

Executive Summary

“Forex never sleeps”. The Foreign Exchange (FX) market contrarily to other major markets in the world, such as the stock exchanges or the future markets, is open 24 hours a day, 5 days a week. This is possible because the foreign exchange market does not have any borders and each currency of the world can be traded independently from the country of origin. The different time zones all over the world and consequently the different market opening and closing hours ensure that there is always an open market throughout the 24 hours of a day. Furthermore the FX market is involved in most of the transactions that take place every moment and this makes sure that it is the world’s largest market.

These particular conditions of the FX market allow for unique researches on intraday exchange rates movements, which are important to understand if the regular trends challenge the random walk of the currencies.

The purpose of this study is to analyze if the depreciation of the local currency during domestic trading hours present in the past literature is still observable, or even accentuated, during and after the recent financial crisis.

With our work we also aim to confirm and underline the important role of the order flow as a driver for the exchange rate returns, which should accordingly follow the intraday patterns of the FX returns.

Furthermore by using recent data sample we try to better understand the consequences on the FX intraday patterns of some extraordinary central bank interventions.

The research extends the extant literature on FX return patterns by providing an analysis of recent FX intraday patterns during a period of crisis and by investigating the US dollar and its various exchange-rate crosses whereas the past literature focuses mainly on the major exchange rates.

Moreover the work analyzes with updated data the order flow as main driver of the FX return patterns and as responsible for the liquidity effect.

This study also contribute to the FX intraday literature by analyzing the market under the special conditions of an acute financial crisis such the one experienced between August, 2008 and September, 2009, when several unconventional monetary policies were put in place to alleviate market strains on the US dollar FX and funding markets or to sustain the CHF.

We choose to focus our analysis on the US dollar and its major crosses because of its world leading role and high liquidity.

The database used in this research is provided by Electronic Broking Services, which is the dominant broker in the major currency pairs like EUR/USD or USD/JPY.

The time period considered is from January, 2007 until Mai, 2012. This time selection covers the most recent financial crisis started in 2007 and allow us to inquire the acute crisis and the period following it.

We first analyze intraday variation by applying a similar procedure of Breedon & Rinaldo (2012), who start considering the aggregated 4-hour return periods data, and subsequently assess the whole sessions’ returns data. With the sessions’ patterns analysis a trading strategy profitability based on

the intraday patterns is tested. We then focus in more depth on a shorter and particularly high strain period, calling it of “acute crisis” and repeating the 4-hour returns intraday analysis.

In addition, we analyze the order flow and its relationship with the exchange rate movements. In this case a 1-hour aggregated order flow data analysis is performed as well as a session data analysis. Furthermore, we run a statistical regression of the exchange rate returns on the order flow in order to uncover the impact and the significance of this last.

The successive order flow analysis underlines the importance of the FX market liquidity for the intraday patterns. Finally the study explores some central banks’ interventions on the home currencies and their effects on the previous patterns.

The research findings empirically confirm that for most of the analyzed currency pairs the previous existing intraday patterns in FX returns continue to exist also during the recent period of crisis and market uncertainty, going from 2007 until 2012. In fact our 4-hour period and session return analysis for the crisis period, confirms the results of Rinaldo (2009) and Breedon & Rinaldo (2012): the local currency depreciates during the domestic FX trading hours and appreciates during the counterparty FX trading hours.

This trend is visible when there are different national trading hours given by different time zones all over the world and when the domestic-time bias realizes. The only exception is the JPY, which shows opposite patterns than the other analyzed currencies.

We have also found that the confirmed patterns in FX returns over the 5 years period are now generally smoother than in the past despite maintaining their statistical significance, especially for the EUR/USD and the GBP/USD.

We mainly explain the observed intraday patterns through the liquidity effect. The principal cause of the regular movements of the exchange rate are to research in the inventory imbalances of the liquidity suppliers, that after experiencing a net buying/selling pressure caused by the domestic-currency bias and the domestic-time bias, adjust their price for the currencies defining the observed patterns. Another, not excludable, explanation is given by the asymmetric information. This explanation implies that the trades convey information about the fundamental values of a currency and therefore determine the price (adjusted by the liquidity suppliers after having seen the informative trades).

Due to the confirmation of the presence of intraday patterns we have decided to test if these patterns can be exploited for profit. With the use of a trading strategy adapted for the observed trends, i.e. buying US dollars at the beginning of the foreign session and selling US dollars when the USA session starts, we have surprisingly discovered that for the EUR/USD the strategy is still profitable after considering the transaction costs (represented by the bid/ask spread).

A possible explanation for this outcome, is related to the limited funding access that market agents experience during adverse market conditions, which particularly emerges during financial crisis. In fact, the market uncertainty and the low liquidity during a crisis, limit the action of market agents, who cannot arbitrage away these profit opportunities left out by the intraday patterns in FX market. For all the other currency pairs the strategies profits result negative.

Another characteristic of the considered period are the continuous changes in market conditions, with some turbulent and quieter times.

In the so called “period of acute crisis” going from August, 2008 until September, 2009 and identified with the help of the VIX and the Libor-OIS spread data, we further analyze the FX patterns during extreme market conditions and higher uncertainty among the market agents.

