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Bid-ask spread dynamics in foreign exchange markets

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ABSTRACT

The aim of this paper is to examine the short term dynamics of foreign exchange rate spreads. Using a vector autoregressive model (VAR) we show that most of the variation in the spread comes from the long run dependencies between past and future spreads rather than being caused by changes in inventory, adverse selection, cost of carry or order processing costs. We apply the Integrated Cumulative Sum of Squares (ICSS) algorithm of Inclan and Tiao (1994) to discover how often spread volatility changes. We find that spread volatility shifts are relatively uncommon and shifts in one currency spread tend not to spillover to other currency spreads.

1. Introduction

The bid-ask spread reflects the revenue that is available to the dealer from trading and over time must reflect the cost components associated with trading. Changes in these costs, generally attributed to order processing, inventory, cost of carry or adverse selection, should therefore have an important impact on the evolution of the spread over time. Demsetz (1968), Benston and Hagerman (1994) and Stoll (1978) highlight the role of order processing costs. The role of inventory costs is highlighted by Garman (1976), Stoll (1978) and Amihud and Mendelson (1980) and Ho and Stoll (1981). While the importance of adverse selection costs is highlighted by, Copeland and Galai (1983), Glosten and Milgrom (1985) and Easley and O'Hara (1987).

In the context of the FX market a large number of papers have shown that the FX dealer adjusts spreads in response to changing expectations about inventory carry costs, see for example, Bessembinder (1994), Jorion (1996), Goodhart and Payne (1996) or Huang and Masulis (1999). A number of papers have also shown that spreads are adjusted to compensate for adverse selection costs, see for example, Bossaerts and Hillion (1991), Perraudin and Vitale (1996) or Lyons (1995).

In this paper we focus our analysis on how unexpected changes in inventory and adverse selection costs influence the unexpected spread. We do this because the effect of unanticipated changes in the spread on its future dynamics has not been studied but is important as the unexpected spread represents unpredictable cost components for dealers. Within the framework of our analysis we are also able to study the impact that collective shocks to adverse selection and inventory costs have on the unexpected spread which will complement earlier studies that have linked these costs to changes in the actual spread.

We use microstructure theory to frame our empirical tests and seek to determine the extent to which inventory control and adverse selection proxies influence shocks to the spread. In the context of equity markets, spread decomposition models such as those of Glosten and Harris (1988), Madhavan, Richardson, and Roomans (1997), George, Kaul, and Nimalendran (1991) or Lin, Sanger, and Booth (1995) have successfully allowed the relative importance of the different spread components to be isolated. Due to the limited availability of transaction information these models have not been employable in FX markets. Consequently, there is a much weaker understanding of how the spread evolves over time.

Using a vector autoregressive framework we model changes to five minute indicative spreads using volatility, interest rate differentials and quote revisions which collectively proxy the independent effects of information arrival, adverse selection and inventory costs. Our aim is to determine how important each of these three components are in determining the evolution of spread shocks. This paper therefore aims to add to the literature which examines liquidity in FX markets, a literature that is relatively small in comparison to that of equity markets. This is in spite of the foreign exchange market being the most actively traded financial market, representing trading activity over ten times that of equity markets (World Federation of Exchanges 2009). Moreover a particular gap exists in understanding the factors that contribute to an evolving spread as much of the previous focus has been on how FX liquidity affects exchange rate dynamics, see for example, Evans and Lyons (2002a), Payne (2003), Froot and Ramadorai (2005) and Breedon and Vitale (2010).

The approach most similar to our own is that of Huang and Masulis (1999) who collectively model the short run interdependencies between spreads, number of active dealers and volatility using a vector

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Table 1
Summary statistics spot exchange rate.
%S is the percentage relative spread, V is volatility, QR are quote revisions, CC is the percentage cost of carry. U are the mean values obtained for each five minute period, S.D. is the sample standard deviation, Min are the minimum values ×10000, max is the maximum value.

Panel A (¥/$)	Asia time				US time				European time			
	%S	V	QR	CC	%S	V	QR	CC	%S	V	QR	CC
U	0.379	0.061	43.8	0.034	0.342	0.629	73.0	0.034	0.378	0.061	53.4	0.034
S.D	0.020	9.90	40.6	0.025	0.019	7.02	58.5	0.025	0.020	9.90	47.56	0.025
Min	0.007	0	0	−0.601	0.007	0	0	−0.601	0.007	0	0	−0.601
Max	0.385	21.26	208.9	0.353	0.385	4.98	270	0. 353	0.385	0.212	241.4	0.353
Panel B (£/$)												
	%S	V	QR	CC	%S	V	QR	CC	%S	V	QR	CC
U	0.335	0.051	26.72	0.034	0.335	0.051	50.71	0.034	0.305	0.461	73.5	0.034
S.D.	0.016	7.65	28.19	0.025	0.017	7.65	51.33	0.025	0.016	3.17	65.9	0.025
Min	0.005	0	0	−0.601	0.005	0	0	−0.601	0.005	0	0	−0.601
Max	0.243	5.13	160.3	0.353	0.243	1.13	265	0.353	0.243	4.89	313	0.353
Panel C (€/$)												
	%S	V	QR	CC	%S	V	QR	CC	%S	V	QR	CC
U	0.354	0.076	77.0	0.001	0.326	0.717	164.7	0.001	0.354	0.076	126.4	0.001
S.D	0.020	1.14	30.32	0.021	0.020	5.75	67.8	0.006	0.021	1.14	49.67	0.021
Min	0.007	0	0	−0.265	0.007	0	0	−0.265	0. 007	0	0.7	−0.265
Max	0.571	1.13	203.3	0.002	0.571	9.76	375.8	0.002	0.571	1.13	269.6	0.002

