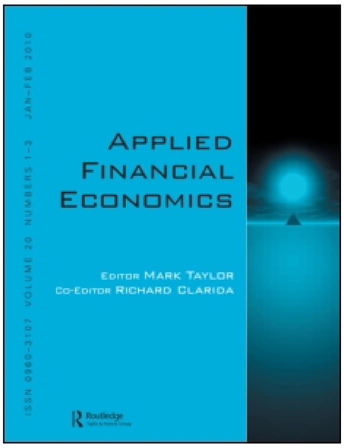

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Do credit default swaps predict currency values?

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Using daily data of four currencies (Japanese Yen (JPY), Euro (EUR), British Pound (GBP) and Australian Dollar (AUD)) in terms of the US Dollar (USD), and JPY, USD, GBP and AUD in terms of the EUR from January 2004 to February 2008, we examine the lead–lag relationship between the Credit Default Swap (CDS) market and the currency market. Results indicate significant Granger-causality effects flowing from changes in both the North American investment-grade (IG) and high-yield (HY) CDS indices to changes in the JPY, EUR and AUD exchange rates in terms of the USD for the whole period and during the credit crisis of 2007 to 2008. However, for the four currencies in terms of the EUR, significant Granger-causality of the credit risk is found only in the AUD. Our results indicate that changes in CDS index spreads signal important carry-trade information for some currencies, but not others.

I. Introduction

Finance theory suggests that the price of a financial asset depends on its risk. The currency of a country is no exception as it is akin to a financial asset. If a country experiences increasing risk, its currency value should decline to reflect the perception or the reality of increasing risk. Among the many risks that may affect the currency value, credit risk has been in the limelight, since the implosion of the US subprime mortgages in 2007. While the US subprime mortgage fiasco was developing into a worldwide credit crisis, the global currency markets had also experienced unusual turbulences caused by unusual trading activities in the US Dollar (USD)/Japanese Yen (JPY) currency market, which has been attributed to the unwinding of massive JPY carry trades.[1] The coincidental occurrence of these events may suggest the pattern of a hidden causal relationship which is not obvious to untrained eyes.

In a typical currency carry trade, investors would borrow the currency of a country whose interest rate is low (i.e. short the currency) and invest in the currency of a country whose interest rate is high (i.e. long the currency), thus profiting from the interest rate differential of the two countries.[2]

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[1] See Dennis and Connor (2008).

[2] This type of uncovered interest-rate arbitrage does not always work. Tiger Fund's failure in carry trades in March 2000 is an interesting case in point where the hedge fund misinterpreted the currency market. Tiger Fund was borrowing JPY and investing the proceeds in USDs; it expected that its short position in yen would benefit the fund from the potential troubles in Asia. Unfortunately, the appreciation of yen prompted a $2 billion loss for Tiger Fund from yen carry trades. Prior to that, Long-Term Capital Management (LTCM) lost more money on the yen unraveling, leading to a liquidity crisis in the US and world markets.

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Both activities are extremely sensitive to changes in currency value and/or credit risk. It is, thus, reasonable to expect that if conditions in the credit market deteriorate, followed by widening Credit Default Swap (CDS) spreads, the currency market will follow in lockstep as investors unwind their carry-trade positions. Therefore, movements in the credit market may become a predictor for some foreign exchange rates. However, this relationship between the credit market and the currency market, to our knowledge, has not been examined in previous studies. This study aims to fill the void.

We hypothesize that the credit market can predict the currency value because the currency value of a country will experience a decline as investments take a flight to safety in other countries if credit risk in the country is perceived to be escalating. Moreover, this effect is expected to be stronger in times of credit crisis because more investors will unwind their carry-trade positions in response to the sharp increase of credit risk and extreme market volatility. Furthermore, such lead–lag relationship is more likely to be found when two countries are dissimilar because more interest rate arbitrage opportunities arise in dissimilar economies, fuelling more carry-trade activities.

We test the hypothesis with a Vector Autoregressive (VAR) analysis (Granger, 1969). CDS indices are used to proxy for credit risk in the credit market. Spreads on the CDS indices will widen when the market detects deterioration in credit risk, and tighten when the market perceives less credit risk.[3] We examine currency value changes with daily data for the Australian Dollar (AUD), Euro (EUR), JPY and British Pound (GBP) in terms of the USD, and for AUD, GBP, JPY and USD in terms of the EUR, respectively, from January 2004 to February 2008. When risk is originated in the credit market, we expect CDS indices to move before the currency value. The detection of the presence of such a relationship is useful for predicting currency movements, hedging currency exposures, speculation and economic policy analysis.

After controlling for other exogenous explanatory factors, several interesting results are obtained. First, we find significant Granger-causality effects flowing from changes in the North American investment-grade (IG) and high-yield (HY) CDS indices to changes in exchange rates (AUD/USD, EUR/USD and JPY/USD) for the whole period. As expected, the effect is stronger in the second sub-period when credit risk shows sharp movements. The reverse causality from exchange rate changes to CDS index changes is not significant. Second, similar findings are obtained for the Granger causality tests of the European CDS index (iTraxx) on the exchange rate of the AUD but not the USD or GBP against the EUR. This result is consistent with the notion that there are more carry-trade opportunities for dissimilar rather than similar economies.

This study contributes to the extant literature and is of particular interest to investors for several reasons. First, this is the first study analysing the relationship between the corporate CDS and currency markets. The CDS market has grown substantially from $180 billion in notional amount in 1997 to $34.5 trillion in 2006 and $62.2 trillion in 2007.[4] The phenomenal growth of the CDS market underscores the efficacy of the CDS as a tool for both hedging and speculation on credit risk. The CDS indices launched in 2004 enable market participants to gauge the credit risk of the entire market and hedge the credit risk of a bond portfolio in a cost-effective way. We examine the contemporaneous correlation between changes in corporate CDS index spreads and changes in currency values. In this regard, this article is most closely related to Carr and Wu (2007), who find a contemporaneous correlation between sovereign CDS spreads and the implied volatility of currency options for Mexico and Brazil. But our focus is on the lead–lag relationship and the predictability of the corporate CDS indices on the currency market. We find that the US corporate CDS indices can predict some currency values during the episodes of credit deterioration. Thus, this article contributes to the extant literature on the behaviour of exchange rates, particularly pertaining to the predictability of exchange rates as compared to the random walk description (MacDonald and Taylor, 1992; Taylor, 1995; Kilian and Taylor, 2003).

Second, we present evidence on the information content differential between the North American CDS index (CDX) spreads and the European CDS index (iTraxx) spreads in their predictability of currency value. In addition to conducting a CDS-currency Granger-causality analysis of several currencies denominated in the USD, we also run the same analysis based on several currencies denominated in the EUR to investigate the lead–lag relationship between the credit and currency markets,

[3] Based on single name CDS spreads, Blanco *et al.* (2005) show that the CDS market is more efficient than the corporate bond market to reflect credit risk. Fung *et al.* (2008) examine the use of CDS indices in predicting the stock returns in the US market.

[4] See International Swaps and Derivatives Association (ISDA) (2008).

rendering results for better generalization. These results contribute new evidence and understanding to the literature.

Third, investors including corporations and hedge funds are believed to have played an important role in contributing to currency fluctuations through carry trades. It is perceived that investors, particularly hedge funds, have financed their investments and corporations have funded their operations in foreign currencies via carry trades. Our study provides evidence supporting the role of carry trades in linking the credit and foreign exchange markets for some economies.

II. Methodology

This article uses a VAR model to investigate the simultaneous interactions between exchange rates and CDS index spreads.[5] The VAR technique estimates simultaneous equations with the lag-dependent variables of each equation. We conduct the Granger causality test to determine the causal relationship between currency values and CDS spreads and the variance decomposition to provide the percentage of the unexpected variations in each currency value produced by the shocks from the other variable, CDS spreads, in the system. The VAR model also enables us to compute the impulse response function to analyse the speed of information transmission among variables within the system.

The VAR model for currency values and CDS spreads

The general VAR model is expressed as

$$Y_t = c + \sum_{k=1}^{L} a_k Y_{t-k} + e_t \tag{1}$$

where Y_t is a 2×1 column vector at time t; c and a_k are, respectively, 2×1 and 2×2 matrices of coefficients; L is the lag length and e_t is the 2×1 column vector of serially uncorrelated error terms. The (i, j) component of a_k measures the direct effect that a change of the i-th variable has upon the j-th variable after k periods. In particular, the i-th component of e_t is the innovation of the i-th variable not predicted by the other variable in the system.

VAR is an appealing approach for conducting cross-market analyses between the CDS and other markets (Blanco *et al.*, 2005; Longstaff *et al.*, 2005; Fung *et al.*, 2008; Chan *et al.*, 2009). To analyse the interrelationships between currency values and CDS spreads, we write the VAR model with FX (currency values expressed as, e.g. JPY/USD for the exchange rate between the JPY and the USD) and CDS spreads in the following equations:

$$\mathrm{FX}_t = c_{10} + \sum_{k=1}^{L} \gamma_{1k}\mathrm{FX}_{t-k} + \sum_{k=1}^{L} \gamma_{2k}\mathrm{CDS}_{t-k} + e_{1t} \tag{2}$$

$$\mathrm{CDS}_t = c_{20} + \sum_{k=1}^{L} \delta_{1k}\mathrm{CDS}_{t-k} + \sum_{k=1}^{L} \delta_{2k}\mathrm{FX}_{t-k} + e_{2t} \tag{3}$$

All variables in the VAR model are assumed to be stationary.

Granger causality test

The null hypothesis that the CDS spreads do not Granger-cause foreign exchange rate (FX) in Equation 2 is stated as

$$H_{10} : \gamma_{21} = \gamma_{22} = \cdots = \gamma_{2L} = 0$$

Similarly, the second null hypothesis that FX does not Granger-cause CDS spreads in Equation 3 is stated as

$$H_{20} : \delta_{21} = \delta_{22} = \cdots = \delta_{2L} = 0$$

The joint hypotheses can be easily tested using the F-statistic.

