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The response of European stock markets to the Brexit

Matthias Raddant

ZUSAMMENFASSUNG / ABSTRACT

In dieser Studie untersuchen wir die Reaktion der europäischen Aktienmärkte auf die Volksabstimmung zum Brexit. Wir analysieren die Korrelationen der Aktienmärkte von Großbritannien, Deutschland, Frankreich, Spanien und Italien sowie die Volatilität einzelner Aktien. Wir finden, dass die Reaktion der Märkte relativ ähnlich war, Italien stellt allerdings eine Ausnahme dar. Hier hat sich die Volatilität von Aktien im Finanzsektor nach der Abstimmung in Großbritannien verfestigt.

This paper reviews the response of the European stock markets to the Brexit referendum. We analyze the correlation of market indices, stock volatility and the special role of stocks from the financial sector. While the impact of the vote was very similar for the stock markets in France, Germany and Spain, in Italy volatility among financial stocks intensified permanently.

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THE RESPONSE OF EUROPEAN STOCK MARKETS TO THE BREXIT*

by Matthias Raddant

I. INTRODUCTION

On 23 June the United Kingdom voted in a referendum not to continue the country's membership in the European Union. Although the relationship of the UK and the EU was a source of debate ever since it joined the EEC in 1973 the outcome was a surprise for most observers and hence stock prices reacted heavily when the markets opened on the day after.

Since then there has been debate about which countries and which companies would be affected most by the Brexit and in fact there is still a lot of uncertainty in the markets. This mostly stems from the fact that it is currently unclear when exactly the UK would leave the EU and more importantly what the new contractual setting will be between the UK and the EU and its member states.

The expectations of market participants express themselves in the stock prices that we can observe in the European markets, but of course the first days after the Brexit vote were not very informative on details since stocks co-moved downwards in an undifferentiated panic reaction. A bit more than one month after the vote we now have sufficient data to disentangle the response of the markets in a bit more detail, and we will do this by looking at a set of 428 stocks, market indices, and exchange rates from the markets in the UK, Germany, Spain, France and Italy.

In the following we will first analyze the dynamics of the five stock indices together with the relevant exchange rates. We will then look at the markets on the level of single stocks and see which sectors reacted most to the Brexit vote. This is especially important in light of the Italian banking crisis which intensified in the aftermath of the vote. Finally we will have a look at a visualization of the correlation structure of the European stock market after the referendum.

II.   STOCK INDICES

The European stock market indices were in a slight upward movement in the first half of 2016 until the beginning of June. After the Brexit vote stock prices dropped by around 10 percent and have since then only slowly returned to mid June levels (see Figure 1). This trend was interrupted by reactions of the markets to the terror attacks in Nice and an attempted coup in Turkey.

For the case of the UK one has to consider the significant changes in the pound/euro and pound/dollar exchange rates, which made investing in the UK cheaper for euro- and dollar-based investors. The figure thus also shows the FTSE index adjusted by the exchange rate as a dotted line.

The development of the exchange rates of the pound, dollar, and euro are shown in Figure 2. In the medium run the pound lost 8% of its value against the euro and 10% against the dollar while the euro depreciated against the dollar by 3.5%.

We can analyze the changes in the correlation of the stock indices by estimating a multivarite GARCH model. This enables us to calculate implied daily correlations between the indices and it overcomes many statistical problems that one would have by calculation correlations on the raw data (Barberis et al. 2005; Cont 2001; Engle 2002; Laloux et al. 1999).

Figure 1:
Stock indices of the five largest EU stock markets, all normalized to a value of 1 on 23 June (DAX30, FTSE100, FTSE MIB, IBEX 35, CAC 40)
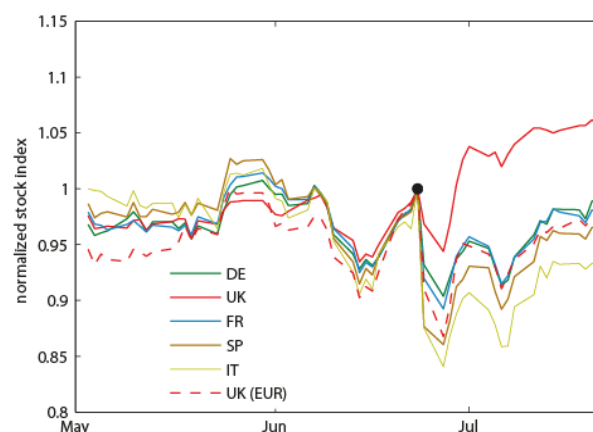
The broken red line shows the FTSE index normalized with the pound/euro exchange rate. The day of the Brexit vote is marked by a black dot.

