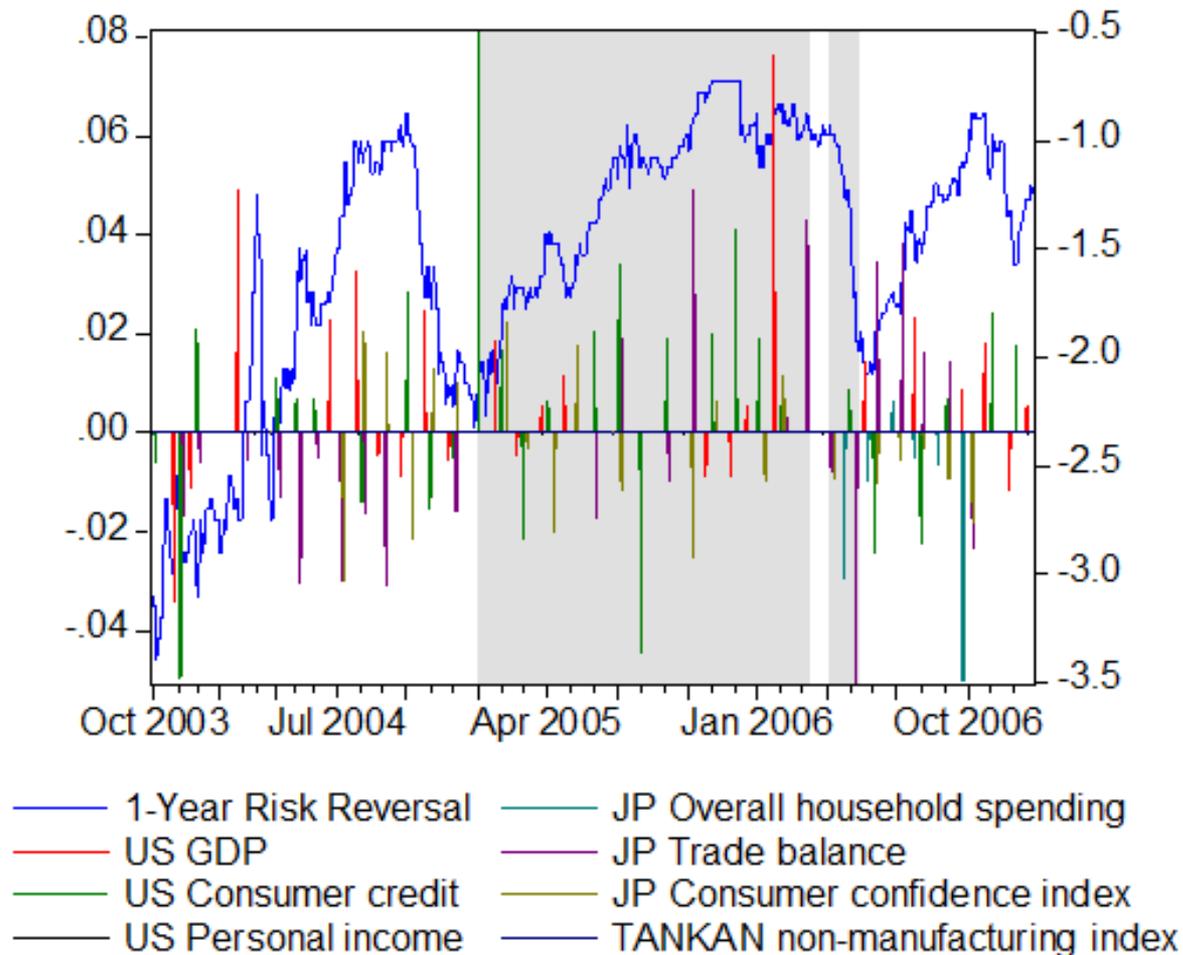
- Results:
- More “news” is evident...consistent with “trade flow” story...single largest impact for Japan is trade balance, and other variables (largely) consistent with this explanation

Table 3: Regression results of significant LARGE macroeconomic announcement surprises on risk reversals