Variance decomposition

The moving average representation of the VAR system may provide additional insight into the dynamic interactions among the variables in the system. The system of Equation 1 as the moving average model of innovations is expressed as

$$Y_t = \sum_{k=0}^{\infty} A_k e_{t-k} \tag{4}$$

Equation 4 indicates that Y_t is a linear combination of current and past one-step-ahead forecast errors, e_t. The i, j-th component of A_k reveals the response of the i-th variable to a unit random shock in the j-th variable after k periods. The moving average model, Equation 4, enables the computation of the m-step-ahead forecast error of Y_t. In addition, the variance decomposition of the forecast error measures the percentage of the unexpected variation in each variable produced by the shocks from other variables in the system.

[5] Hereafter, we refer to CDS index spreads as CDS spreads for brevity, unless specified otherwise.

In addition, we conduct an impulse response analysis that traces out the responsiveness of dependent variables in the VAR to shocks to each of the endogenous variables. However, the innovations, e_t, are serially correlated, and thus, they may not be contemporaneously uncorrelated across equations. Consequently, we use an orthogonalization procedure to remove the contemporaneous residual correlations. We can also expand Equation 1 easily by including other exogenous variables in the system as control variables for testing robustness.

III. Data

Investigations of the relationship between currency values and credit markets are done on four currencies (AUD, EUR, GBP and JPY) with respect to the USD (i.e. the exchange rates of AUD/USD, EUR/USD, GBP/USD and JPY/USD) and the North American CDS indices (CDX), and on four currencies with respect to the EUR (AUD/EUR, GBP/EUR, JPY/EUR, and USD/EUR) with the European CDS index (iTraxx). The historical daily foreign exchange rates are downloaded from the website http://fx.sauder.ubc.ca/data.html. The North American CDS indices include the IG and HY CDX indices. The IG index is composed of 125 high credit names and the HY index 100 high-credit risk names. They are used to represent two credit-risk segments of the US credit market conditions since their inception in January 2004 until the end of February 2008. The iTraxx Europe index (iTraxx hereafter) is the standard European tradable CDS index. It forms a large sector of the overall credit derivative market. The index equally weights the most liquid 125 names in the European markets and is thus easily replicable. The 5-year tranches of the CDS indices are used in this analysis for their greater liquidity. Data on these CDS indices were obtained from JP Morgan Securities. In the regression with the exchange rate as the dependent variable, we expect negative coefficients for the lagged CDS spreads if widening CDS spreads lead to the lower value of the USD (depreciation). In the regression with the CDS spread level as the dependent variable, we expect negative coefficients for the lagged exchange rate if higher value of the USD leads to narrowing CDS spreads. In the VAR analysis, we include a variety of control variables to account for the influence of other effects. The Vanguard Total Bond Market Index (BOND) is included as a control variable to proxy for the US investment-grade bond market conditions to see whether the CDS market contains more information than the corporate bond market. Presumably, BOND is positively related to the investment-grade CDS index (IG), whereas its relationship with the high-yield CDS index (HY) is ambiguous because it can be positive under normal bond market conditions or negative during a credit crisis when flight-to-quality investments take off.

The US stock market index (proxied by the S&P500, SPX) is used as a control variable when we study the relationship between the US CDS market and currency values (FX). Similarly, the European stock market index (proxied by the Vanguard European Stock Index, EURSTK)[6] is used when studying the iTraxx/currency relationship. We expect that a higher equity market index level is associated with a smaller CDS spread due to the lower default probability of firms. In addition, we use the Nikkei 225 index (JPYSTK), the FTSE100 index (GBPSTK) and the ASX Limited Index (AUDSTK) to proxy for the equity market conditions in Japan, the UK and Australia, respectively. Presumably, the stock index of a foreign country (FSTK) should be positively related to the value of the USD and negatively related to the CDS spreads if the foreign country's economy moves in the same direction as the US economy. The relation should be reversed if the foreign country's economy moves in the opposite direction to the US economy.

To account for unusual turbulences in the stock market following the implosion of the US subprime mortgage market, we have included the implied volatility of the S&P500 index option (VIX) as an additional explanatory variable. We expect a positive relationship between VIX and CDS spreads because implied volatility is an indicator of unstable economic outlook, which will increase a firm's default probability and the CDS spread.

The interest rate differential (INTDIF) between a foreign country's short-term interest rate and the short-term interest rate of the reference market (the US or the European markets) is also included as a control variable. For the US short-term interest rate (USINT), the US 3-month interest rates obtained from the Federal Reserve Bank in St. Louis are used. The Japanese basic discount rate, EUR overnight interbank rate, UK's 3-month interbank rate and Australian 13-week Treasury note rate are used for their corresponding currency. INTDIF is expected to

[6] The investment seeks to track the performance of the Morgan Stanley Capital International (MSCI) Europe index, which is a market-cap-weighted index of approximately 603 stocks in major European countries. All equity market indices and interest rates are obtained from the website http://finance.yahoo.com.

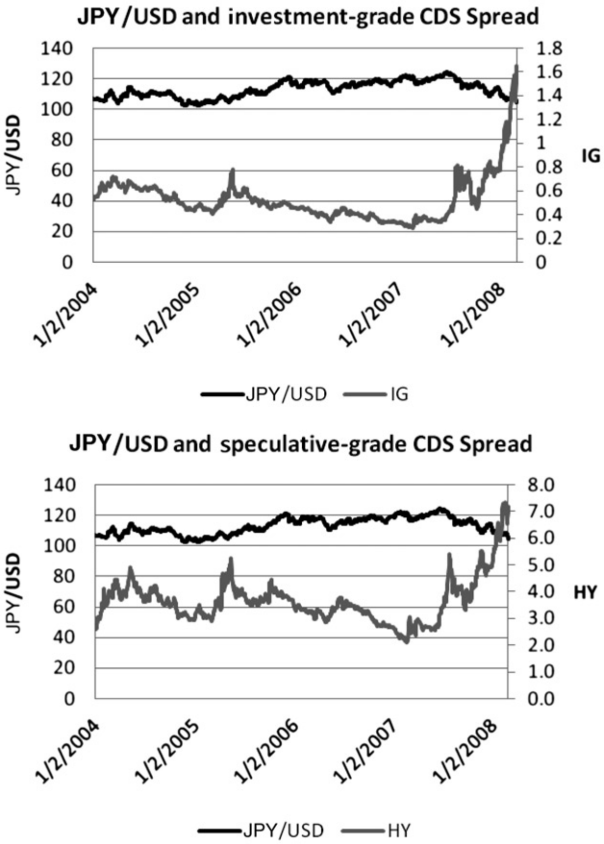

Fig. 1. JPY/USD and CDS index spreads (January 2004 to February 2008)

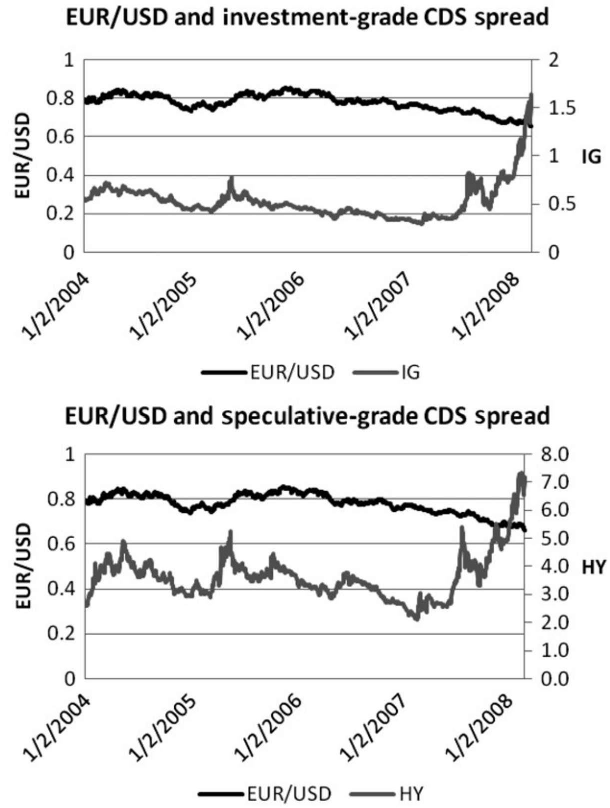

Fig. 2. EUR/USD and CDS index spreads (January 2004 to February 2008)

be positively related to the value of the USD against the foreign currency because the currency of a country with a higher (lower) relative nominal interest rate is expected to depreciate (appreciate) according to the International Fisher Effect. On the other hand, it can be negatively related to the USD value because a greater interest rate differential may imply a higher real risk-free interest rate in a foreign country, representing a better investment opportunity and greater foreign capital inflows. This will result in a higher foreign currency value and a lower USD value. Thus, the sign of the coefficient is theoretically ambiguous. With regard to the credit market, the interest rate differential is expected to be positively associated with the CDS spreads because a higher interest rate differential, which indicates a lower risk-free interest rate in the US, increases the default probability and CDS spreads (Merton, 1974).

Figure 1 shows the relationship between CDS spreads and JPY/USD exchange rates from January 2004 to February 2008. Both IG and HY CDS spreads show greater volatility in the second subperiod (January 2007 to February 2008) than the first subperiod (January 2004 to December 2006) of the sample. The expected inverse relationship between CDS spreads and JPY/USD is observed, i.e. a higher US CDS spread level is associated with a lower US exchange rate. In other words, the higher the credit risk in the US, the lower the value of the USD in terms of yen (i.e. a lower JPY/USD exchange rate). The relationship may have become stronger in the second subperiod during which drastic volatility in the CDS spreads was observed. Similar relationships are observed between the CDS spreads and EUR/USD, GBP/USD and AUD/USD in Figs 2–4, respectively. Figure 5 depicts the relations between the exchange rates of JPY/EUR and AUD/EUR with the iTraxx Europe CDS spreads, for which we find statistical significance in the subsequent analysis.

