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Bid-Ask Spread, Futures Market Sentiment and Exchange Rate Returns

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This paper analyzes spot foreign exchange bid-ask spread and the future market sentiment as two important variables to explain the exchange rate returns. We use two sentiment indices based on futures market return and volume. Time series and cross-sectional analyses of three different currency exchange rates; Australian Dollar, British Pound and Canadian Dollar – to US Dollar suggest that the spot market bid-ask spread is one important variable that positively affects the spot exchange rate returns. The return based sentiment index does not seem to be a significant factor, but the volume based sentiment index affects the spot exchange rate returns significantly. The negative sign of sentiment indices implies lower spot market return associated with higher investor interest in futures market, although higher trading in futures market contributes positively in the spot market.

1. Introduction

Literature on foreign exchange focuses on understanding the exchange rate dynamics both in short and long horizons. Prior researches use both macro- and micro-based models in order to explain the exchange rate return fundamentals. Macro-based models associate macroeconomic variables, e.g., relative money supplies, outputs, inflation and interest rates, with exchange rates (Engel and West, 2005; Groen, 2000; Clarida, Gali and Gertler, 1998). Empirical macro-based researches test the direct impact of both expected and unexpected macroeconomic news on exchange rate return (Evans and Lyons, 2008; Anderson et. al., 2003). These models pay a little attention on the trading mechanism in the

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foreign exchange market. On the other hand, micro-based models test how pricing information are reflected in the exchange rate through the trading process by analyzing the order flow in the foreign exchange market (Evans and Lyons, 2005b, 2002).

Like the spot foreign exchange market, the price discovery in foreign exchange futures market is also important. Tse, Xiang, and Fung (2006) argue that futures market provides both public and private information held by various economic agents. They also show that futures contracts provide the most price discovery for euro. Chen and Gau (2010) analyze the competition in price discovery between spot and futures markets for the euro and Japanese yen and find that the spot rates, on average, provide more price discovery than the futures rates; but the futures rates contribute more to price discovery during macroeconomic announcement releases.

In this paper we analyze this issue from a different direction by focusing on the contribution of spot market bid-ask spread and futures market sentiment on the price discovery in the spot foreign exchange market. Researchers (Evans and Lyons, 2007, 2005a, 2005b, 2002; Cerrato, Sarantis and Saunders, 2011) consider order flow as an important factor that can explain the exchange rate returns. But these studies do not focus on the bid-ask spread (spread) - another important factor in foreign exchange market. On the other hand, liquidity plays an important role in foreign exchange market. Amihud (2002) suggests that spread partly represent the illiquidity premium on the expected stock return. In this light Chen, Chien and Chang (2012) suggest that liquidity providers in the market supply liquidity at a cost – the spread. They find order flow the main explanatory variable for active currencies, but the spread is a potential candidate in explaining the daily returns on infrequently traded currencies. For this, this paper uses spread as one important factor explaining the spot foreign exchange returns.

In this paper, we also analyze foreign exchange futures market sentiment as another important factor that explains the spot exchange rate returns. A number of papers examine futures market effect on the spot market. Board, Sandmann and Sutcliffe (2001) analyze the futures market volume on spot market volatilities. They do not find any evidence suggesting that one market instantly destabilize another after adjusting for the effects of information arrival and time trends. Illueca and

Lafuente (2003) also analyze the relation between spot volatility and trading volume in the stock exchange futures market, but again they find no significant link between the two. Both papers examine the futures market effects on stock market, but ignore the foreign exchange market.

In this paper, we examine the effect of futures market sentiment on the return of spot market in the foreign exchange market. We use two measures of future market sentiment – one based on futures market return and the other based on futures market volume. The return based sentiment index mainly focuses on the returns in the futures market and corresponding investor sentiment, while the volume based sentiment index analyzes the liquidity and trading activity in the futures market. By analyzing three different currencies - Australian Dollar, British Pound and Canadian Dollar – to US Dollar for the period from January 2, 2009 to April 15, 2011, we find that both spread and future market sentiment have significant effect on exchange rate returns. This finding is consistent with the Grossman (1988) theories suggesting that futures trading improves depth and liquidity in spot (equity) market.

This finding of this paper contributes to the literature by adding spread as an explanatory variable to explain the exchange rate returns. Although spread has been used in various researches to explain various macroeconomic variables; e.g., forward rates; very few papers attempt to explain exchange rate returns by using spread. Chen, Chien and Chang (2012) shows that spread can explain exchange rate returns when the trading density is high. In this paper, we extend their analysis by adding two future market sentiment indices as explanatory variables in explaining exchange rate returns.

Section 2 of the paper discusses the information flow in the foreign exchange market and the proposed hypotheses. Section 3 discusses the data sources and summary statistics of the variables used in this paper. Section 4 presents the time series and cross-sectional estimates and section 5 concludes the paper.

2. Information Flow in the Foreign Exchange Market and Hypothesis Development

No dealer in the spot foreign exchange market has complete information about the overall market. Electronic brokerages systems provide information on the best posted bid and ask; which act as benchmarks for prices. The dealers also have information about order flow, but they do not observe the structure of limit orders that determines market liquidity. This liquidity information is important to dealers as they try to keep an overnight position at a minimum. Moreover trades over $25 million need to be split into multiple small trades in order to minimize market impact and execution costs. For all these reasons, it is difficult for dealers to collect information from trades. So in spot foreign exchange market, participants have only two sources of information – order flow and spread.

