E C O N O M I C S B U L L E T I N

Relationship between the yen carry trade and the related financial variables

Hideki Nishigaki
MURC

Abstract

Recently, the yen carry trade has been focused on the international financial market. However, there are few empirical studies on the yen carry trade. This paper investigates the relationship between the yen carry trade and the related financial variables in the US and Japan by the structural vector autoregression (SVAR) model. Our estimation results show that the US stock price has a dominant impact on the activity of the speculative yen carry trade. On the other hand, we found that the interest rate differential between Japan and the US does not have a significant impact on the movement of the carry trade. This result shows that the Bank of Japan fs (BOJ) raising the key rate may not make the yen carry trade less attractive. Our results also indicate that if the carry trade unwinds, the depreciation of the dollar against the yen will take place.

Citation: Nishigaki, Hideki, (2007) "Relationship between the yen carry trade and the related financial variables." *Economics Bulletin*, Vol. 13, No. 2 pp. 1-7
Submitted: March 31, 2007. **Accepted:** May 14, 2007.
URL: http://economicsbulletin.vanderbilt.edu/2007/volume13/EB-07M20002A.pdf

1. Introduction

Recently, the yen carry trade has been focused on the international financial market.

A carry trade involves borrowing money in a currency with low interest rates, for example, the currency of Japan (where the central bank's key lending rate currently sits at 0.5%) in order to purchase assets in a currency with higher interest rates, such as the Australian dollar.

The availability of cheap funds in Japan, along with the relatively low volatility in the currency has encouraged investors to take on additional leverage and use that to purchase not only bonds of other countries but also commodities and stocks.

However, it is difficult to track the precise scale of the feverish activity. As McGuire and Upper (2007) state, it is hard to distinguish carry positions from other trades, and there is no consensus on what exactly constitutes a carry trade. However, there are some indications of the surge of the yen carry trade.

For example, data from the Bank of International Settlements show that Japanese banks increased their net outward yen-denominated lending from $19 billion in 2004 to $87 billion in 2005. Moreover, the positioning on yen futures contracts also points to the existence of an offshore yen carry trade (IMF (2006)). McGuire and Upper (2007) state that data on open positions in exchange-traded FX futures in potential funding and target currencies provide the strongest evidence for a recent growth in carry trade activity. In this paper, we investigate the yen carry trade between Japan and the US, using data of positioning on yen futures contracts for the yen carry trade.

Since exchange rates move, a carry trade involves an exchange rate risk, particularly the possibility that the target currency (US dollar) will depreciate against the funding currency (yen). Nevertheless, the investors engage in the carry trade extensively, due to the forward premium puzzle, which is a well-known empirical anomaly of the foreign exchange market (Cavallo (2006)). The forward premium puzzle refers to the fact that currencies at a forward premium and that have a low interest rate, in reality, on an average, tend to depreciate, and not appreciate; this tendency is not predicted by the theory of interest parity conditions.

Recently, there has been an increasing fear about the unraveling of the surging yen carry trade in the international financial market. If for some reason, investors suddenly decide to unwind this carry trade, there would be negative repercussions. Thus, it is important to investigate the relationship between the carry trade and the related financial variables. However, there are few empirical studies on the carry trade.

Our research aims to examine the relationship between the yen carry trade and the related financial variables, while focusing on the financial markets of the US and Japan.

We consider two questions in this paper.

The first pertains to the determination of the financial factors that have important roles in explaining the yen carry trade. The first factor that can have an impact on the carry trade is the change in interest rate differential. The interest rate differential is said to be a great driving force for the speculative carry trade.

First, we will consider the interest rate differential between the US and Japan. In Japan, from February 1999 until July 2006, the short-term interest rates were near zero, and until March 2006, under its quantitative easing policy, the Bank of Japan (BOJ) continued to provide the banking system with ample reserves. The BOJ raised its key short-term rate to 0.25% in July 2006 and to 0.5% in February 2007. The possibility of the BOJ's further monetary tightening tends to rise. According to some investors, the diminishing benefits of the yen carry trade with the BOJ's monetary tightening may facilitate the market's meltdown; higher rates in Japan might have implied that investors started borrowing less money and investing less elsewhere.

In the US, on the other hand, since the end of June 2006, the FED has kept the federal fund (FF) rate at 5.25%, and the dollar is now the target currency for the yen carry trade. However, the speculation for the FF rate cut has gained momentum due to the recent economic deceleration.

Thus, there is great uncertainty about the market dislocation that would be caused if the carry trade was quickly unwound.

