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Price response functions and spread impact in foreign exchange markets

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Abstract To be done

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1 Introduction

Basic description:

The foreign exchange market is the most volatile and liquid of all financial markets in the world [17]. It is also the largest financial market in the world [16,13]. Its importance in the world economy is prominent. It affects employment, inflation, international capital flows, among others [11]. The foreign exchange market is a decentralized market without common trading floor [11,16,3]

In the foreign exchange market, the trading day begins in the markets of Australia and Asia. Then the markets of Europe open and finishes late in the afternoon in New York [11]. The markets does not formally closes during the week. Thus, using the New York time as reference, the market opens on Sunday at 18h00 and closes on Friday at 18h00 (?).

The term "pip" (Price Increment Point) is commonly used in the foreign exchange market in place of the word 'tick'. Pips arise as a matter of convention. A pip refers to the incremental value in the fifth non-zero digit position from the left. Note that it is not related to the position of the decimal point. For example, one pip in a USD/JPY value of 113.57 would be 0.01, while one pip for EUR/USD of 1.0434 would be 0.0001 [14,11].

The foreign exchange market has attracted a lot of attention in the last 20 years. Electronic trading has changed an opaque market to a fairly transparent with transactions costs that are a fraction of their former level. The large amount of data that is now available to the public make possible different kinds of analysis to this data. A lot of research is currently carry out in different directions [1,2, 18,11,5,9,16,17,7,3,10,12,6,15,13].

Previous works (general):

In [14] they found that smaller volumes cause larger bid-ask spreads for technical reasons to do with measurement, whereas in [8,9] claim that larger bid-ask spreads caused smaller volumes due to trader behavior.

In [1], they found the spreads to be between two and four times larger for emerging market currencies than for developed country currencies.

In [5], they found the Electronic Broking Services (EBS) reduces spreads significantly, but dealers with information advantage tend to quote relatively wider spreads.

In [10], they found that bid-ask spreads increase when the foreign exchange market volatility increases, and decrease when the dealer competition increases.

In [17], they focus in the three major market characteristics, namely efficiency, liquidity and volatility, finding that the market is efficient in weak form.

In [18], they investigate the dynamics of efficiency and long memory of four major traded currencies.

In [4] they analyze the foreign exchange futures market and found that the number of transactions is negatively related with bid-ask spread, whereas volatility in general is positively related.

Previous works (specific):

In [15], they simulate their proposed model for different region foreign exchange markets to analyze the impact of a one-standard-deviation shock using impulse response functions. The general pattern of response was a fairly steep drop over the first couple of days followed by a few days of gradual decline until the response is not statistically different from zero.

In [13], they model the price impact and return reversal to analyze liquidity. Their model predicts that more liquid assets should exhibit narrower spreads and lower price impact.

Explanation of our work:

Due to the lack of available data, very few studies exist on price response functions in the foreign exchange market. Despite the foreign exchange market is often cited as the world's largest financial market, this description fail to consider the considerable differences in trading volume and liquidity across different currency pairs [6]. These differences can be directly seen in the spread. Furthermore,

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the bid-ask spread is directly related with the transaction costs to the dealer [3,4].

Paper distribution:

The paper is organized as follows: in Sect. 2 we present our data set of foreign exchange pairs and briefly describe the physical and trade time. We then analyze the definition of the response functions in Sect. 3, and compute them for the majors pairs in Sect. 4. In Sect. 5 we show how the spread impact the values of the response functions. Our conclusions follows in Sect. 6.

2 Data set

In this study, we analyze foreign exchange pairs from the foreign exchange market.

We selected the foreign exchange market because ...

The foreign exchange financial data was obtained from HistData.com. We used a tick-by-tick database in generic ASCII format for different years and currency pairs. The data comprises the date time stamp (YYYYMMDD HHMMSSNNN), the best bid and best ask quotes prices in the Eastern Standard Time (EST) time zone. No information about the size of each transaction is provided. Also, the identity of the participants is not given.

For each exchange rate, we process the irregularly spaced raw data to construct second-by-second price and volume series, each containing 86,400 observations per day. For every second, the midpoint of best bid and ask quotes or the transaction price of deals is used to construct one-second log-returns.

3 Response functions

In Sect. 3.1 we establish the fundamental quantities used in the price response definitions. In Sect. 3.2 we describe the physical time scale and the trade time scale. We introduce the price response functions used in literature in Sect. 3.3.

3.1 Key concepts

Due to the lack of prices information in the data, we consider a basic definition of the price given by [7,12,13]

$$S_i(t) = \frac{a_i(t) + b_i(t)}{2} \tag{1}$$

Order book ref [11]
Spread ref [3]
Midpoint ref [3]

3.2 Time definition

3.2.1 Trade time scale

3.2.2 Physical time scale

3.3 Response function definitions

4 Price response function implementations

In Sect. 4.1 we analyze the responses functions in trade time scale and in Sect. 4.2 we analyze the responses functions in physical time scale.

4.1 Response functions in trade time scale

4.2 Response functions in physical time scale

5 Spread impact in price response functions

As we showed in 1, due to the difference in the position of the decimal points between foreign exchange rates, we need to introduce a "scaling factor" with the purpose of bringing the pip to the left of the decimal point. For example, the scaling factor for the USD/JPY is 100 and that for the EUR/USD is 10000.

The pip bid-ask spread is defined as [14]:

$$\text{pip}_{spread} = (a(t) - b(t)) \cdot \text{scaling factor} \tag{2}$$

6 Conclusion

7 Author contribution statement

TG proposed the research. JCHL developed the method of analysis. The idea to analyze the spread impact was due to JCHL. JCHL carried out the analyisis. All the authors contributed equally to analyze the results and write the paper.

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Appendix A Foreign exchange pairs used to analyze the spread impact

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