Order flow is one important measure of net liquidity demand in the market. Evans and Lyons (2002) define order flow as the differential order number initiated by buyers and sellers. It measures the net buying pressures and determines prices as it conveys information on market liquidity. Evans and Lyons (2002), by using a macro based portfolio shifts model and tick data, calculate order flow and show that such order flow significantly explains daily exchange rate returns.

Spread is another important source of information foreign exchange market. Osler (2008) defines spread as the difference between the best (lowest) price at which one can buy any currency (the ask) and the best (highest) price at which one can sell it (the bid). Admati and Pfleiderer (1988) suggest that the price discovery process in foreign exchange market is a result of adverse selection process. They develop an asymmetric information model where uninformed traders choose to trade at one time since this brings low adverse selection costs to dealers and thus low spreads. Madhavan and Cheng (1997) show that high spreads at the NYSE reflect high adverse selection risk as information accumulates overnight in the market. Bessembinder (1994) finds that spreads widen with foreign currency inventory risk, price risk and liquidity risk. High spreads reflect high inventory risk. Payne (2003), by using VAR decomposition model, shows that the permanent impact of order flow can account for 60% of spread. Bollerslev and Melvin (1996), by using a GARCH model, find that the size of spread is positively related to the exchange rate uncertainty. Ding (2009) finds spreads to be independent of order sizes in the inter-dealer market and negatively correlated in the retail market. Chen, Chien and Chang (2012) argue that the Evans and Lyons' (2002) order flow model should incorporate spread – the transaction cost of liquidity. They find that both order flows and spreads significantly affect the exchange rate returns when trading density is high. We should expect the same results in our sample. Thus the first hypothesis we propose is:

> *Hypothesis1: The spot exchange rate spread has a positive and significant effect on spot exchange rate returns.*

That is an increase in spot exchange rate spread should increase the spot exchange rate return.

Another important source of information in the futures market is the open interest - the total number of future contracts entered into, but not yet offset, by a transaction or delivery. That is open interest is the sum of positive *net* positions in each contract across traders. It can help futures traders to get a sense of whether the market is gaining strength or getting weaker. It also indicates the market sentiment, which is one aspect of trading often ignored by the researchers. Wang, Keswani and Taylor (2006) suggests open interest as the preferred measure of sentiment in the options market as they argue that the open interest of options is the final picture of sentiment at the end of the day or the week and is therefore likely to have better predictive power for volatility in subsequent periods. Chen, Cuny and Haugen (1995) test a theoretical model of basis and open interest of stock index futures. They find that increased volatility decreases basis and increases open interest. Bessembinder, Chan and Seguin (1996) analyzes open interest as an important factor analyzing foreign exchange return and finds that in a rising foreign exchange future market, trading volume varies positively with open interest – the divergence of trader opinion.

Wang (2004) first transforms the open interest as a measure of market sentiment and find that speculator sentiment is positively related to future returns. Charlebois and Sapp (2006), uses daily data on Dollar-Mark return for the period 1988-1998 and find that moving-average trading rules generate significant excess returns and the excess returns increase when information is included on the open interest differential on currency options. They interpret this partly as risk premia and partly as extra fundamental information that is reflected in options prices. In this paper, we link the spot market to futures market by analyzing the futures market sentiment, by using two indices as proxy for futures market sentiment and by analyzing their effects on spot exchange rate returns. The first index associates the future market returns with the open interest. We calculate this return based sentiment index (*RBSI*) by taking the ratio of daily percent changes in futures prices to the daily percent changes in open interest as presented in equation (1):

$$RBSI = \left[\left(\frac{F_t - F_{t-1}}{F_{t-1}}\right) \Big/ \left(\frac{OI_t - OI_{t-1}}{OI_{t-1}}\right) \right] \quad (1)$$

Here, F_t indicates the exchange rate futures price, OI_t indicates the open interest in futures market, and t is the time index. A positive sign of $RBSI_t$ indicates the same directional movement, while a negative sign indicates the opposite directional movement by futures returns and open interests. Thus a positive sign implies the investors' interest in the futures market and a negative sign implies lack of investor's interest in the futures market.

The second index associates the open interest with the liquidity and trading activity in the futures market. We calculate this volume based sentiment index (*VBSI*) by taking the ratio of daily open interest to the daily volume in the futures market as presented in equation (2):

$$VBSI = \left[OI_t / VOL_t \right] \quad (2).$$

Here VOL_t indicates the volume in the futures market. A $VBSI_t$ ratio more than one indicates the higher trading pressure, less than one indicates the lack of trading pressure, and a ratio of one indicates balanced trading pressure in the futures market. A higher return and associated volume in futures market should take the spotlight off of the spot market and thus should reduce the spot market return. In this light, the second hypothesis we propose is:

Hypothesis 2: The foreign exchange futures market sentiment has a negative effect on the spot exchange rate returns.

That is an increase in futures market sentiment or investor interest in futures market should reduce the spot exchange rate return.

