Strong Sterling Pound and Weak European Currencies in the Crises: Evidence from Covered Interest Parity of Secured Rates [*]

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Abstract

In the post Lehman period, the interest rate of the US dollar became low on the forward contract because of its role as international currency. However, in the Euro crisis, the Sterling pound had equally low interest rate as the US dollar, while the other European currencies increased its liquidity premium. By using secured rates, the following analysis examines why the Sterling pound and the other European currencies showed such different features in the two crises. The regression results suggest that there was a structural break in the determinants of deviations from covered interest parity (CIP) condition across the European currencies during the crises. We find that Euro-specific money market risk was significant in explaining the deviations in the GFC. In contrast, EU banks' credit risk and sovereign risk were useful in explaining the deviations in the Euro crisis. However, in the Euro crisis, there are asymmetric responses between the Sterling pound and the Danish kroner. Strong Sterling pound in the Euro crisis might be attributable to liquidity in the London foreign exchange market which is the largest global money center.

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1. Introduction

The global financial crisis (GFC) and the following Euro crisis had enormous impacts on international markets. In particular, covered interest parity (CIP) condition, which was solidly anchored in riskless arbitrage during tranquil periods, was violated substantially during the crises. Even using secured rates such as overnight index swap (OIS) rates, deviations were substantial in the crises. From June 1, 2006 to February 15, 2012, Figure 1 depicts daily CIP deviations of the US dollar from each of the five non-US dollar currencies: Euro, the Sterling pound, Japanese yen, Swiss franc, and the Danish kroner. We calculated the CIP deviations by the annualized value of $(1+i_t^n) - (1+i_t^{us})(f_{t+1}^n/e_t^n)$, where i_t^n is three-month non-US dollar OIS rate, i_t^{us} is three-month US dollar OIS rate, e_t^n is the spot US dollar exchange rate against each non-US dollar currency, and f_{t+1}^n is its three-month forward exchange rate. All of the data the unit of which is basis point are downloaded from Datastream. For all combinations, deviations had been negligible until the beginning of August 2007. But significant upward deviations had occurred since mid August 2007. In particular, there were large downward deviations after the Lehman shock on September 15 in 2008. The downward deviations were stabilized around the end of 2008 but remained significant in the following Euro crisis.

Regardless of the choice of the currencies, Figure 1 commonly shows substantial positive deviations in the GFC. The OIS rates are secured rates that measure market participants' expected average policy rate over the relevant term. Since secured arbitrage, as opposed to unsecured, removes many of the counter-party credit risks, this may imply that potential liquidity risk in the US dollar was the dominant source in violating the CIP condition. In the GFC, the role of the US dollar as international liquidity made the interest rate of the US dollar lower than those of the other major currencies on the forward market. However, it is noteworthy that since the early 2009, the Sterling pound came to have smaller deviations than the other major currencies. In particular, since the second half of 2010, the Sterling pound had equally low interest rate as the US dollar on the forward contract.

Using the same data set, Figure 2 depicts daily CIP deviations of Euro from the Sterling pound, Japanese yen, Swiss franc, and the Danish kroner from June 1, 2008 to February 15, 2012. We

calculated deviations of the CIP conditions by the annualized value of $(1+ i^{k}_{t}) - (1+i^{euro}_{t})(f^{k}_{t+1}/e^{k}_{t})$, where i^{k}_{t} is three-month non-Euro OIS rate, i_{t}^{euro} is three-month Euro OIS rate, e^{k}_{t} is the Euro spot exchange rate against each non-Euro currency, and f^{k}_{t+1} is its three-month forward exchange rate. The unit is basis point. Except for Sterling pound, we can see significant positive deviations in the figure. The upward deviations which became largest after the Lehman shock persisted in the Euro crisis. The deviations were especially conspicuous for Swiss franc and the Danish kroner. In contrast, the Sterling pound showed negative deviations throughout the period. In particular, the downward deviations were widened in the second half of 2011 when the Euro crisis became more serious. The results imply that in the Euro crisis, Euro was still preferred as an international currency especially among non-Euro members in Europe but that the Sterling pound was preferred more than Euro in the international money markets.

The purpose of this paper is to examine what determined the CIP deviations of the Sterling pound and the Danish kroner from Euro in the GFC and the Euro crisis. Previous studies suggest that the role of international liquidity is important in explaining the CIP deviations in the crises. Because of the role of the US dollar as global liquidity, the interest rate of the US dollar thus naturally became lower than those of the other major currencies in the crises. In addition, because of the role of Euro as international liquidity in Europe and neighboring regions, Euro had lower interest rate than the Danish kroner and Swiss franc in the crises. However, compared with the US dollar and Euro, the Sterling pound has had a limited role in international transactions during the past decades. This implies that to explain lower interest rate of the Sterling pound, we need to explore another determinant for the CIP deviations in the crises.

Table 1 summarizes currency shares of foreign exchange turnover in five countries: France, Germany, UK, Japan, Denmark, and Switzerland. The data is based on each central banks' surveys to construct BIS's Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity in April 2010. It indicates that in all countries, more than 70-80% of the foreign exchange turnovers were those between the US dollar and the other currencies. The US dollar is the dominant

international currency in the global economy including France, Germany, and UK. It is also noteworthy that except in Japan, Euro is also an important counterpart currency in the turnovers. Euro is an important international currency especially for Denmark and Switzerland. In contrast, the share of the Sterling pound is very small in the foreign exchange turnovers. However, in terms of geographical distribution, London is the largest money center in the foreign exchange transactions. Based on the same survey by BIS, Table 2 summarizes currency shares of geographical distribution of global foreign exchange market turnover in 1998, 2001, 2004, 2007, and 2010. It indicates that in each year, the UK share exceeded 30%, which was twice as large as the US share and was much larger than the other shares. No other European countries had comparable shares to the UK.

