Università Ca' Foscari Venezia - Aix Marseille Université

Master's Double Degree in Economics, Econometrics and Finance

Final Thesis

# The effects of Fed's and ECB's quantitative easing on the equity capital flows between Germany and the US

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# Abstract

The study aims at analyzing whether the unconventional monetary policy activity in the U.S. and the Euro Area had significant effects on the bilateral equity flows between the US and Germany, meaning if the actions of the central banks had an impact on the quantity of stocks of the two countries traded, the direction of the flows and the magnitude of the effect. By defining a simple portfolio allocation model where investors have the choice of investing in one of the two countries, conditional on the risk-return and the gain/loss by currency appreciation/depreciation, we state the impact that unconventional policy measures had on the shift in investing (i.e., the capital flows), between the two countries, controlling for the factors stated above. The study approaches the matter with the use of linear regressions allowing for lagged variables, employing monthly datasets for the capital flows and the control variables.

Consistently with literature, the study shows the great impact that unconventional monetary policies had on the magnitude and direction of bilateral capital flows, subdividing for direction of flows, examining separately the actions of the two CBs, and segmenting for statistical breaks in the series and policy periods. It is shown how Quantitative Easing from the ECB has had a far more modest impact on the flows. This result is particularly important as it highlights the relative weight of the American Central Bank with respect to its European counterpart.

The thesis will be structured with an introduction and definition of the research context; the state of the art regarding the major academic works on the subject; an explanation of the datasets used and how they were treated; the methodology section presenting the model; a results section presenting the discarded , inconclusive or inconsistent results; the final results showing evidence of QE as a capital flows driver, and a discussion of such results.

# Contents

## Acknowledgement

*A chi mi è stato vicino, anche da lontano*

# Chapter 1

# Introduction and Literature Review

## 1.1

The Global Financial Crisis started in August 2007 and deepened after the bankruptcy of Lehman Brothers in late 2008, deeply affecting financial markets and consequently the real economy in the USA and in other advanced and developing economies. The collapse of the subprime mortgage market caused a wave of debt defaults and widespread losses in the financial sector, leading to liquidity shortages in the players and widespread distress which threatened the stability of the global financial system. The FED responded by employing "conventional" monetary policy by cutting aggressively interest rates. Similarly did the European Central Bank. However, in late 2008 with the economy still in struggle to recover and having cut rates down virtually to zero (i.e., reaching the "Zero Lower Bound") the need for the implementation of further cuts to the policy rate or the use of alternative measures emerged, triggering the introduction of "Unconventional" or non-standard monetary policies that lasted with different rounds and rebalances for more than a decade. Fawley and Neely (2013) provide an exhaustive outline of unconventional monetary policies of major central banks. We present below the main actions of the Federal Reserve and of the European Central Bank.

On November 25, 2008, the FED announced plans to purchase $100 billion in GSE debt (government-sponsored enterprise) and $500 billion in MBS (mortgage-backed securities). On March 18, 2009, the FED disclosed further purchases of $100 billion in GSE debt, $750 billion in MBS, and additional $300 billions in long-term Treasury securities. This first episode of unorthodox monetary policy (then called "QE1") directly prioritized the support of the real-estate credit market, which was heavily impacted

by the crisis. After the first episode of purchases, which lasted until early 2010, the crisis' turmoil had weakened but the US were experiencing deflationary threats. Hence on November 3, 2010, the FED announced that it would purchase an additional $600 billion in treasury bonds to "promote a stronger pace of economic recovery and to help ensure that inflation, over time, is at levels consistent with its mandate[1]." This second "QE2" episode was explicitly aiming at raising inflation and lowering lending interest rates. In late 2012 the FED announced a third "QE3" round.

In the Eurozone, the ECB responded to the crisis with programs of Large-Scale Asset Purchases and stimulus to the financial sectors without explicitly referring to it as Quantitative Easing, as it would not expand the Central Banks' assets, thus corresponding to qualitative easing. In mid 2010 amid the turmoil of the sovereign debt crisis the ECB announced the Securities Markets Programme (SMP), consisting in the purchase of government debt in the secondary market. In early 2015 the ECB started for the first time the implementation of proper Quantitative Easing, with the introduction of its asset purchase program (thus APP), to respond to the risk of a period of prolonged too low inflation and signs of reduction in inflation expectations even at relatively long maturities (Andrade et al., 2016). Despite being coordinated centrally by the ECB, the program was decentralized. In fact, its shared of purchases accounted for 8% of the program, the remaining 92% would be purchased by the National Central Banks of the Eurozone.

The unconventional monetary policy episodes continued up to the covid crisis with the introduction of the Pandemic Emergency Purchase Programme (PEPP). This last period however will not be covered by this dissertation, as unconventional monetary policy for this case was employed as a response to the sudden and intense economic drawback caused by the months of lockdown which differ profoundly from the reasons for which such policy was introduced in the previous decade, as well as the economic scenario presenting highly peculiar features.

## 1.2 Existing Literature in the study of QE

### Channels of transmission

A primary source of study for the effects of monetary policies can be traced to Mishkin (1996). He provides an outline of the mechanisms of transmission of monetary policies, identifying three main channels, namely interest rates (as in the textbook IS-LM model); asset prices (impact on the exchange rate, cost of capital and equity value);

[1] 11/3/2010 FOMC statement

and credit channels.

Fratzscher, Lo Duca, and Straub, (2013) present four channels through which the FED QE activity affects portfolio allocation decisions, namely the portfolio balance channel (a FED purchase of an asset e.g. a government bond influences the supply of the latter to private investors influencing its yield); the signaling channel (if the Central Bank's operation signals to markets lower future policy rates than the current); the confidence channel (investors might infer the conditions of the economy from the extent of policy actions, impacting their risk appetite); and the effect of operations on liquidity premia (impacting the functioning of the markets and reducing liquidity premia). On the other hand the same authors realize the work also for the ECB Quantitative Easing focusing on the confidence channel; the bank credit risk channel (while the policies were aiming at easing liquidity concerns in the banking sector, this might have influenced credit risk); the sovereign risk channel (ECB policies indirectly eased the premia demanded from some countries that showed excessively high debt levels); the international portfolio balance channel (explained above).

Andrade et al. (2016) identify three other main channels for the propagation of the QE implemented in the euro area, which are the asset valuation channel (the lowering in yields led to an appreciation of the assets on banks' balance sheets, providing them with a form of capital relief); the signaling channel; and the long-term inflation expectations.

**Effects on capital choices/flows**

Fratzscher, Lo Duca, and Straub (2016) assess the impact of ECB's unconventional monetary policy in the period concerning the financial crisis and the European sovereign debt crisis (between 2007 and 2012, thus not covered in this dissertation), showing that the policies had a positive impact on equity prices, results extensively studied and valid for several other countries (Mikayoshi 2017, among the others), and lowered sovereign yields for the most fragile countries of the Eurosystem. The euro slightly depreciated, with the exception of an appreciation in response to the OMT announcement. Risk aversion as expressed in the implied volatility in equity markets decreased (i.e., market confidence increased), as well as sovereign risk fell. By shifting to portfolio decisions, they found that the response of international portfolio flows to ECB policies was small, or smaller than the responses to the Fed's ones, confirming the role of the dollar as primary world currency. The same authors (Fratzscher, Lo Duca, and Straub, 2013) analyze the spillovers of the Fed's first years of QE rounds on the US and on other emerging market economies, finding that QE was effective in lowering sovereign yields and raising equity markets in the US and abroad. The measures triggered a portfolio rebalancing out of emerging market economies and into the US during QE1, and had

an opposite direction during QE2. The Fed's unconventional policies had a significant effect in magnifying the cyclicality of capital flows to emerging markets, while acted countercyclically in the opposite direction indicating stronger effects on asset prices rather than capital flows.

Chen, Lombardi, Ross and Zhu (2017) use shadow rates (implied interest rates when the nominal levels approach the zero-lower bound, which were introduced in Black's (1995) idea of treating nominal rates as options) as a proxy for monetary policy, rather than using Central Banks' balance sheets or purchases. They also find stronger spillover effects for the Fed and less for the ECB, both in terms of impact on the real economy and on asset prices,output growth, exchange rate, inflation, and in terms of capital flows.

