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Does Currency Smirk Predict Foreign Exchange Return?

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ABSTRACT

This paper finds the predictive power of currency smirk to forecast foreign exchange (FX) return to be convincing. Although the steeper currency smirk appears in the middle of the trading day, the conclusive currency smirks' predictability lasts over the next trading day, as the FX market is highly adept at incorporating the information embedded in the currency smirk. The implication of these findings is that the currency smirk is distinctive for forecasting very short-term FX fluctuations, and that day- or overnight FX traders can apply its uniqueness to profit from quick price swings in the 24-hour global FX market.

Keywords: Currency Smirk, Currency Options Market Efficiency, Foreign Exchange Return, Implied Volatility

1. Introduction

The options-implied volatility “smirk” is the difference between the implied volatility of out-of-the-money (OTM) put options and the implied volatility of at-the-money (ATM) call options. Its presence appears in the literature mainly for equity and index options. A number of studies examine the pattern of volatility smirk for index and stock options. Bollen and Whaley (2004), Bates (2003), and Gârleu et al. (2007), among others, have conducted research on volatility smirk for stock options. Pan (2002) shows 10 percent volatility smirk for an S&P 500 index option with 30-day maturity. Bates (1991) argues that the set of index call and put prices across all exercise prices provides a direct indication of market participants’ aggregate subjective distribution of future price insights. The OTM put demand therefore increases and becomes expensive, and volatility smirk becomes especially prominent before big negative jumps in price levels.

Intuitively, an OTM put is a typical spot for informed traders with negative news to place their trades. The shape of the volatility smirk therefore reflects the risk of negative future news. As a consequence, previous literature has mostly focused on the information contained in the options volatility smirk. The study by Xing et al. (2010), however, finds the relationship between volatility smirk and stock return for the individual stock option; they find that the equity volatility smirk has significant predictive power for future equity return. Since the stock market and foreign exchange (FX) market are analogous in the context of financial assets for investment and underlying assets of exchange-traded options with the same maturity (i.e., monthly maturity), the findings of Xing et al. (2010) leave a gap: to study the “currency options–implied volatility smirk” (henceforth “currency smirk”). Our objective with this study is to fill this research gap by examining the predictive power of the currency smirk in forecasting FX returns.

Our study differs from previous research in this area along several dimensions. First, we estimate currency smirk based on major currency options prices to examine its forecasting performance for the FX return. To the best of our knowledge, no researcher has conducted an analysis on the currency smirk, and thus the conclusions of this study add a new dimension of smirk in the literature. Second, we use the efficient ATM call and OTM put options market prices to measure the currency smirk; otherwise, the result is biased currency smirk, resulting from mispriced (i.e., underpriced or overpriced) options price. This fundamental issue has been overlooked in previous studies. Third, to obtain ATM call for currency smirk with higher accuracy, our study uses ten percent narrower swing band than what Xian et al. (2010)¹ employed. The wider swing band provides call prices at near-the-money rather than ATM. Fourth, since the information content changes over the trading day, this study examines the predictive power of currency smirk at the intra-day level, that is, for the opening period², midday period, and closing period. We find that the predictive power of currency smirk is not the same for the different trading periods. This intra-day smirk analysis approach is new in the literature.

¹ Xian et al. (2010) used the ratio of the strike price to the stock price between 0.95 and 1.05 (i.e., 10 percent swing band $[1.05-0.95]*100$). In this study, the ratio of the strike price to the stock price is between 0.995 and 1.005 (i.e., 1 percent swing band $[1.005-0.995]*100$). Therefore, this study uses 10 percent narrower ($[1 \text{ percent}/10 \text{ percent}]*100$) swing band.

² The terms “period” and “hour” are u

The remainder of the paper is organized as follows. The next section describes the methodology and data used in this study. Section 3 investigates the sample currency options' market efficiency, the predictive power of currency smirks, and the length of its persistence. Section 4 concludes the paper with a discussion of the results.