LARGE Macro Surprises	Baseline(2)				ARMA(4,4)			
	Narrow Bounds		Wide Bounds		Narrow Bounds		Wide Bounds	
U.S. Announcements	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
GDP	-4.219 **	(1.747)	-3.557 *	(2.043)	-4.327 **	(1.841)	-3.959 **	(1.982)
Personal income	1.658	(1.293)	1.082 **	(0.421)	1.569	(1.168)	1.211 ***	(0.374)
Consumer credit	-4.873 *	(2.635)	-6.478 *	(3.441)	-5.518 **	(2.726)	-7.033 **	(3.567)
Japanese Announcements	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Trade balance	-5.526 **	(2.793)	-6.396 *	(3.448)	-5.620 **	(2.788)	-6.436 *	(3.512)
Consumer confidence index	3.513 *	(1.855)	1.812	(1.569)	3.538 *	(1.939)	1.680	(1.765)
TANKAN non-manuf. index	-1.946	(3.904)	-3.702 *	(2.100)	-2.765	(3.764)	-3.017 *	(1.658)
Overall household spending	5.583 ***	(1.478)	4.389 ***	(0.928)	5.903 ***	(1.948)	4.794 ***	(1.573)
Exchange rate	5.237 ***	(1.256)	5.193 ***	(1.249)	4.593 ***	(0.705)	4.539 ***	(0.691)
Interest rate differential	-0.068 *	(0.041)	-0.065	(0.041)	-0.076 **	(0.037)	-0.074 **	(0.037)
Lag dependent variable	0.003	(0.044)	0.002	(0.045)				
AR(4)					-0.658 ***	(0.164)	-0.653 ***	(0.169)
MA(4)					0.726 ***	(0.148)	0.724 ***	(0.152)
R-squared	0.212		0.211		0.286		0.286	
Durbin-Watson	2.084		2.078		2.129		2.126	
Akaike info criterion	-2.600		-2.599		-2.696		-2.696	

Note: 3/18/2004 12/29/2006 sample, 715 observations. Standard errors in parentheses; *, **, and *** indicate coefficients significant at 10%, 5%, and 1% level respectively. Constant and day of the week omitted because of insignificant coefficient. Only coefficient on significant macroeconomic surprise announcements Reported. Narrow bounds: outside 1SD. Wide: drop zero values in calculating SD.

MACROECONOMIC SURPRISES (1 S.D. BOUNDS) AND THE PRICE OF INSURANCE AGAINST YEN APPRECIATION (RISK REVERSALS)



IS PERCEIVED RISK OF LARGE APPRECIATION GREATER IF THE YEN APPRECIATED PREVIOUS DAY?

- Look at interaction of variables with dummy for previous day (t-1) rise in risk (fall in RR), where dummy (1=RR declines, 0=otherwise)
- Results:
 - Even more news significant...market “hyper sensitive” to news immediately after risk in risk assessment
 - E.g. “wide bounds” results: 8 US and 5 Japan macro surprise variables are significant,
 - US and Japan trade balance news has largest (and significant) impacts in the predicted direction

Table 4: Regression results of significant LARGE macroeconomic surprise announcements Conditional on previous day appreciation of yen

LARGE Macro Surprises		ARMA(4,4)			
U.S. Announcements	Narrow Bounds		Wide Bounds		
	Coef.	S.E.	Coef.	S.E.	
Capacity utilization	10.679 **	(5.199)	8.407 **	(3.549)	
Personal income	1.126	(0.867)	1.046 ***	(0.349)	
Consumer credit	-5.076	(10.597)	-26.313 ***	(2.157)	
New home sales	-2.690	(1.903)	-1.290 *	(0.742)	
Trade balance	5.558	(6.012)	11.443 ***	(2.736)	
Consumer price index	2.762	(5.401)	-8.416 ***	(1.208)	
Housing starts	7.819 **	(3.871)	9.241 **	(4.276)	
Index of leading indicators	1.432	(10.992)	-10.328 **	(4.480)	
Japanese Announcements	Coef.	S.E.	Coef.	S.E.	
Trade balance	-8.472	(10.264)	-20.050 ***	(0.998)	
Leading economic index	-9.856 *	(5.380)	-	-	
TANKAN large manufacturing index	-3.593	(5.969)	3.060 **	(1.286)	
GDP (quarterly)	-13.323 ***	(5.117)	-	-	
Construction orders	3.788	(3.257)	6.030 ***	(1.224)	
Retail trade	-12.474 ***	(3.797)	-9.351 ***	(0.776)	
Consumer price index	-0.669	(4.440)	-10.530 *	(6.064)	
Overall household spending	10.630 **	(5.148)	4.097	(4.127)	
Exchange rate	4.479 ***	(0.659)	4.443 ***	(0.695)	
Interest rate differential	-0.062 *	(0.034)	-0.065 *	(0.034)	
AR(4)	-0.647 ***	(0.164)	-0.648 ***	(0.161)	
MA(4)	0.728 ***	(0.144)	0.728 ***	(0.142)	
R-squared	0.287		0.290		
Durbin-Watson	2.189		2.160		
Akaike info criterion	-2.701		-2.730		

Notes: All news announcement surprises have been interacted with a lagged dummy variable that takes on a value of 1 if the cost of hedging against sharp yen appreciation rose between day t and $t-1$.