### Impact of Announcements

For the sake of simplicity and to build a model that takes into consideration just the actual implementation of Quantitative Easing measure, in this dissertation we disregard the effect of policy announcements from the Central Banks. However, there is literature studying their impact: Fratzscher, Lo Duca, and Straub (2013) used both announcements and implementation in their models finding a far more present effect of the latter, consistent with the choice of this dissertation.

Georgiadis and Gräb (2016) estimate the announcement effects of the ECB's APP on the euro exchange rate, equity prices and bond yields, finding significant results. Regarding capital flows they detect positive effects on flows from emerging markets to advanced economies but not in the opposite direction.

### Global Flows Cycle

According to existing research, the current level of international financial integration triggered the presence of a global financial cycle, strongly influenced by US monetary policy (Miranda-Agrippino and Rey, 2015), which is important to be kept in mind when studying capital flows. There is a common factor driving the co-movements of stock returns (*Global Financial Cycle*), which is tightly linked to another measure of *global capital flows cycle*, shaping global risk dynamics (Habib and Venditti, 2019). However, Cerutti, Claessens and Rose (2017) seem to find weak evidence for the influence of global cyclical factors, deeming "difficult to find consistent manifestations of the Global Financial Cycle in capital flows".

Forbes and Warnock (2020) shape the presence of global flows episodes and their frequency in the period following the financial crisis, suggesting a change in the capital

flow drivers and a decrease in their intensity and frequency. They build a framework for calculating the incidence of high capital flow episodes, to present that the period of expansionary and unconventional monetary policy that was used during and after the crisis does not appear to have driven extreme volatility in flows, perhaps because of stricter macroprudential regulation frameworks. Nonetheless, cross border flows tend to be highly correlated with risk measures. Gross capital flows (in this case, the total amount of capital moving from a country to another) can be used as a determinant of the conditions of financial markets, as they are an important source of information on risk premia and the weakness of the financial sector (Shin, 2012).

# Chapter 2

# Data

## 2.1

The principal source of data regarding capital flows is the TIC dataset provided by the US Department of Treasury, a reporting system collecting data for the United States on cross-border portfolio investment flows and positions between US residents (including US-based branches of firms headquartered in other countries) and foreign residents (including offshore branches of U.S. firms).[2] Data are reported by brokers, market players and banks. The reporting system does not capture certain types of cross-border movements, for example in cases where investors have monthly transactions amounting to less than $50 million, or flows emerging from stock-swaps of periodic payments associated with holdings of asset-backed securities. We can assume those missing value irrelevant for our analyses.

The dataset can be found with the denomination "U.S. Transactions with Foreign Residents in Long-Term Securities". It comprises all the monthly purchases and sales of securities between the U.S. and Germany, in both directions, subdividing for security type (U.S. Treasury Bonds & Notes, U.S. Government Agency Bonds, U.S. Corporate Bonds, Foreign Bonds, U.S. Corporate Stocks, Foreign Stocks). Clearly, only the last two matter for this research objectives.

From now on, it will be denominated as "Gross Flows to the U.S." all the gross purchases by foreigners[3] from U.S. residents of U.S. Corporate stocks and Foreign corporate stocks, and vice versa as "Gross Flows to Germany". As "Net Flows", all the flows

[2] Source:https://home.treasury.gov/data/treasury-international-capital-tic-system-home-page/frequently-asked-questions-regarding/ticfaq2q1

[3] The denomination "Foreign" refers to German investors.

incoming to the domestic country (in this case the U.S.), less the flows outgoing. Consequently, the first denomination "Gross Flows to the U.S." subtracting the second "Gross Flows to Germany".

The rate of change of flows is not computed, rather the monthly net flows are cumulated from the earliest date possible (January 1977) and the relative rate of change is obtained, when the flows expressed as rate of change of the net position are needed.

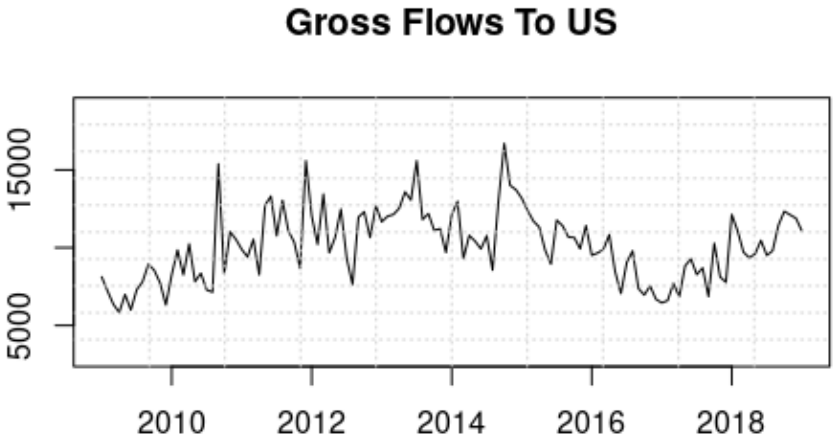


Figure 2.1: Gross Equity Capital Flows to the US, all amounts in million USD

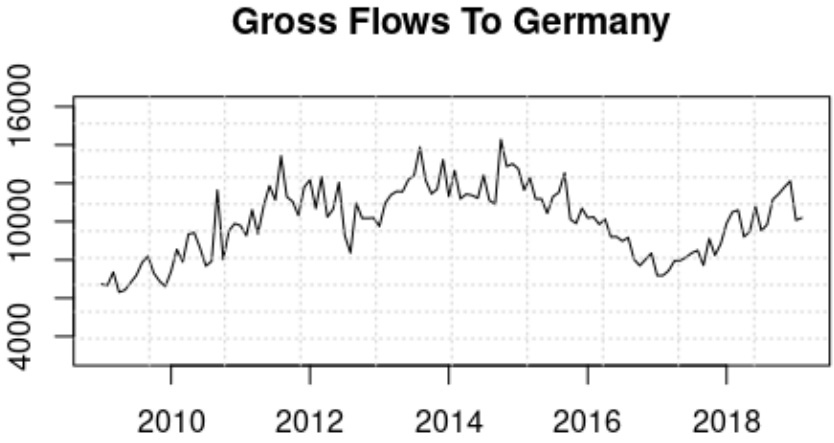


Figure 2.2: Gross Equity Capital Flows to Germany, all amounts in million USD

Monetary Policy was proxied using the rate of change in the total assets held by the Federal Reserve and the European Central Bank. While several research papers differentiate for type of policy employed by separating for the purchase program or the target of the policy (Fratscher, Lo Duca and Straub, 2013 and 2016) or use proxies as the shadow rates (Chen, Lombardi, Ross and Zhu, 2017); similar methodology is employed by Khatiwada (2017), who uses as monetary policy shocks the total Central Bank's purchases, providing only time-based further subdivisions by QE episodes. Other alternatives could have been represented by the Central Banks' total balance sheets sizes or their amounts of excess reserves, while using directly the purchased amounts would have led to problems of scalability between the two central banks (i.e., using directly the European APP or the American LSAP would have caused concerns because of the significantly different size of the Fed and the ECB, leading to problems when dealing with differentials or with the two Central Banks' actions taken together). This issue is solved by normalizing to the percentage rate of change in the assets. Datasets for both Central Banks are downloaded from the FRED database, directly with monthly frequency.

The other control variables are represented by the returns of the main stock market indexes for the two countries (S&P500 for the U.S., DAX for Germany); the USD-EUR exchange rate percentage variation; the market-implied volatility[4] derived from the prices of options on the stock market indexes, reflecting investors' expectations of future market fluctuations. All the above variables are imported by FRED, when not available from Yahoo Finance. All the data are presented with daily frequency, so the monthly series were computed using the average of the daily closing prices for the reference month.

As many series exhibit regular seasonal patterns over the year, to avoid incorporating any seasonal effect in the computations that might impair or bias the results all the variables used are run through the X-13 ARIMA-SEATS package [5] , the seasonal adjustment software developed by the United States Census Bureau. (Sax and Eddelbuettel, 2018). The software detects, estimates and removes any seasonal patterns from the data, decomposing the time series into a trend, an irregular component and a seasonal component, removing the latter. The algorithm works under the assumption that any series can be decomposed additively (trend + irregular component + seasonal component) or multiplicatively (trend x seasonal component x irregular component).