Figure 2:
Exchange rates of the pound, dollar and euro

On the day after the referendum the pound depreciated significantly and has not recovered yet.
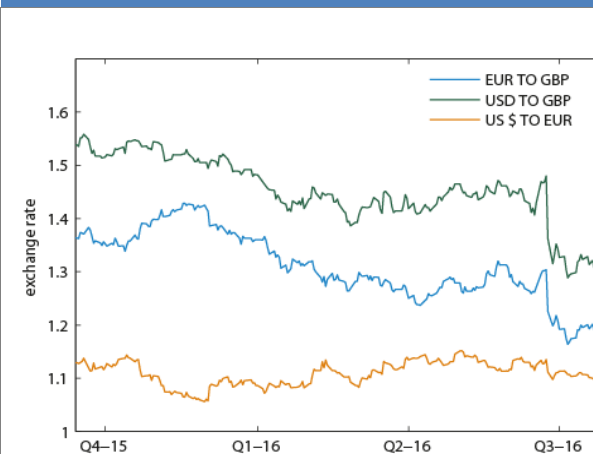
Figure 3 shows the correlation of the stock index returns (daily changes) implied by the DCC GARCH model for the FTSE index with the indices of the other 4 markets. Also here we have calculated one version with the raw FTSE index and one where the FTSE has been

normalized by the pound-euro exchange rate (see the appendix for details on the data that has been used in this study).

The correlations between these indices are rather high and constant. The market in the UK is slightly more correlated to Germany and France than to Italy and Spain. When we normalize the FTSE by the exchange rate the overall correlations are slightly higher and the differences between the countries show more pronounced. France appears stronger, Italy less correlated in the bottom panel. The latter representation also shows the peak in correlation right after the Brexit vote more clearly, in the top panel this effect is partly lost by the synchronous pound depreciation.

Figure 3:
Correlations between the indices of the UK stock market index FTSE100 with all other stock market indices
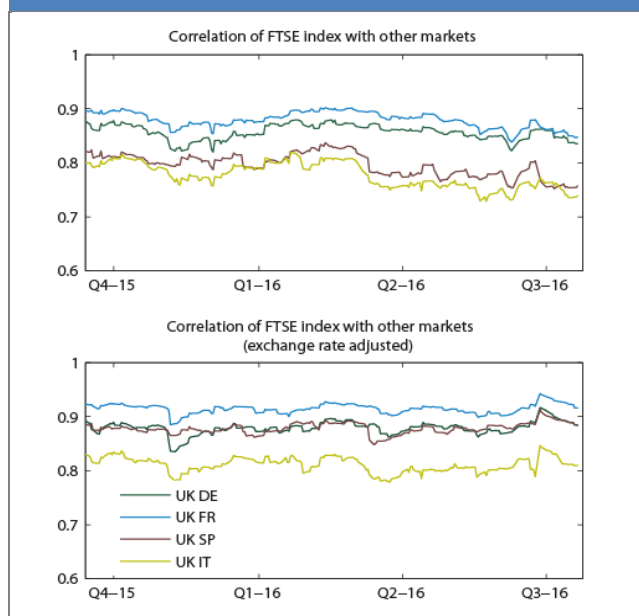
The top panel uses the raw index returns, in the bottom panel we normalize the FTSE index by the exchange rate.

III.   STOCK VOLATILITY

In order to understand the reaction of the European markets in a bit more detail we have to look at the behavior of single stocks. A first step is to analyze in how far the volatility in different markets has changed after the Brexit vote. To calculate the volatility we estimate a univarite GARCH model for all stock in our sample and then average over the obtained estimated daily volatilities (Engle 1982).

Figure 4 shows that we have seen an increase in volatility in all markets right after the Brexit vote, but that volatility has fallen towards pre-vote levels within three weeks. The effect was relatively large in the UK itself and in Italy. In these countries we have however observed comparably large volatility even before the Brexit vote. The stocks from the financial sector do play a special role here. There is noticeable sectoral volatility in the UK weeks before the vote, and a far above market average reaction afterwards.

The Italian financial sector reacted very sharply to the Brexit vote. However, a closer inspection clearly shows that the volatility of financial stocks was already high long before the Brexit vote, even though not persistently. This is a hint that the referendum was a catalyst for worries about Italian banks, not the decisive reason for it.

Let us now look which stocks have been hit most by the Brexit vote. Some results on this are shown in Figure 5. To make figures comparable we have normalized prices to 1 on the day of the vote and show the changes that happened in the month after the vote.