2. Data and Methodology

This section starts with a discussion of the sample data selection procedure, followed by a description of methodology. This paper uses the Nasdaq options market for sample data, and includes the major World Currency Options (WCO)³ of the Australian dollar (AUD), the Canadian dollar (CAD), the Swiss franc (CHF), the Euro (EUR), and the British pound (GBP). All these data are extracted from the Securities Industry Research Centre of Asia-Pacific (SIRCA) database to construct the implied currency smirk for the opening period (9:30 a.m. to 10:00 a.m.), midday period (12:30 p.m. to 1:00 p.m.), and closing period (3:30 p.m. to 4:00 p.m.) of the trading day. We decided to use a half-hour time slot for each period to set them up evenly within a trading day by maintaining the same time difference (i.e., two-and-a-half hours) between the "opening period" and the "midday period" and between the "midday period" and the "closing period."

Norden and Xu (2010) show that option volatility smirk is significantly dependent on the relative liquidity between options series with different "moneyness." Therefore, the sample selection period is critical in order to avoid the data liquidity issue for newly launched WCO. This study considers a four-year sample period from 20 September 2010 to 19 September 2014, based on the ultra-high frequency data available in the SIRCA database. Further, to ensure that the options have adequate liquidity, we only include options with time to maturity between two and ninety days.

The study sample incorporates the ATM call price, the OTM put price, the strike price, the spot price of the sample currency against the US dollar (USD), and the interest rates of the AUD, CAD, CHF, EUR, GBP, and USD to measure the currency smirk. For ATM call, the ratio of strike price to stock price is between 0.995 and 1.005. Similarly, the ratio of strike price to stock price is lower than 0.995 [but higher than 0.80, as Xian et al. (2010) use in their study] for OTM put.

The methodology of this paper is developed through the following steps. First, we examine the sample currency options' market efficiency using the put-call-parity (PCP) regression model of Mitnik and Rieken (2000), as in equation (1):

$$Y_{t,ij} = \beta_0 + \beta_1 X_{t,ij} + \varepsilon_{t,ij}, \quad (1)$$

where

$\forall_i = AUD, CAD, CHF, EUR, GBP$; $\forall_j = \text{Opening hours, Midday hours, Closing hours}$;
 $Y = (C - P)$; $X = (Se^{-R_d T} - Xe^{-R_f T})$; C, P, S, X, R_d , R_f , and T representing, respectively, ATM call price, ATM put price, spot rate, strike price, domestic currency interest rate, foreign currency interest rate, and options maturity. The ATM call and ATM put use ratio of

³ The World Currency Options is an entirely new class of currency options launched at the Philadelphia Stock Exchange (PHLX) on 24 July 2007. These options have a smaller contract size than the existing currency option contract, which matures every 30 days. The new options are available for all major currency trading to those with smaller investment accounts.

strike price to stock price is between 0.995 and 1.005. Under the null hypothesis that PCP is valid, the coefficients β_0 and β_1 in equation (1) should be 0 and 1, respectively.

Next, the efficient ATM call price and OTM put price are employed to measure the daily currency smirk (DCM), as in equation (2); this shows the difference between the implied volatility of OTM put (IVOP) and the implied volatility of ATM call (IVAC):

$$DCS_{t,ij} = IVOP_{t,ij} - IVAC_{t,ij}. \quad (2)$$

The log difference of two consecutive days' spot rate estimates the daily foreign exchange return (DFX).