autoregressive model. We also use a vector autoregressive model but focus instead on the effects that changes in the microstructure proxies have on spread innovations. We use a high frequency sample of foreign exchange quotes over a ten year period. Most previous studies of the spread have focused on relatively short periods of time, a longer period of study will allow us to abstract from short run information events that may have a short term effect on spreads. To circumvent from time of day effects, shown to be important for the spread by Huang and Masulis (1999) and Goodhart and Figliuoli (1991) we present results separately for three separate time zones.

When we examine unexpected changes to the spread the VAR shows that microstructure variables within the VAR system have a small impact on explaining the variation in unexpected spreads. Variance decompositions reveal that about 90% of the variation in the spread originates from the spread itself. Impulse responses show that the largest impact on the spread is derived from prior spread shocks, the other microstructure components have only a marginal influence.

We also apply the Integrated Cumulative Sum of Squares (ICSS) algorithm of Inclan and Tiao (1994) to discover more about the evolution of the relative spread. The aim of the ICSS test is to identify the number and date of any volatility shifts in a series allowing us to ascertain how changeable uncertainties in the trading costs are for each currency and whether volatility shifts in one currency spread are related to any others. We find that there are not a large number of spread volatility shifts each year, although volatility shifts in the spread do tend to cluster year to year. Most volatility shifts indicate a reduction in spread volatility but do not tend to outweigh shifts that cause a rise in volatility as although they tend to be infrequent they tend to be very large and therefore appear to be long lasting.

The remainder of this paper is set out as follows. Section 2 describes the data and shows how the bid-ask spread has evolved over our sample period. Section 3 describes and motivates the use of the VAR methodology that we use. Section 4 provides the main results. Section 5 provides a summary and offers some conclusions to the paper.

2. Data and summary statistics

We use the Olsen & Associates HFDF93 database of spot exchange rate quote information for Yen/US dollar (¥/$), UK pound/US dollar (£/$) and Euro/US dollar (€/$).[1] These are the three most actively traded currency pairs in the foreign exchange market. The period we examine extends from January 1st 1995 to January 31st 2005 for (¥/$), and £/$ from January 1st 2001 to January 31st 2005 for the €/$ dollar. The Olsen database has been used widely in exchange rate studies previously, see for example, Ito, Lyons, and Melvin (1998), Anderson and Bollerslev (1998), Anderson, Bollerslev, Diebold, and Ebens (2001), Andersen, Bollerslev, Diebold, and Vega (2003) or Maheu and McCurdy (2002). A detailed description of the database is provided by Beck, Bowen, and Meissner (1999).

The data we utilize consists of time-stamped five minute interval closing bid and ask quote information. This is a bilateral indicative quote but does not necessarily represent the best prices on both sides of the market. Recently there has been some debate about whether indicative quotes can provide unbiased quotation estimates as dealers can quote to merely retain a presence Demos and Goodhart (1996) or follow a competitor. Despite this possible limitation Goodhart and O'Hara (1997) and Phylaktis and Chen (2009) find that indicative quotes are actually more informative than transaction prices.

Each exchange rate pair trade in a 24 h market as market activity is undertaken in different time zones. Since there are known to be important intra-day seasonality in the behavior of spreads, see for example, Goodhart and Figliuoli (1991) or Huang and Masulis (1999) we examine the Asian, European and US time zones separately. Each of our time zones is based on 8 am to 5 pm local time allowing us to capture most of the daily trading activity that takes place. Each time zone is referenced in terms of Greenwich Mean Time (GMT) as shown in Fig. 1. For each five minute closing quote we calculate the closing relative spread. In Graphs 1.1–1.3 we present the evolution of the daily relative spread calculated as the daily average of five minute daily spreads for the US time zone. Graphs 2.1–2.3 present the information for the Asian time zone and Graphs 3.1–3.3 for the European time zone.

Visible from these graphs is the clear decline in spreads that takes place during the sample period. Also noticeable is that between 1999 and 2001 the relative spreads appear to be more volatile. Looking at the Asian time zone during 1998 the effects of the Asian crisis on

[1] The Olsen database provides information from the Reuters platform.