The second factor that can have an impact on the risky carry trade is the change in investors' sentiments regarding risk-taking. The speculative investors in the international monetary market (IMM) have been using leverage in borrowing yen and buying other assets. Therefore, if investors' sentiment go down, they may sell more US stocks, foreign stocks, and other assets, and the unwinding of such trades will definitely have an impact on the markets.

The second question pertains to the consequences of the unwinding of the yen carry trade. In particular, we are interested in whether the yen carry trade has a statistically significant impact on the foreign exchange rate or stock price.

The movement of the carry trade reflected in speculators' net positions is related to the swing of the foreign exchange rate. Klitgaard and Weir (2004) analyzed the weekly net speculative foreign exchange data between 1993 and 2004. They found a strong contemporaneous relationship between weekly changes in speculators' net positions and exchange rate moves. Mogford and Pain (2006) also conducted a similar analysis, using the weekly data between January 1993 and January 2006. Consequently, the null hypothesis of a zero contemporaneous correlation between the speculative positions and the dollar against the yen rate was rejected at the 1% significance level.

The movement of carry trade is also linked to the stock price. Mogford and Pain (2006) also found a strong contemporaneous relationship between weekly changes in speculators' net positions and the S&P 500. However, the empirical results did not support the view that speculative positioning data are systematically informative about future changes in asset prices or foreign exchange rates (including the dollar against the yen).

The remainder of the paper is organized as follows. In Section 2, we present the structural vector autoregression (SVAR) methodology and the data. The empirical results are presented in Section 3, and Section 4 provides the robustness check. Section 5 provides some concluding remarks.

2. SVAR methodology and data

In this paper, we focus particularly on the financial variables closely related to the yen carry trade. We selected the interest rate differential between the US and Japan (*IRD*), investor's sentiment or volatility in the stock market (*VIX*), the dollar against the yen exchange rate (*FER*), US stock price (*SUS*), and the Japanese stock price (*SJP*) as the financial variables that are closely related to the speculative and risky yen carry trade (*IMR*).

2.1 Methodology

To estimate the effect of financial factors on the carry trade, we use an SVAR. Our identifying assumptions involve the contemporaneous coefficient matrix and can be summarized in the following equations that link the reduced-form errors to the structural shocks.

$$\begin{bmatrix} e_{IRD} \\ e_{VIX} \\ e_{IMR} \\ e_{FER} \\ e_{SUS} \\ e_{SJP} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ g(VIX,IRD) & 1 & 0 & 0 & 0 & 0 \\ g(IMR,IRD) & g(IMR,VIX) & 1 & 0 & 0 & 0 \\ g(FER,IRD) & g(FER,VIX) & g(FER,IMR) & 1 & 0 & 0 \\ g(SUS,IRD) & g(SUS,VIX) & g(SUS,IMR) & g(SUS,FER) & 1 & 0 \\ g(SJP,IRD) & g(SJP,VIX) & g(SJP,IMR) & g(SJP,FER) & g(SJP,SUS) & 1 \end{bmatrix} \begin{bmatrix} u_{IRD} \\ u_{VIX} \\ u_{IMR} \\ u_{FER} \\ u_{SUS} \\ u_{SJP} \end{bmatrix}$$

In the above equations, the e_j represent the structural disturbances, and the u_j represent the residuals in the reduced-form VAR equations.

The first equation depicts the interest rate differential between the US and Japan. We treat *IRD* as exogeneous to the other variables.

The second equation depicts the investor's sentiment or volatility in the US. We consider the sentiment to be affected by *IRD*, which is the borrowing cost.

The third equation depicts the investor's speculative carry trade observed in the yen futures contracts. We assume that the trade depends on *IRD* and *VIX*.

As stated above, higher Japanese interest rates would increase the cost of engaging in such trades, making them less attractive. Further, the decline in the investor's sentiment would depress the risky carry trade.

The fourth equation depicts the nominal dollar against the yen rate. Here, the foreign exchange rate is thought to be affected by *IRD* based on the interest parity, *VIX*, and *IMR*.

With regard to the relationship between *VIX* and foreign exchange, Cairns *et al.* (2007) showed that the dollar against the yen would depreciate—although not significantly—if the VIX index increases.

With regard to the relationship between the futures market and foreign exchange, a general build-up in long (short) positions would seem to be associated with an appreciation (depreciation) in the exchange rate (Mogford and Pain (2006)). This implies that the dollar against the yen would appreciate by the increase in the yen short positions.