During this special time we observe the same patterns over 4-hour return periods, but in this case they are emphasized. In fact, in most of the cases, the returns reach values much higher than in the whole sample analysis. We explain this phenomenon by the reduced liquidity in the FX market and by the increased general uncertainty that both increase the volatility of the exchange rates and highlight the previously observed patterns.

The period of strains has therefore an impact on the returns magnitude but not necessarily on the profitability of the trading strategies. In fact, the larger bid/ask spread present during low liquidity periods and the consequent higher transaction costs, prevent some of our short/long strategies to improve their profitability by exploiting the emphasized intraday patterns. The two currency pairs that deliver a positive profit during the period of acute crisis are the EUR/USD and the USD/CHF.

Based on market microstructure theory, the order flow is the driver for the exchange rate movements, conveying information to the market which then aggregates them for forming the currency price. The order flow is therefore the responsible for the exchange rate movements and our analysis on the intraday 1-hour period data confirms similar patterns as the ones observed for the returns. Especially for the EUR/USD we can notice that there is a dominant US dollar selling pressure during USA trading session and a US dollar buying pressure during the EU session.

A regression of the FX returns on order flow confirms the high statistically significant positive correlation between the order flow and the exchange rate returns, but underlines lower explanatory power (in form of R-square) of order flow compared to the past literature. Therefore, we conclude that the turbulent periods have reduced the explanatory power of the order flow on the returns. Further analysis underlines that the impact of the order flow on the returns increases during low liquidity and uncertainty periods, maintaining the positive correlation and the high statistical significance.

Especially in the order flow analysis the results obtained on currency pairs like AUD/USD, GBP/USD or USD/CAD, which are principally traded on the Reuters platform, are influenced by the lower market share of EBS, which is the most used platform for EUR/USD, USD/JPY and USD/CHF.

Proved the importance of the liquidity in the FX market we have focused on the analysis of the funding liquidity, one of the factors influencing the FX market liquidity through the liquidity spirals mechanism presented in the paper of Brunnermeir & Pedersen (2009). In fact the limited access to funding channels brings the market agents to reduce their positions and consequently the market liquidity shrinks, causing more volatility and higher required margins, which in turn tighten further the agents’ funding constraints and prevent them to provide liquidity.

Central banks’ measures can influence the market agents’ access to funding and are especially used in periods of liquidity stress. In this study we give attention to the swap line program set up by the FED in order to increase the liquidity of the US dollar. This program facilitates the access of foreign central banks to the US dollars which are then injected in the different local markets. By

influencing the funding liquidity of the US dollar the FED influences the whole FX liquidity and consequently the observed patterns.

Our analysis on the effect of the swap line program on the intraday patterns in FX returns focuses on the EUR/USD and the activities of the ECB. The individuation of two periods of activity/non activity of the ECB on the swap line has permitted us to observe that when the ECB actively draws US dollars from the line by the FED, the depreciation pattern of the EUR during the EU session disappears and the overall volatility is reduced. Therefore, the ECB can therefore successfully enhance the liquidity on the EUR/USD market (especially during the EU session) and this smoothes the volatility and the returns' magnitudes, modifying the regular patterns registered when the line is not used or before the swap line program start. This happens because the agents present on the EU market can use another funding channel instead of using the market.

Another example of central bank intervention that modifies FX market liquidity comes from the SNB, that introduced the minimal exchange rate for the EUR/CHF. The massive EUR buying program for sustaining the minimal exchange rate for the CHF has a spillover effect also on the USD/CHF pair and its intraday patterns, with the SNB literally making the market and direct influencing the FX market of the CHF. By analyzing the intraday patterns of the USD/CHF before and after the SNB intervention we can see that the patterns before the minimal threshold are relatively smooth and follow the whole sample patterns. However afterwards the patterns present a large dominance of CHF depreciation through the whole day.

The main findings of our study provide updated information about the intraday exchange rate movements for some major US dollar currency pairs, which represent a large part of the world's market. This information can be used by market agents to optimize their time for transactions and by central banks to estimate the possible changes in the intraday patterns due to their interventions. By summing up the main findings of our research are:

First: the FX intraday patterns during the analyzed 5 years of crisis (2007-2012) are still present for most of the considered currencies (EUR/USD, GBP/USD, AUD/USD and USD/CHF) but are smoother compared to the findings of the past literature.

Second: The patterns during a period of acute crisis, characterized by low liquidity and higher uncertainty in the markets, are emphasized and reach high levels of annualized returns. Usually, less liquidity in the FX market denotes emphasized patterns and more liquidity involves smoothed patterns and less volatility of the returns.

Third: Both during the 5 year and the acute crisis investigations there are some possible profit opportunities with a simple short/long strategy and without any private information, which can be seen as arbitrage opportunities.

Fourth: The order flow of each considered currency pair is positively correlated with the returns and has a very significant impact, which increases when the liquidity is lower. The explanatory power of the order flow is lower than the values showed in the past literature, at least for the currencies where EBS has the largest market share.

Fifth: External extraordinary intervention by the central banks can completely modify the patterns registered during the periods without these additional interventions, the central banks alone have enough power to make the market.