IV. Empirical Analysis

Table 1 presents the descriptive statistics of the variables used in this study. Panel A reports those on the exchange rates of four currencies in terms of the USD (JPY/USD, EUR/USD, GBP/USD and AUD/USD), and four currencies in terms of the EUR (JPY/EUR, USD/EUR, GBP/EUR and

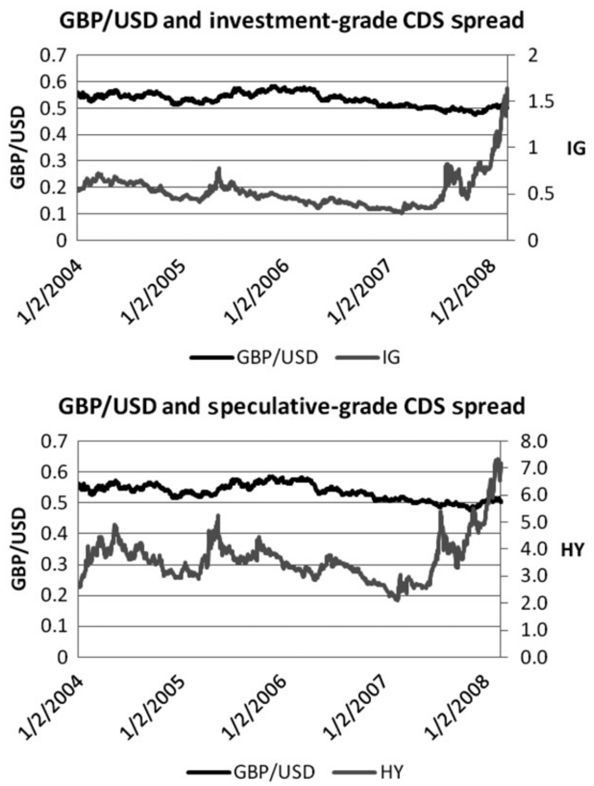

Fig. 3. **GBP/USD and CDS index spreads (January 2004 to February 2008)**

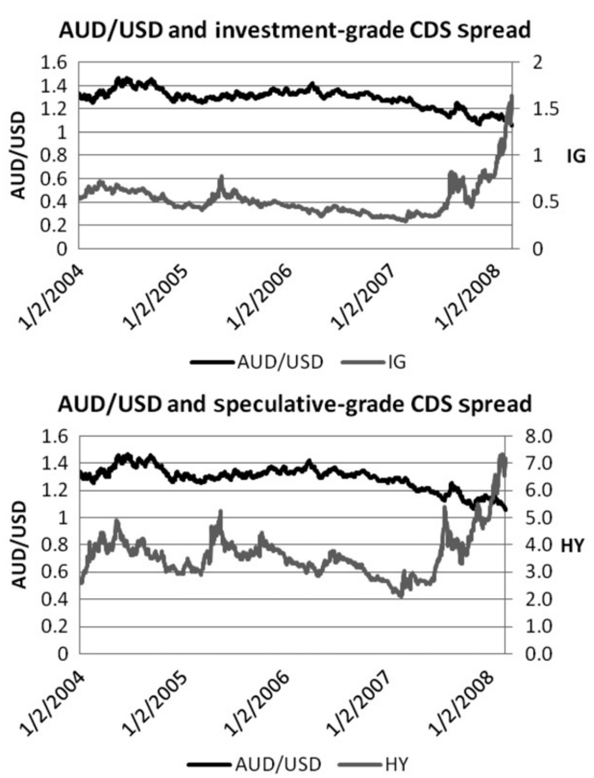

Fig. 4. **AUD/USD and CDS index spreads (January 2004 to February 2008)**

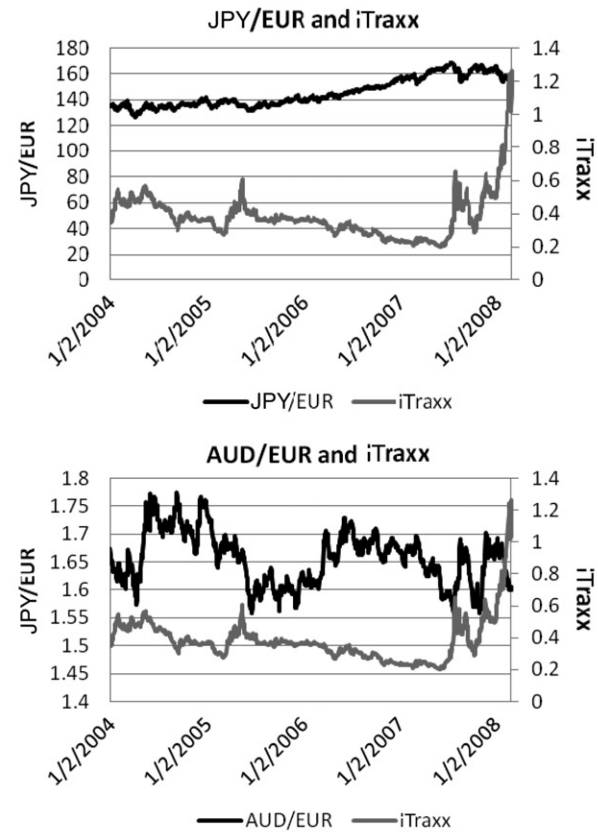

Fig. 5. **JPY/EUR and AUD/EUR with iTraxx spreads (January 2004 to February 2008)**

AUD/EUR). Summary statistics of control variables are also reported. Panel B tabulates the contemporaneous correlations between exchange rates and IG and HY, as well as iTraxx spreads for the whole period (January 2004 to December 2008) and two subperiods. Two findings are noteworthy. First, for the four currencies in terms of the USD, correlations are negative and significant for the whole period. The results imply that a lower value of the USD relates to a greater CDS spread. When the whole period is split into two subperiods, we find that most correlations in the first subperiod (January 2004 to December 2006) become positive and generally significant. That is, a higher USD value is associated with a greater CDS spread. In the second subperiod (January 2007 to February 2008), all correlations are negative and statistically significant. The results imply that the negative correlations for the whole period are likely to be driven by those in the second subperiod when the CDS indices showed sharp movements.

Second, the AUD (in terms of the EUR) is the only currency having a negative but significant correlation with iTraxx in the second subperiod. This pattern

Table 1. Data description and correlation analysis

Panel A: Descriptive statistics

Variable	*N*	Mean	Min.	Median	Max.	SD
IG_Spread	1039	0.53	0.29	0.49	1.65	0.19
HY_Spread	1039	3.63	2.09	3.53	7.34	0.84
iTraxx_Spread	1038	0.38	0.20	0.36	1.27	0.14
JPY/USD	1020	112.88	102.34	113.24	124.11	5.38
EUR/USD	1020	0.78	0.66	0.78	0.86	0.05
GBP/USD	1039	0.53	0.48	0.54	0.58	0.03
AUD/USD	1039	1.29	1.06	1.31	1.46	0.08
JPY/EUR	1039	145.20	126.19	140.88	168.43	11.22
USD/EUR	1039	1.29	1.17	1.28	1.51	0.08
GBP/EUR	1039	0.68	0.66	0.68	0.76	0.02
AUD/EUR	1039	1.66	1.56	1.66	1.77	0.05
BOND	1039	9.11	8.31	8.98	10.29	0.45
SPX	1039	1280	1060	1260	1570	130
VIX	1039	15.08	9.89	13.84	31.01	4.23
JPYSTK	986	14 164.22	10 365.40	14 729.58	18 261.98	2556.54
EURSTK	1039	28.79	19.16	27.60	42.11	6.85
GBPSTK	1021	5520.82	4287.00	5672.40	6732.40	735.70
AUDSTK	1039	31.14	14.46	30.91	60.59	12.79
JPYUSDINTDIF(%)	1039	−3.03	−4.54	−3.33	−0.40	1.28
EURUSDINTDIF(%)	1039	−0.35	−1.85	−0.66	3.34	1.26
GBPUSDINTDIF(%)	1039	1.70	−0.27	1.37	4.60	1.33
AUDUSDINTDIF(%)	1039	2.53	1.02	2.32	6.07	1.26
JAPEURINTDIF(%)	1039	−2.68	−3.99	−2.60	−1.94	0.67
USDEURINTDIF(%)	1039	0.35	−3.34	0.66	1.85	1.26
GBPEURINTDIF(%)	1039	2.05	1.13	1.84	2.78	0.48
AUDEURINTDIF(%)	1039	2.88	1.82	2.91	3.54	0.45

Panel B: Correlation

	Whole period		First subperiod		Second subperiod	
Correlation	IG	HY	IG	HY	IG	HY
JPY/USD	−0.4545	−0.3555	−0.0113	0.3936	−0.7475	−0.7676
	(<0.0001)	(<0.0001)	(0.8040)	(<0.0001)	(<0.0001)	(<0.0001)
EUR/USD	−0.3572	−0.2895	0.3538	0.5250	−0.6665	−0.6337
	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
GBP/USD	−0.1484	−0.8678	0.1159	0.3172	−0.3205	−0.2789
	(<0.0001)	(0.0051)	(0.0096)	(0.0051)	(<0.0001)	(<0.0001)
AUD/USD	−0.3484	−0.3172	0.4248	0.3657	−0.6447	−0.6130
	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)

	Whole period	First subperiod	Second subperiod
Correlation	iTraxx	iTraxx	iTraxx
JPY/EUR	0.0423	−0.4808	0.1620
	(0.1680)	(<0.0001)	(<0.0001)
USD/EUR	0.4772	−0.2856	0.5841
	(<0.0001)	(<0.0001)	(<0.0001)
GBP/EUR	0.7271	−0.5297	0.8411
	(<0.0001)	(<0.0001)	(<0.0001)
AUD/EUR	−0.0084	0.0404	−0.1594
	(0.7835)	(0.3689)	(0.0002)

Notes: *N* is the number of observations. IG_Spread is the spread for the North American IG CDS index; HY_Spread is the spread for the North American high-yield CDS index; iTraxx_Spread is the spread for the European iTraxx CDS index; JPYUSDINTDIF, EURUSDINTDIF, GBPUSDINTDIF and AUDUSDINTDIF refer to the difference in the short-term risk-free interest rate between respectively Japan, the euro zone, the UK and Australia, and the US; JPYEURINTDIF, USDEURINTDIF, GBPEURINTDIF and AUDEURINTDIF refer to the difference in the short-term risk-free interest rate between respectively Japan, the US, the UK and Australia, and the euro zone. Whole period refers to the period from January 2004 to February 2008; First subperiod is from January 2004 to December 2006 and Second subperiod is from January 2007 to February 2008. *p*-values are in parentheses.

seems to suggest that the two may be related because of the carry trades resulting from the interest rate differential between the two currencies. For the JPY, GBP and USD in terms of the EUR, the correlations are positive for the whole period, whereas they are all significantly negative in the first subperiod but become significantly positive in the second subperiod. These results suggest that the EUR appreciation against the JPY, USD and GBP is associated with larger CDS spreads for the whole period and the second subperiod. The positive relationship is perhaps due to the relative strength of the EUR as compared with the USD during the credit crisis that originated in the US. The insignificant correlations between the CDS spreads and the JPY and AUD (JPY/EUR and AUD/EUR) for the whole period seem to be related to the dramatic shift in the correlation with the CDS spreads in the two subperiods.

