Quantitative Easing and the Dollar-Yen Carry Trade

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This paper augments a predictive model of the Dollar-Yen FX trade to take into account central bank quantitative easing. The paper finds that the inclusion of an indicator dubbed "Relative Quantitative Restraint" substantially improves the performance of a three-indicator model based on valuation, interest rate differentials, and momentum. In addition, the analysis provides the following point estimate: During 2007-2017, a 16% monetary base expansion had the same FX impact as a 1% interest rate reduction.

Modeling the "Long JPY, Short USD" Trade

Before the onset of the financial crisis in 2007, a reasonably robust predictive model for the "Long JPY, Short USD" trade could be constructed using three explanatory variables:[1]

1. Value: The "Long JPY, Short USD" trade tends to be more profitable when the yen appears to be undervalued in real terms relative to the dollar

2. Interest Rate Differential: The "Long JPY, Short USD" trade tends to be more profitable when Japanese money market interest rates are high relative U.S. money market interest rates (the carry trade incentive)

3. Momentum: The "Long JPY, Short USD " trade tends to be more profitable when the trade has momentum (that is, when the trade has been recently profitable)

However, the three indicator model's explanatory power waned after the onset of the financial crisis—in what became the era of central bank quantitative easing. To address this shortcoming, this paper augments the three indicator model with a fourth explanatory variable:

4. Relative Quantitative Restraint: The "Long JPY, Short USD" trade tends to be more profitable in periods after monetary base growth has been more restrained in Japan than in the United States.

Econometric Model without Relative Quantitative Restraint

We estimated the three-indicator model (without Relative Quantitative Restraint) over 1985 – 2017. The summary statistics of the regression models are given in the tables below. The model's F-Statistic is highly statistically significant, and each of the three explanatory variables had the expected coefficient

[1] The return of the "Long JPY-Short USD" trade is the difference between (a) the Japanese money market return in USD (unhedged); and (b) the U.S. money market return in USD. Fuller definitions as well as econometric model specifications are given in the appendix.

sign. The t-Statistic associated with the Momentum indicator was high at 2.3, followed by the Interest Rate Differential indicator with a t-Statistic of 1.9 and the Value indicator with a t-Statistic of 1.6.

Regression Analysis of "Long JPY, Short USD" Return
Without Relative Quantitative Restraint
1985 - 2017

	Coefficient	Standard Error	t Stat
Intercept	0.4%	0.2%	1.7
Value	1.6%	1.0%	1.6
Interest Rate Differential	0.2%	0.1%	1.9
Momentum	3.3%	1.4%	2.3
R Square	3.0%		
Adjusted R-Square	2.3%		
F Statistic	4.1		
Significance of F Statistic	0.7%		

Source: Heckman Global Advisors

However, the three-indicator model lost much of its explanatory power during and after the financial crisis (2007-17). During this period, the model's F-Statistic was statistically insignificant, and each of the three explanatory variables had lower t-Statistics than in the full 1985-2017 period. The coefficient signs for Value and Momentum remained positive, but the sign for Interest Rate Differential became indistinguishable from zero.

Regression Analysis of "Long JPY, Short USD" Return
Without Relative Quantitative Restraint
2007 - 2017

	Coefficient	Standard Error	t Stat
Intercept	-0.1%	0.3%	-0.3
Value	2.2%	2.3%	1.0
Interest Rate Differential	0.0%	0.2%	-0.1
Momentum	3.9%	2.8%	1.4
R Square	1.5%		
Adjusted R-Square	-0.8%		
F Statistic	0.7		
Significance of F Statistic	57.6%		