[4] https://www.cboe.com/tradable_products/vix/
[5] https://www.census.gov/data/software/x13as.html

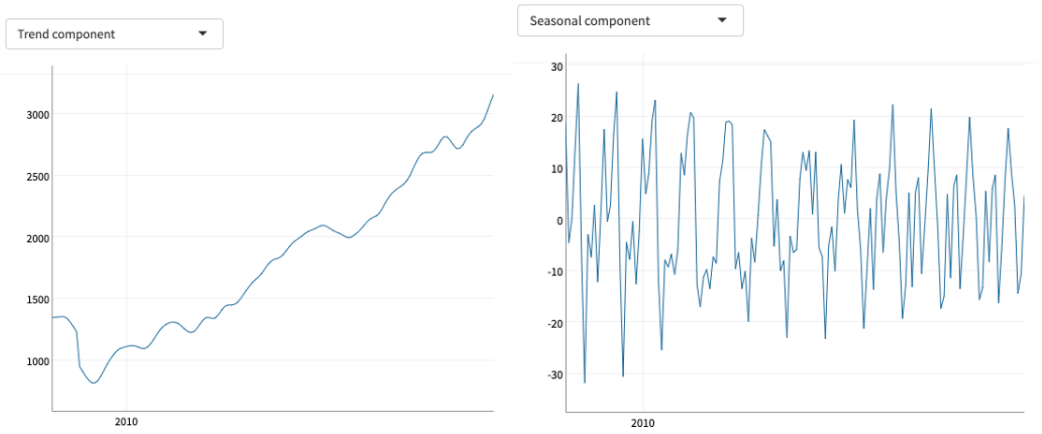


Figure 2.3: example of trend and seasonal component detected for the S&P500

## 2.2 Descriptive Statistics for the Data

The original idea was to begin the analysis with the introduction of the first Quantitative Easing Measures and to finish it just before the Pandemic Crisis, but in order to avoid sharp outliers at the beginning and at the end of the time series it was chosen to eliminate them. This also solves the issue of the possibility that capital flows were influenced by the events of the crisis period of 2008-2009, causing noise in the estimation. The series thus ranges from early 2009 to late 2019. Looking at the capital flows (figures 2.1 and 2.2), it is possible to spot some association with the different unconventional monetary policy events. A surge in the first periods of American QE1 and QE2, a possible stop corresponding to the months of stability between June 2011 and August 2012, another increase after the introduction of QE3 in September 2012, a steep decline matching the prolonged period of Fed's inaction and the introduction of European QE in late 2014, and another surge after the Fed's "balance sheet normalization" period after October 2017. While this information inferred by this very preliminary inquiry could be driven by other variables or due to spurious correlation or other longer-term trends, they indeed give guidance for further investigation and suggest the result that might be expected. Due to the shortness of the sample and the use of monthly data, it will not be possible to study the QE events separately as literature often does, as it would mean working with extremely low numbers of observations.

Looking at the series for the asset sides of the two central banks' balance sheets, it is clearly evident the difference among the different QE events. While the Fed had more pronounced events in the introduction of its QE measures, consisting of rapid surges followed by steadiness periods, the ECB measures have a much smoother and stable growth. This might be caused by the differences in economic circumstances in the two

areas, the objective of QE, and the different policy mandates[6].

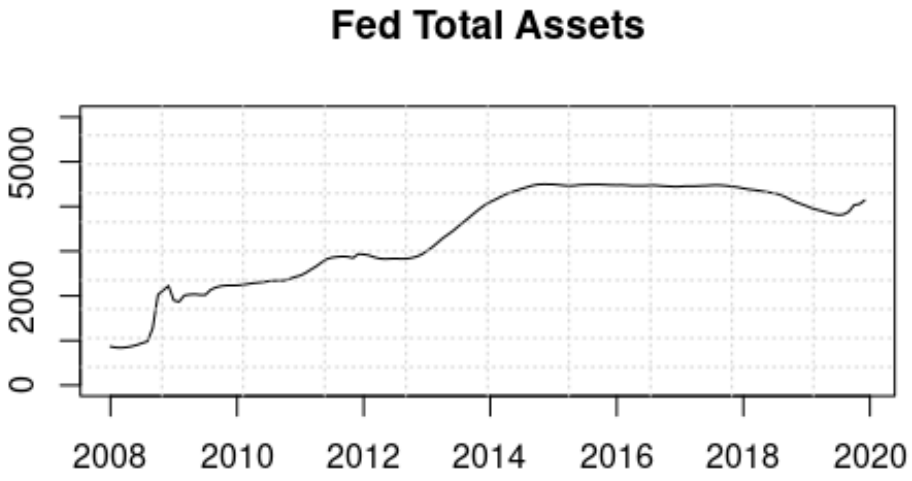


Figure 2.4: Fed total Assets: all amounts in billion USD

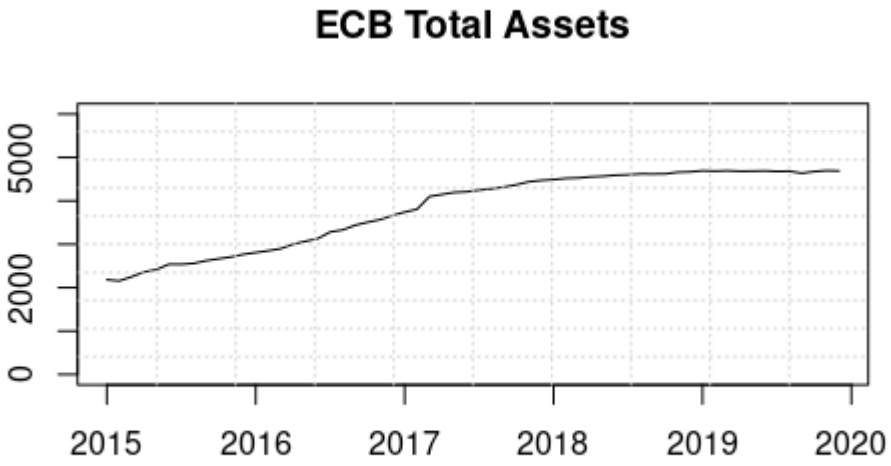


Figure 2.5: ECB total Assets: all amounts in billion USD. Caveat: the series starts in 2015, unlike for the Fed in figure 2.4.

[6]While the Fed has the goal of "pursuing the economic goals of maximum employment and price stability", the ECB has as primary policy goal the maintenance of price stability. Source: https://www.stlouisfed.org/in-plain-english/the-fed-and-the-dual-mandate; https://www.ecb.europa.eu/mopo/intro/html/index.en.html

Regarding the other control variables, the USD-EUR exchange rate and the stock market indices show consistent and stable patterns of respectively decline and growth (see appendix), while the risk measures VIX and VDAX show as expected very similar developments, following the events of the global financial crisis and the sovereign debt crisis. As the measures are used in differential (meaning S&P500 minus DAX, and VIX minus VDAX), there is no risk of collinearity in the analyses. Below, a summary of the descriptive analysis for the variables is presented. Normality was assessed with the use of a Shapiro-Wilk test.

| Variable | Description | Nation | Mean | sd | Skewness | Normality | Min | Max |
|---|---|---|---|---|---|---|---|---|
| EQUITY GROSS FLOWS | Equity gross flows towards the U.S. or Germany. Data in Billion USD | USA | 10,1248 | 2,2621 | 0,3010 | YES | 5,8317 | 16,6956 |
| | | GERMANY | 9,9926 | 1,8534 | -0,0985 | NO | 6,3081 | 14,2845 |
| EQUITY NET FLOWS | % variation of the cumulative net flows | | 0,0039 | 0,0294 | -0,3884 | NO | -0,1034 | 0,0850 |
| STOCK MARKET RETURNS | log-change differential in stock market returns | DIFFERENTIAL | 0,0021 | 0,0281 | 0,1093 | YES | -0,0722 | 0,0928 |
| IMPLIED VOLATILITY | log-change differential in implied volatility | DIFFERENTIAL | -0,0008 | 0,0835 | 0,2675 | YES | -0,1785 | 0,2596 |
| FX RATE | log-change USD-EUR returns | | -0,0008 | 0,0207 | 0,5175 | NO | -0,0538 | 0,0840 |
| QE | % variation in the assets of CB | DIFFERENTIAL | 0,0002 | 0,0218 | -0,0011 | NO | -0,0768 | 0,0774 |
| | | EU | 0,0209 | 0,0161 | 1,5558 | NO | -0,0012 | 0,0768 |

Table 2.1: descriptive analysis for the variables

# Chapter 3

# Methodology

## 3.1

The research objective of the dissertation is to understand whether the unconventional monetary policy activity in the U.S. and the Euro Area had significant effects on the bilateral equity flows between the two countries, meaning if the actions of the central banks had an impact on the quantity of stocks of the two countries traded, the direction of the flows and the magnitude of the effect. The research wants to show if there are major differences between the action of the two central banks, what is the effect when they are combined, if there are different results when taking into consideration different time periods, or to check the presence of any structural breaks. The research attempts to replicate, adapting accordingly to its needs and its limitations, the results presented in the two research papers that served as main source of reference, already cited in the literature review:

"*On the International Spillovers of U.S. Quantitative Easing*" (Fratzcher, Lo Duca and Straub, 2013): the authors build a linear model evaluating the impact on net (bond or equity) flows, regressing them on the announcements of U.S. QE and on the actual implementation of the purchase programs. The set of control variables consists of equity returns, bond yields, exchange rate returns, risk measures like the VIX and liquidity spreads, including also some lagged regressors.