Finally, we follow the regression analysis of Xian et al. (2010) and use the weekly currency smirk (WCS) and weekly foreign exchange return (WFX) as inputs of the regression equation (3) to evaluate the predictability of currency smirk to forecast the FX return. The average of DCS over a week (Monday to Monday) and the average of DFX over a week (Tuesday to Tuesday) estimate the WCS and WFX, respectively:

$$WFX_{t,ij} = \alpha_0 + \alpha_1 WCS_{t,ij} + \varepsilon_{t,ij} \quad (3)$$

3. Empirical Analysis

The empirical analysis begins with the put-call-parity (PCP) test using equation (1) to examine the sample currency options' market efficiency. The test results for the opening hour, midday hour, and closing hour are summarized in Table 1. The standard error (std. error) is given in parentheses below the estimated coefficients. For AUD opening hours, the t-statistic 1.3802 (-0.0824/0.0597) indicates that the null of $H_0: \beta_0 = 0$ cannot be rejected at any significance level. This is also valid for other intercepts of Table 1. In other words, the intercept is not statistically different from 0 for all cases. The slope is greater than 0, however, for the opening hour, midday hour, and closing hour of the sample currency. Further, for the AUD opening hour, the t-statistic $1.76 = (1 - 0.9245)/0.0429$ reveals that the slope null hypothesis $H_0: \beta_1 = 1$ is not significant at the standard level of significance. This is also true for the rest of the slope coefficients in Table 1. The overall regression analysis strongly suggests that PCP holds for all currencies, leading to an efficient sample currency options market.

The currency options markets' degree of efficiency, however, is not same across the opening hour, midday hour, and closing hour. For the opening hour, the average slope coefficient of the five sample currencies is 0.95 $[(0.925 + 1.027 + 0.886 + 1.003 + 0.912)/5]$. Similarly, the average slope coefficient is 0.99 and 0.97 for the midday hour and the closing hour, respectively. The midday hour slope coefficient is close to 1, which suggests that the options market has a greater tendency to be priced efficiently during the middle of the trading day. This insight is very useful for option holders, particularly for OTM put options buyers. Since the options holder buys OTM put only by looking at its lower premium compared to the ATM call, the options dealers' ... tions market is not efficient; by

writing overpriced OTM put where the overpriced premium is lower than ATM call premium, however, it is virtually higher than the premium of efficient OTM put.

Table 1: Currency Options Market Efficiency Analysis

Options	Opening Hour			Midday Hour			Closing Hour		
	Intercept (std. error)	Slope (std. error)	Adj R ²	Intercept (std. error)	Slope (std. error)	Adj R ²	Intercept (std. error)	Slope (std. error)	Adj R ²
AUD	-0.0824 (0.0597)	0.9245* (0.0429)	0.31	-0.0506 (0.0390)	0.9326* (0.0356)	0.36	-0.0102 0.0105	0.9451* (0.0288)	0.39
CAD	0.0079 (0.0248)	1.0271* (0.032)	0.39	0.0046 0.0289	1.002* (0.0373)	0.51	-0.2558 0.1482	0.9416* (0.0314)	0.64
CHF	-0.0951 (0.0489)	0.8856* (0.0603)	0.26	-0.0605 (0.0372)	1.0341* (0.0562)	0.27	-0.0621 (0.0355)	0.9063* (0.0518)	0.25
EUR	0.0156 (0.0353)	1.0025* (0.0756)	0.32	0.1037 0.0551	1.0475* (0.0665)	0.45	0.1008 0.0635	1.0677* (0.0553)	0.55
GBP	-0.3773 (0.2832)	0.9116* (0.1139)	0.39	-0.3099 (0.2209)	0.9089* (0.1042)	0.41	-0.0348 0.0177	0.9913* (0.0410)	0.38

Notes: * denotes at least 5% level of statistical significance; Adj-R² = adjusted R-squared.

Next, equation (3) is estimated to examine the predictive power of currency smirk to forecast FX returns in the opening hour, midday hour, and closing hour. The regression results are given in Table 2, with the t-statistic (t-stat) in parentheses below the estimated coefficient. For all sample currencies, the significant slope coefficient confirms the relationship between currency smirk and FX returns, which justifies this study. The negative slope coefficient indicates that the anticipation of future foreign currency value depreciation against the US dollar increases the demand of OTM put. If there is an overwhelmingly pessimistic perception of the FX market, the currency investors tend to buy put for their FX value protection against future currency price drops (for hedging purposes).

