Master's Degree in Finance

Master 2 Finance: Management des Risques Financiers

Final Thesis

# The effects of Bank of England's and Federal Reserve's unconventional monetary policies on the equity capital flows between the UK and the US


**Supervisor**
Ch. Prof. Eric Girardin

**Graduand**
Marco Cortese
Matriculation Number 873571


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## 1. Introduction

Since the start of the Great Financial Crisis, several measures have been put in place to try to limit the negative effects on the economy. A relevant role in this scenario has been played by the central banks of countries all over the world, which implemented new unconventional monetary policies, as it was the case with the so-called quantitative easing. The impact of those actions has not been limited to the national economies on their own, but also influenced flows of capital between them.

This dissertation focuses on the equity capital flows between the United States and the United Kingdom, and in particular on the effects that the unconventional monetary policies adopted by the central banks of the two nations had on these flows.

The main objective is, in fact, trying to capture the elements that can explain the movement of capital between the two countries, with the intent of assessing the different factors that influenced the decisions took by the actors of the financial market. While the quantitative easing measures clearly represent one on the main expected variables that influenced the equity flows, other elements potentially played a role in shaping the financial scenario in which choices were to be made. The thesis tries to find what these factors were and to what degree they were relevant in explaining the framework.

In the years following the financial crisis, many authors have contributed to the literature on such topic. Of course, the crisis had a global impact, and therefore different approaches and focuses have been utilized, as some researchers decided to focus their efforts on emerging countries rather than on developed economies.

As the United States were the central node in the developments of the events related to the GFC, and considering the importance of the Federal Reserve, its timing and its influence on other central banks' decisions, many papers select the American economy as one of the main elements in their framework.

Fratzscher, Lo Duca and Straub (2013) found that the different phases of quantitative easing had different effects on the markets. In particular, the first phase, known as QE1, boosted the US equity market and led to a portfolio rebalancing across countries, while

QE2 raised non-US equity markets and saw a portfolio rebalancing across asset classes rather than countries.

Park, Ramayandi and Shin (2014), instead, found that there has been a shift in relevance between bonds and equity before and after the crisis. While the former were predominant before the crisis, the latter, together with other flows, became more important in the aftermaths of such events.

For the scope of the dissertation, the analysis has been limited to the equity flows between the United States and the United Kingdom, in order to have a more precise relation to analyze. The selected dataset relies on the *Treasury International Capital (TIC)* provided by the US Department of the Treasury. In detail, the monthly transactions in long-term securities between US and foreign residents are the key treated data.

As far as the method is concerned, a multiple linear regression has been the solution of choice, as it represents the most suitable instrument for such an analysis.

The explanatory variables implemented in the model include a proxy for the monetary policies of the two central banks, one for the stock indices in the two markets, one for the perceived risk, the exchange rate between the two countries and finally the spread between the 10-Year Bond Yield.

The results suggest that the monetary policies implemented had an effect on the equity flows between the United Kingdom and the United States throughout the considered sample, even though the magnitude of such an influence varied with time. Other elements, such as the proxy for risk, also highlight than an increase in such a factor resulted in an outflow from the US to the UK, as one would expect.

In general, it is possible to confirm that the selected regressors had the capacity to partially explain the equity flows between the two countries, even though the relevance differed greatly based on the period taken into consideration.

With respect to the previous works presented by different authors, this dissertation provides a different perspective, as it focuses on the interactions between two specific countries, rather than looking at how a set of economies reacted to the events and policies determined by the crisis at the beginning of the century.

The thesis is divided in different sections. Initially a brief literature review on some of the most relevant works on the topic is presented. The following section, instead, illustrates the data and methodology, explaining in detail the selected dataset, each of the variable chosen and the considerations and adjustments implemented for each one of them. In addition to this, the methodology and the explanation of the specifications are addressed in detail in a paragraph. A further section treats the empirical analysis and the results obtained from it. In particular, the empirical part presents the outcomes of the model specified in the previous section, with all due adjustments, and this is followed by a specific paragraph that explains the interpretation of the final results. After a section dedicated to the conclusions, it is possible to find an appendix with the relevant tests implemented in the analysis and an additional paragraph presenting a failed attempt that has been carried out.

## 2. Literature Review

Over the past decades, several authors have tackled the matter of global capital flows, with the intent of explaining the causes of certain movements and patterns.
The reasons why capital moves from one country to another might be several, and academics have debated for a long time over which is the best approach to adopt in order to address this matter.
In their paper, Fratzscher, Lo Duca and Straub (2013) focus on the international effects of the unconventional monetary policies implemented by the Federal Reserve during the Great Financial Crisis, and it assesses whether each phase corresponded to an inflow or an outflow from the US equity market. The first point made by the authors concerns a crucial distinction in the essence of the quantitative easing operations, with a different approach adopted for the first phase, known as QE1, and the second one, known as QE2. In the former, in fact, the focus was on liquidity operations, while in the latter it was on purchasing US treasury securities. The outcome of the operations was also different, as the paper finds that QE1 boosted the US equity market, while QE2 had the effect of raising foreign equity markets. A further finding affirmed that QE1 measures led to a portfolio rebalancing across countries, while QE2 actions implied a portfolio rebalancing across asset classes.
An additional important differentiation is the one among advanced and emerging economies, for which different variables are implemented in the model. This, of course, gives more depth to the work, as it allows the analysis to distinguish between two macro classes and thus providing much clearer results. Overall, the results state that the unconventional monetary policies implemented by the Federal Reserve have not significantly affected the magnitude of the capital flows to emerging economies, but have rather impacted the variability and pro-cyclicality of capital flows.

In a previous work, Fratzscher (2011) analyzes the capital flows during the Global Financial Crisis distinguishing between push and pull factors. The former can be exemplified by monetary and fiscal policies in advanced economies, while the latter can be illustrated by differences between emerging market economies and advanced

market economies. Of course, the literature is not unanimous on the prevalence of one set of factors over the other, but rather has different views on the matter.
A first important finding suggests that, compared to the years preceding the Global Financial Crisis, a significant reallocation of capital from emerging, and some advanced, countries to the US has been observed. Furthermore, the sign of the effects changes during the crisis, implying that, for example, while before the crisis an increase in risk implied an outflow from advanced economies into emerging economies, during the crisis the opposite happened. These elements suggest that, while the crisis lasted, flight-to-safety played a significant role in influencing capital flows. One consideration emerging from the empirical results of the paper regards the sensitivity of flows to the crisis events, which triggered substantial capital outflows out of equities in both emerging and advanced economies, but induced net inflows into bonds of advanced economies.

A further analysis on the effect of the Quantitative Easing implemented by the Federal Reserve and the relative effects on international capital flows is presented by Khatiwada (2017). Here the author focuses on the capital flows between the US and both emerging and EU countries.
In order to do so several variables are selected and implemented in the model. An example of push factor utilized is the VIX index based on the S&P500, which is taken as a proxy for risk. Other elements are the interest rate differential between the countries, the exchange rate and the difference in the GDP growth rate. As far as the outcome is concerned, the study is aligned to the previous literature on Quantitative Easing and international flows, as it supports the vision that QE episodes led to substantial inflows while tapering was linked with a period of retrenchment. A crucial highlighted point, though, is the different behavior displayed by EU countries compared to emerging economies.

Park, Ramayandi and Shin (2014) also tackled the issue of capital flows during the crisis period, but focused on developing Asian countries. In particular, they concentrated on the spillovers of the three rounds of quantitative easing implemented by the US Federal

Reserve. In their analysis there is an important differentiation between types of capital flows, isolating equity and bonds from other kind of flows, such as foreign direct investments. This distinction allows the authors to have a clearer view on the impact of the measures implemented as a consequence of the crisis, and highlights how, while before the global financial crisis bonds were the predominant component, after that event equity and other flows gained more relevance. The empirical results of the work suggest that the first phase of the quantitative easing implemented by the Federal Reserve had more influence compared to the two following phases.

# 3. Data and Methodology

## 3.1. Data presentation and descriptive analysis

The central dataset for the scope of the dissertation is the *Treasury International Capital* (*TIC*) provided by the US Department of the Treasury. In particular, the data focuses on monthly transactions in long-term securities between US and foreign residents, thus covering US and foreign securities. The data is divided by country, and the subset including the United Kingdom has been selected. The data is presented at a monthly frequency, and the working sample goes from the beginning of 2008 until June 2018.

The net flows between the two countries are obtained by taking the difference between the total inflows and total outflows. The former are calculated by adding the gross purchases by foreigners from US residents of US corporate stocks and foreign corporate stocks, while the latter are obtained by adding the same elements but according to gross sales by foreigners to US residents. A crucial notion is that a US perspective is taken, meaning that inflows mean capital that is going into the United States, while outflows imply capital going out of that country.