In the following analysis, we explore why the Sterling pound and the other European currencies had such different features in the two crises. The regression results based on secured rates suggest that there was a structural break in the determinants of the deviations. We find that Euro-specific money market risk was significant in explaining the deviations in the GFC. In contrast, EU banks' credit risk and sovereign risk were useful in explaining the deviations in the Euro crisis. In Europe, it was in late 2009 when fears of a sovereign debt crisis developed among investors concerning Greece's ability to meet its debt obligations due to strong increase in government debt levels. This led to a crisis of confidence, indicated by a widening of bond yield spreads and the cost of risk insurance on credit default swaps. Our empirical results suggest that investors increased their liquidity preference for the Sterling pound in the crisis because the London market was less risky and more liquid in the foreign exchange transactions.

In previous literature, several studies have explored sources of deviations from CIP condition under the global financial crisis. Baba and Packer (2009a,b) find that deviations from covered interest parity were negatively associated with the creditworthiness of European and US financial institutions. The authors such as Fong, Valente, and Fung (2009) and Coffey, Hrung, and Sarkar (2009) show that in addition to credit risk, liquidity and market risk played important roles in explaining the deviations. Grioli and Ranaldo (2010) find that the results were essentially the same even if we used secured rates such as

OIS. The following analysis confirms many of the findings in previous studies, especially those based on secured rates. However, unlike previous studies, this analysis pays a special attention to different features across several European currencies before and after the Euro crisis which has not been discussed extensively in literature. In particular, we discuss that the strong Sterling pound in the Euro crisis might be attributable to the role of London as the world money market center.

The rest of the paper is organized as follows. Section 2 presents a basic framework of our econometric tests. After explaining how to measure counter-party credit risk and liquidity risk in Section 3, Section 4 reports the results of our regressions. Section 5 concludes and refers to the implications.

2. Empirical Specification

The purpose of the following sections is to examine why several European currencies showed different deviations from the CIP conditions in the GFC and the Euro crisis. Since our main interest is to compare the difference between Euro and the other European currencies, the following analysis focuses the determinants of the CIP deviations between Euro and the two European currencies: the Sterling pound and the Danish kroner. We define deviations from the CIP condition between Euro and currency j (j = the Sterling pound and the Danish kroner) in period t by

$$(1) \quad Dev_t(j) \equiv \{1+i^j{}_t(h)\} - \{1+i^{euro}{}_t(h)\}\{f^j{}_{t+1}(h)/e^j{}_t(h)\},$$

where $i^j{}_t(h)$ is three-month currency j's OIS rate, $i^{euro}{}_t(h)$ is three-month euro OIS rate, $e^j{}_t(h)$ is the euro spot exchange rate against currency j, and $f^j{}_{t+1}(h)$ is its three-month forward exchange rate. The unit is basis point. The spot exchange rates and three-month forward exchange rates used in the analysis are their interbank middle rates at 4pm in London time.

In the following analysis, we examine what factors explain the changes of $Dev_t(j)$ in the

GFC and the Euro crisis. By using daily data, we estimate the following equation:

$$(2) \qquad Dev_t(j) = constant\ term + \sum_h \alpha_h \cdot Credit_t(h) + \sum_q \beta_q \cdot Credit_t(q) + \sum_k \gamma_k \cdot Liquidity_t(k) + \delta \cdot Market_t,$$

for j = the Sterling pound and the Danish kroner. The sample period is from January 2008 to February 15, 2012. We split the sample before and after January 1, 2010 to allow a structural break before and after the Euro crisis. Unless specified, the data are downloaded from Datastream.

The right hand side of (2) includes four types of risk measures in addition to the constant term. The first is $Credit_t(h)$ which is a credit risk measure in currency h (h = the US dollar, Euro, the Sterling pound, and the Danish kroner) in period t. In the crises, term premiums in the international money market became heterogeneous across currencies. In particular, due to the role of the US dollar as international liquidity, traders were especially sensitive to a liquidity shortage of the US dollar in international transactions. The first type of measure is included in (2) to capture such currency-specific risk. The second is $Credit_t(q)$ which is a credit risk measure in country q (q = the United States, UK, EU, Ireland, and Denmark) in period t. In the GFC, the credit quality of European, UK, and US banks deteriorated substantially. In contract, in the Euro crisis, soared sovereign risk hit mainly European banks. This suggests that credit risk might have country-specific features in the two crises. The second type of measure is to capture such country-specific features. The third is $Liquidity_t(k)$ which is a liquidity risk measure in currency k against the US dollar (k = Euro, the Sterling pound, Swiss franc, and the Danish kroner) in period t. In the financial turmoil, some traders are not given as much "balance sheet" to invest, which is perceived as a shortage of liquidity to them. Under this situation, the traders are reluctant to expose their funds during a period of time where the funds might be needed to cover their own shortfalls. Consequently, in the crisis, foreign exchange markets come under stress, and bid-ask spreads may be widened in the markets. The third type of measure is to capture such liquidity tightness in each currency. The fourth is $Market_t$ which is a market risk measure in period t. For the measure, we use the Chicago Board Options Exchange

Volatility Index (VIX) which is a popular measure of the implied volatility of S&P 500 index options. A high value corresponds to a more volatile market and therefore, more costly options. Often referred to as the fear index, the VIX represents a measure of the market's expectation of volatility over the next 30-day period.