The fifth and sixth equations depict the stock prices of US and Japan, respectively.

We consider the stock prices to be affected by all the other variables.

If the FF rate rises with respect to a constant Japanese call rate, the interest rate differential between the US and Japan is larger. As a result, the US stock prices will go down. Also, if the Japanese call rate rises with respect to a constant FF rate, the interest rate differential between the US and Japan will be smaller and the Japanese stock prices will go down.

The stock prices are considered to be negatively related to the US stock volatility (*VIX*). If the volatility in the US increases, the US and Japanese stock prices will decline.

Moreover, the stock prices may depend on the speculative carry trade (*IMR*). If investors are buying US stock largely through the yen carry trade, the US stock prices may decrease by the unwinding of the yen carry trade. In contrast, if the unwinding of the yen carry trade takes place, the Japanese stock prices may increase because of the increase in capital inflow—from the US to Japan—with the appreciation of the yen.

The stock prices may also be affected by the movement of the foreign exchange rate (*FER*). In general, a fall in the real exchange affects the competitiveness of domestic goods versus foreign goods. This increases the level of domestic aggregate demand, the level of output, and the expected future corporate cash flows.

2.2 The data

The US interest rate is the FF rate, which was obtained from the FRB, and the Japanese interest rate is the call rate, obtained from the BOJ. *VIX* represents the Chicago Board Options exchange volatility index. This index is calculated by taking a weighted average of implied volatility for the eight S&P 500 calls and puts. VIX has been used by many as a barometer of investor sentiment and market volatility since its introduction in 1993 (Cairns (2007)).

IMR represents currency speculators' net long positions in yen futures contracts in the IMM. McGuire and Upper (2007) suggested that the data on the positions in exchange-traded FX futures provide the strongest evidence for a growth in carry trade activity. In this paper, we use the net long yen position as the proxy of yen carry trade. We employ the non-commercial data from the Chicago Merchantile Exchange (CME). Non-commercial data are generally interpreted as reflecting the speculative community's positioning. Although the net long yen positions are usually measured as the difference between the long and short yen, we measure *IMR* as the ratio of long to short yen. This idea is sometimes used for showing the trade balance (export/import ratio).

We used S&P 500 for *SUS* and TOPIX for *SJP*[1]. The IMM data is provided by Bloomberg, and the remaining data is from the Thomson Datastream. All the variables, except *IRD*, are entered into natural logarithms. The data are monthly observations from January 1993 to January 2007.

3. Estimation results

3.1 Preliminary analysis

Prior to conducting the SVAR analysis, we tested the order of integration for all the time series. The results of the unit root test, reported in Table 1, indicate that the level of each series is non-stationary. Using the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, the hypothesis of a non-stationary level cannot be rejected at the 1% significance level for any of the series, except *IMR*. However, the results for the first difference clearly indicate that the non-stationary hypothesis can be rejected. Consequently, all our five endogenous variables, except *IMR*, are considered as integrated to the order of one.

The optimal lag length in the VAR system is determined by the Akaike information Criterion (AIC), and we chose lag 2.

3.2 Empirical results

The impulse response functions serve the central role in assessing how and to what extent structural shocks influence *IMR*.

First, we consider the variables that are important in explaining the yen carry trade. Figure 1 displays the responses of *IMR* to a one-standard deviation innovation of a particular structural shock on all the variables over a 20-month period range and contains ±2 standard error bands.

With regard to the interest rate differential shock (Shock1), a larger/smaller differential could increase/decrease the activity of the carry trade. This indicates that the BOJ's raising the call rate at the constant FF rate could force the possibility of the

---

1 We deflated the variables of *IRD, FER*, *SUS*, and *SJP* by the Consumer Price Index of the US and Japan. However, our conclusion did not change.

unwinding of the carry trade to increase.

However, the effect is not statistically significant. This result may reflect that the interest rate differential between Japan and the US was so high that the yen carry trade was still attractive to speculators during the estimated time. There was no fear that the Japanese interest rates were going to rise rapidly with little pressure from inflation.

What emerges from Figure 1 is that a rise in the US stock price (Shock5) provokes an immediate increase in the yen short positions. The impact is statistically significant. This result shows that the investor's ability to engage in risky trade decreases if the US stock price declines. The investors who faced losses in equities will close profitable carry trade positions.

Table 2 reports the variance decomposition. The variance decomposition of *IMR* suggests that shocks in US stock (Shock5) explain about 10% of the variance of *IMR*, 6 months after a shock.