3. Data and Variable Description

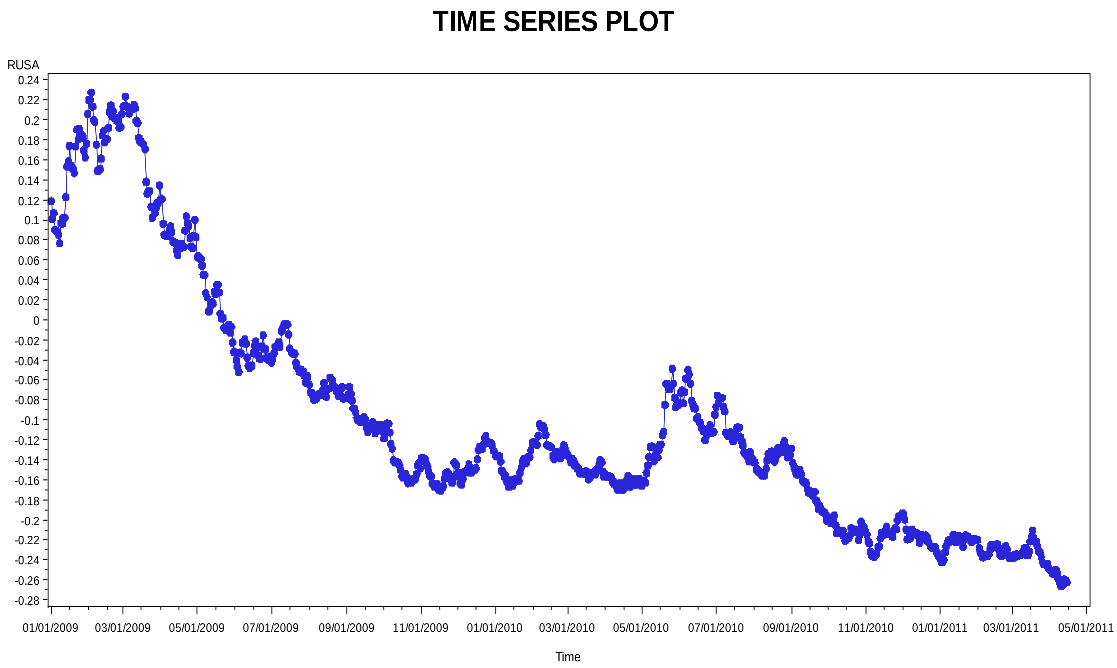
We collect the daily data of foreign exchange rates and their returns on three currencies – Australian Dollar – US Dollar (AUD-USD), British Pound – US Dollar (BP-USD) and Canadian Dollar – US Dollar (CAD-USD) for the sample period from January 2, 2009 to April 15, 2011. The total number of observation for each currency is 578. We collect both the exchange rate and bid-ask rate data from OANDA (www.oanda.com) and calculate the bid-ask spread by deducting the daily bid rate from the ask rate. We calculate the returns of each exchange rate as $\frac{fx_t - fx_{t-1}}{fx_{t-1}}$ where, *fx* indicates the foreign exchange rate and *t* is the time index. We also calculate the futures returns for each currency using the same approach and collect futures data on price, volume, and open interest for the same three currencies over the sample period from Trading Blox (http://www.tradingblox.com), which uses the daily net open interest position available for each currency at the Chicago Mercantile Exchange (CME).

We collect the data on the overnight interest rate from the Federal Reserve Bank of St. Louis, Reserve Bank of Australia, Bank of England, and Bank of Canada. In this paper, we use the interest differential as a control variable as it is used by Evans and Lyons (2002). We calculate such interest rate differential as $i_t - i_t^*$, where i_t is the U.S. overnight interest rate, and i_t^* is the foreign overnight interest rate. This interest differential controls for the "uncovered interest rate parity" condition, which suggests that the expected exchange rate changes is the difference in the interest rates between two countries[2]. This paper does not include order flow in the analysis as it uses the daily foreign exchange returns.

[2] See Bekaert, Wei and Xing (2007) for a detailed overview of "uncovered interest rate parity" condition.

Figure 1, 2 and 3 presents the time series graphs for exchange rate returns for three currencies – AUD-USD, BP-USD and CAD-USD. From all three figures we see a definite trend in the exchange rate returns. For this we control for time trend in the time series analysis, and use futures market returns as an explanatory variable in cross-section analysis.