STATISTICALLY SIGNIFICANT...BUT IS IT ECONOMICALLY IMPORTANT?

- **Decompose effect of news during two distinct periods:**
 - one of falling risk (RR moves from -2.4 to -1.0) during 1/7/2005 to 3/13/2006
 - one during substantial rise in risk (RR moves from -1 to -2) during 4/12/2006 to 5/17/2006.
- **Decomposition based on “narrow” and “wide” band estimates of Table 3 and actual movement news during these two periods**
- **Results: Explain 25-30% of falling risk with news (mainly US consumer credit, US GDP and Japan Trade Balance)**
- **...explain less during the second (rise in risk) episode ...and that is almost entirely due to improvement in Japan’s trade balance and hence more risk of large yen appreciation**

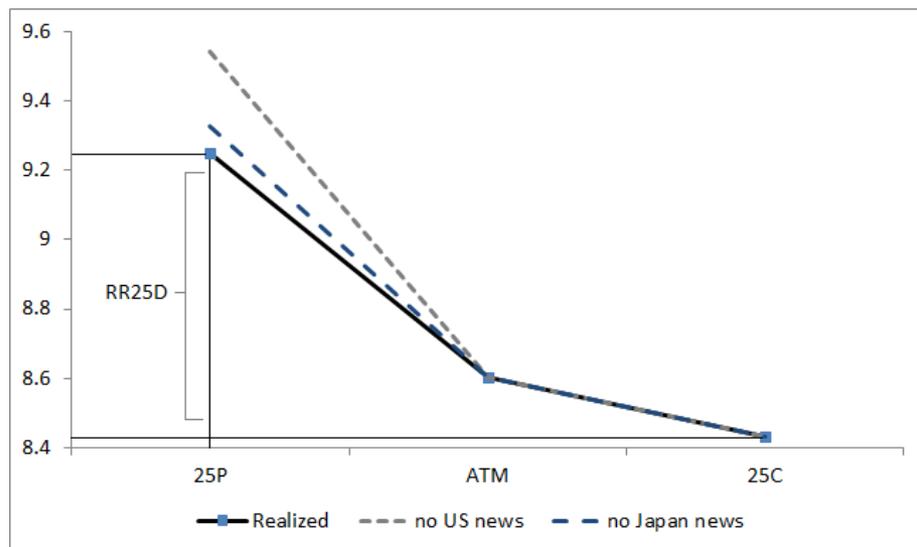
Table5: Impact of significant news surprises on the value of 1-year risk reversals

Surprise Announcement	Subsample Period: 01/07/2005-03/13/2006		04/12/2006-05/17/2006	
	Narrow Bands	Wide Bands	Narrow Bands	Wide Bands
US GDP	0.096	0.070	0.000	0.000
US Personal income	0.000	0.014	0.000	0.000
US Consumer credit	0.198	0.143	0.009	0.000
JP Trade balance	0.091	0.106	-0.058	-0.058
JP Consumer confidence index	-0.012	0.000	-0.009	0.000
TANKAN non-manufacturing index	0.000	-0.016	0.000	0.000
JP Overall household spending	0.000	0.000	-0.029	-0.024
Total	0.373	0.317	-0.088	-0.081
% of Change in 1-Year Risk Reversal	29.84%	25.34%	9.24%	8.56%