3. Basic Statistics of Various Risk Measures

3.1. Currency-specific credit risk

To measure the currency-specific credit risk $Credit_t(h)$, the following analysis uses the spreads between LIBOR and OIS rate. LIBOR (London Interbank Offered Rate) is a daily reference rate in the London interbank market calculated for various currencies, while OIS rate is a daily secured rate that removes counter-party credit risks. Since LIBOR is based on the interest rates at which banks borrow unsecured funds from other banks in each currency, each spread reflects a counterparty credit risk in each currency. For example, the US dollar-denominated LIBOR–OIS spread reflects credit risk of the US dollar, while the Euro-denominated LIBOR–OIS spread reflects that of Euro. In calculating the spreads, we use daily data of three-month LIBORs which were published by the British Bankers' Association, after 11:00 a.m. each day (Greenwich Mean Time). And that of OIS rates which were downloaded from Datastream.

Table 3 summarizes basic test statistics for these daily credit risk measures for the two sub-sample periods: from September 1, 2008 to December 31, 2009 and from January 1, 2010 to February 15, 2012. It also reports those from September 1, 2008 to December 31, 2008 (the Lehman shock period) and from September 1, 2011 to December 31, 2011 (the Euro crisis period). All spreads had larger mean, median, standard deviation, and skewness for the first sub-sample period than for the second sub-sample period. This indicates that regardless of the currency denomination, the turbulence in the short-term money markets were more serious in the GFC than in the Euro crisis. The feature was conspicuous especially in the US dollar and the Sterling pound. The mean of the spreads in the

US dollar which was close to 80 basis points for the first sub-sample dropped to about 20 basis points for the second sub-sample period. The mean in the Sterling pound which exceeded 90 basis points for the first sub-sample dropped to less than 30 basis points for the second sub-sample period. This implies that after the Lehman shock, currency-specific risk in the money markets rose sharply in the US dollar and in the Sterling pound.

The mean of the Euro-denominated spreads also dropped significantly for the second sub-sample period. However, the spreads of Euro which were smaller than the US dollar and the Sterling pound for the first sub-sample became larger than those of the US dollar and the Sterling pound for the second sub-sample. Euro which was a relatively safe currency in the GFC became a relatively risky currency in the Euro crisis. Among the European currencies, Swiss franc had smallest spreads for both of the two sub-sample periods. This was partly because the data of Swiss franc denominated spreads starts only after November 17, 2008. But on the whole, Swiss franc was less risky currency in the money markets during the two crises. In contrast, the Danish kroner had relatively high mean for both of the two sub-sample periods. The Danish kroner tended to increase its risk premium in the money markets during the two crises.

3.2. Country-specific credit risk

To measure the country-specific credit risk $Credit_t(q)$, the following analysis uses the credit default swap (CDS) prices for each country. Since credit risk was conspicuous in banking sector, we use the daily time series of the five-year banks sector CDS indexes for EU, the United Kingdom, and the United States. To capture sovereign credit risk, we also use the daily time series of the five-year sovereign CDS for US, Germany, France, the United Kingdom, Italy, and Ireland. The data is downloaded from Datastream, which is based on CMA Data Vision.

Table 4 summarizes basic test statistics for these daily banks sector and sovereign CDS for the two sub-sample periods (from January 2008 to December 30, 2009 and from January 2, 2010 to February 15, 2012). Among the three banks sector CDS indexes, US banks had larger mean,

median, standard deviation, and skewness for the first sub-sample period. Although the Lehman shock damaged both European and UK banks, the credit quality US banks deteriorated more in the GFC. In contrast, European banks had larger mean, median, standard deviation, and skewness for the second sub-sample period. The mean, median, and standard deviation for EU banks sector in the second sub-sample period were more than doubled from those in the first sub-sample period and far exceeded those of US and UK banks in the same period. In the Euro crisis, only the credit quality of European banks deteriorated dramatically.

Except for Ireland, sovereign CDS indexes were relatively stable for the first sub-sample period. However, reflecting their fiscal crisis, the mean, median, standard deviation of sovereign CDS indexes for Italy, Spain, and Ireland increased dramatically in the second sub-sample period. French sovereign CDS index also increased its mean, median, standard deviation substantially in the Euro crisis. In contrast, CDS indexes for the UK and Denmark increased their mean and median only modestly and reduced their standard deviation in the same period. The mean and median of Germany CDS index was lowest not only in the first sub-sample period but also in the second sub-sample period. The Euro crisis had only limited impacts on the UK and Danish sovereign risk and few on Germany sovereign risk.

3.3. Currency-specific liquidity risk

To measure the currency-specific liquidity risk $Liquidity_t(k)$, we use bid-ask spreads of three-month forward rates. We use the daily time series of the spreads in the three-month forward markets for Euro-dollar rate, the Sterling pound-dollar rate, the Danish kroner-dollar rate, and Swiss franc-dollar rate,. The bid-ask spreads are negligible in normal time. But when the market faces a shortage of liquidity, they tend to be widened in the markets. In particular, they increased sharply after the Lehman shock.

Table 5 summarizes basic statistics for these daily series for the two sub-sample periods (from January 2008 to December 30, 2009 and from January 2, 2010 to February 15, 2012). For

comparison, it also reports the corresponding statistics for the Japanese yen-dollar rate. Because of the Lehman shock, the bid-ask spreads had larger mean and standard deviation in the first sub-sample period than in the second sub-sample period. But when excluding the data of September and October in 2008 in the first sub-sample period, the basic statistics of the bid-ask spreads were not so different between the two sub-sample periods.