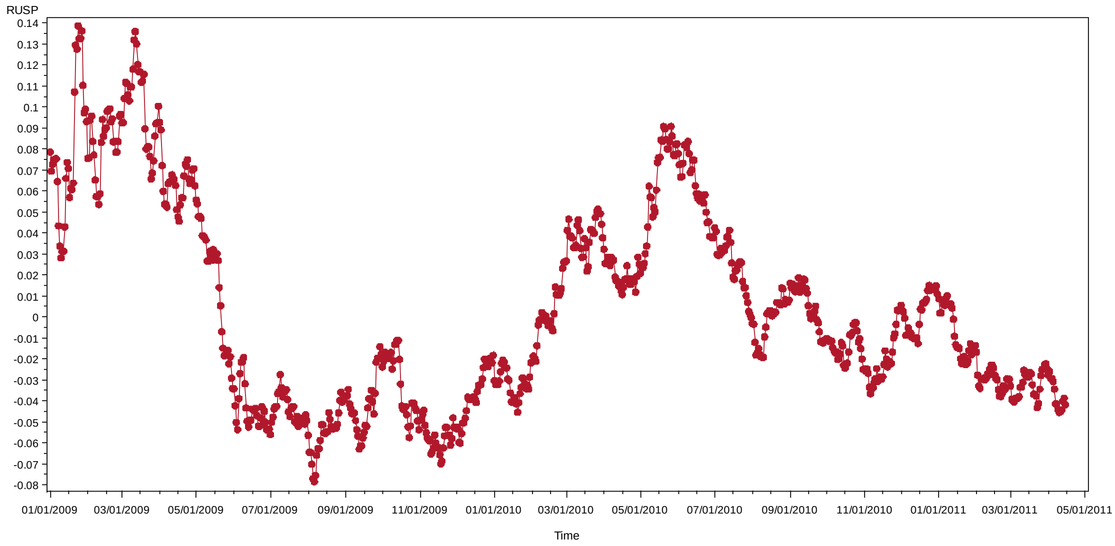
Figure 1: AUD-USD



Note: This figure presents the time series plot of the Australian Dollar-U.S. Dollar return for the period January 2, 2009 to April 15, 2011

Figure 2: BP-USD

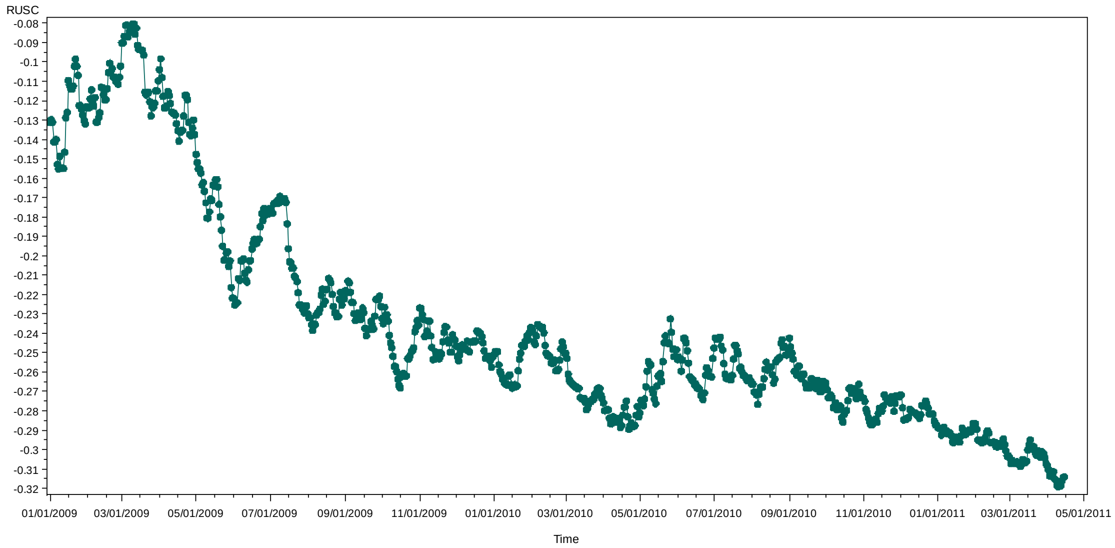
TIME SERIES PLOT



Note: This figure presents the time series plot of the British Pound-U.S. Dollar return for the period January 2, 2009 to April 15, 2011

Figure 3: CAD-USD

TIME SERIES PLOT



Note: This figure presents the time series plot of the Canadian Dollar-U.S. Dollar return for the period January 2, 2009 to April 15, 2011

4. Results

4.1. Summary Statistics

Table 1: Summary Statistics

Currency	Variables	Mean	Std. Dev.	Min	Max
AUD-USD	Spot Return	-10.056%	12.149%	-26.600%	22.750%
	Futures Return	0.103%	1.221%	-5.467%	4.501%
	Futures Volume	86,771.23	38,544.34	7,052	269,973
	RBSI	0.005	4.523	-64.303	30.761
	VBSI	1.420	0.961	0.384	19.463
	Interest Differential	-3.766%	0.675%	-4.670%	-2.750%
	Bid-Ask Spread	0.0005	0.0005	0.0001	0.0030
BP-USD	Spot Return	0.348%	4.773%	-7.830%	13.650%
	Futures Return	0.025%	0.772%	-5.084%	2.088%
	Futures Volume	111,203.71	36,043.55	12,149	307,280
	RBSI	0.407	28.477	-194.769	630.915
	VBSI	1.028	0.533	0.441	10.549
	Interest Differential	-27.499%	6.292%	-36.640%	-11.280%
	Bid-Ask Spread	0.0002	0.0001	0.0000	0.0009
CAD-USD	Spot Return	-23.567%	5.827%	-31.890%	-8.030%
	Futures Return	0.045%	0.787%	-3.028%	2.198%
	Futures Volume	75,187.77	28,894.04	7,205	222,644
	RBSI	0.044	10.186	-221.202	63.392
	VBSI	1.550	0.970	0.585	20.540
	Interest Differential	-0.400%	0.353%	-1.403%	0.007%
	Futures Spread	0.0005	0.0003	0.0002	0.0020
	Obs.	578	578	578	578