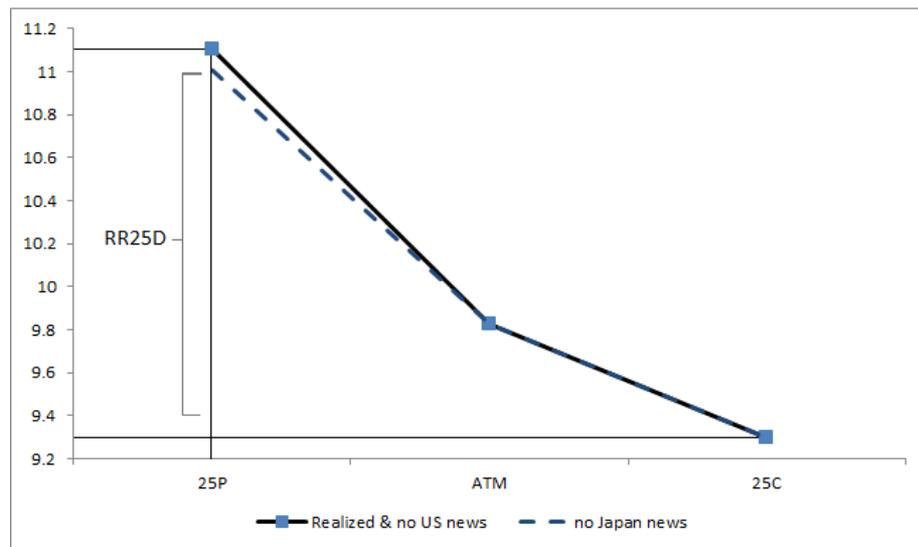
Note: The impact is calculated by multiplying the standardized value of the news surprise component relative to the Bloomberg survey of market expectation by the regression coefficient. The bottom row reports the cumulative impact of news surprises during each subsample period as a percentage of change in the value of 1-year risk reversal during the same time period.

ANOTHER LOOK AT NEWS IMPACTS DURING EPISODES: IMPACT OF MACROECONOMIC SURPRISES ON JPY/USD IMPLIED VOLATILITY SMIRK

Implied volatility: 01/07/2005 – 03/13/2006
subsample (realized fall in volatility)



Implied volatility: 04/12/2006 – 05/17/2006
subsample (realized rise in volatility)



Notes: Implied volatility smirk means yen calls/dollar puts are more expensive.
The vertical distance indicates the absolute value of 25-delta risk reversal:

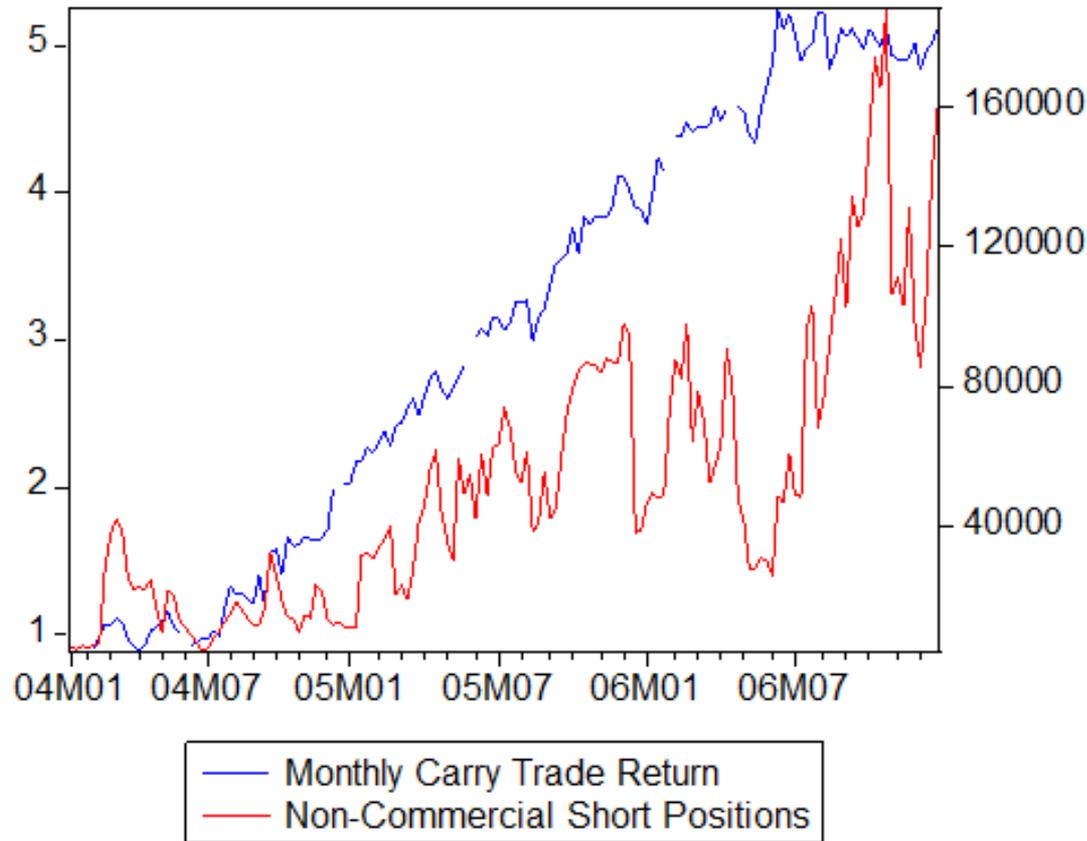
$$RR^{25\delta} = \sigma_c^{25\delta} - \sigma_p^{25\delta}$$