In both sub-periods, the Euro-dollar had the smallest mean, median, and maximum. This suggests that Euro is an international currency with the smallest transaction costs when turning over from or to the US-dollar. In both periods, the Sterling pound-dollar had the second smallest mean, median, and maximum. Reflecting limited turnovers in the foreign exchange markets, it had significantly larger mean and median than the Euro-dollar in the first-subsample period. However, the difference in mean and median became negligible in the second sub-sample period when Euro member countries faced further turmoil. In the second sub-sample period, the Sterling pound-dollar had smaller standard deviation than the Euro-dollar. As Tables 3 and 4 suggested, the Euro crisis had limited impacts on the Sterling pound risk premium and the UK banking sector. In addition, London is the largest money center in the foreign exchange transactions. These factors might have made the transaction costs of the Sterling pound equally small as those of the Euro when turning over from or to the US-dollar.

In contrast, the Swiss franc-dollar had the largest mean, median, and maximum in both sub-periods. Unlike the other European countries, the Euro crisis had limited impacts on the Swiss franc risk premium. In addition, the Swiss franc appreciated not against Euro but against the US dollar especially before the Swiss National Bank's unlimited interventions in September 2011. Regardless of the facts, the Swiss franc had high transaction costs when turning over from or to the US-dollar. The transaction costs were larger not only than Euro and the Sterling pound but than Japanese yen and the Denish kroner.

4. Estimation Results

This section reports our empirical results concerning the effects of various risk measures on the CIP deviations of Sterling pound and Danish kroner from Euro. In each regression we use daily data during the sample period from January 2, 2008 through February 15, 2012, a span of time that includes both the GFC and the Euro crisis. The unit of each interest rate is basis point. We run OLS regressions for equation (2) with two lagged dependent variables for each of the two sub-sample periods: from September 2008 to December 2009 and from January 2010 to February 15, 2012. The standard errors of the coefficients are calculated by Newey-West HAC Standard Errors & Covariance with lag truncation 6. The estimated results are summarized in Table 6. It shows that several credit and liquidity risk measures had significant effects on the CIP deviations of both Sterling pound and Danish kroner. However, many of the risk measures had different significance levels and different signs for the two sub-sample periods, suggesting structural breaks before and after the Euro crisis. We also found some asymmetry between the Sterling pound and the Danish kroner.

4.1. The first sub-sample period

We first consider what determined CIP deviations of the Sterling pound and the Danish kroner from Euro in the first sub-sample period. For both the Sterling pound and the Danish kroner, the Euro-denominated spread (i.e., LIBOR–OIS spread) had a significantly positive effect on the deviations. The pound-denominated spread had a significantly negative effect on the Sterling pound's deviations, and so did the kroner-denominated spread on the Danish kroner's deviations. The symmetric results indicate that in GFC, an increase in currency-specific credit risk made liquidity of the currency tighter and decreased its secured interest rate on the forward contract. In addition, the US dollar-denominated spread had a significantly negative effect for the Sterling pound's deviations. After the Lehman shock, liquidity shortage remained in the international money markets. This made not only the secured interest rate of the US dollar but also that of the Sterling pound lower on the forward contract, suggesting that the Sterling pound became a substitute for the US dollar in the

international money markets.

Regarding the effects of country-specific credit risks, no banks sector CDS had significant coefficient. The Lehman shock damaged the credit quality of both the US and European banks. As a result, country-specific banks sector CDS soared up in GFC. However, the increased credit risk in banking sectors did not lead to a significant change in the relative interest rate between Euro and the other European currencies on the forward contract where a shortage of liquidity was vital. For the Danish kroner, sovereign risk in Ireland had a significantly positive coefficient. This may reflect some vulnerability of the Danish kroner to the crisis. However, no country-specific credit risk measure was significant for the Sterling pound. The results may reflect the fact that until the end of 2009, country-specific credit risk was relatively stable in Europe except for Ireland and Iceland. But they may also suggest that GFC was a liquidity crisis where solvency was less important than money market risk on the forward contract. The estimated coefficient of VIX was significantly positive for the Danish kroner. However, it was not significant for Sterling pound, although it was still positive. This suggests that the Danish kroner was more vulnerable to the market risk than the Sterling pound.

Regarding the effects of market liquidity, the bid-ask spread in Swiss franc-dollar rate took a significantly positive coefficient for the Sterling pound. This may reflect some substitutability between the Sterling pound and Swiss franc in the international money markets where increased bid-ask spread in Swiss franc shifts precautionary demand from the Sterling pound to Swiss franc and increases the secured interest rate of the Sterling pound. In contrast, for the Danish kroner, the coefficient of bid-ask spread in kroner-dollar rate was significantly positive, while that in Euro-dollar rate was significantly negative. Unlike in the global transactions, turnover costs from or to Euro are vital in the Regional transactions in Euro. Consequently, increased bid-ask spread in Euro increases Danish precautionary demand for Euro and decreases its secured interest rate, while increased bid-ask spread in the kroner decreases Danish precautionary demand for Euro and increases its secured interest rate.

4.2. The second sub-sample period

We next consider what determined CIP deviations of the Sterling pound and the Danish kroner from Euro in the second sub-sample period. Unlike in the first sub-sample period, Euro-specific spreads (i.e., LIBOR–OIS spreads) were not significant either for the Sterling pound or for the Danish kroner. In GFC, markets were sensitive to liquidity shortage of Euro so that a rise of Euro-specific risk premium increased precautionary demand for Euro. However, in the Euro crisis, markets became less sensitive to a liquidity shortage of Euro. Consequently, a rise of Euro-specific risk premium in the international money markets had little impact on the relative interest rate between Euro and the other European currencies. Except for the kroner-specific spread, country-specific spreads had no significant effect on the Danish kroner's deviations. This may reflect the fact that coordinated monetary policies by central banks gradually enhanced safety net in the international money markets after GFC. However, for Sterling pound, the US dollar-specific spread remained having a significantly negative effect, while pound-specific spread had a significantly positive effect. This may imply that markets were still sensitive to liquidity shortages of the US dollar and Sterling pound. As in GFC, a rise of the US dollar-specific risk premium increased precautionary demand for the Sterling pound in the Euro crisis. But the sign of pound-specific spread was reversed in the second sub-sample period. Unlike in GFC, a decline of the pound-specific risk premium increased precautionary demand for Sterling pound in the Euro crisis. This may suggest that relatively smaller risk in the Sterling pound in the money markets shifted precautionary demand from Euro to the Sterling pound in the Euro crisis.