"*Quantitative Easing by the Fed and International Capital Flows*" (Khatiwada, 2017): the author builds various panel models, regressing the gross or net capital flows on the QE purchases, controlling for the VIX, GDP growth differential, interest rate differential, exchange rate among the others; subdividing for emerging market economies and the European Union.

## 3.2 The Model

The baseline model is built as such:

$$y_{i,t} = \alpha_t + \beta_1 UMP_i + \beta_2 StockMkt + \beta_3 FX + \beta_4 RiskMeasure + \epsilon_t$$

Where

$$UMP_i = (Fed\,QE; ECB\,QE; Fed - ECB\,differential)$$

with the dependent variable $y_{i,t}$ being the net inflows expressed as percentage change in the net equity position invested in the U.S. (alternatively as the percentage change in the cumulative flows to the U.S. minus the flows to Germany); or the gross flows in either direction. The "main" independent variable $\beta_1 UMP_i$ represents unconventional monetary policy expressed as the percentage variation in the assets side of the central bank's balance sheet, it can be the QE of the Fed, of the ECB, the differential between the two ($Fed$–$ECB$). It is important to notice that in the last case, contingent on how the variable is built, it would be virtually impossible to distinguish between a decrease in the Fed's assets or an increase in the ECB's assets, as they would be represented both with a negative sign. Vice versa, the same would hold for ECB expansion and Fed tightening.

The set of control variables is defined individuating three fundamental factors able to drive bilateral flows in one or the other direction, representing three different portfolio choice dimensions:

- The **return** dimension, identified by the differential in stock market percentage returns, i.e., % return of the S&P500 minus the % return of the DAX, ($\beta_2 StockMkt$)
- The **currency exchange rate** dimension, identified with the percentage returns of the USD-EUR exchange rate ($\beta_3 FX$)
- The **risk** dimension, identified by the differential in the percentage change of the equity market-implied volatility measures, i.e., % change of the VIX minus the % change of the VDAX ($\beta_4 RiskMeasure$)

It was deliberately chosen not to include in the model the interest rate differential/bond yield for the following two reasons: firstly, it would imply excessive intricateness of the model by allowing for the presence of another portfolio allocation driver on top of the U.S./Germany investment choice, namely the bond/equity selection; with the result of

assuming four portfolio choices (U.S. bonds – German bonds – U.S. equity – German equity) while the model is interested only in the last two. Secondly, rates have been at the zero level or close to it for the length of all the period in question (this is the very same reason for the introduction of QE), so that the new variable would probably only have the effect of adding noise to the model.

Akin to what explained above, it was chosen to discard other measures despite them being often used in literature and possibly being explanatory for capital flows, such as GDP growth used by Khatiwada (2017), discarded because of its high correlation with the stock market indices in the reference period[7] , or other risk measures like the EPU index (Baker, Bloom, Davis, 2016), because of its high correlation with other risk measures like the VIX and the VDAX.

An expansion of the model provides for the introduction of lagged dependent and independent variables. The reasons for the introduction lie in the possible sluggish response of investors to policy shocks or new information, possible illiquidity issues, and the fact that working with data at monthly frequency implies that there is no way to know if information is dragged from to month to month, or if the reaction happens in the same period. In other words, assume an investor that takes one week to react to new information: if a shock happened in the first days of the month, her response would be in the same time t, while if the shock happened from the 25th onwards, the response would be found in the following period. Allowing for lagged response would imply better characterization of the phenomena. Moreover, it would be beneficial were there the need of addressing colinear variables.

The introduction of lags in the dependent variable is useful when dealing with the presence of possible autocorrelational effects. The **expanded model** thus takes the form of:

$$y_t = \sum_{n=0}^{n} y_{t-n} + \alpha + \sum_{n=0}^{n} \beta_1 UMP_{i,t-n} + \sum_{n=0}^{n} \beta_2 StockMkt_{t-n} + \sum_{n=0}^{n} \beta_3 FX_{t-n} + \sum_{n=0}^{n} \beta_4 RiskMeasure_{t-n} + \epsilon$$

Where

$$UMP_i = (Fed\,QE; ECB\,QE; Fed - ECB\,differential)$$

And $n$ is the optimal lag individuated for each variable.

[7] https://blogs.cfainstitute.org/investor/2023/03/17/myth-busting-the-economy-drives-the-stock-market/

It is important to notice that when the variable $UMPi$ takes the second value (ECB QE), the sign of the data is opposite with respect to the third (QE differential). This is because in the first case the changes in the CB assets are taken "as they are", while in the second they are transformed with a negative sign to build the differential. This caution is crucial for a correct interpretation of the results.

As presented by Fratzcher et al. (2013), three caveats need to be underlined. The first is the possibility of endogeneity: the central bank's intervention might be not exogenous but dependent on market developments, which might in turn be reflected in the set of control variables introduced. This issue will be solved by instrumenting in case significant multicollinearity among the regressors were detected. The same problem theoretically applies specifically to the exchange rate variable, as it is indeed a component of the international investor's return, but it is in turn influenced by the capital flows themselves. Regarding the last point no significant endogeneity is detected, and the equity flows between the U.S. and Germany representing only a small portion of the whole financial and non-financial trade between the euro area and the U.S., we can safely assume this issue as non-problematic.

The second caveat presented refers to the speed with which financial markets react to the Central Banks' policy announcements and implementation, as presented earlier.

The third issue regards the extent to which the markets have been able to anticipate the policies, causing possible portfolio allocations to be adjusted before the event. As the model ignores the effect of announcements, it comes naturally to also ignore the *market anticipations* of said effects. Moreover, when assuming as monetary policy transmission channels the ones presented in the first part of the thesis, this problem would have an impact only on a small share of them.

# Chapter 4

# Initial Attempts

## 4.1

During the earliest phase of the elaboration of this thesis, the first computations developed consisted in dynamic models having as dependent variable the percentage change in the cumulative net bilateral flows between the two countries. In this way it was possible to have the variable expressed as a percentage variation of past cumulative values. This approach was not successful in obtaining results that were significant enough to be satisfactory, or consistent with what presented by past literature. This section will briefly present the partial results obtained by this methodology.

The first results of the dynamic model showed results inconsistent with past literature. In particular, the result of the regression showed an increase in the net flows to the U.S. following Fed's QE activity. This result is contradictory to what presented by Khatiwada (2017), which shows that the first Fed's QE episodes caused strong and significant net equity flows into the European Union. Given that the German GDP represented about one third of the whole European Union GDP at the time[8], we deem unlikely a behavior of Germany opposite to what shown for the EU in aggregate. In order to deeply study the matter and inquire into whether it was possible to find an explanation or a solution to the issue, various methods have been tried.

The first attempt was the division into subperiods. The series for the dependent variable was run through a Bai-Perron multiple structural change test, that individuated a significant break in July 2013. The sample was split into two subperiods (pre and post break), and the regressions run again. The results were not only similar to what found in the first attempt, but not significant as well.

[8]Source: www.statista.com

The second solution explored was to begin to work with lagged variables, for the reasons presented in the methodological section. After obtaining optimal lags for each variable, multiple regressions were tested but the results were not showing significant coefficients.

A third approach was to inquire whether the likely incorrect results were caused by multicollinearity among the variables. Multiple models with different lags were tested, and no outstanding values in the VIFs[9] were detected.

