INTRADAY ANALYSIS OF CURRENCY ETFS

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ABSTRACT

In this paper I study on intradaily-one-minute interval basis six currency exchange traded funds/ETFs' tracking errors and pricing deviations and how they relate to the ETFs' arbitrage mechanism. The ETFs are the Australian Dollar ETF, the British Pound ETF, the Canadian Dollar ETF, the Euro ETF, the Swiss Franc ETF and the Japanese Yen ETF. I document that the average intradaily tracking errors and pricing deviations for the six currency ETFs are relatively small and stable. I also find that these exchange traded funds' arbitrage mechanism is more closely related to the exchange traded funds' pricing deviation than tracking error.

INTRODUCTION

In this paper I study on intradaily basis six currency exchange traded funds' tracking errors and pricing deviations and how they relate to the exchange traded funds' arbitrage mechanism. I study the Australian Dollar ETF (ticker: FXA), the British Pound ETF (ticker: FXB), the Canadian Dollar ETF (ticker: FXC), the Euro ETF (ticker: FXE, the Swiss Franc ETF (ticker: FXF) and the Japanese Yen ETF (ticker: FXY). The ETF sponsor, develops the ETF strategy and selects authorized participants who are the only investors allowed to create ETF units/shares for underlying basket or cash. At the same time the authorized participants are the only entity allowed to redeem ETF shares from the sponsor. This arbitrage mechanism ensures that the ETF closely tracks the underlying currency and is measured with tracking error.

ETFs have exploded in popularity in recent times due to their structure, simplicity, cost and tax efficiency, diversification benefits and intradaily trading ability. The cost and tax efficiency stems from their unique legal set-up. Most ETFs are registered as Unit Investment Trusts or open-end funds. The six currency ETFs used in this study, however, are registered as Grantor Trusts. Grantor Trust's shares represent fractional and undivided beneficial interest and ownership of the assets that the trust holds. This means that in contrast to unit investment trusts or open-end funds that do not necessarily need to hold the exact assets and thus generate a tracking error, the grantor trusts hold the exact asset. This is the reason why most commodity and currency ETFs are structured as grantor trusts. However, the fact that the asset is held in storage, does not generate income and incurs expenses suggests that the ETF price would potentially constantly decrease relative to its tracking asset value. This naturally raises the interesting research question – does tracking error or pricing deviation play a more prominent role in currency ETFs performance? To the best of my knowledge no study has addressed this issue so far. The

answer to this question would definitely interest investors who might see their portfolio value constantly be eroded due to expenses.

I document that the average intradaily tracking errors for the six currency ETFs are relatively small and stable. The tracking errors are highest for the FXF, 0.000311% and smallest for FXB, -0.000014%. FXB is the only ETF with a negative tracking error. All tracking errors exhibit skewness, kurtosis, and negative and statistically significant but not necessarily economically meaningful first order autocorrelation with the exception of FXC and FXY. All six ETFs average intradaily pricing deviations are negative with the exception of the FXA pricing deviation which is a positive $0.17; the rest of the ETFs pricing deviations are -0.3778 for FXB, -0.3231 for FXC, -0.2697 for FXC, -0.2697 for FXE, -0.6484 for FXF and -0.9273 for FXY. All exhibit skewness, kurtosis, very high levels of positive autocorrelation and negative trends, which suggests erosion of value. I also find that these exchange traded funds' arbitrage mechanism is more closely related to the exchange traded funds' pricing deviation than tracking error. This suggests that pricing deviation is a much more appropriate tracking metric for currency ETFs than the traditional tracking error metric.

LITERATURE REVIEW AND METHODOLOGY

To the best of my knowledge, this is the first comprehensive study of currency ETFs. Considering, that I am in an unchartered territory I relate this study to the equity ETF literature where the majority of the focus has been. Most equity ETF studies focus on the ETFs' arbitrage mechanism and tracking error. Studies that focus on the ETF arbitrage mechanism are [1] [2] [3] [4] [10] are studies in the area of ETF arbitrage. [1] study S&P 500 and S&P 400 ETFs and compare and contrast them with closed-end funds. They document that because of arbitrage inherent in ETFs, ETFs experience lower discounts in comparison to similar closed-end funds. [4] study index and futures arbitrage for S&P 500 ETF and find that arbitrage in this setting is difficult to exploit. [10] study NASDAQ 100 ETF spot futures arbitrage and document, similar to [4] a difficulty to exploit this arbitrage mechanism. [2] examine hedging and arbitrage opportunities also in the S&P 500 ETF and spot market and find higher hedging efficiency in the ETF market than they are in the spot market. In their 2008 paper, [3] extend their 2005 study to the four most popular ETFs - DIA, SPY, QQQQ and IWM.

Equity ETF studies also focus on the ETF tracking error, such as [6] [7] [8]. Tracking error has different specifications but most often refers to how well in terms of return does the ETF track its underlying asset return. Most equity ETF studies document that ETFs are efficient in terms of ability to track their underlying index return. In contrast, [5] define pricing deviation, which differs from tracking error, in that it is defined as index price minus ETF price. [5] define and study daily pricing deviation based on an arbitrage argument and provide practical examples of profiting from ETF arbitrage if the pricing deviation becomes sufficiently large. [9] uses the [5] methodology and examines ETFs pricing deviation on intradaily basis and finds that the DIA, SPY and QQQQ pricing deviations are 0.0429, -0.0743 and 0.4298, respectively.