On the other hand, the shock in interest rate differential (Shock1) has a negligible effect on the investor's speculation (*IMR)* over a 20-month period.

We will now describe the consequences of the unwinding of the yen carry trade. Figure 2 shows the impulse responses of all the variables to *IMR* shock (Shock 3).

The graphs reveal that *IMR* shocks, in general, have a significant impact on the foreign exchange rate (*FER*). This implies that the unwinding of the yen carry trade could decrease the dollar against the yen rate. This result is not necessarily inconsistent with that of Mogford and Pain (2006) since the latter use weekly data, which is different from our monthly data.

Table 2 shows that the carry trade has the ability to noticeably influence the dollar against the yen rate. The shocks in *IMR* (Shock3) explain about 38% of the variance of *FER*.

On the other hand, as Figure 2 shows, the unwinding of the yen carry trade may cause the VIX index to decline and the US stock price to rise, although not significantly. This may reflect that the decline in the dollar against the yen rate, raised by the increase in the net yen long positions, results in the competitiveness of US domestic goods becoming stronger and the expected future corporate cash flows increasing. Table 2 shows that *IMR* has a negligible impact on *VIX* and *SUS*. The shocks in *VIX* (Shock2) explain the larger part of the variance in stock prices, except the stock price per se, than do the other shocks.

The unwinding of the yen carry trade may increase the Japanese stock price, although not significantly. This may reflect the tendency of investors to buy Japanese stock more with the appreciation of yen.

4. Robustness check

We examined the robustness of the results shown above.

First, we employed the cumulative sum of recursive residuals (CUSUM) and the

CUSUM of square (CUSUMSQ) tests proposed by Brown *et al*. (1975) in order to assess parameter constancy. If the plots of CUSUM and CUSUMSQ lie outside the area between the two critical lines, the parameters and variance are said to be unstable. However, each of the six reduced VAR equations indicates that the elasticities are stable or almost stable. The only exception was the *IRD* equation, wherein the plots of CUSUM and CUSUMSQ lie slightly outside the critical line.

Second, we rearranged the order of the six variables, based on the Granger Causality test (shown in Table 3) and the possibility of the preceding of stock prices over the speculative carry trade. Figure 1 and Table 2 indicate that *SUS* has a strong impact on *IMR*. Moreover, with regard to the relationship between the dollar against the yen and speculative positions, Mogford and Pain (2006), by using the Granger causality test, showed that it is more likely that the movement of the dollar against the yen rate leads to changes in speculative positions. Considering these analyses, we arranged the data in the order *VIX, SUS, IRD, FER, SJP*, and *IMR*. We considered that *IMR* would be affected by all the other financial factors.

According to the impulse response result, as shown in Figure 1, since even the effect of *IRD* on *IMR* is not statistically significant, our conclusion did not change. In addition, the result that the movement of *SUS* has a strong influence on *IMR* was also the same.

5. Conclusion

The objective of this paper was to examine the relationship between the yen carry trade and the related financial variables by constructing a six-dimensional version of the SVAR model. Several important conclusions were derived from our analysis.

First, our empirical results suggest that the interest rate differential between the US and Japan does not significantly affect the movement of the yen carry trade. This result may reflect that the interest rate differential is so substantial that the yen carry trade is still attractive to speculators. Even if the BOJ changed its monetary policy stance, the movement in speculative carry trade is likely to continue.

Second, we found that the financial variable that can have a dominant impact on the yen carry trade is *SUS*. The speculative investors in the international monetary market had been using leverage in borrowing yen and buying other assets. Therefore, if the asset price declines sharply, they will sell more US stocks and other assets and close the profitable positions.

We also verified that these two results are robust to structural changes and alternative specifications.

Third, we found that the speculative yen carry trade has a significant impact on the exchange rate. If the long position of the yen is larger, the dollar will depreciate against the yen.

References

Brown, R.L., J. Durbin, and J.M. Evans (1975) "Techniques for testing the constancy of regression relationships over Time" *Journal of the Royal Statistical Society*, Series B **37**, 149-92.

Carins, J., H. Corrinne, and R. McCauley (2007) "Exchange rates and global volatility: Implications for Asia-Pacific currencies" BIS Quarterly Review, March, 41-52.

Cavallo, M. (2006) "Interest rates, carry trades, and exchange rate movements" *FRBSF Economic Letters* **31**, November,17, 1-3.

Dickey, D.A. and W.A. Fuller (1979) "Distribution of the Estimators for Autoregressive Time Series with a Unit Root" *Journal of the American Statistical Association* **74**, 427-431.