Regarding the effects of country-specific credit risks, EU banks sector CDS had a significant effect on the deviations of both the Sterling pound and the Danish kroner. Irish CDS had a significant effect on the Sterling pound's deviations and so did Danish CDS on the Danish kroner's deviations. From late 2009, fears of a European sovereign debt crisis developed among investors as a result of the rising government debt levels around the world together with a wave of downgrading of government debt in some European states. Concerns intensified in early 2010, particularly in April 2010 when

downgrading of Greek government debt to junk bond status created alarm in financial markets. The significant coefficients of EU banks sector CDS and the sovereign CDS reflected the environments. However, it is noteworthy that the sign of significant coefficients were opposite between the Sterling pound and the Danish kroner. In the case of the Sterling pound, a rise of European crisis increased precautionary demand for the Sterling pound and decreased its secured interest rate. This may reflect the fact that the Sterling pound substituted the role of Euro as a potential international currency in the crisis. In contrast, in the case of Danish kroner, a rise of European crisis increased precautionary demand for Euro and increased its secured interest rate. For Danish international transactions, Euro is an important counterpart currency in the turnovers. Consequently, in the Euro crisis, it became more indispensable to avoid Euro liquidity for them, which decreased the secured interest of Euro for the Danish forward contracts. Similar opposite effects were observed in the estimated coefficient of VIX. That is, a rise of VIX made the pound secured rate lower than Euro secured rate but the Danish secured interest rate higher. The increased market risk in the Euro crisis enhanced the role of Sterling pound as a potential substitute for Euro in international transactions but increased precautionary demand for Euro in regional transactions in European countries such as in Denmark.

Regarding the effects of market liquidity, the coefficient of the bid-ask spread in Swiss franc-dollar rate was significantly positive and that in pound-dollar rate was significantly negative for the Sterling pound. The tighter liquidity in Swiss franc shifts precautionary demand from the Sterling pound to Swiss franc, while the tighter liquidity in the Sterling pound increases precautionary demand for the Sterling pound. This probably reflects the fact that demand for the Sterling pound was determined from global perspectives rather than from regional perspectives in Euro. In contrast, for the Danish kroner, no coefficient of bid-ask spread was significant. In the Euro crisis, increased credit risk in Euro was more vital than a shortage liquidity of international currencies for the Danish international transactions. Consequently, even if turnover costs from or to the US dollar increased, it affected Danish precautionary demand little and led its secured interest rate relatively unchanged against Euro secured rate.

5. Concluding Remarks

Financial crises increase various premiums in national and regional financial markets. But unlike medium- or long-term financial markets, liquidity shortage became vital in financial turmoil. In the post Lehman period, the interest rate of the US dollar became low on the forward contract because of its role as international currency. However, in the Euro crisis, the Sterling pound had equally low interest rate as the US dollar, while the other European currencies increased its liquidity premium. In this paper, we examined why the Sterling pound and the Danish kroner had shown different features in the two crises. The regression results suggested that there was a structural break in the determinants of deviations from covered interest parity (CIP) condition during the crises. In particular, we found that strong Sterling pound in the Euro crisis might be attributable to liquidity in the London foreign exchange market which is the largest global money market center.

It was in late 2009 when fears of a sovereign debt crisis developed among investors concerning Greece's ability to meet its debt obligations due to strong increase in government debt levels. This led to a crisis of confidence, indicated by a widening of bond yield spreads and the cost of risk insurance on credit default swaps in several European countries such as Ireland, Portugal, Italy, Greece, and Spain. However, the effects of the crisis were not symmetric across European currencies. For the Danish kroner, turnover costs from or to Euro are vital in the Regional transactions. Consequently, increased bid-ask spread in Euro increases Danish precautionary demand for Euro and decreases its interest rate. In contrast, relatively smaller risk in Sterling pound in the money markets shifted precautionary demand from Euro to the Sterling pound in the crisis. Consequently, the increased market risk in the Euro crisis enhanced the role of the Sterling pound as a potential substitute for Euro in international transactions.

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Table 1. Currency Shares of Foreign Exchange Turnover in Five Countries

		USD	EUR	CHF	Kroner	Other	Total
Germany	2007	79%	63%	NA	NA	58%	200%
	2011	79%	64%	NA	NA	58%	200%
France	2007	88%	51%	NA	NA	61%	200%
	2011	86%	55%	NA	NA	59%	200%
UK	2007	88%	42%	NA	NA	71%	200%
	2011	85%	44%	NA	NA	71%	200%
Switzeland	2007	85%	43%	29%	NA	42%	200%
	2011	84%	42%	30%	NA	43%	200%
Denmark	2007	74%	48%	NA	25%	55%	202%
	2011	71%	57%	NA	17%	55%	200%

Note) Because two currencies are involved in each transaction, the sum of the percentage shares of individual currencies totals 200% instead of 100%.