It is important to point out that not all ETFs have pricing deviation. The reason is not all ETFs attempt to be a proportion of their underlying asset's price. The currency ETFs used in this study do attempt to replicate the prices of the currencies that they track. The Australian Dollar ETF (ticker: FXA) is designed to be 100 times the US Dollar value of the Australian Dollar, the British Pound ETF (ticker: FXB) is designed to be 100 times the US Dollar value of the British Pound, the Canadian Dollar ETF (ticker: FXC) is designed to be 100 times the US Dollar value of the Canadian Dollar, the Euro ETF (ticker: FXE) is designed to be 100 times the US Dollar value of the Euro, the Swiss Franc ETF (ticker: FXF) is designed to be 100 times the US Dollar value of the Swiss Franc and the Japanese Yen ETF (ticker: FXY) is designed to be 10,000 times the US Dollar value of the Japanese Yen. I use these proportions to adjust ETF and currency prices so that the numbers can be comparable.

In this study, I use a model based on an [6] study. The Moving Average (MA) model that I use is as follows:

$$\Delta Volume_t = \alpha + TM_{t-1} + \beta(TM_{t-2}), \quad (1)$$

where ΔVolume_t is the change in trading volume between times 't' and 't-1', and TM_{t-1} is the tracking metric, either TE_{t-1} tracking error or PD_{t-1} pricing deviation. We use the model developed by [6] the difference here is the use of TE and PD whereas [6] use the ratio of lagged Spider price minus lagged Spider net asset value (NAV). In addition, we use intradaily data whereas [6] use daily data. Also, I cannot use the variable used in [6] study because there are no intradaily data available on currency ETFs' NAV and I use the ETF's underlying currency US Dollar value instead.

ANALYSIS

The intradaily-one-minute ETF and currency data are obtained from Pi Trading Corporation. The Total Assets (TA) and Expense Ratio (ER) data are from Morningstar.com and were retrieved on June 16, 2014. The intradaily-one-minute interval data starts at a different time for each of the six examined currency ETFs but ends on April 5, 2013. All ETFs have the same expense ratio as of June 16, 2013, 40 bps, but they differ in terms of their size. The Euro ETF, FXE is the largest with $300 million in assets, whereas the British Pound ETF (FXB) is the smallest with $75 million in assets.

Table 1 provides descriptive statistics on the six ETFs' tracking error, pricing deviation and change in intradaily volume. The average intradaily tracking error for the ETFs is very small, it is highest for the FXF, 0.000311% and smallest for FXB, -0.000014%. FXB is the only ETF with a negative tracking error. All tracking errors exhibit skewness, kurtosis, and negative and statistically significant but not necessarily economically meaningful first order autocorrelation with the exception of FXC and FXY. All six ETFs average intradaily pricing deviations are negative with the exception of the FXA pricing deviation which is a positive $0.17; the rest of the ETFs pricing deviations are -0.3778 for FXB, -0.3231 for FXC, -0.2697 for FXC, -0.2697 for FXE, -0.6484 for FXF and -0.9273 for FXY. All exhibit skewness, kurtosis and very high levels of positive autocorrelation.

Table 1. Descriptive Statistics, Entire Sample.

		N	Mean	Std Dev	Min	Max	Skew	Kurt	Pearson Autocorr
FXA	te	259521	0.00000014	0.00	-0.03	0.04	3.34	574.83	-0.39
	pd	259521	0.1742	0.12	-3.10	3.29	0.96	9.97	0.95
	chgv	259521	2.5997	16.28	-1.00	2473	46.16	4118	-0.03
FXB	te	122594	-0.00000014	0.00	-0.02	0.02	-1.91	343.45	-0.48
	pd	122594	-0.3778	0.69	-2.34	2.37	-0.30	-0.81	0.99
	chgv	122594	2.0684	15.04	-1.00	3249	117.48	22554	-0.03
FXC	te	226446	0.00000058	0.00	-0.06	0.05	-1.04	256.05	0.01
	pd	226446	-0.3231	0.29	-1.61	1.46	0.67	-1.04	0.99
	chgv	226446	2.3446	23.82	-1.00	8449	238.14	77370	-0.01
FXE	te	435149	0.000000001	0.00	-0.01	0.01	-0.02	32.57	-0.45
	pd	435149	-0.2697	0.39	-1.15	0.97	0.09	-0.97	0.99
	chgv	435149	3.8045	32.25	-1.00	5424	71.87	8807	-0.02
FXF	te	159312	0.00000311	0.00	-0.16	0.05	-9.15	1001	-0.01
	pd	159312	-0.6484	0.63	-1.93	2.08	-0.20	-1.41	0.99
	chgv	159312	2.4344	13.78	-1.00	1999	49.91	5390	-0.04
FXY	te	273328	0.00000117	0.00	-0.06	0.11	1.72	707.32	0.00
	pd	275503	-0.9273	0.78	-2.50	0.77	-0.44	-1.28	0.99
	chgv	278499	3.1683	23.65	-1.00	3278	60.05	5750	-0.02

Note: Figures in bold indicate statistical significance at least at the 10% level.