Given the dramatic increase in volatility during the second subperiod, we first examine the stationary of the CDS spreads and currency values using the Augmented Dickey–Fuller (ADF) (Dickey *et al.*, 1984) and Phillips and Perron (PP) (1988) unit root tests. The null hypothesis in both tests is that the series are characterized by a unit root. Test statistics show that we cannot reject a unit root for all spread levels, but the hypothesis of a unit root in the first differences is rejected for all series, indicating that they are stationary at the first difference.

Johansen's (1991) cointegration rank tests are used to evaluate the null hypothesis of no cointegration. This null hypothesis states that the coefficient matrix has full rank. If this null hypothesis is rejected, then the series are cointegrated. Our tests show that there is no cointegration relationship between exchange rates and the corresponding CDS spreads.[7] Thus, the VAR analysis based on the first difference of the variables is appropriate for the relationship between exchange rates and CDS spreads.

To test for price leadership, we rely on the concept of Granger causality in a VAR in differences. Since the hypothesis of a unit root in the first difference is rejected for all series, we use the changes in CDS spreads and changes in exchange rates as variables in the VAR system. In this test, the null hypothesis is that prices in one market do not Granger-cause prices in the other market, or equivalently, price discovery does not occur in the first market. We determine the optimal lag length in the VAR analysis based on the Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC). When the two criteria indicate different lag lengths, we report only the results with the shorter lag length to conserve space, because both results are similar.

Table 2 report the results of the VAR model with control variables. The optimal lag length for the CDS and currency series is shown on the top of each panel in the table. Panel A of Table 2 shows the regression coefficients, and their corresponding *t*-values of the VAR results for each currency (JPY/USD, EUR/USD, GBP/USD and AUD/USD) with the IG and HY CDS spreads for the whole period (i.e., January 2004–February 2008) are shown underneath. The directions of significant coefficients on control variables are generally as predicted in the previous section. Specifically, BOND is positively related to IG CDS spreads, which is significant, and negatively related to HY CDS spreads, which is not significant. VIX and INTDIF have positive relationships with the CDS spreads, suggesting that higher volatility and greater interest rate differential between the foreign country and the US contribute to wider CDS spreads. SPX is negatively related to CDS spreads, consistent with the hypothesis that higher stock market index level indicates a promising economy and lower default probability, and thus smaller CDS spreads. FSTK is positively related to the value of the USD versus JPY and GBP and negatively related to the USD value versus the EUR and the AUD. INTDIF is negatively related to the USD value versus all four currencies, supporting that a greater interest rate differential attracts more foreign capital inflows and a higher foreign currency value.

For the JPY/USD case with IG CDS spreads, the coefficient of the first IG lag on FX (−3.287) is negative and significant; the magnitude of the coefficient (in absolute term) is larger than that of the 2-day ahead IG (2.924), which is positive and significant, implying that there was a positive reaction to the initial IG on FX 2 days ago, but it had been corrected since. That is, when the US CDS spreads started to widen 2 days ago, the USD in terms of the JPY appreciated but was finally largely reduced by the widening CDS spreads the day before. This result suggests that currency values fluctuate widely with the CDS market. Likewise, the results of HY CDS spreads on JPY/USD are similar to those of the results on IG CDS spreads.

The cross-market *F*-test reported at the bottom of each panel is used to test the Granger-causality relationship between the CDS and currency markets. The null hypothesis for the *F*-test with FX as the dependent variable is that, coefficients on both

[7] Results for unit root and cointegration tests are not reported here for brevity, but are available from the authors upon request.

Table 2. VAR system with exogenous variables

Panel A: FX and IG, HY

Independent	FX(t)	IG(t)	Independent	FX(t)	HY(t)
FX = JPY/USD (Lag = 2)					
BOND	−0.349	0.089	BOND	−0.331	−0.179
	−0.33	3.12		−0.31	−1.27
SPX	1.120	−0.923	SPX	0.507	−5.171
	0.29	−9.03		0.13	−10.29
FSTK	0.533	−0.005	FSTK	0.560	−0.010
	3.81	−1.30		3.98	−0.75
VIX	−0.001	0.003	VIX	−0.004	0.021
	−0.02	2.85		−0.09	4.13
INTDIF	−1.020	0.038	INTDIF	−1.029	0.118
	−2.45	3.35		−2.45	2.13
FX($t-1$)	−0.080	−0.001	FX($t-1$)	−0.077	0.002
	−2.22	−0.96		−2.14	0.38
FX(t−2)	0.038	0.002	FX(t−2)	0.039	−0.002
	1.07	1.86		1.09	−0.51
IG($t-1$)	−3.287	0.112	HY($t-1$)	−0.481	0.099
	−2.95	3.72		−2.27	3.54
IG(t−2)	2.924	−0.022	HY(t−2)	0.572	−0.006
	2.60	−0.71		2.68	−0.20
Constant	−0.001	0.001	Constant	−0.002	0.007
R^2 (%)	6.07	39.15	R^2 (%)	5.63	44.06
Overall *F*-value	5.34	53.18	Overall *F*-value	16.14	65.11
p-value	(<0.0001)	(<0.0001)	*p*-value	(<0.0001)	(<0.0001)
F-test cross market	15.67	4.76	*F*-test cross market	12.14	0.44
p-value	(0.0004)	(0.0924)	*p*-value	(0.0023)	(0.8026)
FX = EUR/USD (Lag = 1)					
BOND	−0.004	0.095	BOND	−0.004	−0.113
	−0.66	3.35		−0.65	−0.80
SPX	−0.011	−0.954	SPX	−0.017	−5.227
	−0.46	−9.26		−0.73	−10.29
FSTK	−0.006	−0.003	FSTK	−0.006	−0.012
	−11.54	−1.19		−11.65	−1.06
VIX	0.000	0.003	VIX	0.000	0.019
	0.33	2.66		0.48	3.70
INTDIF	−0.004	0.047	INTDIF	−0.004	0.113
	−0.77	1.87		−0.48	0.89
FX($t-1$)	−0.062	−0.079	FX($t-1$)	−0.060	−0.617
	−1.87	−0.53		−1.83	−0.84
IG($t-1$)	−0.029	0.069	HY($t-1$)	−0.006	0.068
	−3.97	2.13		−4.19	2.24
Constant	0.000	0.001	Constant	−0.004	0.007
R^2 (%)	15.37	35.64	R^2 (%)	15.56	40.51
Overall *F*-value	20.34	62.01	Overall *F*-value	20.64	76.28
p-value	(<0.0001)	(<0.0001)	*p*-value	(<0.0001)	(<0.0001)
F-test cross market	15.72	0.29	*F*-test cross market	17.56	0.71
p-value	(<0.0001)	(0.5933)	*p*-value	(<0.0001)	(0.3995)
FX = GBP/USD (Lag = 2)					
TBOND	0.007	0.089	BOND	0.007	−0.122
	1.55	3.25		1.55	−0.89
SPX	−0.033	−0.845	SPX	−0.032	−4.967
	−1.97	−8.41		−1.96	−9.83
FSTK	0.001	−0.001	FSTK	0.001	−0.001
	1.95	−2.45		1.94	−2.38
VIX	−0.001	0.003	VIX	−0.001	0.020

(*continued*)

Table 2. Continued

Panel A: FX and IG, HY

Independent	FX(t)	IG(t)	Independent	FX(t)	HY(t)
	−1.42	3.37		−1.42	4.10
INTDIF	−0.001	0.018	INTDIF	−0.002	0.066
	−1.01	2.19		−1.10	1.56
FX($t-1$)	0.047	−0.329	FX($t-1$)	0.048	−1.571
	1.31	−1.52		1.34	−1.45
FX(t–2)	−0.056	0.053	FX(t–2)	−0.055	−0.481
	−1.58	0.25		−1.54	−0.44
IG($t-1$)	0.004	0.120	HY($t-1$)	0.007	0.081
	0.85	3.88		0.66	2.81
IG(t–2)	0.007	−0.044	HY(t–2)	0.002	−0.013
	1.47	−1.46		1.72	−0.47
Constant	−0.001	0.001	Constant	−0.001	0.001
R^2 (%)	2.26	35.51	R^2 (%)	2.33	40.52
Overall F-value	2.013	47.79	Overall F-value	2.068	59.13
p-value	(0.035)	(<0.0001)	p-value	(0.029)	(<0.0001)
F-test cross market	3.06	2.35	F-test cross market	3.55	2.37
p-value	(0.2167)	(0.3094)	p-value	(0.1691)	0.3053
FX = AUD/USD (Lag = 2)					
BOND	0.045	0.075	BOND	0.044	−0.156
	3.21	2.77		3.14	−1.14
SPX	−0.135	−0.892	SPX	−0.135	−4.973
	−2.63	−8.90		−2.63	−9.84
FSTK	−0.001	−0.001	FSTK	−0.001	−0.002
	−1.72	−1.40		−2.11	−0.41
VIX	−0.002	0.003	VIX	−0.002	0.020
	−3.97	2.98		−3.96	4.06
INTDIF	−0.009	0.021	INTDIF	−0.009	0.052
	−1.78	2.21		−1.86	1.11
FX($t-1$)	0.048	−0.078	FX($t-1$)	0.051	−0.579
	1.39	−1.15		1.47	−1.71
FX(t–2)	−0.120	−0.037	FX(t–2)	−0.122	−0.413
	−3.50	−0.55		−3.55	−1.22
IG($t-1$)	0.016	0.131	HY($t-1$)	0.002	0.091
	1.03	4.41		0.67	3.26
IG(t–2)	0.039	−0.032	HY(t–2)	0.005	0.005
	2.49	−1.06		1.83	0.19
Constant	0.000	0.001	Constant	0.000	0.006
R^2 (%)	6.67	35.69	R^2 (%)	6.27	40.68
Overall F-value	6.33	49.15	Overall F-value	5.92	60.73
p-value	(<0.0001)	(<0.0001)	p-value	(<0.0001)	(<0.0001)
F-test cross market	7.37	1.69	F-test cross market	3.94	4.62
p-value	(0.0251)	(0.4287)	p-value	(0.1392)	(0.0991)