Galati, G., and M. Melvin (2004) "Why has FX trading surged? Explaining the 2004 triennial survey." BIS Quarterly Review, December, 67–98.

International Monetary Fund (2006) Global Financial Stability Report, September.

Klitgaard, T., and L. Weir (2004) "Exchange rate changes and net positions of speculators in the future market" *Federal Reserve Bank of New York Economic Policy Review*, May, 17-28

McGuire, P., and N. Tarashev (2006) "The International Banking Market" BIS Quarterly Review, June, 11–25.

McGuire, P., and C. Upper (2007) "Detecting FX carry trades" BIS Quarterly Review, March, 8-9.

Mogford, C., and D. Pain (2006) "The information content of aggregate data and financial futures positions" Bank of England, *Quarterly Bulletin*, Spring, 57-65.

Table 1: Unit Root Tests

ADF												
	Intercept						Intercept and Trend					
Variable	Levels			First Differences			Levels			First Differences		
	(lag)			(lag)			(lag)			(lag)		
IRD	(3)	-2.518		(2)	-3.970	***	(3)	-2.490		(2)	-4.057	***
VIX	(0)	-2.346		(2)	-10.119	***	(0)	-2.243		(3)	-9.520	***
IMR	(0)	-4.812	***	(0)	-14.161	***	(0)	-4.934	***	(0)	-14.118	***
FER	(1)	-2.698	*	(0)	-9.357	***	(1)	-2.982		(0)	-9.359	***
SUS	(1)	-1.492		(0)	-10.684	***	(1)	-1.209		(0)	-10.723	***
SJP	(1)	-1.773		(0)	-9.282	***	(1)	-1.640		(0)	-9.288	***

PP								
	Intercept				Intercept and Trend			
Variable	Levels		First Differences		Levels		First Differences	
IRD	-2.219		-8.293	***	-2.179		-8.421	***
VIX	-2.276		-15.654	***	-2.113		-30.083	***
IMR	-4.812	***	-18.147	***	-4.991	***	-18.057	***
FER	-2.373		-9.395	***	-2.646		-9.395	***
SUS	-1.534		-10.686	***	-1.153		-10.696	***
SJP	-1.729		-9.303	***	-1.585		-9.309	***

Note:The lags in the tests were estimated through the Schwartz information criterion
*significant at the 10% level, ***significant at the 1% level

Table 2: Variance Decompositions

Variance Decomposition of D(IRD):						
Period	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	100.000	0.000	0.000	0.000	0.000	0.000
6	91.353	2.309	1.538	0.330	4.416	0.054
12	90.560	2.362	2.268	0.366	4.387	0.056
20	90.493	2.362	2.332	0.366	4.389	0.058
Variance Decomposition of D(VIX):						
Period	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	0.107	99.893	0.000	0.000	0.000	0.000
6	0.662	96.176	1.114	0.105	1.008	0.936
12	0.698	96.018	1.175	0.105	1.067	0.937
20	0.703	96.009	1.176	0.105	1.070	0.937
Variance Decomposition of IMR:						
Period	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	0.006	2.682	97.312	0.000	0.000	0.000
6	0.517	2.048	84.753	1.208	10.633	0.842
12	1.424	2.014	82.768	1.152	11.699	0.943
20	1.568	2.023	82.546	1.151	11.768	0.945
Variance Decomposition of D(FER):						
Period	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	0.106	2.740	38.087	59.068	0.000	0.000
6	3.518	2.611	37.964	51.096	3.933	0.878
12	3.546	2.649	37.989	50.997	3.942	0.877
20	3.546	2.649	37.992	50.993	3.943	0.877
Variance Decomposition of D(SUS):						
Period	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	0.234	0.784	2.307	0.553	96.122	0.000
6	1.961	41.497	1.452	0.901	53.873	0.315
12	2.066	41.459	1.472	0.901	53.787	0.315
20	2.068	41.457	1.476	0.901	53.784	0.315
Variance Decomposition of D(SJP):						
Period	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	0.369	0.831	0.271	0.521	6.801	91.208
6	1.612	15.428	2.282	0.665	5.127	74.887
12	1.615	15.348	2.677	0.665	5.208	74.488
20	1.624	15.343	2.688	0.665	5.218	74.463

Table 3: VAR Granger Causality Test (P-values)