It is important to underline that, for the scope of the dissertation, the data is taken in cumulative form. The selected variable to work on is then the rate of change of cumulative net flows. The original dataset is not seasonally adjusted, and thus, this issue had to be taken into consideration and accounted for in the elaboration of the data.

As observed in Figure 1, the net flows experience an inversion of the trend and of the sign approximately in 2016. This period of time corresponds to the developments of the Brexit, which may have played a role in the shift of capital flows. While before such moment the cumulative net flows were positive, meaning that more capital was going into the US, after that date the opposite was true. During that timeframe, the rate of change also displayed some spikes. This was due to the fluctuation of the cumulative net flows and the change in sign, giving rise to very high rates of change.

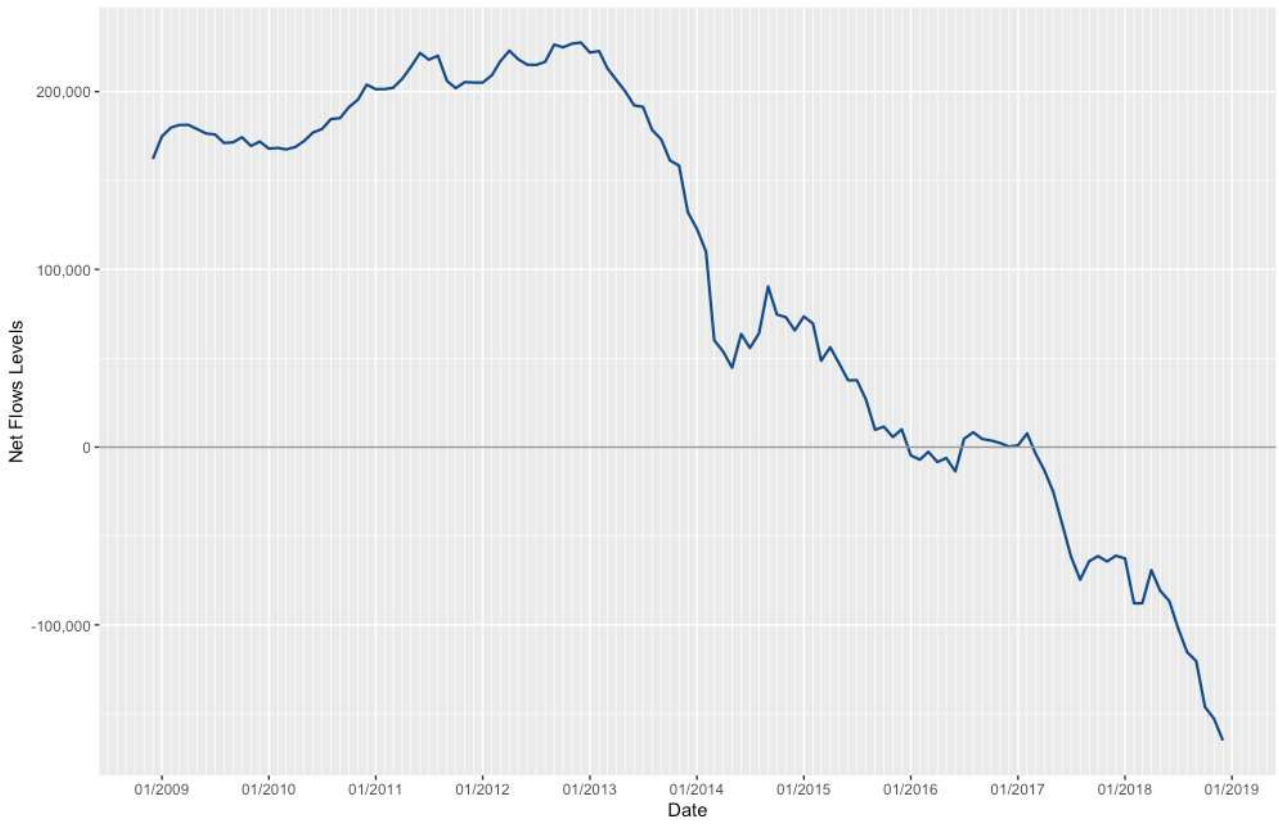


*Figure 1: Net Flows Levels between the United States and the United Kingdom over the period from 12/2008 to 12/2018*

As far as the independent variables are considered, the first one to be presented focuses on the balance sheet of the central banks of the two countries. In order to measure the level of the quantitative easing, several proxies could be chosen. For the scope of this dissertation, the selected one is the total assets of the central banks. For the total assets of the Federal Reserve, the dataset was retrieved by FRED St. Louis, and the selected time series is total assets every Wednesday. Once again, the original dataset was not seasonally adjusted, and so measures to tackle the matter had to be implemented.

As far as Bank of England's total assets were concerned, instead, two datasets had to be considered. The main reason is that the central bank, that is the source of the data taken into consideration, ratified a change in the reporting system of its balance sheet in 2014. In order to obtain a time series with monthly observation, the data had to be harmonized on a frequency scale as well, as initially it was provided weekly.

As shown in Figure 2 and Figure 3, the total assets of each of the two central banks follow a similar and generally increasing trend, even though the sizes of the two balance sheets are significantly different.

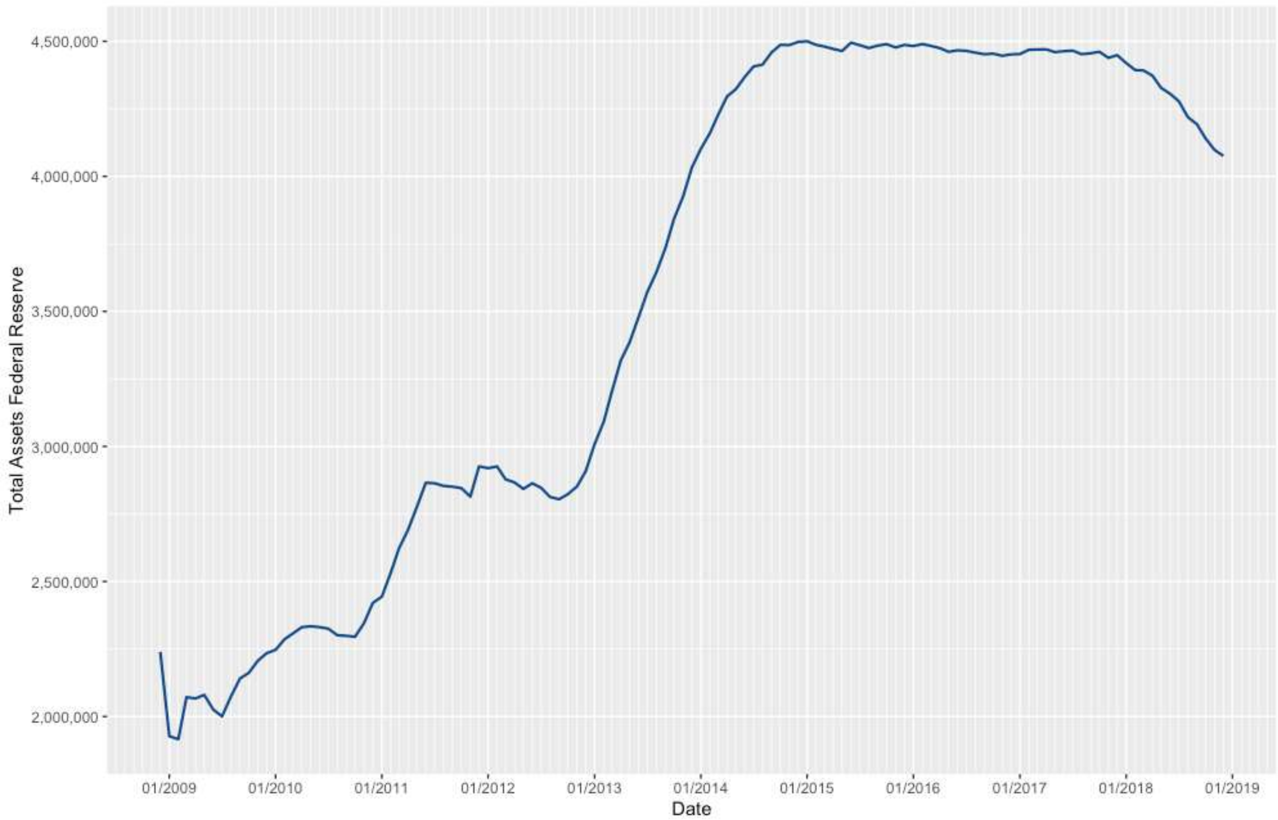


*Figure 2: Total Assets of the Federal Reserve over the period from 12/2008 to 12/2018*