Panel B: FX and iTraxx

FX = JPY/EUR (Lag = 1)			FX = USD/EUR (Lag = 1)		
Independent	FX(t)	iTraxx(t)	Independent	FX(t)	iTraxx(t)
BOND	−0.428	0.055	BOND	0.003	0.040
	−0.39	2.48		0.35	1.73
EURSTK	0.383	−0.019	EURSTK	0.003	−0.026
	3.54	−8.69		2.65	−10.02
FSTK	0.408	−0.020	FSTK	0.014	0.127
	2.81	−6.72		0.34	1.31

(*continued*)

Table 2. Continued

Panel B: FX and iTraxx

FX = JPY/EUR (Lag = 1)			FX = USD/EUR (Lag = 1)		
Independent	FX(*t*)	iTraxx(*t*)	Independent	FX(*t*)	iTraxx(*t*)
	2.05	−0.44		1.50	−0.56
INTDIF	−2.824	0.009	INTDIF	−0.004	−0.009
	−2.52	0.96		−1.35	−1.16
FX($t-1$)	0.044	−0.002	FX($t-1$)	−0.010	0.205
	1.37	−2.38		−0.30	2.51
iTraxx($t-1$)	1.913	0.080	iTraxx($t-1$)	−0.001	0.095
	1.37	2.80		−0.07	3.24
Constant	−0.011	−0.001	Constant	−0.001	−0.001
R^2 (%)	4.12	21.88	R^2 (%)	1.35	17.10
Overall *F*-value	5.99	39.05	Overall *F*-value	2.01	30.28
p-value	(<0.0001)	(<0.0001)	*p*-value	(0.052)	(<0.0001)
F-test cross market	1.87	5.67	*F*-test cross market	0.01	6.29
p-value	(0.1715)	(0.0173)	*p*-value	(0.9442)	(0.0121)
FX = GBP/EUR (Lag = 1)			FX = AUD/EUR (Lag = 1)		
BOND	−0.003	0.001	BOND	0.009	0.046
	−0.93	0.05		0.81	2.14
EURSTK	0.001	0.001	EURSTK	−0.001	−0.020
	0.11	0.09		−0.47	−9.60
FSTK	0.001	−0.001	FSTK	−0.001	−0.005
	1.01	−13.13		−1.30	−7.34
VIX	−0.001	0.001	VIX	−0.001	−0.001
	−0.09	0.06		−2.57	−0.47
INTDIF	0.001	−0.007	INTDIF	−0.018	−0.013
	0.79	−0.39		−1.90	−0.79
FX($t-1$)	0.095	0.579	FX($t-1$)	0.102	0.267
	3.04	3.02		3.26	4.78
iTraxx($t-1$)	−0.005	0.129	iTraxx($t-1$)	−0.053	0.082
	−1.04	4.81		−3.32	2.97
Constant	−0.001	−0.001	Constant	0.001	−0.001
R^2 (%)	1.62	29.09	R^2 (%)	4.08	23.12
Overall *F*-value	2.37	59.26	Overall *F*-value	6.26	44.16
p-value	0.021	(<0.0001)	*p*-value	(<0.0001)	(<0.0001)
F-test cross market	1.09	9.14	*F*-test cross market	11	22.89
p-value	(0.2971)	(0.0025)	*p*-value	(<0.0001)	(<0.0001)

Notes: In Panel A, H_0 for the *F*-test with FX(*t*) as the dependent variable is that coefficients on both IG ($t-1$) and IG($t-2$) are equal to zero when the optimal lag is equal to 2, and IG($t-1$) is equal to zero when the optimal lag is equal to 1. H_0 for the *F*-test with IG(t) as the dependent variable is that coefficients on both FX($t-1$) and FX($t-2$) are equal to zero when the optimal lag is equal to 2, and FX($t-1$) is equal to zero when the optimal lag is equal to 1. In Panel B, H_0 for the *F*-test with FX(*t*) as the dependent variable is that the coefficient of iTraxx($t-1$) is equal to zero. H0 for the *F*-test with iTraxx(*t*) as the dependent variable is that the coefficient of FX($t-1$) is equal to zero.

IG($t-1$) and IG($t-2$) (or HY($t-1$) and HY($t-2$)) are equal to zero. The null hypothesis for the *F*-test with IG or HY CDS spreads as the dependent variable is that, coefficients on both FX($t-1$) and FX($t-2$) are equal to zero. The *F*-test results indicate that there is a significant feedback effect from the US CDS markets (IG and HY) to the JPY currency, but the reverse is much less significant.

These results are consistent with the prediction of the interest rate arbitrage theory that investors, including many hedge funds that have access to international markets, would scan the global markets in search of higher yields and arbitrage the interest rate differential between two economies. For example, carry trades, an uncovered interest rate arbitrage strategy, aim to benefit from the general direction or trend of the currency pair. A carry trade involves buying a currency (e.g. the USD) which is expected to appreciate with relatively higher interest rates and funding it with a currency which is expected to depreciate (in this case, the JPY) with low interest rates. The most commonly used currency to fund carry trades has been the JPY because of exceptionally low interest rates in Japan since the 1990s.

At times when investors become more risk averse, they would unwind their carry trades by buying back the borrowed currency (the JPY) with the proceeds from selling off the investments in the other currency (the USD). In the second half of the sample period in this study, the USD's value was driven down with the widening of CDS spreads, which is indicative of increasing risk aversion.

For the EUR/USD case, the IG effect on the EUR and the HY effect on the EUR are similar. That is, the coefficient of the first lag (-0.029) is negative and significant, implying that larger CDS spreads lead to the devaluation of the USD versus the EUR. The cross-market tests of the CDS spreads on the EUR are highly significant, implying that the CDS markets do predict the EUR/USD movements. Again, we find insignificant result (F-statistic $= 0.29$ for the IG CDS spreads and F-statistic $= 0.71$ for the HY CDS spreads) of the Granger causality test of the EUR on the CDS spreads. These results confirm the earlier results of the uncovered interest rate arbitrage analysis. For the GBP/USD case, both IG and HY CDS indices do not seem to have a significant effect on the currency. Coefficients of both two lags of CDS spreads are not statistically significant. The cross-market F-test is also insignificant. These results imply that the US CDS markets do not predict the GBP currency value. The insignificant CDS result on the GBP supports our hypothesis that the lead–lag relationship between the CDS and currency markets is less likely to be found when the two countries are similar. This may arise because the British monetary policy is largely consistent with the US, and thus there is less profit opportunity for the uncovered interest rate arbitrage and fewer carry trades are conducted.

In the case of AUD/USD, the CDS markets (both IG and HY) have a positive and significant effect on the currency. In addition, the cross-market F-test for the IG CDS spreads does have a significant value, implying that larger CDS spreads are associated with higher USD value. The Granger causality results (F-statistic $= 7.37$ for IG CDS spreads) suggest that the US CDS market can predict the AUD value in terms of the USD.[8]

Results for JPY/USD, EUR/USD and AUD/USD in Panel A of Table 2 suggest that the CDS markets convey useful information above and beyond what is provided by other markets, i.e. after incorporating the effects of the bond and equity markets. Thus, CDS markets are useful in capturing information more than that of the bond and equity markets, which are widely used to predict currency value in the foreign exchange market.

Panel B of Table 2 reports the relationship between exchange rates (JPY/EUR, USD/EUR, GBP/EUR and AUD/EUR) and iTraxx spreads with the appropriate control variables. Results for control variables are generally consistent with those in Panel A of Table 2. The significant variables have the predicted signs. Moreover, we find that the lagged iTraxx spreads have a negative and significant effect on the AUD. Significant cross-market F-tests ($F = 11.79$, p-value $= 0.0006$) further support the earlier explanations of carry trades. In addition, the currency market is found to have a feedback effect on the CDS market.

For the other three currencies, the JPY, GBP and USD, the lagged iTraxx spreads do not seem to affect these currencies. The result of the GBP is expected because the UK is part of the EU. Its monetary policy largely supports that of the European Central Bank, and thus provides less opportunity for interest rate arbitrage for market participants. The insignificant result for the USD/EUR requires elaboration. There is indeed evidence of carry trades between the USD and the EUR as demonstrated by the US CDS indices in Panel A of Table 2. However, Panel B of Table 2 shows no evidence of the lead–lag relationship between iTraxx and the EUR. These results suggest that investors utilize the US but not the European CDS market to obtain information for carry trades between the USD and the EUR. The predominant use of the US CDS market in the USD/EUR carry trades is likely attributable to its large size and liquidity. The insignificance of iTraxx on the exchange rate of JPY/EUR is likely due to the fact that the majority of carry trades are done between the JPY and the USD, leaving out the interest rate arbitrage in the European economies.

One interesting result is noted for Panel B of Table 2. The respective currency in different markets appears to have significant effects on iTraxx, a result in contrast to the US credit market in Panel A of Table 2. This suggests that the US credit market may reflect financial market information more efficiently.

We conjecture that the leadership of CDS spreads in price discovery may be attributed to two reasons. First, the CDS market is the venue for credit risk trading. The CDS may serve as an early warning

[8] Because Australia has relatively high interest rates and its currency is floating freely without much government interventions, the implied future currency spot rate relative to the USD will be expected to depreciate according to the Open Fisher Theory. As a result, carry trades based on the speculative profit opportunities through selling the USDs and buying the AUDs are unlikely to occur. Thus, the negative sign between the CDS spreads and the USD currency value is not observed.