The fourth attempt investigated whether the net flows were influenced by long-term trends which were not detected by the solutions explored earlier. The intuition was that in case of a positive (or negative) longer-term trend, the flows would show values depending on it and it would not be possible to assess the impact of the shock caused by Unconventional Monetary Policy. In order to untangle the two effects, the series of the cumulative net flows was run through a Hodrick-Presscot Filter. The tool, proposed by Hodrick and Presscot (1997) implements the removal of the trend component of a time series via a decomposition into a stochastic trend and a cyclical term.

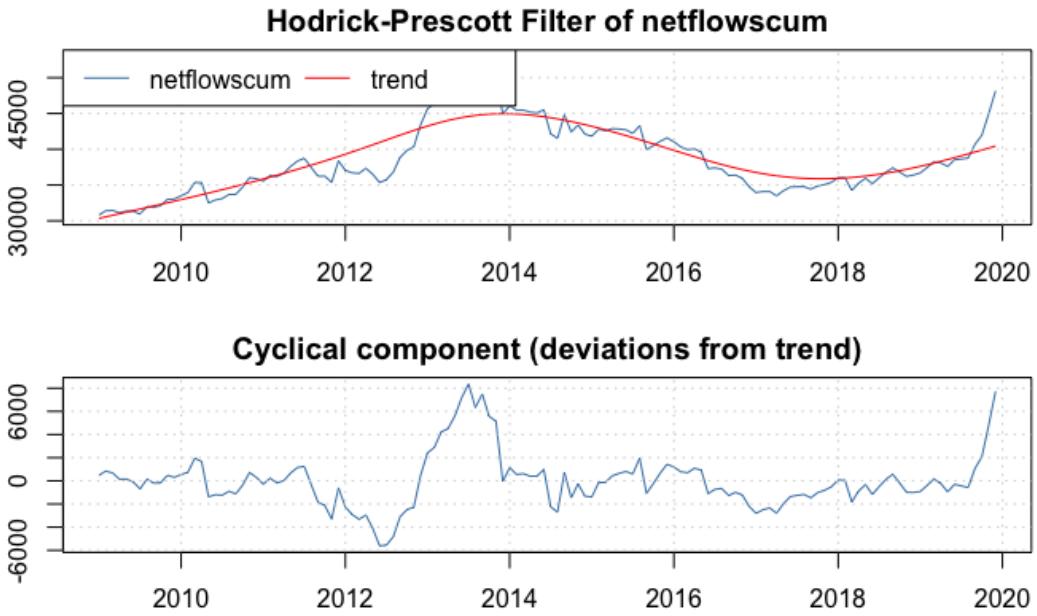


Figure 4.1: HP decomposition of the cumulative net flows.

The new net flows, expressed as percentage change of the "detrended" series were again analyzed, but no significant results were obtained.

A final attempt involved the use of different datasets from the TIC database, such as

[9] Variance Inflation Factor

the denominations of portfolio holdings of U.S. and Foreign securities[10] "U.S. Securities held by foreigners" and "Foreign Securities held by U.S. citizens".

Some examples of results for these earlier "unsuccessful" attempts are presented in the Appendix.

The reasons for these unsuccessful results could be various, and there are several other possible other solutions that would be worthy to further explore, without the time constraint posed by the development of this thesis.

- Model misspecification: alternative specifications like the use of ARDL or VAR models could better describe the interaction among variables, especially when dealing with complex systems and interactions at lagged levels.
- External factors or omitted variables: there could be some other push and pull factors driving capital across the two nations that were not considered in the tested models. The control variables could not be sufficient in explaining variability, and the "general equilibrium model" could be incomplete.
- The "flight to safety effect" has not been taken into consideration. Kekre and Lenel (2021) highlight the strength of the U.S. as safe haven during periods of uncertainty shocks, causing a dollar appreciation and decline in global output. This effect could be present, especially during the sovereign debt crisis in Europe in 2010-2011, causing a flight from European markets into American markets, which is not directly related to Central Bank activity. At the same time, Germany is one of the most stable countries of its continent, and a flight to safety effect might have been present from other Eurosystem countries towards Germany. While this clearly does not directly impact the equity flows between Germany and the U.S., it may influence the portfolio allocation choices of German investors.

[10] https://home.treasury.gov/data/treasury-international-capital-tic-system-home-page/tic-forms-instructions/securities-b-portfolio-holdings-of-us-and-foreign-securities

# Chapter 5

# Results: evidence of the strenght of QE as an Equity Flows Driver

## 5.1

Following the attempt to work with net flows without significant results presented in section "Earlier attempts", the focus of the research was shifted to Gross Flows in the two directions. This approach is found in Davis, Valente and van Wincoop (2019). The authors present that until the global financial crisis, scientific literature on international capital flows was focusing mainly on the net capital flows, however after the crisis there has been a shift to gross flows. This is because the crisis marked a change in the capital flows dynamics, with a strong simultaneous decline in both gross inflows and outflows, together with the tendency of both to co-move with more strength than they used to. This results in higher volatility of gross flows incoming and outgoing, without producing differences in the difference of the two, i.e., the net flows. When looking at the flows from the U.S. to Germany, and from Germany to the U.S. in figure 2.1 and 2.2 in section "Data", this is indeed what occurs. We can observe how both series have similar patterns and similar developments and reactions to shocks. While the two do not show exact correlation, it seems reasonable to take into account the similarity presented above and to start reasoning in terms of gross flows, i.e. separating the two and work in terms of variability of gross flows per country of recipient, rather than attempting to identify shocks that have brought capital from one country to the other.

The new approach therefore starts with the expanded model presented in the methodology section, with the use of an OLS model allowing for lagged variables. The extent

of how to lag each variable was chosen by computing the optimal value for each one, maximizing selection criteria like the AIC and the BIC. A linear regression was then run with all the variables lagged to their optimum value, and then the model was adjusted by iteratively removing all the non-significant variables starting with the ones with the highest p-values, in order to reach a final model, satisfactory in terms of results, of significance, and with a number of variables coherent with the number of observations in the series.

Initially, six models were run. For each "flow direction" (i.e., gross flows to the U.S., and gross flows to Germany), the coefficients were estimated for the following three subdivisions:

- Along all the sample length (December 2008 – February 2019), regressing on the QE differential.
- During the period of American QE1, QE2, QE3 (December 2008 – October 2014), regressing on the Fed's QE.
- During the ECB QE period (March 2015 – February 2018), regressing on the ECB's QE.

In this way there is an attempt to study the actions of the two central banks jointly, in the first case, and separately in the other two.

Table 5.1 shows the results for the gross flows to the United States:

| USA | FED - ECB Whole Sample | | QE 1-2-3 (DEC 08 - OCT 14) | | ECB QE (MAR 15 - FEB 18) | |
|---|---|---|---|---|---|---|
| R^2 | 45% | | 38% | | 50% | |
| Adj R^2 | 42% | | 32% | | 38% | |
| Observations | 123 | | 71 | | 35 | |
| | *Coefficient* | *p-value* | *Coefficient* | *p-value* | *Coefficient* | *p-value* |
| **Y t-1** | 0,3654 | 0,0000 *** | 0,4980 | 0,0001 *** | 0,3987 | 0,012236 * |
| **Y t-2** | 0,3463 | 0,0001 *** | | | | |
| **QE** | 15,5874 | 0,0398 * | 44,4750 | 0,0188 * | -19,9285 | 0,2247 |
| **QE t-1** | | | | | -12,6098 | 0,4434 |
| **QE t-2** | | | | | 31,2048 | 0,0848 |
| **FX RATE** | -4,0767 | 0,6473 | 17,6310 | 0,1569 | -49,3860 | 0,0286 * |
| **FX RATE t-1** | 0,5009 | 0,9544 | | | | |
| **FX RATE t-2** | | | | | | |
| **FX RATE t-3** | | | -45,4220 | 0,0009 *** | | |
| **STOCK MKT RET DIFFERENTIAL** | | | 9,2670 | 0,2627 | | |
| **STOCK MKT RET DIFFERENTIAL t-1** | | | | | 33,3274 | 0,0201 * |
| **VIX - VDAX DIFFERENTIAL** | 2,6435 | 0,1634 | | | 6,4639 | 0,0474 * |
| **VIX - VDAX DIFFERENTIAL t-1** | | | | | | |
| **VIX - VDAX DIFFERENTIAL t-2** | | | -6,8430 | 0,0412 * | | |
| **VIX - VDAX DIFFERENTIAL t-3** | | | -2,8290 | 0,3962 | | |

Table 5.1: results for the flows to the US.