	Dependent variable					
	D(IRD)	D(VIX)	IMR	D(FER)	D(SUS)	D(SJP)
D(IRD)	-	0.549	0.397	0.084	0.328	0.484
D(VIX)	0.974	-	0.001	0.593	0.000	0.000
IMR	0.624	0.300	-	0.181	0.425	0.524
D(FER)	0.754	0.884	0.076	-	0.557	0.798
D(SUS)	0.009	0.453	0.001	0.055	-	0.178
D(SJP)	0.969	0.486	0.674	0.557	0.925	-
All	0.228	0.613	0.009	0.169	0.000	0.000

Figure 1: Impulse Responses of IMR

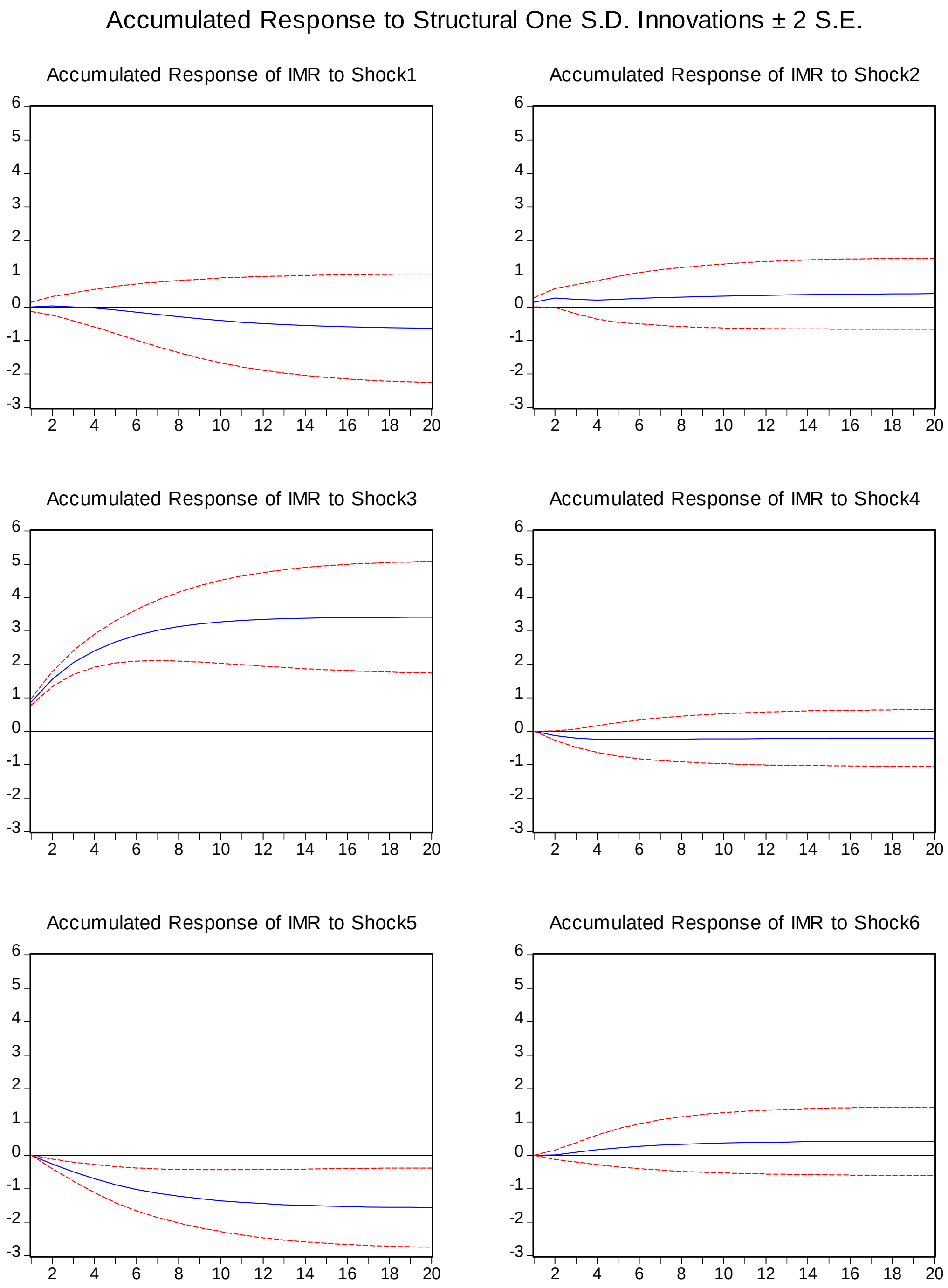

Figure 2: Impulse Responses to IMR shock