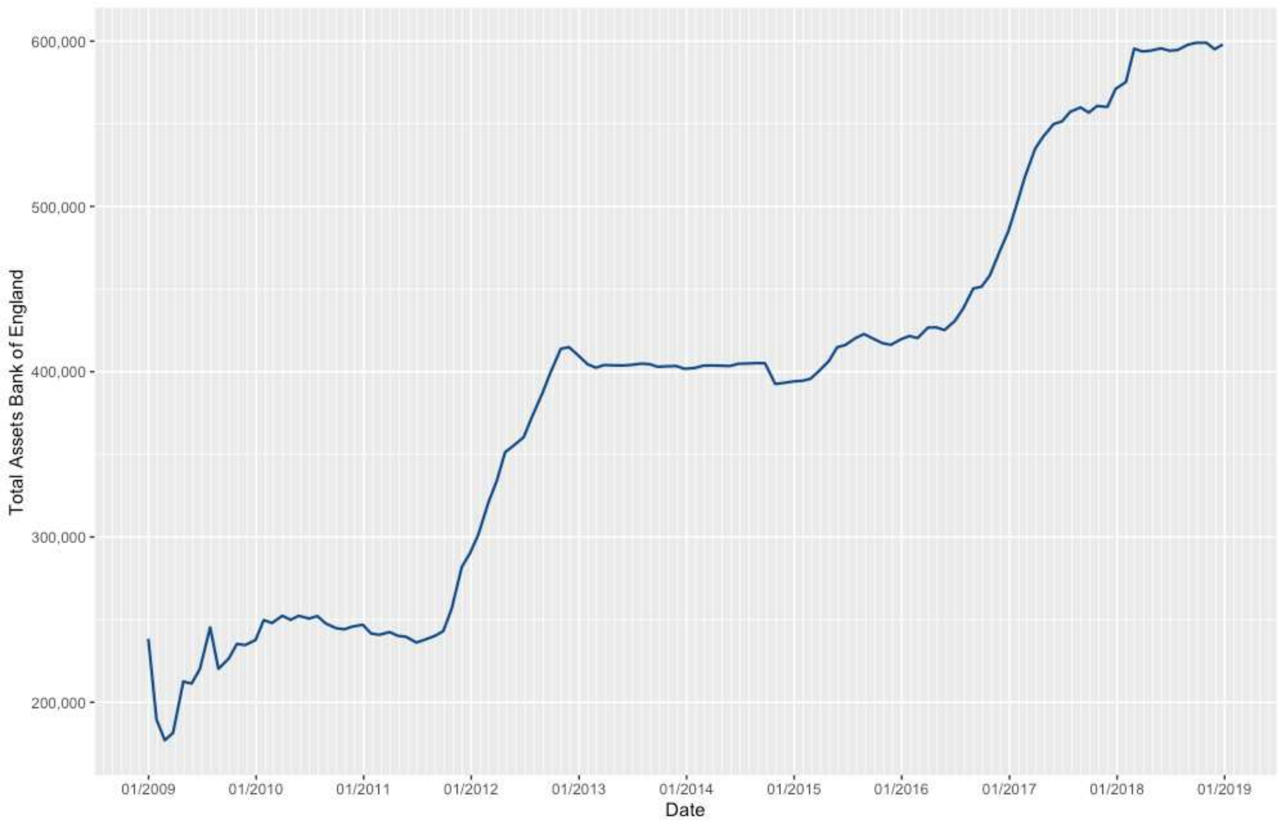


*Figure 3: Total Assets of the Bank of England over the period from 12/2008 to 12/2018*

Finally, to obtain the final variable for the analysis the differential between the two rates of change was taken. As shown in Figure 4, the main fluctuations in the rate of change of the differential of the total assets is observed in the first period of the dataset, while the swings tend to normalize and decrease in magnitude as the quantitative easing operations were limited and came to an end.

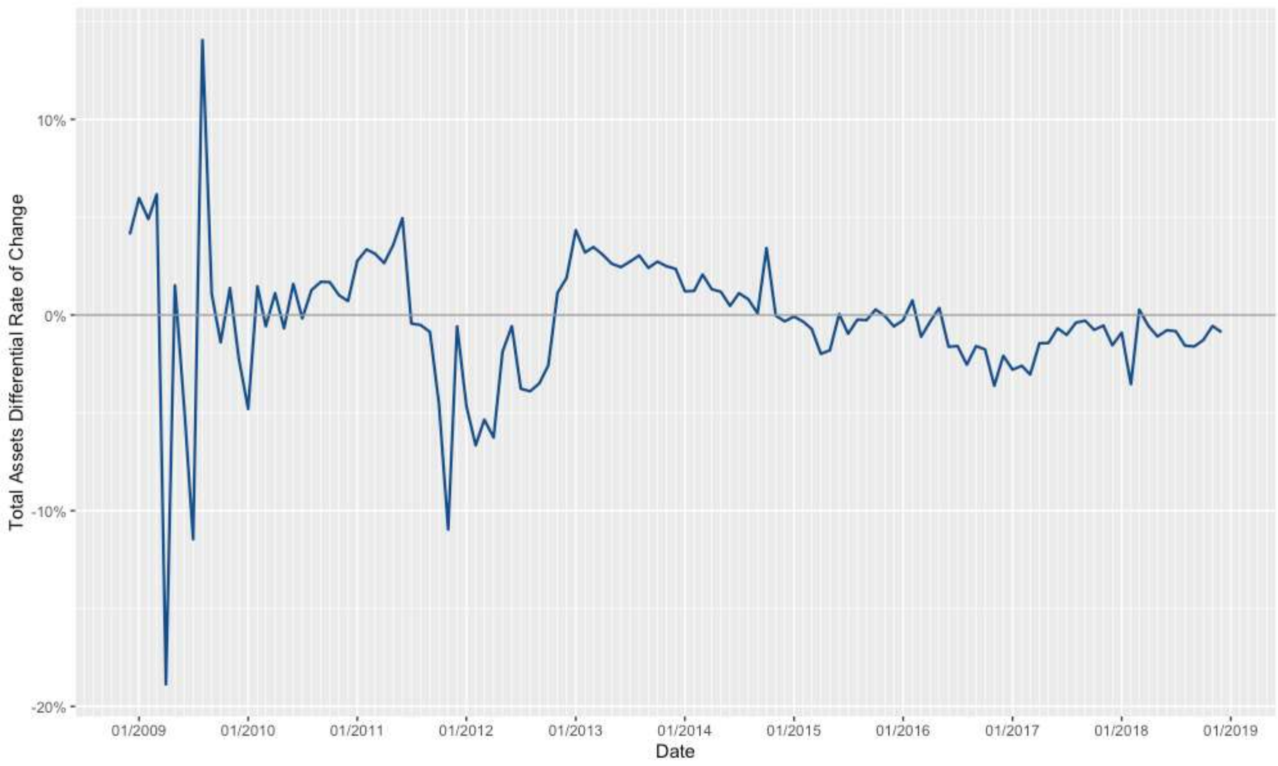


*Figure 4: Total Assets Differential Rate of Change over the period from 12/2008 to 12/2018*

The second variable focuses on the equity markets of the two nations. For the equity market in the United States, the S&P 500 was selected. The time span of the observation is equivalent to the one mentioned for the net flows. In order to recreate a variable with frequency matching the one of the TIC dataset, we took daily observation and created a monthly proxy by means of selecting the average of close observations. Once again, the original data was not seasonally adjusted, and this matter had to be taken into account and treated in order to obtain a time series free of the seasonal component. An equivalent procedure has been adopted for the United Kingdom, with the FTSE100 being the selected equity index. For each of the two indices, the rates of change of the monthly observation were taken. Finally, in order to create the variable to be implemented into the model, the difference between the S&P500's and the FTSE100's returns were taken, keeping the same order as in the net flows.

As presented in Figure 5, the time series is stationary, with swings comprised between -6% and +8% approximately.


*Figure 5: Stock Indices Differential Rate of Change over the period from 12/2008 to 12/2018*

As a proxy for risk, a measure involving the VIX indices of the equity markets of the two countries has been included in the model as well. For the United States, the VIX index for the S&P500 was the series of choice. In order to get a viable measure, a similar approach to the one implemented for obtaining the monthly data for the stock indices has been implemented. In particular, starting from daily data, the average of closing value for each month has been selected in order to create a time series with monthly frequency. Once again, the data was not seasonally adjusted. As far as the United Kingdom is concerned, the VFTSE index has been selected. The time series has been obtained through Refinitiv. The procedure to obtain a monthly series is equivalent to the one illustrated above for the VIX index.

As with the previous variables, this time as well a further elaboration that accounted for taking the differential of the rates of change of the two elements has been implemented.

As plotted in Figure 6, the seasonally adjusted rate of change of the VIX indices differential is stationary, with swing comprised between approximately -20% and +50% at the highest observations.