We can observe, as expected, a positive and statistically significant coefficient for the QE differential in the first and second model, corresponding respectively to the impact of the QE differential along the whole sample, and the impact only of Fed's QE during the three early episodes, ranging from the begining of the sample up to late 2014, where the purchase program stopped considerably. In the third model, while the result for the ECB's purchase program shows as expected a negative coefficient at lag zero and lag one, there are no statistically significant results. This is perhaps due to the short size of the sample, which may generate higher standard errors, but it is consistent with past literature exposing weaker results for the ECB QE with respect to its American counterpart. There seems to be some minor regularity in the control variables found significant, where in the second model the exchange rate and the VIX-VDAX differential are found to have both significant coefficients, albeit at different lags, while in the third model also the lagged stock market return differential is found to be having a positive effect on the flows to the U.S., as expected. As it can be observed, the same variables are found to be significant at different lags across the models.

Table 5.2 presents the results for the gross flows to Germany:

| GERMANY | FED - ECB Whole Sample | | QE 1-2-3 (DEC 08 - OCT 14) | | ECB QE (MAR 15 - FEB 18) | |
|---|---|---|---|---|---|---|
| R^2 | 74% | | 66% | | 81% | |
| Adj R^2 | 73% | | 62% | | 76% | |
| Observations | 123 | | 71 | | 35 | |
| | *Coefficient* | *p-value* | *Coefficient* | *p-value* | *Coefficient* | *p-value* |
| **Y t-1** | 0,4640 | 0,0000 *** | 0,7671 | 0,0000 *** | 0,72 | 0 *** |
| **Y t-2** | | | | | | |
| **QE** | 13,2844 | 0,0014 ** | 29,7983 | 0,0143 * | -13,7876 | 0,0989 |
| **QE t-1** | | | -6,9476 | 0,5011 | | |
| **QE t-2** | | | | | -7,1998 | 0,3895 |
| **FX RATE** | -5,1169 | 0,2708 | -2,6414 | 0,7330 | | |
| **FX RATE t-1** | | | | | -23,9481 | 0,0426 * |
| **FX RATE t-2** | | | | | | |
| **FX RATE t-3** | | | -20,5393 | 0,0120 * | | |
| **STOCK MKT RET DIFFERENTIAL** | 7,6733 | 0,1368 * | 10,2610 | 0,0480 * | 12,3525 | 0,0361 * |
| **STOCK MKT RET DIFFERENTIAL t-1** | | | | | 11,1541 | 0,1511 |
| **STOCK MKT RET DIFFERENTIAL t-2** | | | 5,0083 | 0,3420 | | |
| **VIX - VDAX DIFFERENTIAL** | 2,5519 | 0,1458 * | | | | |
| **VIX - VDAX DIFFERENTIAL t-1** | | | | | | |
| **VIX - VDAX DIFFERENTIAL t-2** | | | -2,1491 | 0,2836 | 3,2744 | 0,0394 * |
| **VIX - VDAX DIFFERENTIAL t-3** | | | | | | |

Table 5.2: results for the flows to Germany.

We can immediately notice that, similarly to the results for the U.S., we encounter significant positive coefficients for the QE in the first two models, while a negative, albeit not significant effect in the third one is detected. The USD-EUR exchange rate is observed having a negative effect on the gross flows in all three cases, but it is not significant in the complete model. The stock market return is observed having positive and significant impact in all three models, while the VIX-VDAX differential is found having a positive and significant effect as well along the whole sample length, and in the third model. Again, there seems to be no uniformity in the lags at which significant effects are observed, with the exception in this case of the stock market returns differential, consistently significant when not lagged.

## 5.2 Diagnostics

In order to evaluate the goodness of fit of the models, some tests on the residuals have been implemented, namely

- Ljung-Box test, testing the null hypothesis that the autocorrelations of a time series up to a certain lag are zero, denoting no statistically significant autocorrelation, against the alternative hypothesis of autocorrelation present in the data.
- Shapiro-Wilk test, to assess the normality of the residuals.

- Breusch-Pagan test, testing the null hypothesis of homoscedasticity in the regression model, against the alternative of heteroscedasticity.

**USA**

| | **FED - ECB whole sample** | **QE 1-2-3 (DEC 08 - OCT 14)** | **ECB QE (MAR 15-FEB 18)** |
|---|---|---|---|
| LJUNG-BOX TEST | No AC detected | No AC detected | No AC detected |
| SHAPIRO-WILK TEST | No Normality | No Normality | Normality |
| BREUSCH-PAGAN TEST | No Heterosk. | No Heterosk. | No Heterosk. |

Table 5.3: Results diagnostics for the US

**GERMANY**

| | **FED - ECB whole sample** | **QE 1-2-3 (DEC 08 - OCT 14)** | **ECB QE (MAR 15-FEB 18)** |
|---|---|---|---|
| LJUNG-BOX TEST | No AC detected | No AC detected | No AC detected |
| SHAPIRO-WILK TEST | Normality | Normality | Normality |
| BREUSCH-PAGAN TEST | No Heterosk. | No Heterosk. | No Heterosk. |

Table 5.4: Results diagnostics for the Germany

The results of the test presented in Table 4 show desirable outcome in all models, except for the first two models for the flows to the U.S., which show non-normal residuals. Despite being a desirable condition, residual normality is not a crucial assumption of OLS models as it is does not take place in the Gauss-Markov conditions[11] . While the risk of having less robust results needs to be taken into consideration, as the other regression diagnostic look satisfactory we can reasonably assume the inferences should not be far wrong. Moreover, both models have residuals with mean extremely close to zero.

[11]The Gauss-Markov theorem states that a model is the Best Linear Unbiased Estimator when the following conditions hold: linearity, no multicollinearity, strict exogeneity and spherical errors.

## 5.3 Statistical Breaks detection

The following step consists in detecting statistical breaks in the dependent variables. Until now, the divisions in those three subsamples have been based on our policy knowledge, following the breaks represented by the time periods marked by the differences in QE activity by the two central banks. The goal of this extension of the model is to observe whether first, which statistical breaks can be observed in the variables, second if those breaks correspond to the policy dates chosen earlier, and third if new regression can be run on new subsamples and if we can obtain better results accordingly.

The breaks were detected by means of a Bai-Perron multiple structural change test, running it on the dependent variable. The breaks it found are the following, reported in Table 5.5:

| | |
|---|---|
| USA | August 2010 |
| | December 2015 |
| | August 2017 |
| GERMANY | August 2010 |
| | February 2016 |
| | August 2017 |

Table 5.5: Statistical Breaks Detection

It is possible to notice how in both cases the structural break dates individuated are the same, except for a small two-month difference in the second break (December 2015 for the series of flows to the U.S., February 2016 for the series of flows to Germany).

Due to sample-length constraint, it is not feasible to run regressions on all the subsamples individuated (for example, wanting to work with the third subsample individuated would mean having to use about twenty observations, a number which is clearly too low). Hence, it is chosen to test only the subsamples between the first and second break, and between the first and the third. In these cases, UMPi will take the values of the QE difference.

| | |
|---|---|
| USA | August 2010 |
| | December 2015 |
| | August 2017 |
| GERMANY | August 2010 |
| | February 2016 |
| | August 2017 |

Tables 5.6 and 5.7 report the results:

| USA | AUG 2010 - DEC 2015 | | AUG 2010 - AUG 2017 | |
|---|---|---|---|---|
| R^2 | 27% | | 48% | |
| Adj R^2 | 19% | | 43% | |
| Observations | 64 | | 84 | |
| | *Coefficient* | *p-value* | *Coefficient* | *p-value* |
| **Y t-1** | 0,1858 | 0,1095 | 0,3945 | 0,0000 *** |
| **Y t-2** | | | | |
| **QE** | 35,7600 | 0,0035 ** | 40,1734 | 0,0005 *** |
| **QE t-1** | | | | |
| **QE t-2** | | | | |
| **FX RATE** | -27,8140 | 0,0221 * | -16,7649 | 0,1224 |
| **FX RATE t-1** | | | | |
| **FX RATE t-2** | | | | |
| **FX RATE t-3** | -19,5802 | 0,0964 . | -20,6867 | 0,0617 . |
| **STOCK MKT RET DIFFERENTIAL** | | | | |
| **STOCK MKT RET DIFFERENTIAL** | -8,6668 | 0,1916 | -5,7914 | 0,3534 |
| **VIX - VDAX DIFFERENTIAL** | | | 1,2661 | 0,5922 |
| **VIX - VDAX DIFFERENTIAL t-1** | 4,4724 | 0,0832 . | | |
| **VIX - VDAX DIFFERENTIAL t-2** | | | -2,9212 | 0,2075 |
| **VIX - VDAX DIFFERENTIAL t-3** | | | | |

Table 5.6: results for the flows to US after the statistical breaks detection.