Note: This table provides the summary statistics of returns, spreads and open interests of three foreign exchange rates – Australian Dollar – U.S. Dollar (AUD-USD), British Pound - U.S. Dollar (BP-USD), and Canadian Dollar – U.S. Dollar (CAD-USD) over the period of January 2, 2009 to April 15, 2011. The spot market returns of each exchange rate is calculated as $(fx_t - fx_{t-1})/fx_{t-1}$, where *fx* indicates the spot exchange rate and *t* is the time index. The futures returns are calculated using the similar approach. The return based sentiment index is calculated as $RBSI = \%\Delta Futures\ prices/\%\Delta pen\ interest$. The volume based sentiment index is calculated as $VBSI = Open\ interest/Volume$. The interest rate differential is calculated as $i_t - i_t^*$, where i_t is the U.S. overnight interest rate and i_t^* is the foreign overnight interest rate (Australia, U.K., and Canada). The spread for each exchange rate is calculated by *Spread = Ask – Bid*.

Table 1 presents the summary statistics of spot market exchange rate returns, futures market exchange rate returns, futures market volume, return based sentiment index (*RBSI*), volume based sentiment index (*VBSI*), overnight interest rate differential, and spot market bid-ask spreads for three currencies. The summary statistics indicate that the BP-USD has the highest average return (0.348%) of all three currencies with a standard deviation of 4.77%. The other two foreign exchange returns are negative in the sample period. The AUD-USD and CAD-USD returns are volatile and negative; average -10.056% and -23.567% respectively. The AUD-USD return has the highest standard deviation and is the least stable among the three currency returns. All three currency futures earn positive returns with little volatility. Because of the stable nature of the BP-USD, the volume of its futures is the highest of three futures. The volumes of AUD-USD and CAD-USD are close to each other.

RBSI is the highest for the BP-USD (0.407) and lowest for the AUD-USD (0.005), but it is the most volatile for the BP-USD. *VBSI* is the highest for the CAD-USD (1.55) and lowest for the BP-USD (1.028), but in this case it the least volatile for the BP-USD. Both the indices indicate a positive sentiment and active futures market for these three exchange rates. The average *VBSI* is above one for all three currencies, implying sufficient trading pressure and positive sentiment in the futures market.

The average spreads of three exchange rates are very close. The variations in the spreads are also very low. BP-USD has the largest interest differential (-27.499) with a large standard deviation of 6.292%. The average interest differential for Australian dollar futures and Canadian dollar futures are relatively small with low volatility.

4.2. Time Series Analysis

4.2.1. Lag Selection

For three currencies, lag one was selected as the optimum number of lags by using the *Minimum Information Criterion (MINIC)* based on AICC (corrected Akaike's information criterion; Hurvich and Tsai, 1989), AIC (Akaike's information criterion; Akaike, 1974), SBC (Schwarz Bayesian information criterion; Schwarz, 1978) and HQC

(Hannan–Quinn information criterion; Hannan and Quinn, 1979) values. Table 2 presents the values of information criterion, which show that the value for ARMA (1, 0) order is the smallest one, indicating lag one as the optimal lag.

Table 2: Information Criteria for ARMA (1,0) Model

		AUD-USD	BP-USD	CAD-USD
Information Criteria	AICC	-16.789	-19.888	-18.792
	HQC	-16.754	-19.854	-18.758
	AIC	-16.789	-19.888	-18.793
	SBC	-16.698	-19.798	-18.702

Note: This table provides with different values for lag selection criterion – AICC (corrected Akaike's information criterion), HQC (Hannan-Quinn information criterion), AIC (Akaike's information criterion), and SBC (Schwarz Bayesian information criterion) for all three exchange rate returns.

4.2.2. Unit Root Test

For cointegration test, it is important that at least two of the series should be non-stationary process that contain a single unit root (Integrated of order one (*I*(1)). Otherwise the test significance becomes overstated and provides a spurious result. We use the Augmented Dickey-Fuller (1981) test to test for the non-stationarity of the series. The test equation is –

$$\Delta y_t = \alpha_0 + \theta y_{t-1} + \gamma t + \alpha_1 \Delta y_{t-1} + \alpha_2 \Delta y_{t-2} + \cdots + \alpha_p \Delta y_{t-L} + \varepsilon_t \qquad (3)$$

where, y is any time-series variable (*RBSI* or *VBSI*), Δ is the first-difference operator, t is the time trend, L is the augmented lags and ε_t is a stationary random error. The hypotheses for the test are:

H_0: $\theta = 0$, the series need to be differenced to make it stationary.

Ha: $\theta < 0$, the series is trend stationary.

Table 3 indicates the results of Unit Root test for each series. The Augmented Dickey-Fuller (1981) test indicates that the spot market returns of all three currencies and all other series are stationary at 1% level, except for return based sentiment index (*RBSI*), which is stationary at 5% level. The Phillips-Perron (1988) unit root test also provides similar results for all series.