Table 3. Granger-causality tests of CDS markets (IG, HY, iTraxx) on FX

FX=JPY/USD									
	First subperiod		Second subperiod			First subperiod		Second subperiod	
	FX(*t*)	IG(*t*)	FX(*t*)	IG(*t*)		FX(*t*)	HY(*t*)	FX(*t*)	HY(*t*)
F-test cross market	3.81	0.53	18.24	4.79	*F*-test cross market	6.06	0.46	19.71	4.34
p-value	(0.1491)	(0.7663)	(0.0001)	(0.0909)	*p*-value	(0.0484)	(0.7958)	(<0.0001)	(0.1144)
FX=EUR/USD									
	First subperiod		Second subperiod			First subperiod		Second subperiod	
	FX(*t*)	IG(*t*)	FX(*t*)	IG(*t*)		FX(*t*)	HY(*t*)	FX(*t*)	HY(*t*)
F-test cross market	11.4	0.75	4.39	0.2	*F*-test cross market	10.7	0.25	14.99	0.24
p-value	(0.0007)	(0.3864)	(0.0361)	(0.6587)	*p*-value	(0.0011)	(0.6194)	(<0.0001)	(0.6263)
FX=GBP/USD									
	First subperiod		Second subperiod			First subperiod		Second subperiod	
	FX(t)	IG(t)	FX(t)	IG(t)		FX(t)	HY(t)	FX(t)	HY(t)
F-test cross market	2.22	0.06	3.57	3.28	*F*-test cross market	2.97	0.34	1.05	4.53
p-value	(0.3296)	(0.9685)	(0.1674)	(0.1942)	*p*-value	(0.2270)	(0.84194)	(0.5917)	(0.1039)
FX=AUD/USD									
	First subperiod		Second subperiod			First subperiod		Second subperiod	
	FX(t)	IG(t)	FX(t)	IG(t)		FX(t)	HY(t)	FX(t)	HY(t)
F-test cross market	6.21	0.18	5.52	2.86	*F*-test cross market	5.74	0.96	0.57	6.66
p-value	(0.0448)	(0.9134)	(0.0632)	(0.2397)	*p*-value	(0.0567)	(0.6202)	(0.7525)	(0.0358)
FX=JPY/EUR					FX=USD/EUR				
	First subperiod		Second subperiod			First subperiod		Second subperiod	
	FX(t)	iTraxx(t)	FX(t)	iTraxx(t)		FX(t)	iTraxx(t)	FX(t)	iTraxx(t)
F-test cross market	0.04	1.65	3	14.7	*F*-test cross market	0.51	2.84	0.5	4.01
p-value	(0.8339)	(0.1988)	(0.0832)	(0.0001)	*p*-value	(0.4758)	(0.0920)	(0.4810)	(0.0452)
FX=GBP/EUR					FX=AUD/EUR				
	First subperiod		Second subperiod			First subperiod		Second subperiod	
	FX(t)	iTraxx(t)	FX(t)	iTraxx(t)		FX(t)	iTraxx(t)	FX(t)	iTraxx(t)
F-test cross market	0.8	0.95	1.02	12.5	*F*-test cross market	1.5	2.04	9.54	23.76
p-value	(0.3722)	(0.3307)	(0.3128)	(0.0004)	*p*-value	(0.2205)	(0.1530)	(0.0020)	(<0.0001)

Note: First subperiod is from January 2004 to December 2006; Second subperiod is from January 2007 to February 2008.

Table 4. Variance decomposition from VAR for currencies with USD (second subperiod)

Panel A-1

Horizon	Explained variables	JPY/USD (%)	IG (%)
1	JPY/USD	84.27	3.99
5		82.63	4.24
10		82.63	4.24
15		82.63	4.24
20		82.63	4.24
1	IG	3.15	94.11
5		3.63	91.60
10		3.63	91.60
15		3.63	91.60
20		3.63	91.60

Panel A-2

Horizon	Explained variables	JPY/USD (%)	HY(%)
1	JPY/USD	84.45	4.23
5		82.03	4.07
10		82.03	4.07
15		82.03	4.07
20		82.03	4.07
1	HY	1.57	92.54
5		1.58	90.89
10		1.58	90.89
15		1.58	90.89
20		1.58	90.89

Panel B-1

Horizon	Explained variables	EUR/USD (%)	IG (%)
1	EUR/USD	93.57	0.71
5		90.68	1.03
10		90.68	1.03
15		90.68	1.03
20		90.68	1.03
1	IG	0.13	97.76
5		0.82	95.14
10		0.82	95.14
15		0.82	95.14
20		0.82	95.14

Panel B-2

Horizon	Explained variables	EUR/USD (%)	HY (%)
1	EUR/USD	93.48	0.25
5		90.74	0.96
10		90.74	0.96
15		90.74	0.96
20		90.74	0.96
1	HY	0.00	94.74
5		1.03	93.06
10		1.03	93.06
15		1.03	93.06
20		1.03	93.06

Panel C-1

Horizon	Explained variables	GBP/USD (%)	IG (%)
1	GBP/USD	94.62	0.07
5		92.40	0.59
10		92.40	0.59
15		92.40	0.59
20		92.40	0.59
1	IG	0.75	96.80
5		1.40	94.26
10		1.40	94.26
15		1.40	94.26
20		1.40	94.26

Panel C-2

Horizon	Explained variables	GBP/USD (%)	HY (%)
1	GBP/USD	94.59	0.01
5		92.17	0.14
10		92.17	0.14
15		92.17	0.14
20		92.17	0.14
1	HY	1.32	93.34
5		2.31	90.63
10		2.31	90.63
15		2.31	90.63
20		2.31	90.63

Panel D-1

Horizon	Explained variables	AUD/USD (%)	IG (%)
1	AUD/USD	94.21	0.38
5		90.54	2.61
10		90.54	2.61
15		90.54	2.61
20		90.54	2.61
1	IG	1.32	96.30
5		2.41	93.96
10		2.41	93.96
15		2.41	93.96
20		2.41	93.96

Panel D-2.

Horizon	Explained variables	AUD/USD (%)	HY (%)
1	AUD/USD	93.69	0.82
5		89.45	1.11
10		89.45	1.11
15		89.45	1.11
20		89.45	1.11
1	HY	1.02	92.51
5		2.60	88.94
10		2.60	88.94
15		2.60	88.94
20		2.60	88.94

Table 5. Variance decomposition from VAR for currencies with EUR (second subperiod)

Panel A

Horizon	Explained variables	JPY/EUR (%)	iTraxx (%)
1	JPY/EUR	98.11	0.73
5		97.97	0.83
10		97.97	0.83
15		97.97	0.83
20		97.97	0.83
1	iTraxx	10.28	87.40
5		10.87	86.25
10		10.87	86.25
15		10.87	86.25
20		10.87	86.25

Panel B

Horizon	Explained Variables	USD/EUR (%)	iTraxx (%)
1	USD/EUR	99.58	0.00
5		99.57	0.00
10		99.57	0.00
15		99.57	0.00
20		99.57	0.00
1	iTraxx	0.30	97.08
5		0.30	97.05
10		0.30	97.05
15		0.30	97.05
20		0.30	97.05

Panel C

Horizon	Explained variables	GBP/EUR (%)	iTraxx (%)
1	GBP/EUR	97.52	0.29
5		97.41	0.31
10		97.41	0.31
15		97.41	0.31
20		97.41	0.31
1	iTraxx	0.54	94.06
5		0.90	93.60
10		0.90	93.60
15		0.90	93.60
20		0.90	93.60

Panel D

Horizon	Explained variables	AUD/EUR (%)	iTraxx (%)
1	AUD/EUR	95.09	2.93
5		94.81	3.13
10		94.81	3.13
15		94.81	3.13
20		94.81	3.13
1	iTraxx	6.53	90.17
5		7.45	88.84
10		7.45	88.84
15		7.45	88.84
20		7.45	88.84

signal of investors' risk aversion. This will gradually feed into the foreign exchange market when investors sell risky currencies and buy safer currencies to cover their interest rate arbitrage positions. This may help the CDS market lead the foreign exchange market. Second, participants in the CDS market, who are typically large institutional investors, may have information advantage that will subsequently be incorporated into the foreign exchange market.

To test whether the leadership of the CDS market is stronger during the recent credit crisis, we conduct separately the VAR analysis for the first subperiod (January 2004 to December 2006) and the second subperiod (January 2007 to February 2008). Table 3 shows the results of Granger causality tests of CDS markets on different currencies.[9] The results in general convey a stronger Granger-causality effect of the IG and HY indices on JPY/USD, EUR/USD, AUD/USD and the iTraxx index on AUD/EUR during the second subperiod. This provides evidence to support our expectation that the CDS market can better predict currency values during the credit crisis. This is consistent with the notion that more carry trade investors will unwind their positions as credit risk increases sharply and the credit market becomes more volatile. This is also in line with the finding of Blanco *et al*. (2005) that the CDS market leads the corporate bond market during the episodes of credit deterioration. We do not find significant causality effect of the CDS indices on GBP/USD, JPY/EUR, GBP/EUR and USD/EUR in both periods. The Granger causality test results for the subperiods are largely consistent with those for the whole period.

Table 4 shows the results of the variance decomposition for JPY/USD, EUR/USD, GBP/USD and AUD/USD, and IG and HY for the second subperiod, in which we find more significant Granger-causality effect from the CDS market to the foreign exchange market. Consistent with the results in Tables 2 and 3, we find a stronger

[9] The full results for the VAR system are not reported here to conserve space. They are available from the authors upon request.