For the opening hour, the average slope coefficient of the five sample currencies is -0.321 [(-0.367 + -0.438 + -0.273 + -0.391 + -0.136)/5]. Similarly, the average slope coefficient is -0.443 and -0.312 for the midday and closing hours, respectively. Interestingly, the average slope coefficient for the opening hour and closing hour is very close (and substantially lower) than that of the midday hour. The steepness of the slope measures the intensity of put option demand, and the steeper slope of the midday hour indicates significant buying pressure on the OTM put in the middle of the trading day. This happens because risk-averse investors are interested in buying OTM put during the midday period rather than during the opening and closing periods, as they believe that the OTM put option is priced more efficiently when the market is less volatile at the middle of the trading day. This perception by the options holders is consistent with the findings of the options market efficiency analysis in Table 1, where the options market of the midday hour is more efficient than that of the opening and closing hours.

Table 2: Currency Smirks' Predictive Power Analysis

Options	Opening Hour			Midday Hour			Closing Hour		
	Intercept (t-stat)	Slope (t-stat)	Adj-R ²	Intercept (t-stat)	Slope (t-stat)	Adj-R ²	Intercept (t-stat)	Slope (t-stat)	Adj-R ²
AUD	0.0005* (4.472)	-0.367* (-5.200)	0.0041	0.0006* (4.216)	-0.544* (-5.332)	0.0260	0.0005* (3.058)	-0.204* (-3.878)	0.0135
CAD	0.0003* (3.292)	-0.438* (-4.597)	0.0212	0.0005* (4.892)	-0.657* (-6.393)	0.0384	0.0002* (2.571)	-0.402* (-3.747)	0.0129
CHF	0.0006* (3.914)	-0.273* (-2.948)	0.0028	0.0006* (5.339)	-0.197* (-3.065)	0.0100	0.0004 (1.153)	-0.354* (-2.085)	0.0720
EUR	0.0004* (3.402)	-0.391* (-4.293)	0.0170	0.0004* (4.106)	-0.471* (-6.135)	0.0122	0.0003* (2.886)	-0.415* (-3.709)	0.0121
GBP	0.0002 (1.678)	-0.136* (-2.062)	0.0565	0.0003* (2.160)	-0.346* (-3.506)	0.0841	0.0002* (2.486)	-0.189* (-3.302)	0.0066

Notes: * denotes at least 5% level of statistical significance; Adj-R² = adjusted R-squared.

Finally, we examine the question: how long does the currency smirks' predictability persist? We start by regressing the currency smirk on the FX return over the next one and two days to examine its FX return forecasting power over the one-day and two-day horizons, respectively. The regression results for one-day analysis are given in Table 3. The slope coefficient is statistically different from zero for all sample currencies across the opening, midday, and closing hours. Although the two-day regression results are not statistically significant and thus we do not report them here, the results are available upon request. The overall results substantiate our hypothesis that currency smirks have a strong capability of forecasting the FX returns of the next trading day. This temporary predictability of currency smirks makes sense because the FX market is very efficient in incorporating new information from the options market. We therefore argue that the currency smirk captures information for future short-term FX price fluctuations.

The conclusive predictive power of currency smirks is not the same, however, at the opening, midday, and closing periods. For the opening hour, the average slope coefficient of the five sample currencies is -0.4672 $[(-0.415 + -0.826 + -0.279 + -0.697 + -0.119)/5]$. Similarly, the average slope coefficient estimates are -0.5472 and -0.3436 for the midday and closing hours, respectively. The higher coefficient of the midday hour currency smirk signifies its superiority against the opening and closing hours' currency smirk in forecasting FX returns. This occurs because the midday hour currency smirk obtains adequate information as it builds, using options prices from the more efficient options market in the middle of the trading day.