Table 3: Unit Root Tests

Variables	Currency	ADF test: *p*-values	Phillips-Perron Test: *p*-values
Returns in the Spot Market	AUD-USD	0.001[a]	0.0001[a]
	BP-USD	0.001[a]	0.0001[a]
	CAD-USD	0.001[a]	0.0001[a]
Returns in the Futures Market	AUD-USD	0.001[a]	0.001[a]
	BP-USD	0.001[a]	0.001[a]
	CAD-USD	0.001[a]	0.001[a]
Interest Differential (i_t-i_t^*)	AUD-USD	0.001[a]	0.0001[a]
	BP-USD	0.001[a]	0.0001[a]
	CAD-USD	0.001[a]	0.0001[a]
Return based Sentiment Index	AUD-USD	0.0497[b]	0.0392[b]
	BP-USD	0.0180[b]	0.0104[b]
	CAD-USD	0.0248[b]	0.0146[b]
Volume based Sentiment Index	AUD-USD	0.001[a]	0.001[a]
	BP-USD	0.001[a]	0.001[a]
	CAD-USD	0.001[a]	0.001[a]
Futures Market Spread	AUD-USD	0.001[a]	0.0001[a]
	BP-USD	0.001[a]	0.0001[a]
	CAD-USD	0.001[a]	0.0001[a]
Futures Market Volume	AUD-USD	0.001[a]	0.001[a]
	BP-USD	0.001[a]	0.001[a]
	CAD-USD	0.001[a]	0.001[a]

a, b, and c indicates significance level at 1%, 5% and 10% level.

Note: This table presents the significance level for the Augmented Dickey-Fuller (1981) and Phillips-Perron (1988) unit root test for each variable and their first differences.

4.2.3. The Engle-Granger (1987) Cointegration Test

This test suggests that, for any two time series variables y_t and x_t, if y_t and x_t are both $I(1)$, and if

$$y_t = \theta' x_t + e_t \quad (4)$$

then the test include estimating $\widehat{\theta'}$ by ordinary least squares (OLS) and testing for unit roots in $\widehat{e_t} = y_t - \widehat{\theta'}\, x_t$. Table 4 indicates the results of the Engle-Granger (1987) cointegration test for the returns of three currencies with corresponding spreads, sentiment indices, and the interest rate differentials. The estimates are compared with the critical values suggested by Mackinnon (1991). The results suggest existence of significant long-run cointegration among the variables for all three currencies.

Table 4: Engle-Granger (1987) Cointegration Test

Return		Return based Sentiment Index	Volume based Sentiment Index	Spread	Interest Difference
AUD-USD	Single	-15.965[a] (0.001)	-16.568[a] (0.001)	-17.996[a] (0.001)	-17.284[a] (0.001)
	Trend	-16.016[a] (0.001)	-16.572[a] (0.001)	-18.006[a] (0.001)	-17.289[a] (0.001)
BP-USD	Single	-16.523[a] (0.001)	-16.579[a] (0.001)	-19.186[a] (0.001)	-16.884[a] (0.001)
	Trend	-16.537[a] (0.001)	-16.583[a] (0.001)	-19.188[a] (0.001)	-16.891[a] (0.001)
CAD-USD	Single	-17.281[a] (0.001)	-16.591[a] (0.001)	-18.613[a] (0.001)	-17.983[a] (0.001)
	Trend	-18.287[a] (0.001)	-16.623[a] (0.001)	-18.618[a] (0.001)	-17.991[a] (0.001)

a, b, and c indicates significance level at 1%, 5% and 10% level.

Note: This table presents the test of cointegration for the returns for each currency with corresponding spread, sentiment indices, and interest rate differential by using Engle-Granger (1987) two-step method. The *p*-values are presented in parentheses.

4.2.4. Granger (1969) Causality Test and Error Correction Model

For any two time series variables y_t and x_t, if y_t and x_t are both $I(0)$, then the error correction model is –

$$\Delta y_t = \gamma_1 \Delta x_t + \gamma_2 [y_{t-1} - \alpha_i x_{t-1}] + \epsilon_t \quad (5)$$

The terms in the parenthesis is the long-run model and the first differences are used to estimate the error correction model to determine the short-run deviations from the long-run equilibrium. Table 5 presents the short-run analysis by Granger (1969) causality analysis and error correction model estimates for three currencies. All error correction coefficients except one are statistically significant. The estimates suggest causality from spot exchange rate spread and futures market sentiment indices toward the spot exchange rate returns.