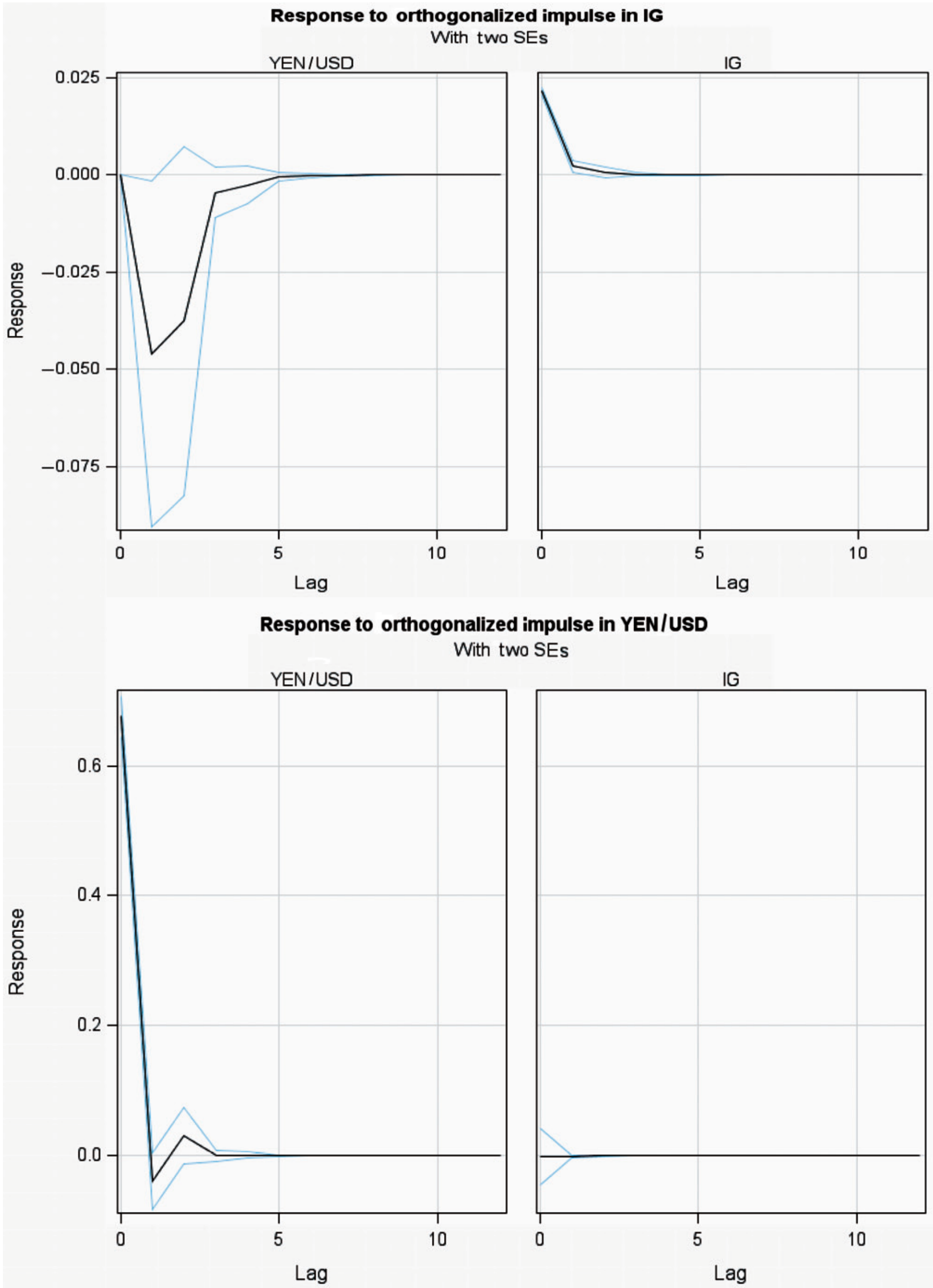

Fig. 6. Impulse response of IG and JPY/USD

relationship between the foreign exchange market and the US credit market for three currencies (the JPY, the EUR and the AUD).[10] For instance, in Panel A-1, when JPY/USD is used as the dependent variable, we observe that 82.63–84.27% of the forecast error variance is explained by its own lagged volatility. The innovation of IG explains the error variance of JPY/USD up to 4.24%. For the forecast error of IG, its own variations explain 91.6–94.11% of its movements, and JPY/USD explains

[10] We included BOND, SPX, JAPX and USINT in the variance decomposition analysis, but here we only report the results for major variables to conserve space. Likewise, the same analysis was done for the whole period, but not reported here for the same reason.

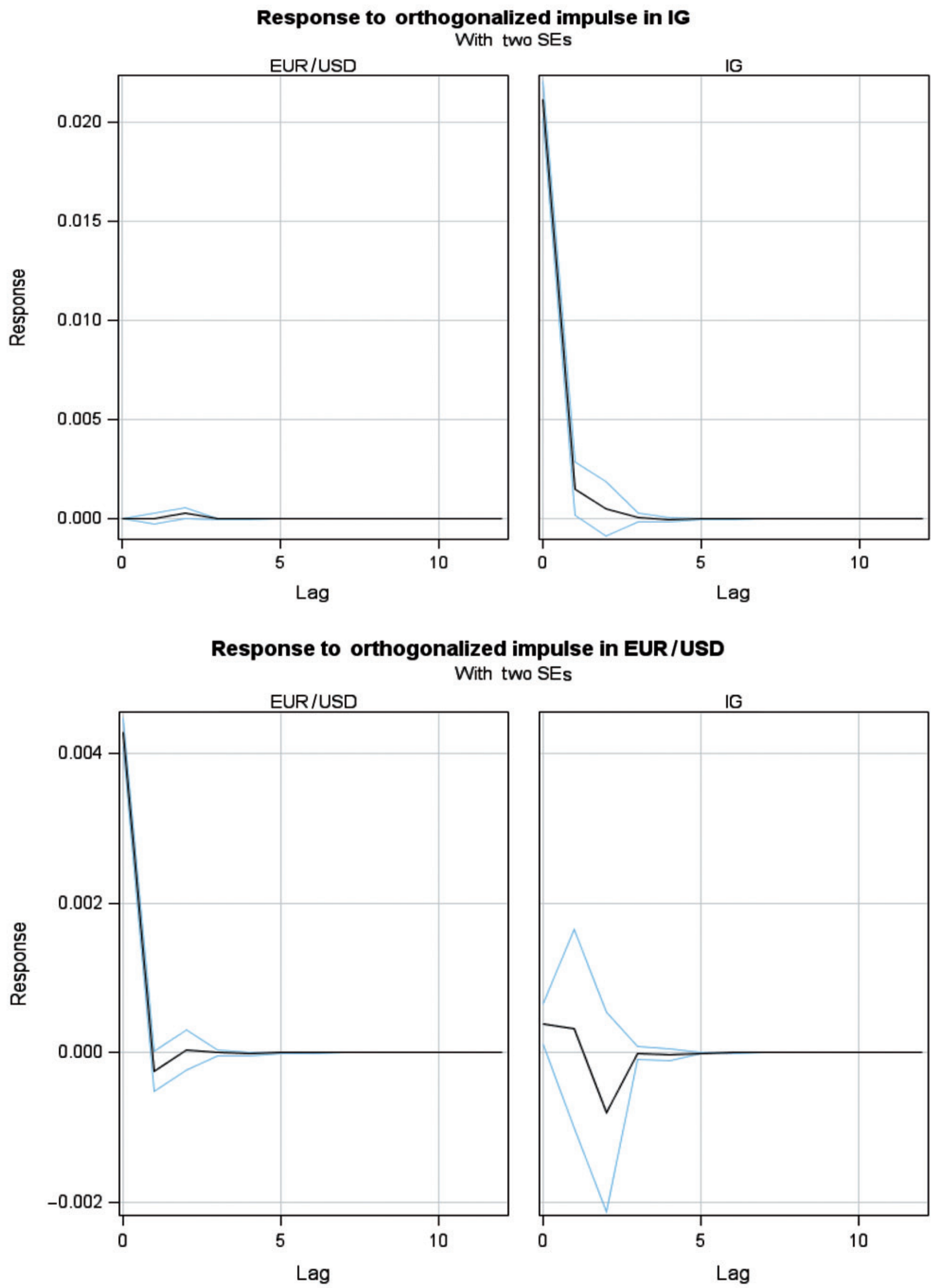

Fig. 7. Impulse response of IG and EUR/USD

3.15–3.63% of IG's forecast error. In Panel A-2, 82.03–84.45% of the forecast error variance of JPY/USD is explained by its own lagged volatility. The innovation of HY explains the error variance of JPY/USD up to 4.23%. For HY, its own variations explain 90.89–92.54% of its movements, and up to 1.58% is explained by the variations of JPY/USD.

Table 5 reports the variance decomposition of the VAR model for the currencies denominated in the EUR for the second subperiod. The iTraxx CDS market appears to have a stronger effect on the AUD and JPY than on the USD and GBP.

We also conduct impulse response analyses for different currencies. To conserve space, we only illustrate with a few currencies.[11] In Fig. 6, the top-panel

[11] The plots of impulse response analyses for other currency–index pairs are available from the authors upon request.