Estimates of the shift in the implied volatility curve are based on results in Table 5. Assuming all RR adjustment is in put values.

LINKING NEWS AND RISK REVERSALS TO CARRY TRADE

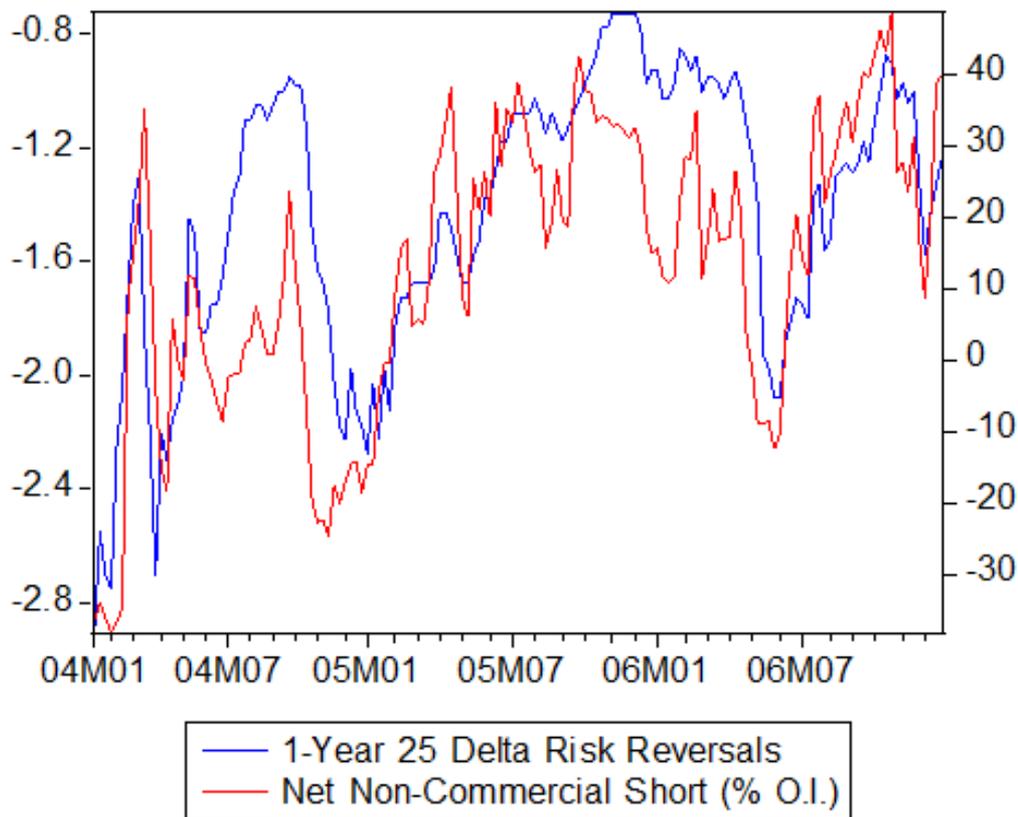
- **Aggregate carry trade flow volumes difficult to measure partly because of diverse carry trade strategies and data limitations**
- **Following Brunnermeier et al. (2009) and others, we proxy carry trade activity with yen futures short positions of non-commercial traders on CME (released by CFTC)...weekly data**
- **Broad proxy...but consistent with work of Cecchetti et al.**
- **Quick illustration: short positions highly correlated with ex post carry trade return (next figure)**
- **...and very close link between carry trade and short futures positions (calculated as short minus long; percentage of open interest)**
 - **Less risk of yen appreciation (rise in RR, lower cost of insurance), more speculation in yen short positions in futures market**

CARRY TRADE RETURN AND TOTAL CME NON-COMMERCIAL SHORT POSITIONS



Note: We calculate carry trade return as $CR_{t+k} = (1+i_{k,t}^{US})S_{t+k} / S_t - (1+i_{k,t}^{JP})$ where ik,t denote the effective k-period deposit rates available in Japan and U.S. at time t . CFTC classifies traders as non-commercial if they have no foreign exchange exposure to hedge. A position corresponds to a contract value of 2.5 million yen (CFTC Explanatory Notes, <http://www.cftc.gov/>).