Table 5: Granger Causality and Error Correction Model

	Dependent Variable	**ΔReturn based S.I.**	**ΔVolume based S.I.**	**ΔReturn**	**ΔSpread**	**ECM_{t-1}**
AUD-USD	*ΔReturn*	0.87287	0.75982^{c}	-	0.27469	4.8124^{c}
		(0.646)	(0.063)		(0.872)	(0.09)
	ΔSpread	10.292^{a}	7.543^{a}	2.725	-	10.931^{a}
		(0.006)	(0.001)	(0.256)		(0.004)
	ΔReturn based S.I.	-	16.589^{a}	9.7282^{a}	1.0767	715.28^{a}
			(0.001)	(0.008)	(0.584)	(0.000)
	ΔVol. based S.I.	11.698^{a}	-	10.368^{a}	0.6981	736.589^{a}
		(0.007)		(0.006)	(0.758)	(0.00)
BP-USD	*ΔReturn*	0.05379	5.96547^{c}	-	0.7908	6.1402^{b}
		(0.973)	(0.092)		(0.673)	(0.046)
	ΔSpread	3.123	9.517^{b}	10.73^{a}	-	16.341^{a}
		(0.21)	(0.021)	(0.005)		(0.000)
	ΔReturn based S.I.	-	8.985^{b}	13.394^{a}	0.07279	532.93^{a}
			(0.032)	(0.001)	(0.964)	(0.000)
	ΔVol. based S.I.	7.699^{b}	-	12.698^{a}	0.85631	978.15^{a}
		(0.025)		(0.002)	(0.823)	(0.000)
CAD-USD	*ΔReturn*	0.57516	6.96284^{c}	-	0.22611	3.5202
		(0.75)	(0.075)		(0.893)	(0.172)
	ΔSpread	15.4^{a}	19.37^{a}	2.0267	-	34.751^{a}
		(0.000)	(0.000)	(0.363)		(0.000)
	ΔReturn based S.I.	-	17.269^{a}	3.5538	0.88461	5.4347^{c}
			(0.000)	(0.169)	(0.643)	(0.066)
	ΔVol. based S.I.	16.547^{a}	-	11.689^{a}	0.42691	4.965^{c}
		(0.001)		(0.003)	(0.378)	(0.072)

a, b, and c indicates significance level at 1%, 5% and 10% level.

Note: This table presents the Granger Causality test and Error Correction Model estimates for the returns for each currency with corresponding spread and open interest. The first entry of each row indicates the χ^2 estimates and the second entry indicates the *p*-values in parenthesis.

4.3. Cross-sectional Analysis

For cross-sectional analysis, we use ordinary least squares (OLS) estimates of the following model –

$$R_t = \beta_0 + \beta_1\, RBSI_t + \beta_2\, VBSI_t + \beta_3\, RF_t + \beta_4\, FVol_t + \beta_5\, (i_t - i_t^*)_t + \beta_6\, SPR_t + \varepsilon_t \qquad (6)$$

Here *R* is the foreign exchange rate return calculated as $\frac{fx_t - fx_{t-1}}{fx_{t-1}}$, and f_x indicates the foreign exchange rate, for each exchange rate and combined and *t* is the time index. *RF* is the futures returns calculated using the similar approach. *FVol* is the volume in the futures market, *RBSI* is the return based sentiment index calculated in equation (1), *VBSI* is the volume based sentiment index calculated in equation (2). The interest rate differential is calculated as $i_t - i_t^*$, where i_t is the U.S. overnight interest rate and i_t^* is the foreign overnight interest rate (Australia, U.K., and Canada). The spread for each exchange rate is calculated by *SPR = Ask – Bid*. Table 6 presents the OLS estimates of equation (6).

From Table 6, we find that spread has a significant effect on the spot market returns in all specifications. The sign of spread is positive, which is consistent with our first hypothesis and literature. This implies that higher spread contributes to higher returns in the foreign exchange market to compensate for various risks. This finding is consistent with the findings of Bessembinder (1994), which states that spreads include foreign currency inventory risk, price risk, liquidity risk, and inventory risk.

The return based sentiment index (*RBSI*) is significant at 1% level only for Canadian dollar spot market returns. For Australian dollar and British pound spot market returns, *RBSI* is not significant at all. The futures return does not seem to be an important factor as it is not significant in most of the specifications. In the same way, the return based sentiment index (*RBSI*) does not seem to be affecting the spot returns except for Canadian dollars. This implies the returns in the futures market do not have much impact on the spot exchange rate returns.