Table 2. Currency Shares of Geographical Distribution of Foreign Exchange Market Turnover

Country	1995	1998	2001	2004	2007	2010
Australia	2.5	2.3	3.2	4.1	4.1	3.8
Denmark	1.9	1.3	1.4	1.6	2.1	2.4
France	3.8	3.7	2.9	2.6	3.0	3.0
Germany	4.8	4.7	5.4	4.6	2.4	2.1
Hong Kong SAR	5.6	3.8	4.0	4.1	4.2	4.7
Japan	10.3	7.0	9.0	8.0	5.8	6.2
Singapore	6.6	6.9	6.1	5.1	5.6	5.3
Switzerland	5.4	4.4	4.5	3.3	5.9	5.2
United Kingdom	29.3	32.6	32.0	32.0	34.6	36.7
United States	16.3	18.3	16.1	19.1	17.4	17.9
others	13.5	15.0	15.2	15.6	14.8	12.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note) Daily averages in April, in billions of US dollars and percentages.

Table 3. Basic Test Statistics for Daily Credit Risk Measures for the Two Sub-sample Periods

(1) First Sample (from Jan 2, 2008 to Dec. 31, 2009)

	US Dollar	Euro	Sterling pound	Kroner	Swiss franc	Japanese yen
Mean	0.79	0.71	0.90	0.87	0.35	0.42
Median	0.72	0.63	0.79	0.69	0.30	0.40
Maximum	3.64	1.95	3.00	2.00	1.76	0.81
Minimum	0.07	0.21	0.15	0.32	0.19	0.18
Std. Dev.	0.65	0.40	0.59	0.40	0.21	0.14
Skewness	1.85	1.22	0.83	0.98	3.38	0.36
Kurtosis	7.26	4.02	3.07	2.96	16.85	2.94
Obervations	522	522	522	522	294	522

(2) Second Sample (from Jan 2, 2010 to Feb. 15, 2012)

	US Dollar	Euro	Sterling pound	Danish krone	Swiss franc	Japanese yen
Mean	0.21	0.36	0.29	0.40	0.09	0.13
Median	0.16	0.25	0.24	0.42	0.07	0.13
Maximum	0.51	0.93	0.60	0.71	0.40	0.17
Minimum	0.06	0.09	0.15	−0.05	−0.01	0.09
Std. Dev.	0.12	0.24	0.12	0.19	0.06	0.02
Skewness	1.00	1.19	1.25	−0.38	1.38	−0.25
Kurtosis	2.86	2.83	3.35	2.08	4.80	2.34
Obervations	553	553	553	553	553	553

Table 4. Basic Test Statistics for Daily Banks Sector and Sovereign CDS

(1) First Sample (from Jan 2, 2008 to Dec. 31, 2009)

	US bank	EU bank	UK bank
Mean	191.9	143.3	141.6
Median	170.6	126.4	137.7
Maximum	596.0	319.5	235.2
Minimum	86.5	49.8	70.7
Std. Dev.	78.7	57.1	34.8
Skewness	1.3	1.1	0.4
Kurtosis	5.4	3.9	2.6
Obervations	522	522	522

sovereign	USA	Germany	UK	France	Italy	Spain	Ireland	Denmark
Mean	31.1	25.7	56.9	30.2	78.8	67.2	127.7	43.1
Median	25.9	22.5	52.1	25.2	63.2	61.0	139.8	27.0
Maximum	95.0	92.5	165.0	96.5	190.0	163.5	390.0	150.0
Minimum	6.0	5.2	7.4	6.7	21.1	19.8	12.8	5.4
Std. Dev.	23.0	20.0	41.8	21.2	46.8	33.9	95.2	40.2
Skewness	1.0	1.2	0.7	1.1	0.9	0.7	0.5	1.1
Kurtosis	3.2	4.3	2.5	3.7	2.7	2.7	2.5	2.9
Obervations	522	522	522	522	522	522	522	522

(2) Second Sample (from Jan 2, 2010 to Feb. 15, 2012)

	US bank	EU bank	UK bank
Mean	138.6	297.7	166.8
Median	122.0	296.6	153.9
Maximum	264.9	606.4	295.4
Minimum	82.9	97.0	102.7
Std. Dev.	45.2	118.0	44.9
Skewness	1.1	0.4	1.0
Kurtosis	3.0	2.4	2.9
Obervations	553	553	553

sovereign	USA	Germany	UK	France	Italy	Spain	Ireland	Denmark
Mean	44.7	39.4	67.1	79.8	199.7	214.8	524.8	50.6
Median	44.7	34.9	67.2	65.7	146.0	194.8	588.3	32.9
Maximum	65.0	79.3	95.0	171.6	498.7	399.6	1249.3	147.1
Minimum	31.9	18.0	42.4	30.0	72.0	73.5	114.9	18.9
Std. Dev.	5.8	13.6	12.3	34.2	116.5	75.8	255.7	35.8
Skewness	0.3	0.7	0.1	1.0	1.1	0.3	−0.1	1.2
Kurtosis	2.7	2.5	2.0	2.7	2.8	2.2	2.1	2.8
Obervations	553	553	553	553	553	553	553	553

Table 5. Basic Test Statistics for Daily bid-ask spreads of three-month forward rates

(1) First Sample (from Jan 2, 2008 to Dec. 31, 2009)

	Euro	Sterling pound	Danish kroner	Swiss franc	Japanese yen
Mean	0.033	0.038	0.067	0.071	0.051
Median	0.027	0.032	0.055	0.064	0.041
Maximum	0.118	0.163	0.176	0.208	0.193
Minimum	0.021	0.022	0.028	0.049	0.031
Std. Dev.	0.016	0.019	0.031	0.023	0.026
Skewness	2.863	3.252	1.164	2.383	2.916
Kurtosis	12.201	15.741	3.429	9.378	12.508
Obervations	522	522	522	522	522