Source: Heckman Global Advisors

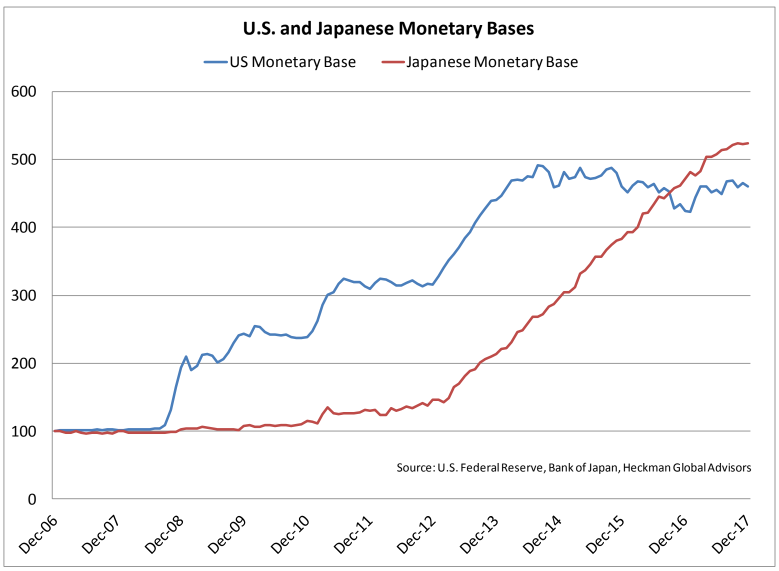
The results for 20017-17 raise the question of whether model performance could be improved by explicitly accounting for the role of quantitative easing during the financial crisis and its aftermath.

Quantitative Easing in the United States and Japan Since 2007

A central bank engages in quantitative easing by expanding its balance sheet through open market purchases of securities and other extensions of credit. This expansion can be monitored by tracking the liability side of the central bank's balance sheet, which is known as the monetary base.

The chart below shows monetary base indexes (December 2006 = 100) for the United States and Japan. The U.S central bank (the Fed) began to aggressively expand its balance sheet as early as the second half of 2008 when the U.S. monetary base increased by roughly 100%. The Fed continued to expand its balance sheet (in fits and starts) until 2014 (after Bernanke's "quantitative tapering" statement before Congress in May 2013).

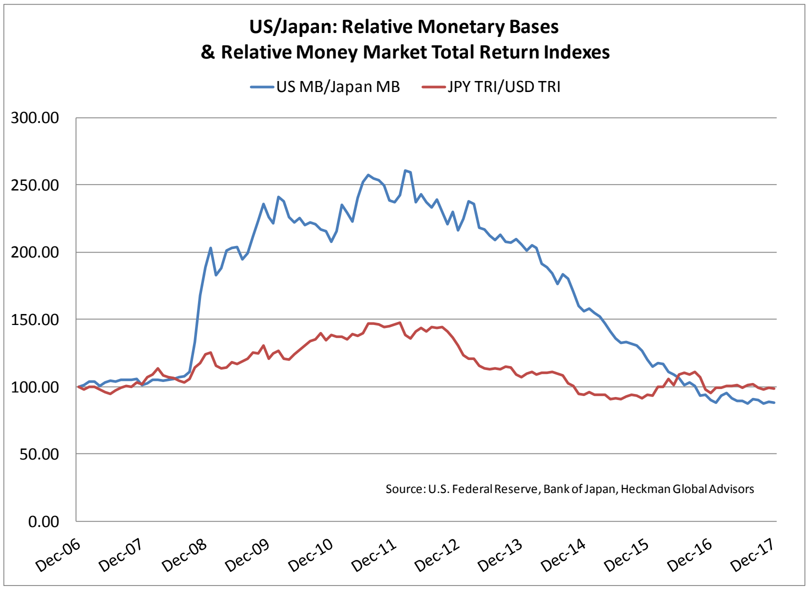
Quantitative easing in Japan was rather tepid until the implementation of "Abenomics" by the Bank of Japan (BOJ) in 2013. Despite its relatively late start, BOJ monetary base expansion was consistently aggressive during 2013-17. In fact, on a cumulative basis, BOJ monetary base expansion caught up with Fed monetary base expansion by 2016.