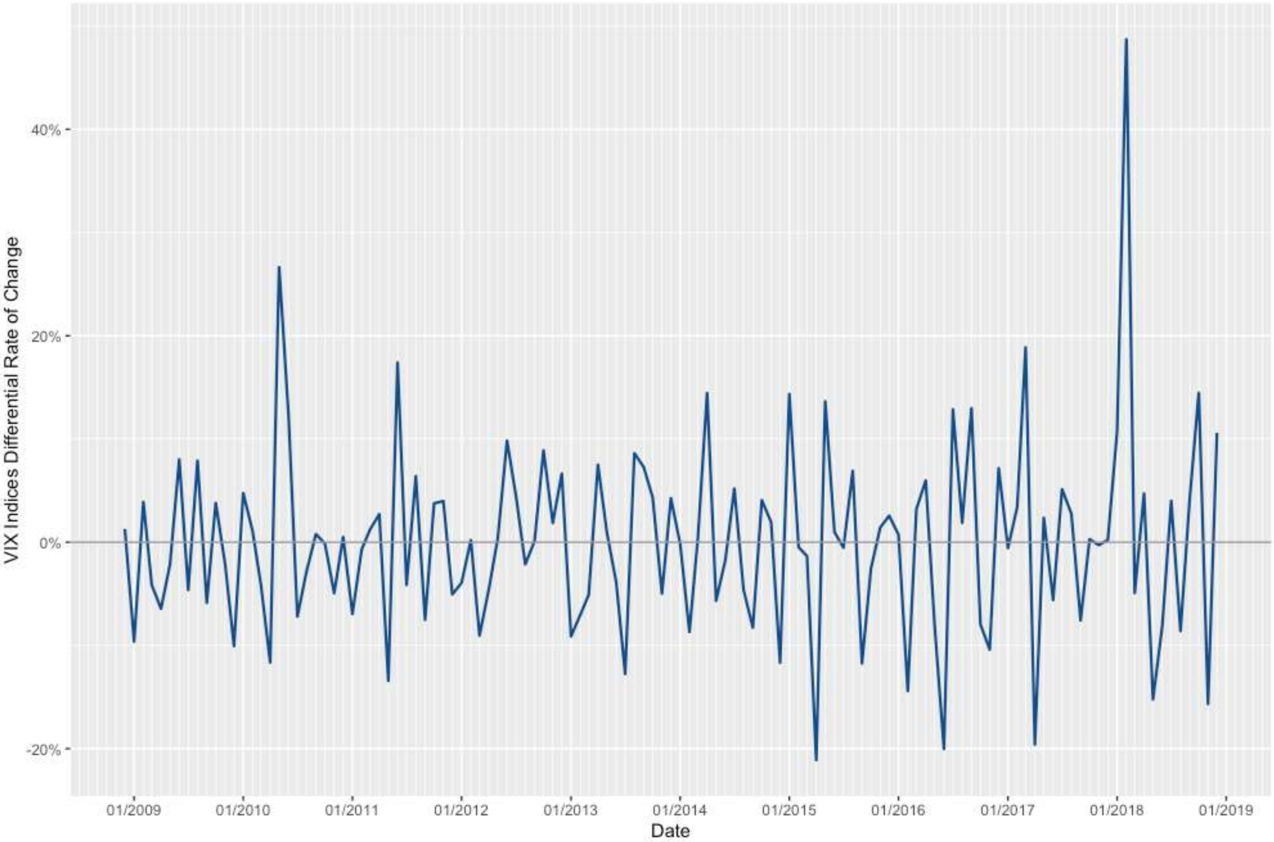


*Figure 6: VIX Indices Differential Rate of Change over the period from 12/2008 to 12/2018*

In addition to these factors, a further variable relevant for the model has been identified as the exchange rate between the US dollar and the UK sterling pound. In particular, the quote of US dollar per one UK sterling pound has been selected, and the relative series retrieved from FRED St. Louis. As presented in Figure 7, the value of the exchange rate was slightly declining at the beginning, but then it stabilized to then decrease again in the aftermaths of the Brexit events. Once again, this component had to be seasonally adjusted. As with the previous variables, the rate of change has been the chosen solution.

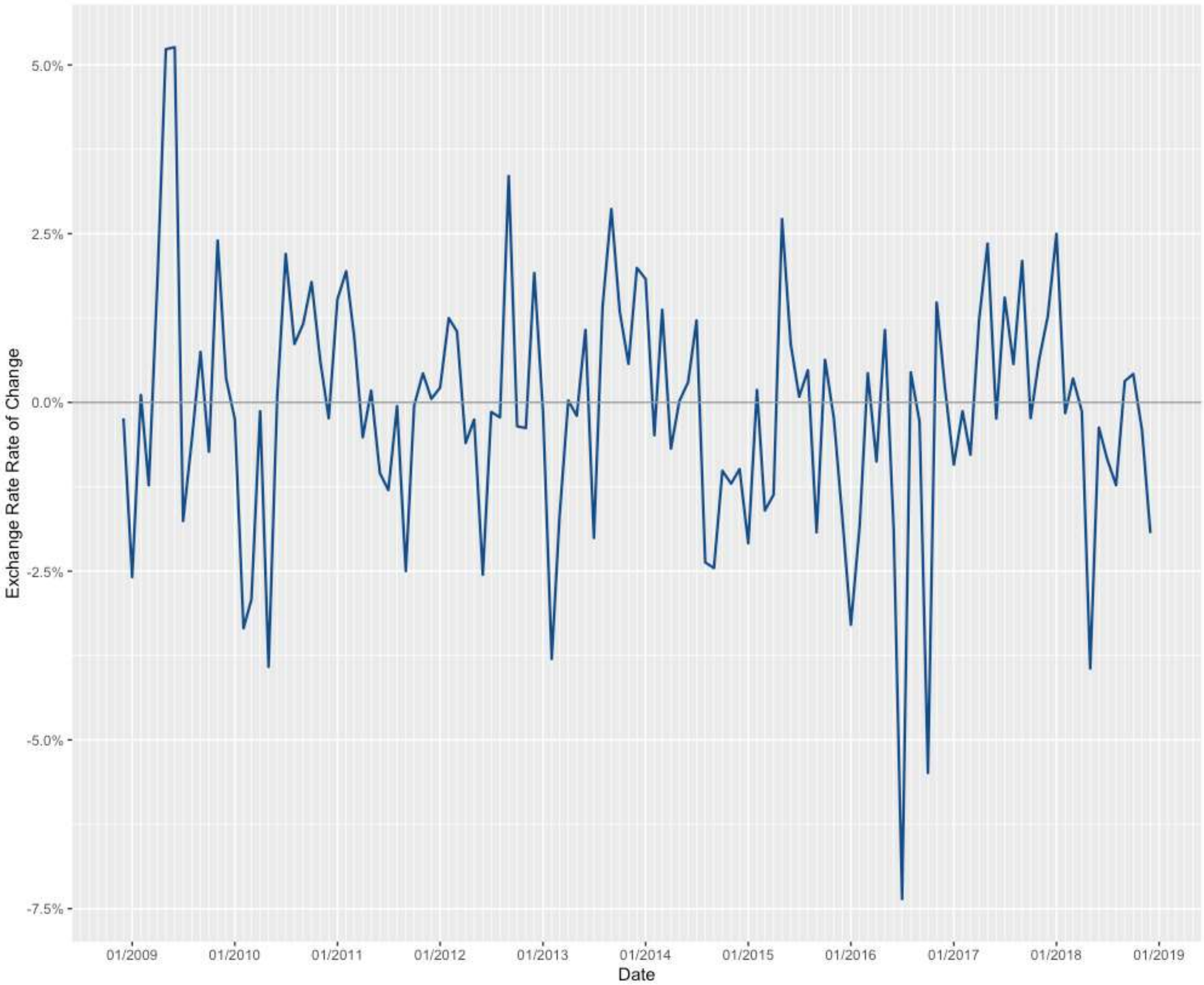


*Figure 7: Exchange Rate Rate of Change over the period from 12/2008 to 12/2018*

Finally, a variable aiming at measuring the spread between the US and the UK bonds has been selected to be implemented in the model. We chose the US and UK 10-Year Bond Yield. In this case the data has been retrieved from Investing.com. The difference of the two yields has been calculated, and then, the simple change has been taken.
As observed in Figure 8, the spread between the US-UK 10-Year Bond Yield displays a similar pattern to the one displayed by the net flows between the United States and the United Kingdom in Figure 1.