The intradaily volume changes exhibit statistically significant but economically insignificant first order autocorrelations. Formal Durbin-Watson tests for first-order autocorrelation for the tracking error and change in volume (results not reported in the interest of brevity but are available upon request). The autocorrelation results suggest that the tracking errors and volume changes are autocorrelated in each year, with the exception of the FXF and FXY, whose tracking errors do not exhibit consistent autocorrelation based on the Durbin-Watson test p-value results. Therefore, this suggests high levels of predictability but also that I should correct in the model used in the study to allow for this autocorrelation. The regression results are presented in Tables 2 and 3. Table 2 uses equation (1) and tracking error as the tracking metric, whereas Table 3 reports results for equation (1) and the pricing deviation as the tracking metric. The results for the tracking error coefficient are consistently insignificant, whereas those for pricing deviation are consistently significant across the years, with the exception of FXA. Similar to [6] the regression analysis is performed both for the entire sample of each ETF but also per year, as well. These results suggest that pricing deviation appears to be more relevant to currency ETF investors than tracking error.

Table 2. Regression Analysis Results over Each ETF's Entire Sample Period, Dependent Variable is Change in Volume, Tracking Error is used as Tracking Metric.

		FXA	FXB	FXC	FXE	FXF	FXY
Year		coefficient	coefficient	coefficient	coefficient	coefficient	coefficient
Whole	C	**2.69**	**2.12**	**2.38**	**3.87**	**2.54**	**3.24**
	lchgv	**-0.03**	**-0.03**	**-0.01**	**-0.02**	**-0.04**	**-0.02**
	lpd	-42.8	-190	-8.57	45.95	18.7	-0.20
2011	C	**2.85**	**2.63**	**2.87**	**4.34**	**2.75**	**3.73**
	lchgv	**-0.03**	**-0.08**	-0.01	**-0.01**	**-0.05**	**-0.02**
	lte	-109	-961	-19.8	-2780	-12.0	-7.30
2012	C	**3.06**	**1.76**	**2.14**	**3.60**	**1.98**	**3.95**
	lchgv	**-0.02**	**-0.05**	**-0.06**	**-0.04**	**-0.02**	**-0.02**
	lte	58.82	506.8	1.13	1820.2	74.02	35.81
2013	C	**2.43**	**2.27**	**2.36**	**4.75**	**2.90**	**4.76**
	lchgv	**-0.06**	**-0.03**	**-0.04**	**-0.04**	**-0.03**	**-0.03**
	lte	-691	125.3	59.09	2930.5	-40.5	217.4

Note: Figures in bold indicate statistical significance at least at the 10% level.

Table 3. Regression Analysis Results over Each ETF's Entire Sample Period, Dependent Variable is Change in Volume, Pricing Deviation is used as Tracking Metric.

		FXA	FXB	FXC	FXE	FXF	FXY
Year		coefficient	coefficient	coefficient	coefficient	coefficient	coefficient
Whole	C	**2.68**	**2.03**	**2.14**	**3.60**	**2.45**	**2.55**
	lchgv	**-0.03**	**-0.03**	**-0.01**	**-0.02**	**-0.04**	**-0.02**
	lpd	0.06	**-0.25**	**-0.74**	**-0.98**	-0.14	**-0.75**
2011	C	**2.45**	**2.41**	7.56	**-10.5**	**1.79**	2.14
	lchgv	**-0.03**	**-0.08**	-0.01	**-0.01**	**-0.05**	**-0.02**
	lpd	**2.05**	-0.20	8.14	**-28**	**-0.79**	-0.92
2012	C	**3.05**	**5.26**	**4.08**	**2.35**	1.79	-4.27
	lchgv	**-0.02**	**-0.05**	**-0.06**	**-0.04**	**-0.02**	**-0.02**
	lpd	0.07	**2.36**	3.38	**-1.81**	-0.13	**-3.83**
2013	C	**2.56**	-0.54	5.37	-0.66	-14.6	**33.11**
	lchgv	**-0.06**	**-0.03**	**-0.04**	**-0.04**	**-0.03**	**-0.03**
	lpd	-1.32	-1.59	5.27	-5.16	-9.60	**13.16**

Note: Figures in bold indicate statistical significance at least at the 10% level.

CONCLUSION

In this paper I study on intradaily-one-minute interval basis six currency exchange traded funds' tracking errors and pricing deviations and how they relate to the exchange traded funds' arbitrage mechanism which ensures that the exchange traded fund closely replicates its underlying currency value. I find that the tracking errors are small and stable whereas pricing deviations at first are positive but become negative and constantly increase in absolute value terms, which suggests erosion of value. I also find that these

exchange traded funds' arbitrage mechanism is more closely related to the exchange traded funds' pricing deviation than tracking error, which suggests that to currency ETF investors pricing deviation is more relevant than tracking error.

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