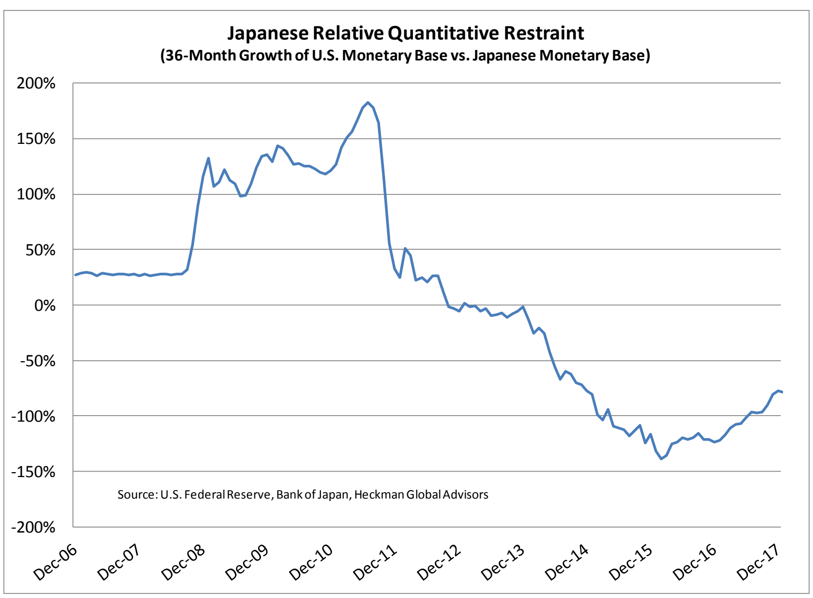
The next chart compares two ratios: (1) the ratio of the U.S. monetary base to the Japanese monetary base; and (2) the ratio of Japan's money market total return index to the U.S. money market total return index (where both total return indexes reflect cumulative USD returns to unhedged money market investments). [2] The chart shows that the U.S. monetary base increased relative to the Japan's monetary base during 2008-2011, but thereafter the U.S. monetary base declined relative to the Japanese monetary base. The chart also shows that, during 2008-2011, an unhedged investment in Japan's money market outperformed an unhedged investment in the U.S. money market. Thereafter, however, the relative performances reversed.

[2] Money market return definitions are shown in the appendix.

Broadly speaking, Japan's money market performance was relatively strong when U.S. quantitative expansion was relatively aggressive (and Japan exhibited relative quantitative restraint); and Japan's money market performance was relatively weak when U.S. quantitative expansion was relatively restrained (and Japan exhibited relative quantitative aggressiveness).



The existence of this broad relationship suggests that a measure of Japan's relative quantitative restraint may have predictive power over the return to the "Long JPY, Short USD" trade. The chart below shows one such measure: the 36-month growth rate of the U.S. monetary base *minus* the 36-month growth rate of the Japanese monetary base. It shows that Japan's quantitative expansion was relatively restrained during 2008-11 and relatively unrestrained (or aggressive) thereafter.



Econometric Model with Relative Quantitative Restraint

The inclusion of Relative Quantitative Restraint improved the econometric model's explanatory power substantially over 2007 - 2017. The summary statistics of the regression models are given in the tables below. The model's F-Statistic is statistically significant at the 10% level, and each of the four explanatory variables had the expected coefficient sign. Value and Relative Quantitative Restraint posted the highest t-Statistics, followed by Momentum and Interest Rate Differential (with the latter showing a much higher t-Statistic than in the model without Relative Monetary Restraint).

The regression analysis produced the following rule of thumb. Based on point estimates, a 16% increase in relative monetary base expansion has the same impact as a 1 percentage point decrease in the interest rate differential.

Regression Analysis of "Long JPY, Short USD" Return
With Relative Quantitative Restraint
2007 - 2017

	Coefficient	Standard Error	t Stat
Intercept	-0.5%	0.3%	-1.5
Value	11.3%	4.1%	2.8
Interest Rate Differential	0.2%	0.2%	1.1
Momentum	5.3%	2.8%	1.9
Relative Quantitative Restraint	1.4%	0.5%	2.7
R Square	6.8%		
Adjusted R-Square	3.9%		
F Statistic	2.3		
Significance of F Statistic	6.1%		