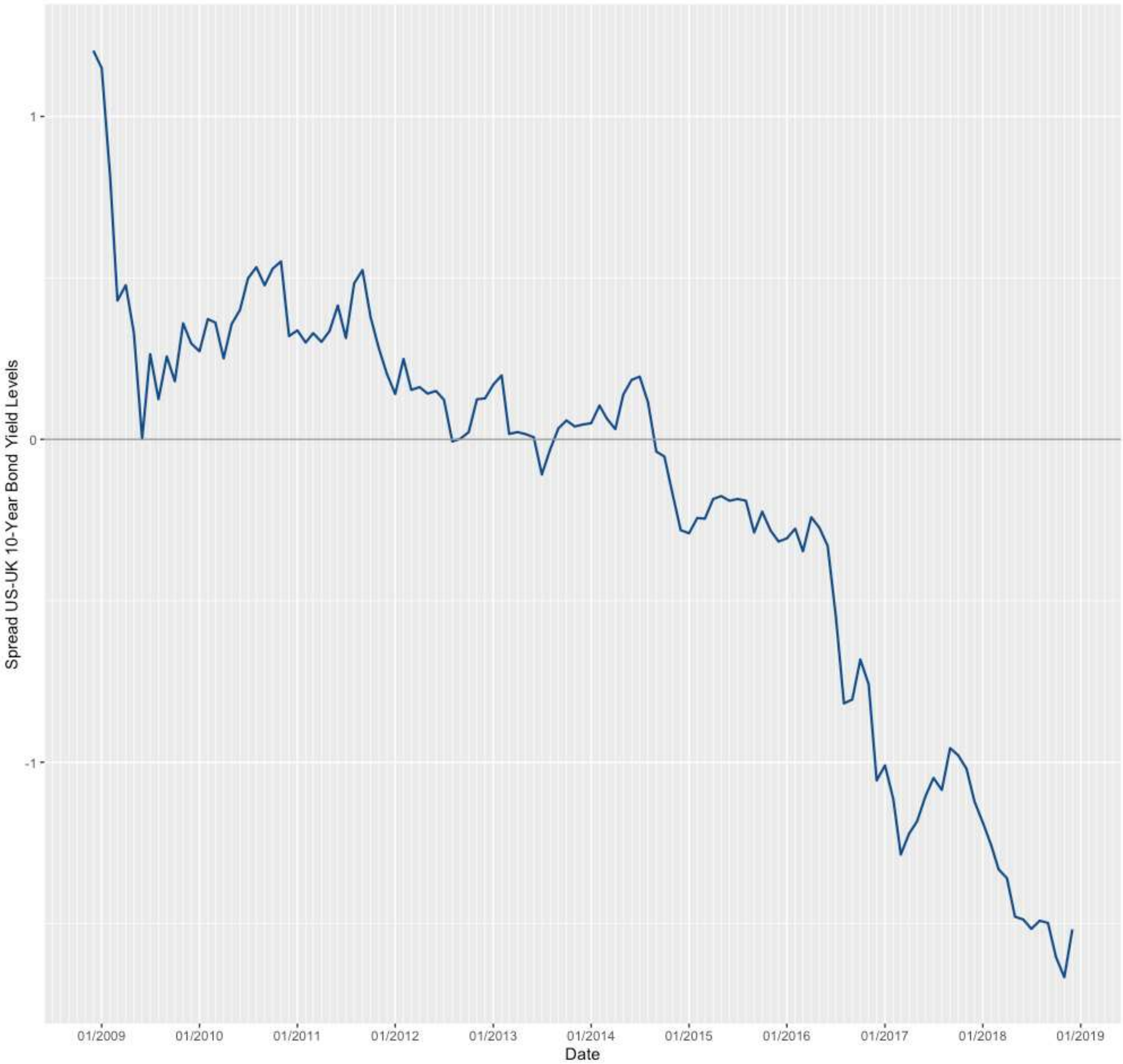


*Figure 8: Spread US-UK 10-Year Bond Yield over the period from 12/2008 to 12/2018*

### 3.2. Descriptive Analysis

The following section analyzes matters such as stationarity and autocorrelation of the variables.

The first issue concerned checking the stationarity of the elements, as such a result would influence the choice of the model specification to pursue in the empirical section. As illustrated in the previous section, the variables have been considered in terms of rate of growth rather than pure level. This choice has been made in order to deal with the issue of non-stationarity. The levels of the net flows, for example, are non-stationary, but the relative rate of change is. The same considerations can be made for all the independent variables to be included in the model, as the levels hardly displayed characteristics of a stationary time series, but the transformation in rate of change solved the issue for each one of them.

In order to have a formal check on this matter, a Phillips-Perron Unit Root Test has been performed, so to obtain a statistically valid figure that could confirm the goodness of the assumptions made.

The tests gave back encouraging results, as each confirmed with excellent values the stationarity of every time series taken into consideration. The results can be observed in Table A1.

Additionally, a check for autocorrelation was ran on the utilized net flows from late 2008 to the end of 2018.

The graphical results can be observed in Figure 9**.** the figure suggests the existence of autocorrelation specifically at lag 2 and at lag 10, while lag 7 displays a behavior that, even though very close to the threshold, appears not imply autocorrelation.

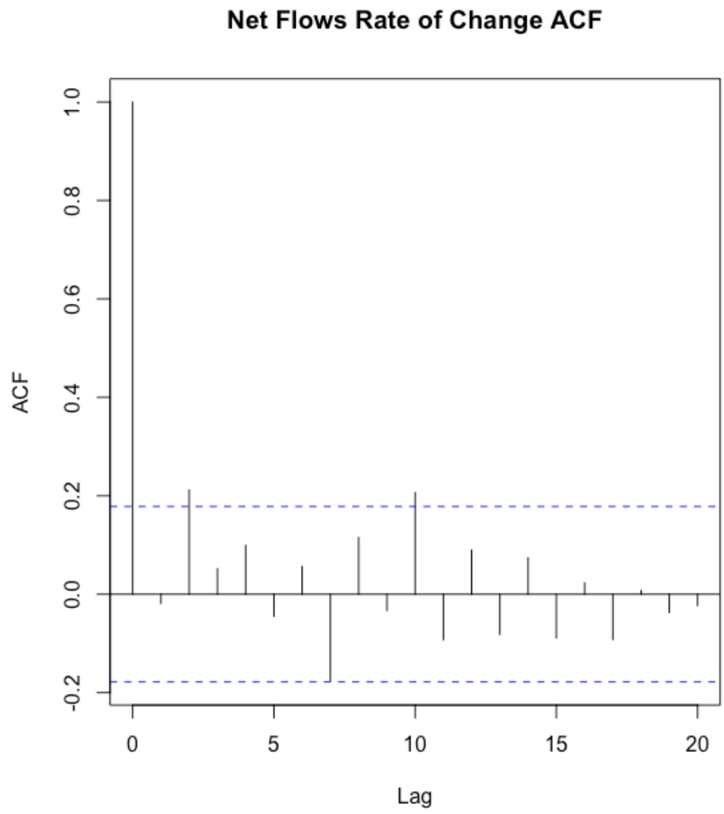


*Figure 9: Net Flows Rate of Change Autocorrelation*

As mentioned in the previous section, a seasonality analysis and adjustment had to be performed for each variable but the spread US-UK, as, by its nature, did not need such an adjustment. In order to perform the analysis and, whether necessary, apply the required changes, the chosen solution relied on the Census X-13 method. The analysis has not been carried out directly on the rates of change, but rather on the levels of each variable, and then the rates of change of the seasonally adjusted series have been computed.

The seasonal components highlighted by the chosen methodology have been of significant magnitude, with each element showing different trends and seasonal patterns, clearly depending on the nature of the variables themselves.

### 3.3. Methodology

The chosen statistical model to perform the empirical analysis is based on a OLS multiple regression. Clearly, in order to fit such a model, the variables must be stationary, and this explains the choice of the selection of rates of changes for the elements presented in the previous sections.
For the scope of the dissertation the dependent variable has been identified as the equity net flows between the United States and the United Kingdom. The regressors are the total assets growth differential between the balance sheets of the Federal Reserve and the Bank of England, the stock returns differential of the S&P500 and the FTSE100, the VIX indices returns differential of the VIX of the S&P 500 and the VFTSE, the exchange rate returns between the US dollar and the UK sterling and, finally, the change on the spread between the US and UK 10-Year Bond Yield.
The OLS equation to be fitted is then the following:

$$\boldsymbol{Y} = \alpha + \boldsymbol{\beta_1} \boldsymbol{X_1} + \boldsymbol{\beta_2 X_2} + \boldsymbol{\beta_3 X_3} + \boldsymbol{\beta_4 X_4} + \boldsymbol{\beta_5 X_5} + \boldsymbol{\varepsilon}$$

*Equation 1*: Y *is the dependent variable,* $\boldsymbol{X_1}$ *is the total assets differential,* $\boldsymbol{X_2}$ *is the stock indices differential,* $\boldsymbol{X_3}$ *is the* VIX *indices differential,* $\boldsymbol{X_4}$ *is the exchange rate and* $\boldsymbol{X_5}$ *is the spread.*

As the rates of change of both the net flows and the regressors are stationary, it is feasible to proceed to fit a model based on OLS. This is a key assumption in determining the correct specification, as non-stationarity of the parameters would have implied the need for an alternative solution.
Before fitting the model, though, it is important to consider further matters that can potentially influence the final empirical results. One of these issues, in particular, concerns the optimal lag to be selected for each variable. After carrying out several tests to evaluate the best options, the choice has been to select different lags from those suggested by the performed analysis, but that actually appeared to be more meaningful as they allow for more time to influence the variables. Specifically, the selected lag for

both the total assets differential and the VIX indices differential is of order three, for the stock indices differential of order two, for the exchange rate of order one while the spread the variable has not been lagged at all. The results are reported in Table A3.