Regarding the QE variable, it is effectively possible to highlight results with slightly more explanatory power than in the previous models. In particular, along the sample dates August 2010 to August 2017, we can encounter very significant effects. There seems to be no particular improvement in the significance of the control variables, as the only one we encounter to be statistically significative is the negative effect of the USD-EUR exchange rate, consistently to what was highlighted by the previous models.

| GERMANY | AUG 2010 - FEB 2016 | | AUG 2010 - AUG 2017 | |
|---|---|---|---|---|
| R^2 | 34% | | 65% | |
| Adj R^2 | 27% | | 62% | |
| Observations | 66 | | 84 | |
| | *Coefficient* | *p-value* | *Coefficient* | *p-value* |
| **Y t-1** | 0,3645 | 0,0020 ** | 0,6035 | 0,0000 *** |
| **Y t-2** | | | | |
| **QE** | | | | |
| **QE t-1** | | | | |
| **QE t-2** | | | | |
| **QE t-3** | 17,7421 | 0,0182 * | 19,1625 | 0,0020 ** |
| **FX RATE** | | | | |
| **FX RATE t-1** | -10,1797 | 0,1449 | -6,0021 | 0,3439 |
| **FX RATE t-2** | | | | |
| **FX RATE t-3** | -8,2500 | 0,2507 | -4,9463 | 0,4422 |
| **STOCK MKT RET DIFFERENTIAl** | 6,7991 | 0,0955 . | 6,2620 | 0,1040 |
| **STOCK MKT RET DIFFERENTIAL t-1** | | | | |
| **VIX - VDAX DIFFERENTIAL** | 2,3738 | 0,1672 | 1,3409 | 0,3546 |
| **VIX - VDAX DIFFERENTIAL t-1** | | | | |
| **VIX - VDAX DIFFERENTIAL t-2** | | | | |
| **VIX - VDAX DIFFERENTIAL t-3** | | | | |

Table 5.7: results for the flows to Germany after the statistical break detection..

Regarding the effects of the flows to Germany, it is surely curious to notice that it is only possible to find significant effects of the QE difference at lag 3, which had never happened in the previous models. Additionally, these models do not show substantially improved results. Again, the only control variable that shows significant coefficient, is the USD-EUR exchange rate.

## 5.4 Diagnostics

The usual diagnostic tests (reference to tables 5.3 and 5.4) are run for the four models and show satisfactory results in all cases.

**USA**

| | | |
|---|---|---|
| LJUNG-BOX TEST | No AC detected | No AC detected |
| SHAPIRO-WILK TEST | Normality | Normality |
| BREUSCH-PAGAN TEST | No Heterosk. | No Heterosk. |

Table 5.8: Results diagnostics for the US

**GERMANY**

| | | |
|---|---|---|
| LJUNG-BOX TEST | No AC detected | No AC detected |
| SHAPIRO-WILK TEST | Normality | Normality |
| BREUSCH-PAGAN TEST | No Heterosk. | No Heterosk. |

Table 5.9: Results diagnostics for Germany

# Chapter 6

# Discussion of the results

We have encountered positive and significant effects of American Quantitative Easing along all the (policy and statistical) subsamples;, with the introduction of Unconventional Monetary Policy raising the variability of monthly equity capital flows between the two countries. The same result holds when dealing with QE difference, thus considering jointly the effect of both American and European Central Bank.

Both in the case of flows to the U.S. and to Germany, the period of American "stability" and the introduction of QE in the Eurosystem caused a diminishing effect and a retrenchment in the volumes of capital exchanged, although statistically significant effects were not found. In all cases, the variable QE is found having its most significant effects when not lagged: this may be caused by the relative speed in adjustment to shocks of equity markets and the relative high liquidity of the American and German stock market, contingent on the extremely high level of financial development of the two countries. When dealing with less financially integrated countries or with markets with a lower degree of liquidity (for example, the corporate bond market), different results may be expected. The only exception is found for the gross flows to Germany for the subperiods August 2010 to February 2016, and August 2010 to August 2017: differently from earlier cases, the variable is found to be significant only at lag three. A possible explanation for this might be the strong interconnection of the various monetary policy transmission channels presented in the introductory section and the effect of announcements, a relation not explored in this dissertation due to time constrains, or country-specific features or events.

We find the percentage change in the USD-EUR exchange rate consistently having negative and significant effects on the gross flows to both countries along the majority of subsamples, perhaps due to the trend of euro depreciation which was fairly consistent

along all the time period.

Surprisingly enough, no significant coefficient for the differential in the stock market returns was detected for the U.S., while it has a positive and significant coefficient for the flows to Germany. It should be safe enough to consider this counterintuitive result as caused by spurious correlation or interaction between the variables, rather than characterizing it as a capital flow driver. It would be hazardous to define the return of the American stock market minus the return of the German stock market as driver of flows out of the U.S. and towards Germany.

The risk measures show weaker but positive coefficients, implying higher trade volumes during and following periods of high volatility in the U.S. The only exception to this is found in the subperiod December 2008 – October 2014 for the flows towards the United States, where the coefficient is significant and negative. Generally speaking, significant results are encountered at lag zero and lag two.

The results provided by the model do not seem in contrast with what shown by past literature. They are consistent with the proposition of Khatiwada (2017) that the episodes of unconventional monetary policy were associated with increased flows to the EU, and that Fed QE accounted for most of the variation in flows. Moreover, exchange rate movements were deemed having impact on the equity gross flows. The weaker results obtained for the ECB's QE are consistent with what proposed by Chen et al. (2017), who show that US unconventional monetary policy has had much stronger effects than the ECB's. Both policies had effect domestically, but the cross-border impact of the Fed's action were larger and more persistent. This is consistent with the primal role of the United States in the global economy, and of the strength of the dollar as primary world currency. Apart from the ones presented in the methodology section, other limitations of the study might be considered:

- Short sample length: the use of monthly data indeed poses some complications in the analysis, both in terms of number of observations per subsamples (for example many papers subdivide by QE event, which is impossible to do with monthly data due to the shortness of the events); and in terms of analysis capacity, as the fast reaction to new information of the equity markets may not be captured when working on a monthly basis. Most of the literature works with datasets with daily frequency provided by EPFR[12] , which are not available for free.
- The study considers bilateral flows between the U.S. and a single country, differently to the literature stream presented in the review that considers mainly flows

[12] https://epfr.com

to emerging countries or to developed economies. It is likely that the same capital drivers that influence German investors influence other similar Euro countries, and analyzing them in aggregate would "diversify out" the possibility of country-specific factors that are not captured by this study.

# Chapter 7

# Conclusion

The study proposed an analysis of the bilateral equity capital flows between the U.S. and Germany and aimed at assessing the impact of Quantitative Easing performed by the relative Central Banks on them. Using multiple linear regression models, the study first tried to gauge the impact on net flows (i.e., the flows from Germany to the U.S. minus the flows in the other direction) without encountering significant or valuable results, and then shifted to analyzing the gross flows (i.e., the flows in one or the other direction) by recipient country. A set of control variables was employed in order to account for any other factors identified as drivers of flows.

The study revealed a strong and significative influence of the Unconventional Monetary Policies employed by the Fed on the equity flows between the two countries, with the periods of high levels of central bank's purchases characterized by large flows to both countries. Consistently with past literature, the Quantitative Easing from the ECB has had a far more modest impact on the flows. This result is particularly important as it highlights the relative weight of the American Central Bank with respect to its European counterpart, and poses the accent on the fact that the American monetary policy might have disruptive effect on external countries, which are influenced by factors outside their control.

The study did not find great impact of the control variables on the flows, with the USD-EUR exchange rate being the most influential on the flows towards the U.S., and the differential in returns of the S&P500 and the DAX having a more prominent effect on the flows to Germany.