Table 3: Currency Smirks' Forecast Horizon Analysis

Options	Opening Hour			Midday Hour			Closing Hour		
	Intercept (t-stat)	Slope (t-stat)	Adj-R ²	Intercept (t-stat)	Slope (t-stat)	Adj-R ²	Intercept (t-stat)	Slope (t-stat)	Adj-R ²
AUD	0.0004 (1.830)	-0.415* (-4.699)	0.0015	0.0008 (2.846)	-0.662* (-4.286)	0.0166	0.0013 (4.122)	-0.499* (-5.553)	0.0281
CAD	0.0008 (3.550)	-0.826* (-5.493)	0.0303	0.0007 (3.4911)	-0.846* (-5.460)	0.0279	0.0002 (1.023)	-0.302* (-2.061)	0.0032
CHF	0.0005 (1.475)	-0.279* (-2.180)	0.0019	0.0005 (2.115)	-0.214* (-2.283)	0.0039	0.0006 (2.234)	-0.387* (-2.918)	0.0021
EUR	0.0008 (3.387)	-0.697* (-4.982)	0.0229	0.0008 (3.438)	-0.700* (-5.070)	0.0232	9.45E-5 (0.491)	-0.283* (-2.131)	0.0043
GBP	5.89E-5 (0.3540)	-0.119* (-1.986)	0.0028	0.0003 (1.753)	-0.314* (-3.332)	0.0096	0.0003 (1.955)	-0.247* (-2.660)	0.0058

Notes: * denotes at least 5% level of statistical significance; Adj-R² = adjusted R-squared.

4. Conclusion

Although the equity currency that smirks' information contains (and its predictive power for future stock return analysis) is not new in the literature, our study is the first to explore currency smirk for the foreign exchange (FX) market. The rationality of this study is based on the consideration that the stock market and the FX market are analogous in the context of financial assets for investment and underlying assets of exchange-traded options with the same maturity (i.e., monthly maturity).

In addition to the new research idea of the option currency smirk, we introduce three distinct major methodological developments in this study to measure currency smirk with higher degrees of accuracy. The first is the efficient ATM call and the OTM put price used to estimate the currency smirk, which prevents currency smirks from containing inappropriate information due to mispriced (i.e., underpriced or overpriced) options prices.

Second, our design of 1 percent swing band (the ratio of the strike price to the stock price between 0.995 and 1.005) for ATM call increases its implied volatility accuracy. In previous studies, the wider swing band (e.g., Xian et al. [2010] use 10 percent swing band) contaminates the characteristics of ATM call implied volatility by including undesirable near-the-money call observations, which distorts smirks' information.

Third, since the information does not remain the same throughout the trading day, we conduct the analysis of currency smirk at the intra-day level for a greater picture of its predictive power for FX returns. The discrete findings for the opening, midday, and closing hours also substantiate the validity of our intra-day approach. Further, for sample periods used, previous researchers have occasionally studied the opening period, hardly studied the midday period, and have widely studied the closing period. Our study shows that the middle of the trading day's information, which previous studies have ignored, has major impacts on the findings of currency smirks' analysis.

The currency smirks' predictive power analysis may be summarized as follows. The significant slope coefficients for all sample currencies in Table 2 indicate that there is a relationship between currency smirk and FX return, which supports the justification of this study. The negative slope coefficient reveals that the expectation of decreasing future foreign currency value against the US dollar increases the demand of OTM put. This is consistent with the findings of Xing et al. (2010) for the equity options market.

We find convincing predictive power of currency smirk to forecast FX returns, which lasts over the next trading day. This temporary predictability of currency smirk is reasonable because the FX market is very efficient in incorporating new information from the options market. Furthermore, the currency smirk captures information that is appropriate to forecast short-term FX price fluctuations. Therefore, the employment of currency smirk to predict FX returns is a unique approach for FX traders, particularly short-term, day-, and overnight traders who rely on volatility in order to profit from quick price swings in the 24-hour global FX market.

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