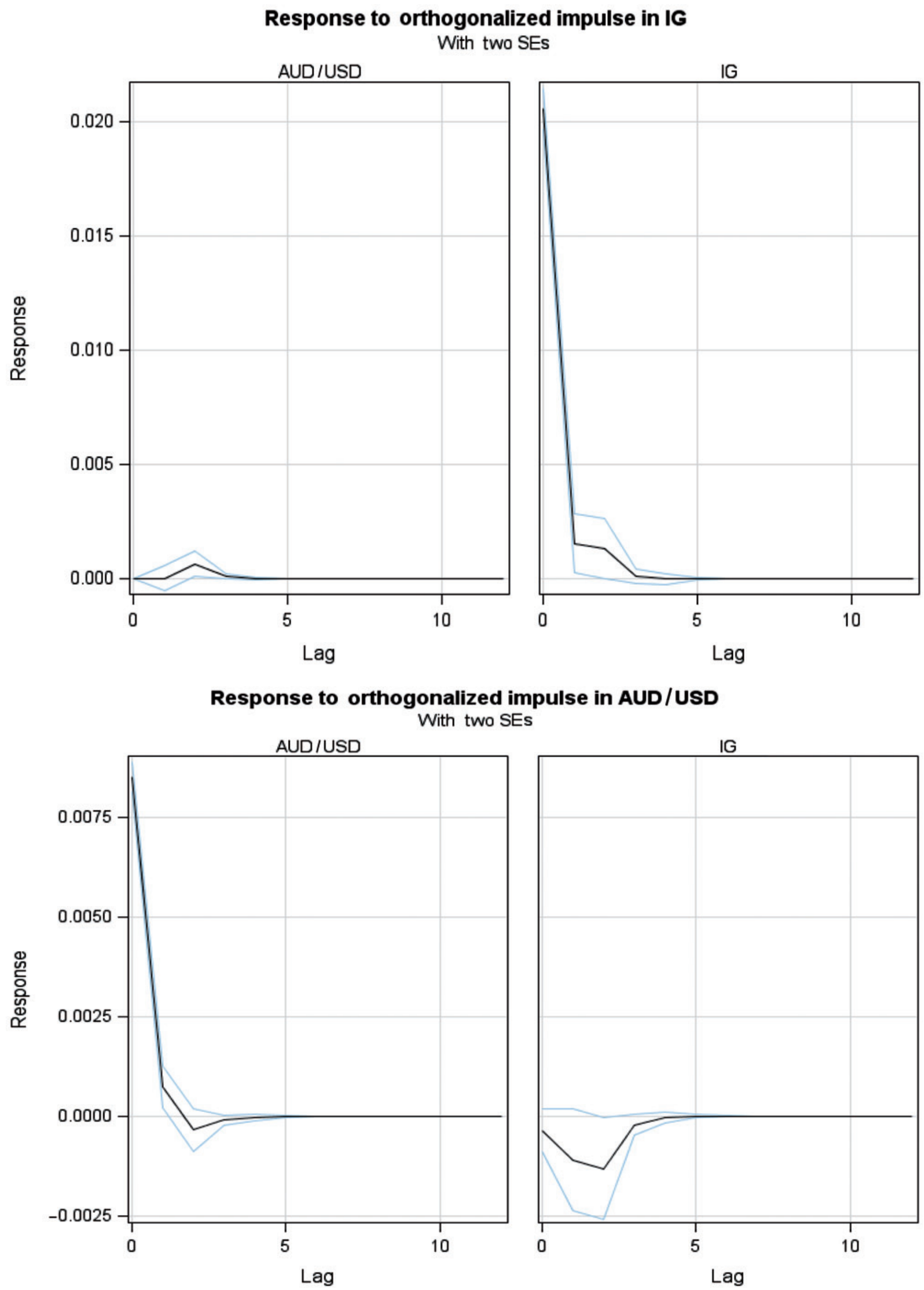

Fig. 8. Impulse response of IG and AUD/USD

graphs illustrate the response of the JPY and IG CDS spreads to a shock in IG. The yen and IG appears to take, respectively, 3 days and 1 day to absorb the shock in IG. For the currency shock, the yen takes 3–4 days to digest the shock in the yen and IG takes only 2 days to absorb the shock. Figure 7 shows that the EUR takes three days to absorb the unit shock in IG and IG takes four days. For the currency shock, both EUR and IG take about 3 days to digest the shock. Figure 8 confirms a similar pattern of short-term duration adjustments for shock in the CDS indices. Both the AUD and IG take about 3 days to absorb the shock originating in the CDS and currency markets. Figure 9 shows the impulse response of the AUD in terms of the EUR on shocks in iTraxx. Results are similar to those in Figs 6–8. That is, the currency market is quite efficient in dissipating the shock information and takes only a few days to complete the information transmission.

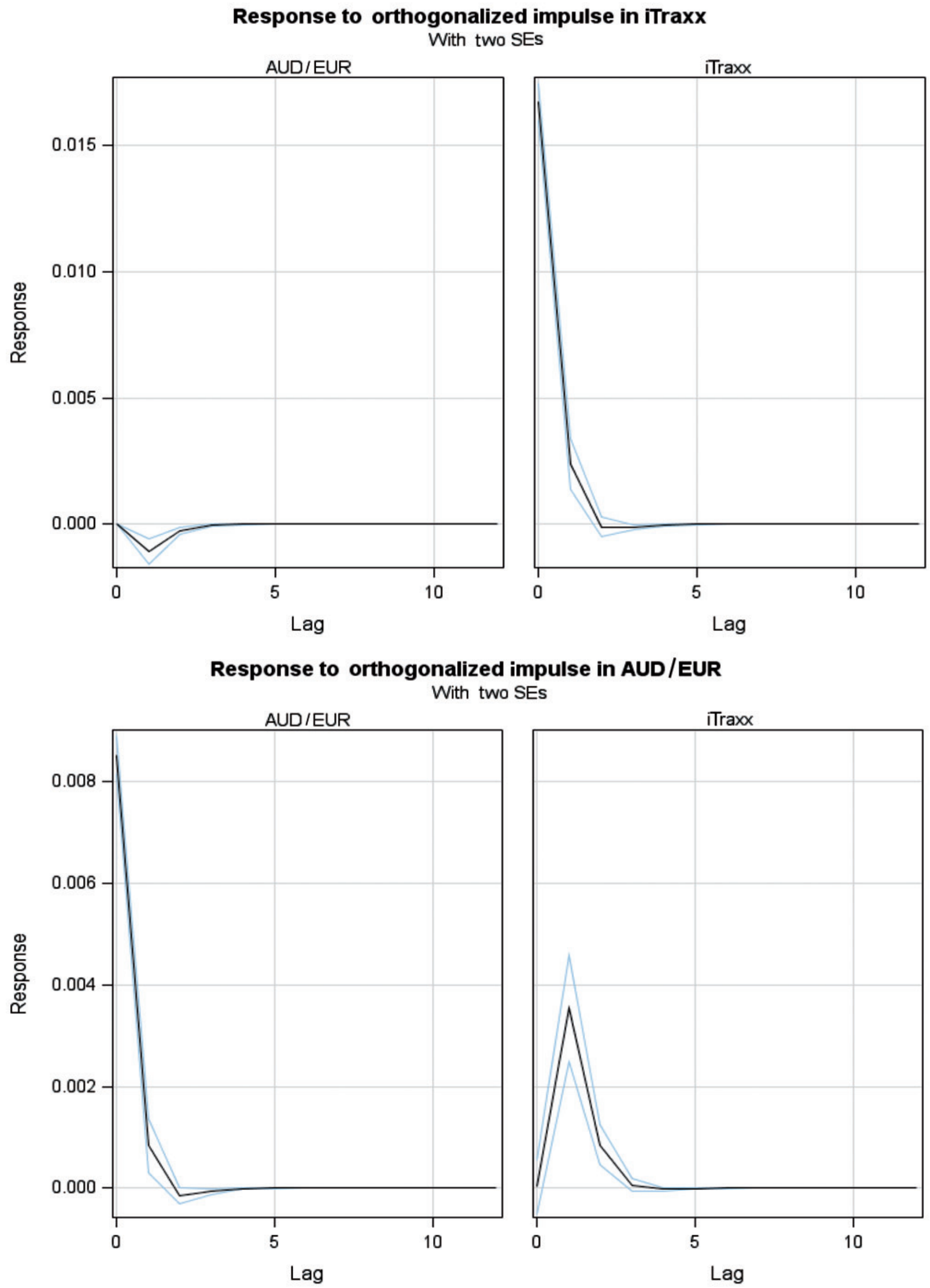

Fig. 9. Plot of impulse response of iTraxx and AUD/EUR

V. Summary and Conclusions

This study examined the lead–lag relationship between the credit and currency markets using a VAR model. We used two sets of daily exchange rate data covering the period from January 2004 to February 2008. First, we used the IG and HY indices in the North America CDS market and four currencies (AUD, EUR, GBP and JPY) in terms of the USD in the analysis. Second, we used the European iTraxx CDS index and four currencies (AUD, GBP, JPY and USD in terms of the EUR) to analyse their relationship. After incorporating control variables including the bond and the stock market returns, the US stock market volatility and interest rate differentials into the VAR model, the results show a strong price leadership from the CDS market to the currency market.

This study provides several interesting findings. When the currencies are in terms of the USD, we find significant Granger-causality flowing from IG and HY spread changes to changes in JPY/USD, EUR/USD and AUD/USD currency for the whole period (January 2004 to February 2008) and the second subperiod (January 2007 to February 2008), but not the exchange rate, GBP/USD. The reverse causality from changes in exchange rates to changes in CDS spreads is not as significant as the other direction. These results support the CDS spreads as a leading indicator of the several currencies versus the USD, in particular in the second subperiod.

When currencies denominated in terms of the EUR and iTraxx are used in the analysis, the credit market has a significant effect only on the AUD, but not on the JPY, GBP and USD. The result on the GBP suggests that carry trades are unlikely to be conducted in GBP because the British interest rate policy is more likely to heed that of the European Central Bank. The results on the USD and the JPY imply that investors are more likely to scan the US rather than the iTraxx CDS spreads for carry-trade transactions. This may be attributed to greater liquidity and market size in the US CDS market.

The results of variance decomposition indicate that the contribution of the CDS market to the currency market is higher in the yen/dollar market as compared with the other currency markets, implying that there have been more yen carry-trades.

This study makes the first contribution to the study of the lead–lag relationship between the credit and currency markets. Results from this study suggest that carry trades are more likely to involve currencies that are dissimilar, such as the USD and the JPY or the AUD. Because of the policy coordination in interest rates among similar countries (such as the US and the UK), carry trades are less likely to arise in these economies. This study demonstrates that some currency values can be predicted through the use of the CDS market, especially during the episodes of credit deterioration. This finding provides a basis for cross-market trading and hedging. It is also useful for economic policy analysis. When the currency and credit markets are efficient, prices of the financial assets reflect all publicly available information, implying no trading profits. In light of the strong price effect leading from the credit market to the currency market, it suggests that the credit market indeed moves the currency market via carry trades. Although it takes only a few days for the currency to absorb the shock, there appears room for trading profits or hedging opportunity, particularly for large banks and hedge funds.

In this study, the relative importance of price discovery of the CDS spreads compared with other different variables (such as interest rates or equity returns) on the currency values has not been examined. This warrants future research.

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