This thesis contributed to existing literature by analyzing both net and gross flows and focusing on the latter, and by analyzing the flows between the U.S. and a single country, in this case Germany, while past literature studied the impact on broader geographical

areas, like the European Union or “Advanced Economies”.

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# Appendix A

# Additional Data


Figure A.1: U.S. Dollars to Euro Spot Exchange Rate, U.S. Dollars to One Euro, Seasonally Adjusted.

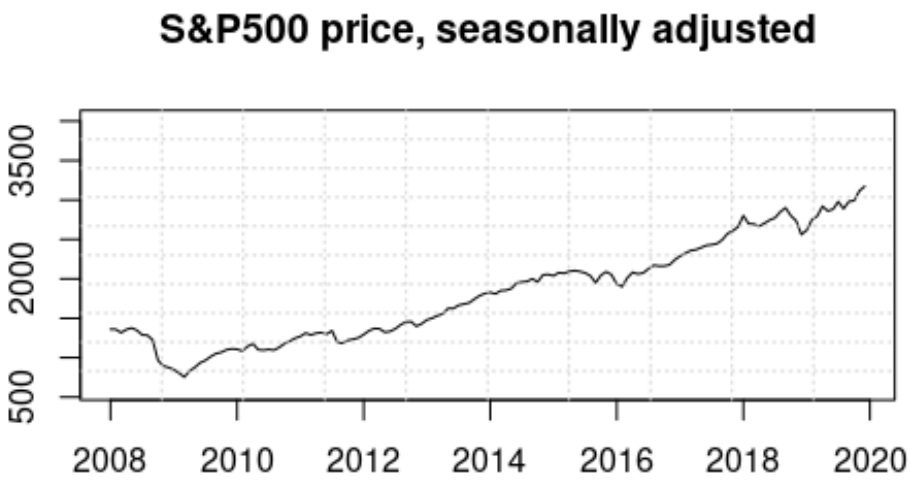


Figure A.2: S&P500 price, Seasonally Adjusted.


Figure A.3: DAX price, Seasonally Adjusted.


Figure A.4: VIX level, Seasonally Adjusted.

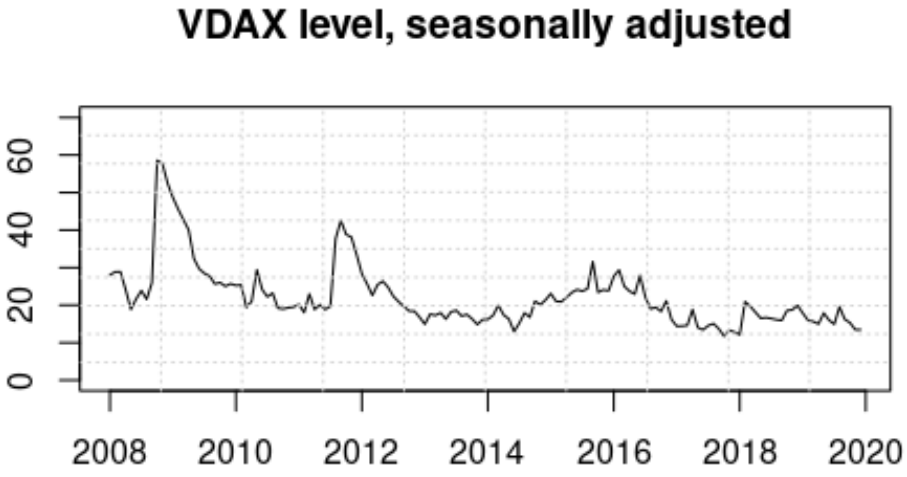


Figure A.5: VDAX level, Seasonally Adjusted.

# Appendix B

# Initial attempts

Some examples of the discarded results, as presented in chapter 4 "Initial Attempts".

| | FED - ECB Differential | | | FED QE | | | ECB QE | | |
|---|---|---|---|---|---|---|---|---|---|
| R^2 | 12% | | | 4% | | | 12% | | |
| Adj R^2 | 10% | | | 2% | | | 8% | | |
| Observations | 132 | | | 132 | | | 58 | | |
| | *Coefficient* | *p-value* | | *Coefficient* | *p-value* | | *Coefficient* | *p-value* | |
| **Intercept** | 0,0046 | 0,0000 | *** | 0,0044 | 0,0000 | *** | 0,0054 | 0,0000 | *** |
| **QE** | 0,0440 | 0,0002 | *** | 0,0355 | 0,0224 | ** | -0,0873 | 0,0098 | *** |
| **STOCK MKT RET DIFFERENTIAL** | -0,0003 | 0,9656 | | -0,0001 | 0,9906 | | -0,0185 | 0,4230 | |
| **VIX - VDAX DIFFERENTIAL** | 0,0001 | 0,7923 | | 0,0000 | 0,8614 | | 0,0002 | 0,7976 | |

Table B.1: Results of preliminary regressions, using the Net Flows (See definition in section 2.1 and model in section 3.2)

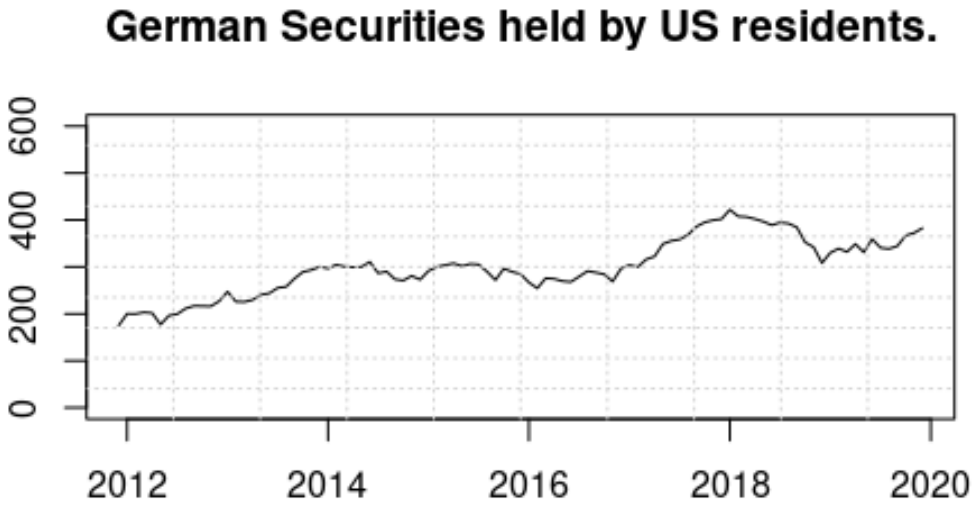


Figure B.1: German Securities held by US residents. Series starts in 2011. Data in million USD, Seasonally Adjusted.

| | FED - ECB Whole Sample | | Only ECB QE Whole Sample | | QE3 (SEPT 12 - OCT 14) | | FED STABILITY (NOV 14 - SEPT 17) | |
|---|---|---|---|---|---|---|---|---|
| R^2 | 20% | | 35% | | 29% | | 36% | |
| Adj R^2 | 16% | | 28% | | 12% | | 25% | |
| Observations | 96 | | 58 | | 26 | | 35 | |
| | *Coefficient* | *p-value* | *Coefficient* | *p-value* | *Coefficient* | *p-value* | *Coefficient* | *p-value* |
| **Intercept** | 0,0129 | 0,0055 | 0,0131 | 0,0845 | -0,0106 | 0,5245 | 0,0090 | 0,4563 |
| **QE DIFFERENTIAL** | -0,3625 | 0,2489 | -0,3511 | 0,2673 | 1,7062 | 0,4473 | -0,5277 | 0,1835 |
| **QE DIFFERENTIAL t-1** | 0,5818 | 0,0624 | 0,4545 | 0,1695 | -0,5611 | 0,7900 | 0,4598 | 0,2465 |
| **STOCK MKT DIFFERENTIAL** | -0,5481 | 0,0029 | -0,9347 | 0,0005 | -0,2385 | 0,5158 | -1,1437 | 0,0021 |
| **VIX DIFFERENTIAL** | -0,1560 | 0,0014 | -0,1949 | 0,0003 | 0,0326 | 0,7457 | -0,1755 | 0,0391 |
| **FX RATE** | 0,6252 | 0,0315 | 1,3025 | 0,0021 | 0,8968 | 0,0650 | 0,9671 | 0,0624 |

Table B.2: Results of preliminary regressions, using the German Securities held by US residents, see figure B.1