(2) Second Sample (from Jan 2, 2010 to Feb. 15, 2012)

	Euro	Sterling pound	Danish krone	Swiss franc	Japanese yen
Mean	0.031	0.032	0.046	0.076	0.050
Median	0.031	0.032	0.045	0.073	0.051
Maximum	0.046	0.049	0.074	0.144	0.071
Minimum	0.022	0.025	0.027	0.052	0.033
Std. Dev.	0.005	0.004	0.010	0.015	0.008
Skewness	0.268	0.556	0.256	1.586	0.161
Kurtosis	2.437	3.631	2.081	6.773	2.487
Obervations	553	553	553	553	553

Table 6. The estimated results of Equation (2)

(1) First Sample (from Jan 2, 2008 to Dec. 31, 2009)

		Sterling pound		Danmark krone	
	Constant term	−0.018	−0.053	−0.061	−0.120
		−0.704	−3.130	−2.035	−3.750
Lagged	Dependent var. (-1)	0.841	0.819	0.560	0.560
dependent		10.201	11.663	12.603	12.329
var.	Dependent var. (-2)	−0.083	−0.057	0.123	0.138
		−1.109	−0.823	2.322	2.612
Measure of	Euro LIBOR spread	0.145	0.166	0.195	0.284
currency-		2.756	4.127	4.051	5.089
specific	Dollar LIBOR spread	−0.097	−0.099	0.024	
credit risk		−2.244	−3.568	0.767	
	Pound LIBOR spread	−0.046	−0.049	0.028	
		−1.721	−2.503	1.158	
	Krone LIBOR spread			−0.168	−0.181
				−3.924	−3.745
Measure of	EU bank CDS	0.000		0.000	
country-		0.500		−1.339	
specific	US bank CDS	0.000		0.000	
bank credit		−0.282		−1.223	
risk	UK bank CDS	0.000		0.000	
		−0.147		0.023	
Measure of	Log (demank CDS)			−0.002	−0.041
country-				−0.110	−1.781
specific	Log(Ireland CDS)	−0.012		0.025	0.055
sovereign risk		−1.157		2.657	3.208
Market	VIX	0.001		0.001	0.002
risk		0.777		1.836	1.906
Measure of	3M Euro-dollar	−0.656		−1.388	−1.079
market		−0.874		−2.280	−2.131
liquidity	3M pound-dollar	−0.279		−0.028	
(bid-ask spread		−0.496		−0.051	
in foreward	3M swiss franc-dollar	0.783	0.460	0.405	
exchange		2.327	1.679	1.190	0.581
rate)	3M krone-dollar			0.415	2.828
				2.581	
	Adjusted R-squared		0.769687		
	Observation number				

For each variable, the upper line shows its estimated coefficient and the lower line shows its t-value.

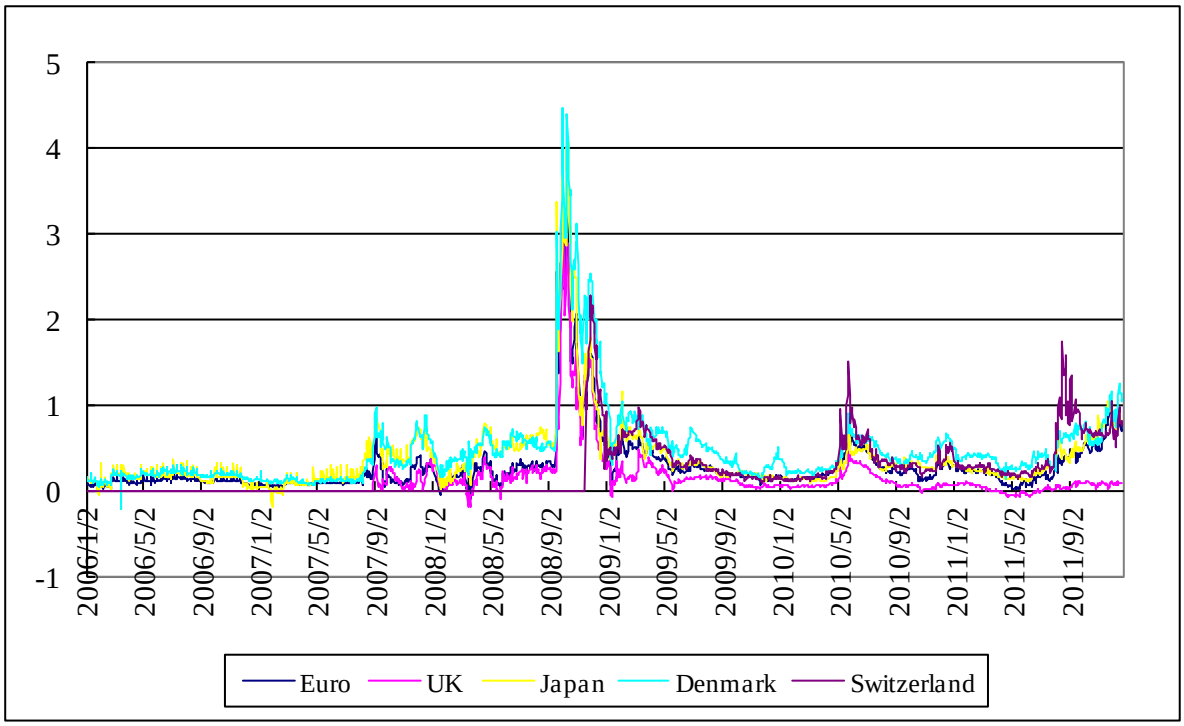
(2) Second Sample (from Jan 2, 2010 to Feb. 15, 2012)