RISK REVERSALS AND CME NET NON-COMMERCIAL YEN SHORT FUTURES POSITIONS



Notes: We construct the measure of CME net non-commercial short positions (NCMS) as a percentage of open interest (% O.I.) by subtracting non-commercial long from non-commercial short positions divided by total open interest in yen futures.

FINAL STEP

- **Link between RR and Net (non-commercial) short positions...established by Granger causality tests**
 - RR cause short positions (controlling for interest rate change)
 - No reverse causality
- **Use previous results linking news to RR, then link this impact on short positions**
- **Using two episodes again highlight:**
 - Explain up to 40% of NCMS (short positions) in first episode...sharp rise in NCMS...with news
 - Explain less than 10% in period of risking risk

Table 6: Granger causality tests between risk-reversals and net non-commercial short positions (% O.I.)

	Baseline				Controlling for exchange rate			
	1-lag		2-lag		1-lag		2-lag	
	risk reversals cause positions	positions cause reversals	risk reversals cause positions	positions cause reversals	risk reversals cause positions	positions cause reversals	risk reversals cause positions	positions cause reversals
1-Month Risk Reversals								
F-Statistic	3.837**	0.483	8.832***	2.213	4.326**	0.362	8.374***	1.409
Probability	0.052	0.488	0.000	0.113	0.039	0.548	0.000	0.248
Coeff. Sum	6.042	0.002	21.439	0.000	7.683	0.002	24.116	0.004
Obs.	146		143		146		143	
1-Year Risk Reversals								
F-Statistic	9.023***	0.521	9.611***	2.570*	7.720***	0.022	6.924***	1.798
Probability	0.003	0.471	0.000	0.080	0.006	0.882	0.001	0.169
Coeff. Sum	14.491	0.001	29.964	-0.003	15.495	0.000	30.388	-0.005
Obs.	151		150		151		150	

Note: *, **, and *** indicate the null hypothesis of no Granger-causality is rejected at significant at 10%, 5%, and 1% level respectively.

Table 7: Approximate cumulative impact of macro surprises on CME net non-commercial futures short positions through Risk Reversal valuation.

Subsample Period:	01/07/2005-03/13/2006		04/12/2006-05/17/2006	
	Wide Bounds 1-Lag Coeff.	Narrow Bounds 2-Lag Coeff.	Wide Bounds 1-Lag Coeff.	Narrow Bounds 2-Lag Coeff.
Calculation Method:				
Surprise Announcement	Δ NCMS (% O.I)	Δ NCMS (% O.I)	Δ NCMS (% O.I)	Δ NCMS (% O.I)
US GDP	1.08	2.92	0.00	0.00
US Personal income	0.22	0.00	0.00	0.00
US Consumer credit	2.22	6.01	0.00	0.27
JP Trade balance	1.64	2.76	-0.89	-1.77
JP Consumer confidence index	0.00	-0.37	0.00	-0.28
TANKAN non-manufacturing index	-0.25	0.00	0.00	0.00
JP Overall household spending	0.00	0.00	-0.37	-0.89
Total	4.91	11.33	-1.26	-2.67
% of Total Δ NCMS(%O.I.)	16.47%	38.03%	4.79%	10.14%

Note: The table shows the estimated cumulative impact over the sample period of macroeconomic news surprises on net non-commercial short positions (NCMS) as a percentage of total open interest (% O.I.) on the Chicago Mercantile Exchange (CME). The impact is calculated by multiplying the cumulative impact of news surprises on risk-reversals by the Granger-causality coefficients of risk-reversals on NCMS (% O.I.).

CONCLUSION

- Macroeconomic news is an important determinant of risk during periods of heavy carry trade volume: 7 macro surprises have statistically significant impact consistent with exchange rate/balance-of-payments nexus
- Cumulative impact on risk reversals is economically significant: up to 30% of total change during periods of major shifts in risk expectations Risk reversals and speculative positions are linked risk reversals Granger-cause speculative positions, relationship robust to controlling for FX rate
- Macroeconomic surprises impact carry trade activity through the cost of hedging (risk reversals): up to 40% of total change during periods of major position adjustments