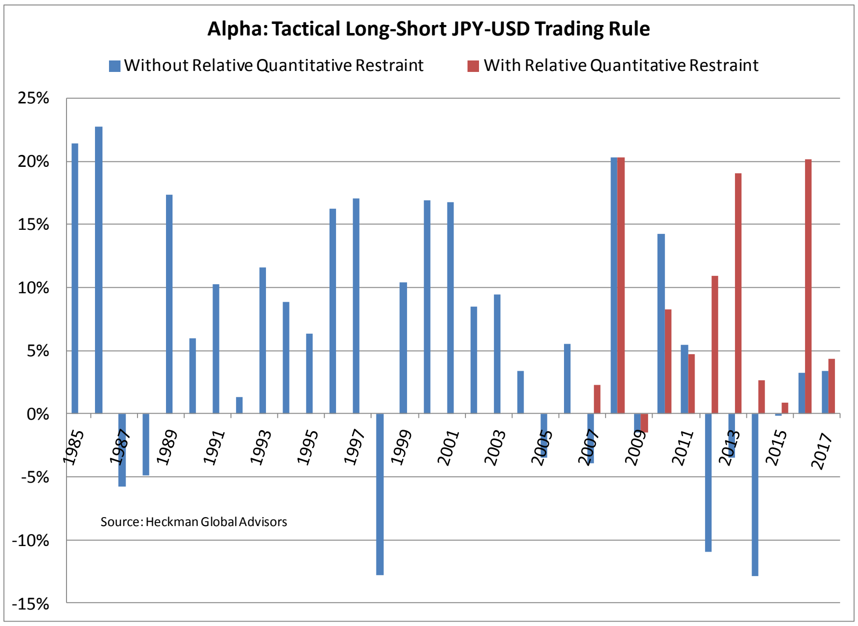
Source: Heckman Global Advisors

We conducted a thought experiment to illustrate the relative performances of the models with and without Relative Monetary Restraint. We back-tested the following tactical strategy:

- Go 100% "Long JPY, Short USD" in months beginning with a positive expected return for "Long JPY, Short USD"
- Go 100% "Long USD, Short JPY" in months beginning with a positive expected return for "Long USD, Short JPY"

Of course, this back-test is admittedly unrealistic, given that expected returns were calculated based on coefficients that were estimated based on the entire data base. Nevertheless, the results are interesting.

The chart below shows annual back-test alphas (based on annualized monthly averages). During 1985-2017, the model without Relative Quantitative Restraint had an average annualized alpha of 6%. However, the model's annualized alpha declined to 1% on average during 2007-2017. In contrast, the model with Relative Quantitative Restraint performed much better during 2007-2017, registering an average annualized alpha of 8%



Appendix: Definitions

Japanese and U.S. Market Returns in USD (Unhedged)

$$Japanese\ Money\ Market\ Return\ in\ USD\ (Unhedged) = (1 + i^{J}) * \frac{s_0}{s_1} - 1$$

$$U.S.Money\ Market\ Return\ in\ USD = i^{US}$$

$$Where:\ i^{J}\ is\ Japan's\ money\ market\ interest\ rate;$$

$$i^{US}\ is\ the\ U.S.money\ market\ interest\ rate;$$

$$s_0\ is\ the\ current\ spot\ FX\ rate;\ and\ s_1\ is\ the\ ending\ spot\ FX\ rate$$

$$(the\ price\ of\ one\ USD\ in\ terms\ of\ JPY).$$

Long-Short Return

$$Long\ JPY, Short\ USD\ Return = (1 + i^{J}) * \frac{s_0}{s_1} - (1 + i^{US})$$

Econometric Model without Relative Quantitative Restraint

$$Long\ JPY, Short\ USD\ Return = \alpha + \beta_1 * Value +$$

$$\beta_2 * Interest\ Rate\ Differential + \beta_3 * Momentum + \varepsilon$$

Note: All right-hand-side variables are lagged.

Econometric Model with Relative Quantitative Restraint

$$Long\ JPY, Short\ USD\ Return = \alpha + \beta_1 * Value +$$

$$\beta_2 * Interest\ Rate\ Differential + \beta_3 * Momentum$$

$$+ \beta_4 * Relative\ Quantitative\ Restraint + \varepsilon$$

Note: All right-hand-side variables are lagged.

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