Table 6: Ordinary Least Squares (OLS) Results

	Const.	Return Based S. I.	Volume Based S. I.	Futures Return	Futures Volume	$i_t - i_t^*$	Spread
Panel A: Dependent Variable: Spot Return (AUD-USD)							
(I)	0.27709[a]	0.00228	-	0.81907[*]	-0.0000005[a]	9.54015[a]	40.98710[a]
	(0.000)	(0.499)		(0.054)	(0.004)	(0.000)	(0.000)
(II)	0.39857[a]	-	-0.19560[a]	-0.13863	-0.0000024[a]	6.97707[a]	45.35050[a]
	(0.000)		(0.000)	(0.665)	(0.000)	(0.000)	(0.000)
(III)	0.41381[a]	-0.00317	-0.21833[a]	0.62564[b]	-0.0000025[a]	7.30675[a]	39.42720[a]
	(0.000)	(0.263)	(0.000)	(0.049)	(0.000)	(0 .000)	(0.000)
Panel B: Dependent Variable: Spot Return (BP-USD)							
(I)	0.071472[a]	-0.00055	-	0.471271	0.0000000	0.298344[a]	66.8227[a]
	(0.000)	(0.726)		(0.222)	(0.535)	(0.000)	(0.001)
(II)	0.05038[a]	-	-0.084264[a]	0.463692	0.00000063[a]	0.436646[a]	30.5049[b]
	(0.000)		(0.000)	(0.037) [b]	(0.000)	(0.000)	(0.039)
(III)	0.037602[a]	-0.00165	-0.078118[a]	0.412447	0.0000005[a]	0.385596[a]	36.898
	(0.010)	(0.231)	(0.000)	(0.235)	(0.000)	(0.000)	(0.105)
Panel C: Dependent Variable: Spot Return (CAD-USD)							
(I)	-0.169557[a]	0.00565[a]	-	0.508281	-0.0000008[a]	3.4259[a]	24.355[b]
	(0.000)	(0.002)		(0.110)	(0.000)	(0.000)	(0.020)
(II)	-0.069373[a]	-	-0.106805[a]	-0.093749	-0.0000018[a]	1.43743[a]	31.1269[a]
	(0.000)		(0.000)	(0.718)	(0.000)	(0.006)	(0.000)
(III)	-0.0551[a]	0.00370[a]	-0.112133[a]	0.547173	-0.0000019[a]	1.70387[b]	21.5417[a]
	(0.002)	(0.009)	(0.000)	(0.030) [b]	(0.000)	(0.014)	(0.009)
Panel D: Dependent Variable: Spot Returns of all exchange rates (pooled regression)							
(I)	-0.11377[a]	-0.00041	-	0.71127	-0.000002[a]	1.7889	45.569[a]
	(0.000)	(0.776)		(0.342)	(0.000)	(0.000)	(0.000)
(II)	-0.09173[a]	-	-0.14895[a]	0.46832	-0.0000027[a]	2.6417[a]	61.673[a]
	(0.000)		(0.000)	(0.412)	(0.000)	(0.000)	(0.000)
(III)	-0.01147[a]	0.00249[a]	-0.19856	0.44823	-0.0000019[a]	3.1296[a]	51.957[a]
	(0.001)	(0.004)	(0.000)	(0.085)	(0.000)	(0.000)	(0.000)

a, b, and c indicate significance at 1%, 5%, and 10% level.

Note: This table presents the heteroskedasticity corrected OLS estimates and p-values of the model, $R_t = \beta_0 + \beta_1\, RBSI_t + \beta_2\, VBSI_t + \beta_3\, RF_t + \beta_4\, FVol + \beta_5\, (i_t - i_t^*) + \beta_6\, SPR + \varepsilon_t$, for each exchange rate and combined. Here R is the foreign exchange rate return calculated as $(fx_t - fx_{t-1})/fx_{t-1}$, where fx indicates the spot exchange rate and t is the time index. RF is the futures returns calculated using the similar approach. $RBSI$ is the return based sentiment index calculated as

$RBSI = \%\Delta Futures\ prices/\%\Delta pen\ interest$. *VBSI* is the volume based sentiment index calculated as $VBSI = Open\ interest/Volume$. The interest rate differential is calculated as $i_t - i_t^*$, where i_t is the U.S. overnight interest rate and i_t^* is the foreign overnight interest rate (Australia, U.K., and Canada). The spread for each exchange rate is calculated by *Spread* = *Ask* – *Bid*. The *p*-values are in parentheses. (I), (II) and (III) indicates the rows with different specifications.

On the other hand the volume based sentiment index (*VBSI*) is significant at 1% level for all three spot exchange rate returns. The effect of both the sentiment indices on spot market returns is negative. This implies reduced spot exchange rate returns when trading activity in futures market is high and also investors reveal high interest in the futures market. This suggests that active futures market contributes significantly in the spot market returns.

The control variables volume of the futures market and interest rate differentials are significant in all specifications. Both these variables positively affect the spot market returns. This implies that higher volume in futures market does not attract away the investors from the spot market. Even after controlling for volume the negative sign of sentiment indices implies that, the investor sentiment in the futures market reduces spot market returns because of higher interest of investors in the futures market. The positive significance of the interest rate differentials provides evidence for “uncovered interest rate parity” condition.

5. Conclusion

This paper tests the effects of spot exchange rate bid-ask spread and the future market sentiment as two important factors that explain the spot exchange rate returns. We use the future market open interest to develop two sentiment indices – return based sentiment index and volume based sentiment index. The sample includes three different currencies - Australian Dollar, British Pound and Canadian Dollar – to US Dollar for the period January 2, 2009 to April 15, 2011. We use time series and cross-sectional analyses to test the impact of spot market spread and future market sentiment on the spot exchange rate returns.

The time series estimates indicates that, variables of three currencies are cointegrated and both spot market spread and future market sentiment indices have significant causal relation with the exchange rate returns. The cross-sectional analysis shows that both spot market spread and futures market indices significantly affect the spot market returns. The positive sign of the spot market spread implies that higher returns in the spot markets are risk premia for higher spread and corresponding risks, as suggested by Bessembinder (1994). The positive sign of futures market volume and the negative sign of the sentiment indices imply that spot market returns suffer because of investors' higher interest in futures market, but not because of higher trading in the futures market. The overnight interest rate differentials are also positive and significant, and provide support for "uncovered interest parity" condition in foreign exchange market.

The overall results suggest that, the spot market bid-ask spread and futures market investor sentiment have significant impact on the spot exchange rate returns. Although the return based sentiment index does not seem to be significant for all currencies, the volume based sentiment index provide a clear picture of trading activities in futures market and its impact on the spot market. This finding is important as to incorporate futures market dynamics in spot market returns. Further research may include the classification of futures market sentiments into hedging and speculation activities and analyzing their impact on the spot exchange rate returns.

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