		Sterling pound		Danmark krone	
	Constant term	−0.048	−0.035	0.126	0.086
		−1.296	−1.221	2.366	1.901
Lagged dependent var.	Dependent var. (-1)	0.787	0.784	0.735	0.732
		11.198	11.053	10.993	11.332
	Dependent var. (-2)	0.101	0.099	0.095	0.111
		1.297	1.316	1.659	1.877
Measure of currency-specific credit risk	Euro LIBOR spread	0.027		0.028	
		1.217		1.045	
	Dollar LIBOR spread	−0.087	−0.050	0.005	
		−1.827	−2.440	0.086	
	Pound LIBOR spread	0.061	0.047	0.012	
		2.140	2.384	0.356	
	Krone LIBOR spread			−0.050	−0.036
				−1.932	−2.199
Measure of country-specific bank credit risk	EU bank CDS	0.000	0.000	0.000	0.000
		−3.064	−3.584	3.801	2.379
	US bank CDS	0.000		0.000	
		−0.005		−0.492	
	UK bank CDS	0.000		0.000	
		−0.464		−1.260	
Measure of country-specific sovereign risk	Log (demank CDS)			−0.012	−0.012
				−1.929	−2.365
	Log(Ireland CDS)	0.021	0.017	−0.015	−0.008
		2.916	2.973	−1.768	−0.955
Market risk	VIX	−0.001	−0.001	0.001	0.001
		−2.029	−3.378	1.583	1.939
Measure of market liquidity (bid-ask spread in foreward exchange rate)	3M Euro-dollar	0.173		−0.367	
		0.530		−1.042	
	3M pound-dollar	−0.974	−0.956	0.311	
		−2.609	−2.598	0.759	
	3M swiss franc-dollar	0.299	0.325	0.226	
		2.344	2.362	1.585	
	3M krone-dollar			0.154	
				0.947	
	Adjusted R-squared		0.961		
	Observation number				

For each variable, the upper line shows its estimated coefficient and the lower line shows its t-value.

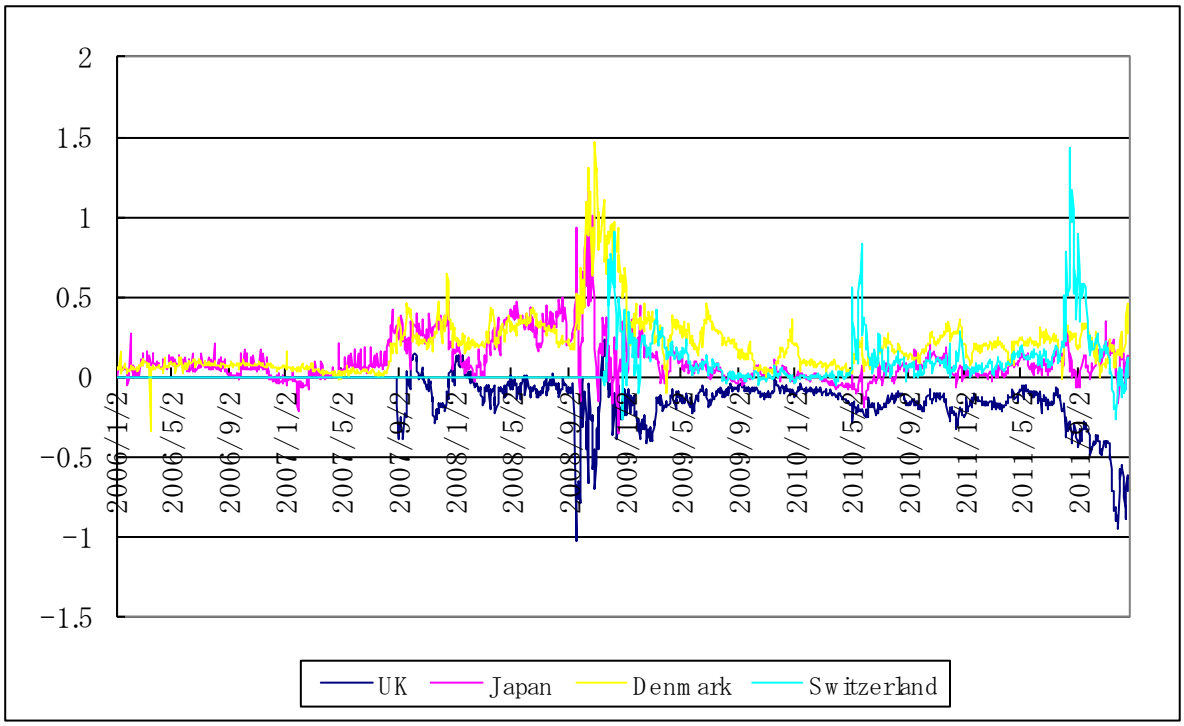
Each table gives the results of OLS regressions testing the impact of various credit risk measures, several types of US dollar liquidity provisions, and two types of Japanese yen liquidity provisions on deviations from CIP condition.

Figure 1. Deviations from the CIP condition between the US dollar and five currencies



This figure depicts daily deviations from CIP condition between the US dollar and each of the five non-US dollar currencies. The upward deviations imply that the US dollar had lower interest rate on the forward market.

Figure 2. Deviations from the CIP condition between Euro and four currencies



This figure depicts daily deviations from CIP condition between Euro and each of the four non-Euro currencies. The upward deviations imply that Euro had lower interest rate on the forward market.