Furthermore, an additional important aspect to consider is the possibility of the existence of structural break over the sample. As the time series of the net flows is relatively large, with about 120 observations spread over ten years, and considering the series of events that happened during such times, such as the aftermaths of the Global Financial Crisis and the Brexit process, testing for breaks has been a key analysis. Such an investigation has been made by the means of a Bai-Perron test on the net flows. The results are observable in Table A2. As the outcome of the test suggests, the sample can actually be divided in several subsamples. Given the number of regressors and the nature of the model, though, some of these subperiods appeared to be too short, as they could be based as few as less than twenty observations.
In parallel to the breaks suggested by the analysis though, other significant dates could be relevant for the matter of this paper. In particular, the timeline relative to the quantitative easing episodes carried out by the two central banks turned out to be of crucial importance. Relatively to the sample, a key date has been identified in December 2013, moment in time in which the Federal Reserve announced a reduction in the magnitude of its quantitative easing efforts. This intuition is supported also by a graphical approach, as it can be observed in Figure 10. The growth of the total assets, in fact, started to gradually decrease around that point in time.

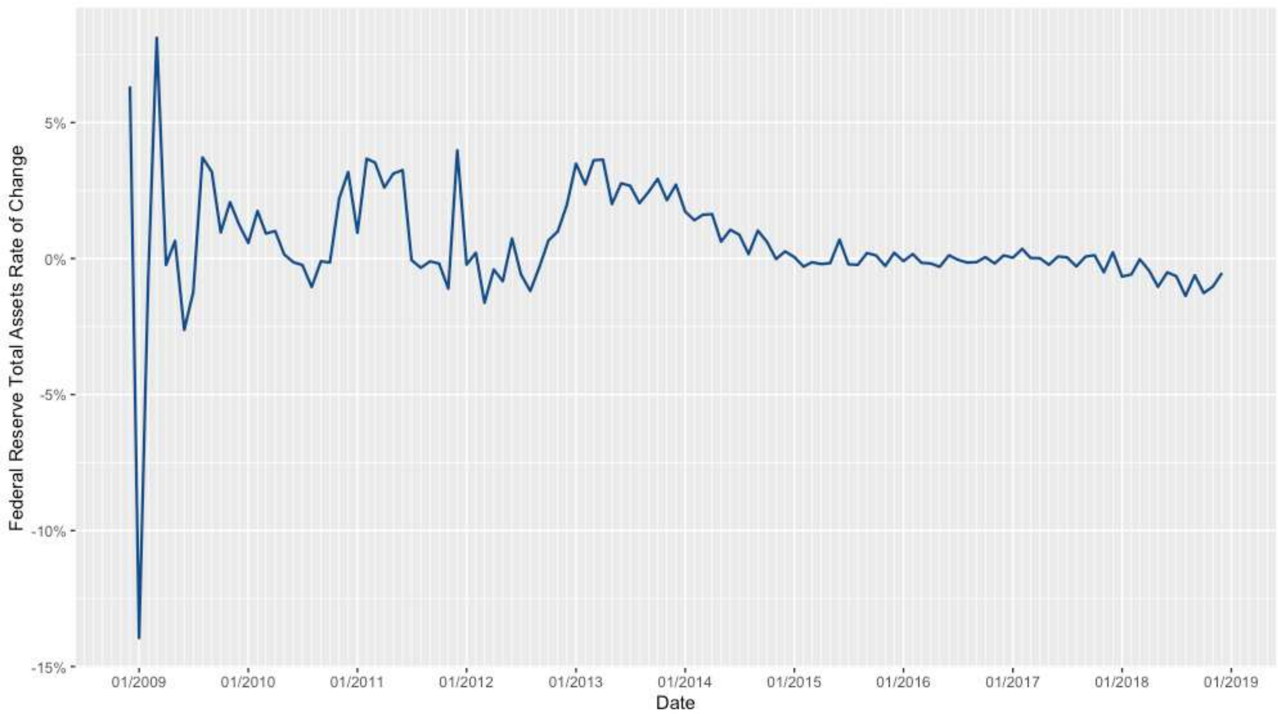


*Figure 10: Federal Reserve Total Assets Rate of Change over the period from 12/2008 to 12/2018*

As it will be illustrated in the next sections, the empirical analysis has been carried out with this crucial point in mind, as it acted as a break for the actual specification.

In addition, a further source of concern in the analysis has been represented by the possible presence of multicollinearity between some of the variables. Particular attention had to be paid to the relations between the total assets differential and respectively the exchange rate and the spread. The reason behind this is that the quantitative easing policies put in place by the two central banks had a possible influence on the other two variables, and concerns relative to these two pairs of regressors could emerge during the analysis.

# 4. Empirical Analysis and Results

## 4.1. Empirical Analysis

As explained in the previous section, in order to fit the model, two specifications have then been defined. The first starting in December 2008 and terminating in December 2013, with the second one, instead, ranging from January 2014 to December 2018. The entire sample is therefore split in two subsamples of equivalent length, that allows for a reliable analysis as the number of observations, relative to the quantity of regressors to be implemented, is sufficient.

Following the model illustrated above, the work has proceeded in parallel on the two specifications. Clearly, the two subsamples behave in different ways and different results are expected, as both the net flows and the regressors experience some changes throughout the period of concern.
Considering the possible problems mentioned in the previous section, the first thing after running the model and obtaining the first results has been checking the validity of those outcomes and evaluating possible implications on the goodness of fit and reliability of the two specifications.

Besides looking at the regression statistics such as multiple r-squared, adjusted r-squared and the p-values, close attention had to be paid at the interactions between the variables. Furthermore, a detailed check on both the regressions and the residuals had to be carried out, to assure the validity of the assumption made and of the fitted model overall. In order to carry out these analyses, several tests have been implemented. In particular, as far as autocorrelation in concerned, the Durbin-Watson test has been performed. The null hypothesis of the test states that there is no autocorrelation in the residuals, while the alternative hypothesis accounts for the case of existing autocorrelation. In addition to that, the normality of the residuals has been checked by means of a Kolmogorov-Smirnov test, as the number of observations in the samples were high enough for this option to be considered suitable. In this case the null hypothesis considers the case in which the data is normally distributed. Finally, a

Breusch-Pagan test to check for the presence of heteroskedasticity in the model has been added. Also in this test, the null hypothesis regards the most favorable case, while the alternative suggests presence of heteroskedasticity.

The first step consisted in analyzing the results of the regression going from December 2008 to December 2013, and checking for possible complications. The regression statistics were satisfactory as it can be observed in Table 1.

| | | First Subsample | | | |
|---|---|---|---|---|---|
| R-squared | | 19,76% | | | |
| Adjusted R-squared | | 12,47% | | | |
| Observations | | 61 | | | |
| Dates | | 12/2008 - 12/2013 | | | |
| | Lag | Coefficient | p-value | VIF | |
| Intercept | | -0,0027 | 0,5349 | | |
| Total Assets Differential | (-3) | -0,1552 | 0,0251 | 1,1429 | * |
| Stock Indices Differential | (-2) | -0,4847 | 0,0194 | 1,1630 | * |
| VIX Indices Differential | (-3) | -0,0423 | 0,4706 | 1,1245 | |
| Exchange Rate | (-1) | -0,0172 | 0,9314 | 1,0493 | |
| Spread (IV) | | -0,0505 | 0,1515 | 1,2070 | |

Significance: 0 '***' 0,001 '**' 0,01 '*' 0,05 '.'

*Table 1: Summary Statistics of the regression without autoregressive component over the period from 12/2008 to 12/2013*

According to the variance inflation factor (VIF), multicollinearity between the variables appeared to be a modest problem, which could be fixed by means of an instrumental variable. The residuals of the model positively passed the test, and therefore the assumption of normality could be confirmed. The Breusch-Pagan test also gave satisfactory results, suggesting that heteroskedasticity did not represent a problem. The main concern, though, arose following the implementation of the Durbin Watson test, as this highlighted an autocorrelation issue in the specification. The results are reported in Table 2.

| Dates | 12/2008 - 12/2013 | |
|---|---|---|
| | statistic | p-value |
| Durbin-Watson Test | 1,2020 | 0,0005 |
| Kolmogorov-Smirnov | 0,0931 | 0,6313 |
| Breusch-Pagan Test | 4,0221 | 0,5462 |

*Table 2: Summary of the tests for autocorrelation, normality of the residuals and heteroskedasticity*

To tackle the problem, an autoregressive component of the net flows has been introduced in the model, in order to evaluate whether this modification improved the specification. This solution solved the autocorrelation issue that was present in the specification without the lagged component among the regressors, as confirmed by the Durbin-Watson test. Additionally, tests for normality of the residuals and detection of heteroskedasticity in the model were performed once again, and they still provided valid results. The results can be observed in Table 4.

The following step consisted in dealing with the multicollinearity between the variables. Introducing an autoregressive component, of course, added a new layer of complexity, as variables appeared to show a non-negligible level of correlation to this element. After analyzing the situation and the results of the correlation test and the VIF indicator, to fit the model two instrumental variables have been specified: the first one between the spread and the total assets differential, and the second one between the total assets differential and the lagged net flows. For the former, the relation suggested that, also thanks to the different selected lags, total assets influenced the spread variable. The latter, instead, was aimed at solving the natural correlation issue between two such important variables. These solutions significantly improved the specification, and in particular the significance of the total assets' differential, which is a component of key importance for the scope of the analysis. The summary of the results of the model is available in Table 3.

| | | First Subsample | | | | Second Subsample | | | |
|---|---|---|---|---|---|---|---|---|---|
| R-squared | | 46,33% | | | | 19,01% | | | |
| Adjusted R-squared | | 40,37% | | | | 11,51% | | | |
| Observations | | 61 | | | | 60 | | | |
| Dates | | 12/2008 - 12/2013 | | | | 01/2014 - 12/2018 | | | |
| | Lag | Coefficient | p-value | VIF | | Coefficient | p-value | VIF | |
| Intercept | | -0,0020 | 0,5682 | | | 0,0024 | 0,9880 | | |
| Net Flows (IV) | (-2) | 0,5244 | 0,0000 | 1,0496 | *** | | | | |
| Total Assets Differential | (-3) | -0,1293 | 0,0191 | 1,0569 | * | -27,6596 | 0,0048 | 1,0272 | ** |
| Stock Indices Differential | (-2) | -0,4309 | 0,0123 | 1,1675 | * | 8,2584 | 0,2891 | 1,0195 | |
| VIX Indices Differential | (-3) | -0,0560 | 0,2501 | 1,1279 | | -2,0280 | 0,1279 | 1,0498 | |
| Exchange Rate | (-1) | 0,1438 | 0,3944 | 1,0869 | | -3,3102 | 0,6767 | 1,0819 | |
| Spread (IV) | | -0,0385 | 0,1864 | 1,0985 | | -1,8358 | 0,2524 | 1,0582 | |

Significance: 0 '***' 0,001 '**' 0,01 '*' 0,05 '.'

*Table 3: Summary statistics of the two models*

The analysis on the regression, carried on in a second step, going from January 2014 to December 2018 had, in principle, the same possible concerns. After carrying out the initial checks by means of the Durbin-Watson, the Breusch-Pagan and the normality tests, though, the model appeared to be solid already. Differently from the other model, then, no autocorrelation issue arose, and thus no modifications in the overall specification had to be implemented. A summary of the results of the tests can be observed in Table 4.

| | First Subsample | | Second Subsample | |
|---|---|---|---|---|
| Dates | 12/2008 - 12/2013 | | 01/2014 - 12/2018 | |
| | statistic | p-value | statistic | p-value |
| Durbin-Watson Test | 1,6094 | 0,0970 | 2,0899 | 0,8211 |
| Kolmogorov-Smirnov | 0,0823 | 0,7720 | 0,0931 | 0,6313 |
| Breusch-Pagan Test | 10,4290 | 0,1077 | 4,0221 | 0,5462 |

*Table 4: Summary of the tests for autocorrelation, normality of the residuals and heteroskedasticity*

In order to make the analysis completer and more consistent, though, an attempt to use a specification equivalent as in the first subsample was made, but the model did not pass the Breusch-Pagan test, and therefore the original specification was kept.

The VIF indicator did not suggest the mandatory need for the application of instrumental variables to solve hypothetically important issues. As in the previous case, though, the decision has been implementing one for treating the relation between the spread and the total assets. The improvement in the significance of the variables was very modest, but still present. The summary of the results of the model is available in Table 3.

### 4.2. Discussion of the results

As it is possible to observe in Table 1, the results in terms of multiple R-squared and adjusted r-squared are clearly different in magnitude. The first specification reaches significantly higher figures compared to the second one. The main reason why, in this case, is the addition of the autoregressive component among the regressor, feature that is not present in the second subsample. As illustrated above, the sample ranging from 2014 to 2018 did not present autocorrelation issues of any kind, and thus the decision has been not to apply any alternation to the original specification.

The total assets differential, which is desirably the most relevant regressor in the model, is clearly significant in both the subsamples. In both cases, though, the results have been improved by the specification of an instrumental variable, as mentioned in the previous paragraphs.
Although the size of the coefficients differs between the two samples, the sign remains negative in both. This implies that, following an increase in the total assets' differential, the capital experiences an outflow from the United States and into the United Kingdom.

Secondly, it is interesting to point out the results as far as the stock indices differential are concerned. Here, differently from what happened with the total assets' differential, the behavior displayed in the two samples is different not only in size, but also in the sign of the coefficients. In the first subsample, the one ranging from 2008 to 2013, the component is significant and has a negative sign, surprisingly implying that an increase in the differential is associated with an outflow from the United States towards the United Kingdom. In the sample going from 2014 to 2018, instead, the variable is not significant, but its coefficient has a positive sign, which has a more intuitive economic explanation compared to the previous case.

The proxy for risk, identified in the model by the VIX indices differential, shows a different outcome compared to the two previously illustrated variables. Both subsamples are characterized by coefficients with negative sign, even though the magnitude of the one in the first subsample is modest and very close to zero. In this case, an increase in risk implies, once again, an outflow of capital from the United States into the United Kingdom, which is considered another solid economy and thus seen as a safe option. The significance of the variable is not equivalent for the two specifications. In the first one, in fact, the variable is not significant at any traditional confidence level, while on the second one it is possible to appreciate its significance only at a 90% level.

Another crucial variable is represented by the exchange rate returns between the US dollar and the UK sterling. Once again, the results differ between the two samples, both in terms of size, sign and significance of the coefficients. With an increase in the exchange rate, it would be expected to see capital flow from the United Kingdom into the United States, as the UK sterling would appreciate with respect to the US dollar, making US goods more attractive. This intuition is confirmed by the positive coefficient present in the sample going from 2008 to 2013. In this case the significance is not satisfying, as the p-value highlighted is, even if by a relatively small degree, out of the most conventional confidence levels. In the second regression, instead, the situation is rather different. The sign of the coefficient is the opposite, making the economic interpretation of such a relation trickier, but the p-value is, in this case, very high, making the variable clearly not significant for the scope of the specification.

Finally, the last variable featured in the model to be analyzed is the spread between the US and UK 10-Year Bond Yield. First, it is important to highlight that, in both specifications, an instrumental variable between the spread and the total assets differential has been implemented, and thus the elements fed into the model are not the original rates of change of the spread itself, but rather the results of the instrumental variable. Once again, there is a diversion in magnitude and significance in the two specifications. In the first subsample the coefficient is negative, but its size is very close to zero, making it difficult to say whether an increase in the spread is associated with an inflow, an outflow or, as it is suggested by the result, neither of the two. In the second specification the sign is still negative, but the size of the coefficient is not close to zero anymore. As in the previous subsample the significance of the variables is not encouraging, as the p-value approached high thresholds that make it very far from being significant at any common level.

## 5. Conclusions

The Global Financial Crisis started in 2007 had a heavy impact on economies all over the world. Central banks around the globe responded to the crisis at different moments in time and with different techniques aimed at solving issues that were not equivalent for all of them.

One of the first central banks to respond was the Federal Reserve, which implemented a set of unconventional monetary policies, including the so-called quantitative easing, as did the Bank of England in the following months.

As it has been the case also for other elements, the equity capital flows between the United States and the United Kingdom have been impacted as well.

The variation in the pattern of these flows can be addressed by several measures, as for example with a proxy aimed at capturing the monetary policies put in place by the central banks. As the dissertation shows, this variable is useful in explaining part of the variation in the equity flows in the period starting at the end of 2008 and terminating at the end of 2018. Other proxies accounting for different elements, such as perceived risk the state of the stock markets in the two countries, have proven to be useful in partially explaining the variability in the behavior of the flows.

An interesting point that could be useful to expand the results found in this dissertation revolves around the United Kingdom. The UK, in fact, plays a very important role as London is a crucial global financial center, and therefore acts as an intermediary between different financial markets. Analyzing the flows between the United States and the United Kingdom with this point in mind could, in fact, prove to be useful in understanding whether the flows into the United Kingdom from the United States stayed within the borders or rather reached different financial markets.

# Appendix

## A.1. Stationarity Test

In order to carry out an OLS regression, one of the fundamental conditions is that the variables fed into the model display a stationary behavior. If that is not the case, in fact, other techniques and models can be implemented.
As explained in the data section, the levels of the time series did not always display a stationary behavior, and thus the decision was to tale the rate of change, as this adjustment should have solved the issue. As a graphic interpretation was clearly not rigorous enough to confirm such a characteristic, a Phillips-Perron Unit Root Test was carried out for each variable. The null hypothesis, in this case, states that there is a unit root, while the alternative hypothesis accounts for a unit root not being present. The results of the test are displayed in Table A1. It is important to specify that the p-values, although being indicated at 0,01, were actually much smaller, but are provided in this form in order to make the interpretation easier.

| | statistic | p-value |
|---|---|---|
| Net Flows | -158,86 | 0,01 |
| Total Assets Differential | -117,77 | 0,01 |
| Stock Indices Differential | -114,49 | 0,01 |
| VIX Indices Differential | -135,40 | 0,01 |
| Exchange Rate | -101,41 | 0,01 |
| Spread | -125,14 | 0,01 |

*Table A1: Phillips-Perron Unit Root Test*

## A.2. Break Test

Being the sample taken into consideration of several years and with a pattern that suggested a change in the behavior of the time series, for the completeness of the analysis a test to check for the presence of possible structural breaks had to be implemented. To do so, the chosen solution coincided with the Bai-Perron test, which was carried out on the levels of the net flows.

The results are reported in the following table:

| period | intercept |
|---|---|
| Dec 2008 - Nov 2012 | 162417,4 |
| Dec 2012 - Aug 2014 | 746496,5 |
| Sep 2014 - Jun 2016 | 439000,5 |
| Jul 2016 - Dec 2018 | 546025,4 |

*Table A2: Bai-Perron Test for structural breaks*

As it is possible to notice, the test highlights the presence of several breakpoints at different dates, thus implying that implementing different specifications could be a more suitable solution given the behavior of the net flows. It is important to notice that the suggested subsamples have different lengths in terms of observations.

### A.3. Optimal Lag Selection

The chosen model specification accounted for several variables to be implemented. Clearly, each one had a unique behavior and different driving forces, as they were different in nature and were meant to capture different factors for the analysis.

Therefore, an important element to consider was the optimal lag at which each variable had to be selected in order to maximize its explicative power and influence on the model. This was done by means of the vars library in the R software. The results are reported in Table A3.

| variable | AIC | BIC | selected lag |
|---|---|---|---|
| Total Assets Differential | 10 | 10 | 2 |
| Stock Indices Differential | 2 | 1 | 3 |
| VIX Indices Differential | 1 | 1 | 2 |
| Exchange Rate | 1 | 1 | 3 |
| Spread | 1 | 1 | 1 |

*Table A3: Summary of the results for the optimal lag selection*

As it can be observed in the table above, both the AIC and BIC criteria were provided by the test. After several considerations and attempts, though, the decision was to select different lags to the ones suggested. The final solution, in fact, saw every element being considered at a lag of either two or three months, with the exception being the spread, which was instead took at a one-month lag.

**A.4. Failed Attempt**

As mentioned in the previous paragraphs, two analyses had been carried out in parallel. The two differentiate each other based on the breakpoint that divides the entire sample in two smaller subsamples. The model presented in the dissertation, in fact, had December 2013 as a breakpoint.
For the other specification, instead, the breakpoint was obtained by means of a Bai-Perron test, as reported in the previous paragraph. The suggested breakpoints were November 2012, August 2014 and June 2016.

As explained in the previous sections, some of these subsamples had too few observations to be viable standalone models, and thus the decision was to unify them into two macro subsamples, with December 2012 acting as the key breakpoint in the model. The first subsample, then, was going from December 2008 to November 2012, while the second one was going from December 2012 to December 2018. Differently from the model presented in the dissertation, the two samples do not have an equivalent length, but rather have two years of difference in observations. The specified model was the same as in equation 1, with the only difference being the just mentioned characteristic.

The first specification displayed some preliminary interesting results as far as the regression statistics were concerned. The total assets differential and stock indices differential, in fact, were both significant at a 0.05 level, with the spread being significant at a 0.10 level and the other variables being not significant. The VIF indicator, though, showed signs of possible multicollinearity with the logic illustrated in the body of the paper, thus suggesting that some instrumental variables to overcome this issue could have been put in place. Before doing that, tests on autocorrelation and normality of the residuals and on heteroskedasticity were carried out. All the Durbin-Watson test, the normality test and the Breusch-Pagan test gave back satisfying results, as it is possible to observe in Table A4 under the column "original specification". Nonetheless, in order to try to ulteriorly improve the results, an equivalent technique to the one adopted in the empirical analysis above was implemented. The net flows with lag two were added to the regressors, and the specification was tested again. Both the R-squared and the adjusted R-squared increased. The significance of the parameters generally improved as well, even though the total assets differential lost some explanatory power in favor of the other variables. The VIF, instead, remained of the same magnitude. The tests for autocorrelation, normality and heteroskedasticity were run again. As in the previous case, all the three tests did not give rise to any source of concern. The results are listed in Table A4 under the column "autoregressive component".

| | Original Specification | | Autoregressive Component | |
|---|---|---|---|---|
| Dates | 12/2008 - 11/2012 | | 12/2008 - 11/2012 | |
| | statistic | p-value | statistic | p-value |
| Durbin-Watson Test | 1,5434 | 0,1044 | 1,5401 | 0,0936 |
| Kolmogorov-Smirnov | 0,0665 | 0,9744 | 0,0761 | 0,9239 |
| Breusch-Pagan Test | 6,3084 | 0,2774 | 6,0513 | 0,4175 |

*Table A4: Tests for autocorrelation, normality of the residuals and heteroskedasticity for the first subsample*

An equivalent analysis was carried out for the sample going from December 2012 to December 2018.

This time only the stock indices differential was significant at a high significance level, with the total assets differential close to be significant at a 0.05 level. The other variables, instead, were not significant. The following step was, as usual, performing the tests to check the behavior of the model. While both the Durbin-Watson and the Breusch-Pagan test were as expected, the residuals turned out to be not normal, as it can be observed in Table A5 in the first column. Therefore, the next step consisted in adding the autoregressive component among the regressors. The significance of the parameters did not significantly improve. The VIF element, additionally, showed relatively low figures. The Durbin-Watson test confirmed that the residuals were not autocorrelated. The normality of the residuals, which represented the main problem in the previous specifications, was acceptable, even though if at the limit of the threshold. Heteroskedasticity, as tested in the Breusch-Pagan test, though, became a problem, as the results suggested a clear presence of this characteristic in the specification, as it can be seen in Table A5 under the column "autoregressive component".

While solving one issue, in fact, other problems were created, making it complicated to find a single solution that gave as a result a reliable model.

| | Original Specification | | Autoregressive Component | |
|---|---|---|---|---|
| Dates | 12/2012 - 12/2018 | | 12/2012 - 12/2018 | |
| | statistic | p-value | statistic | p-value |
| Durbin-Watson Test | 2,0681 | 0,8761 | 2,0051 | 0,9258 |
| Kolmogorov-Smirnov | 0,1889 | 0,0094 | 0,1461 | 0,0799 |
| Breusch-Pagan Test | 9,1695 | 0,1025 | 17,6790 | 0,0071 |

*Table A5: Tests for autocorrelation, normality of the residuals and heteroskedasticity on the second subsample*

# Bibliography

## B.1. Bibliography

Donghyun Park, Arief Ramayandi, and Kwanho Shin (2017), *Capital Flows During Quantitative Easing and Aftermath: Experiences of Asian Countries*, ADB Economics Working Paper Series, Working Paper No. 409

Marcel Fratzscher (2011), *Capital flows, push versus pull factors and the Global Financial Crisis*, *ECB Working Paper Series*, *Working Paper* No. 1364.

Marcel Fratzscher, Marco Lo Duca and Roland Straub (2013), *On the international spillovers of* US *Quantitative Easing*, *ECB Working Paper Series*, *Working Paper* No. 1557.

Sameer Khatiwada (2017), *Quantitative Easing by the Fed and International Capital Flows*, *Graduate Institute of International and Development Studies*, Working Paper Series, Working Paper No. HEIDWP02- 2017.

**B.2. Sitography**

Federal Reserve Bank of St Louis, Federal Reserve Economic Data (FRED),

URL: https://fred.stlouisfed.org/

Federal Reserve reduction of bond purchase:

URL: https://www.cnbc.com/2013/12/18/fed-begins-taper-program.html

Statology, for statistical tests implementations in R:

URL: https://www.statology.org/

REFINITIV:

URL: https://www.refinitiv.com/en

U.S. Department of the Treasury:

URL: https://home.treasury.gov/