Figure 4:
Average daily volatility $\left(\sqrt{h_t}\right)$ of stocks in the UK, Germany, France, Spain and Italy (black line), volatility for stocks from the industrial sector (purple), consumer cyclicals (red), and financials (orange)
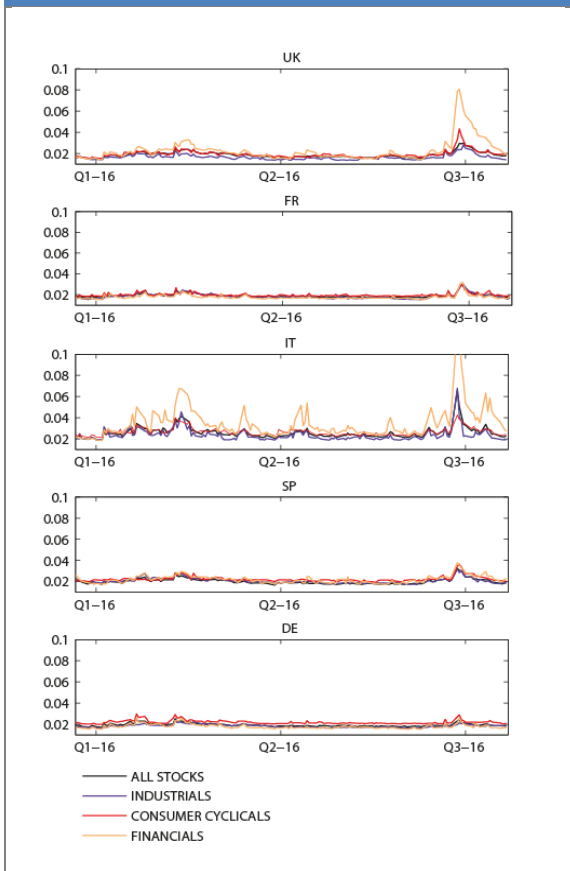
Figure 5:
Average impact on stock prices in the UK, Germany, France, Spain and Italy (black)
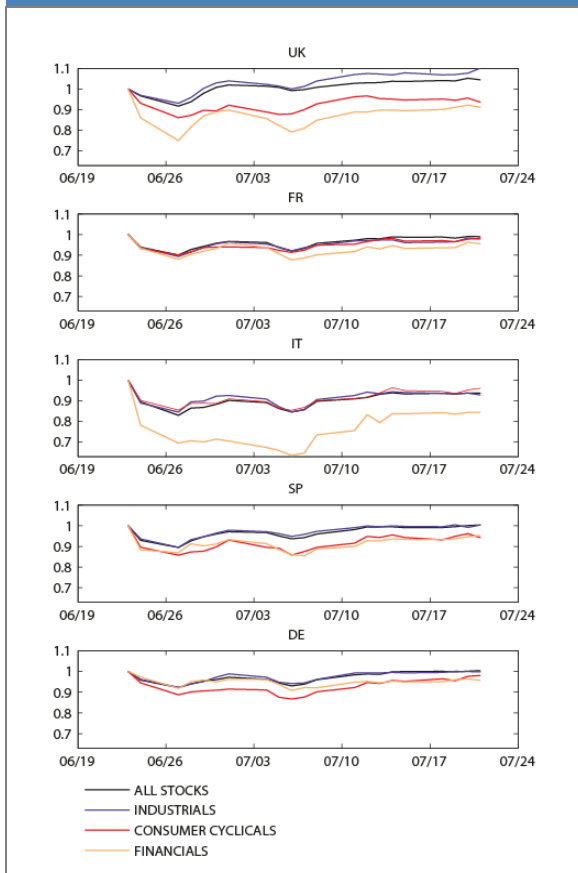
Impact for stocks from the industrial sector (purple), consumer cyclicals (red), and financial (orange). The calculation is based in the accumulated log returns after the Brexit vote, the prices on that day are normalized to 1.

In the UK we observe pronounced differences in the price impact for different sectors. While stock from the industrial sector have recovered rather fast (we show pound based prices here), stocks from the consumer cyclicals sector perform weaker, even worse are the stocks from the financial sector. The results are qualitatively similar in France, Spain, and Germany, even though the differences between the sectors are much smaller. For Italy we observe a much more pronounced decrease in stock prices for the financial sector. Financials constitute a large group in the FTSE MIB index, in fact 14 out of the 38 stocks we consider for Italy are from the financial sector, two of them, Unicredit and Intesa can be considered as international banks, the other companies are insurances (i.e. Generali) and smaller financial institutions.

IV.   STRUCTURE OF THE EUROPEAN STOCK MARKET TODAY

Despite obvious regional effects the European stock markets are highly integrated. Investors can shift between markets easily and many companies have strong cross-border ties, both result in a steady co-movement of stock prices within Europe, at least for the larger companies. The co-movement between the UK and the rest of the EU has always been a little weaker than between other member states, this is a result of differences in industrial structure (to a small amount also the time difference accounts for this, in study we do not correct for this effect).

One can analyze this co-movement by calculating different correlation measures (Rigobon 2003; Kenett et al. 2012; Raddant and Kenett 2016; Raddant and Wagner 2016). For illustrative purposes we present a network representation of such an analysis in Figure 6. The network is based on the correlation matrix of de-garched returns of all stocks in the 4 weeks after the Brexit vote, leaving out the first two days. Stocks appear as nodes and edges

Figure 6:
Network representation of a filtered correlation matrix of stock returns for the month after the referendum
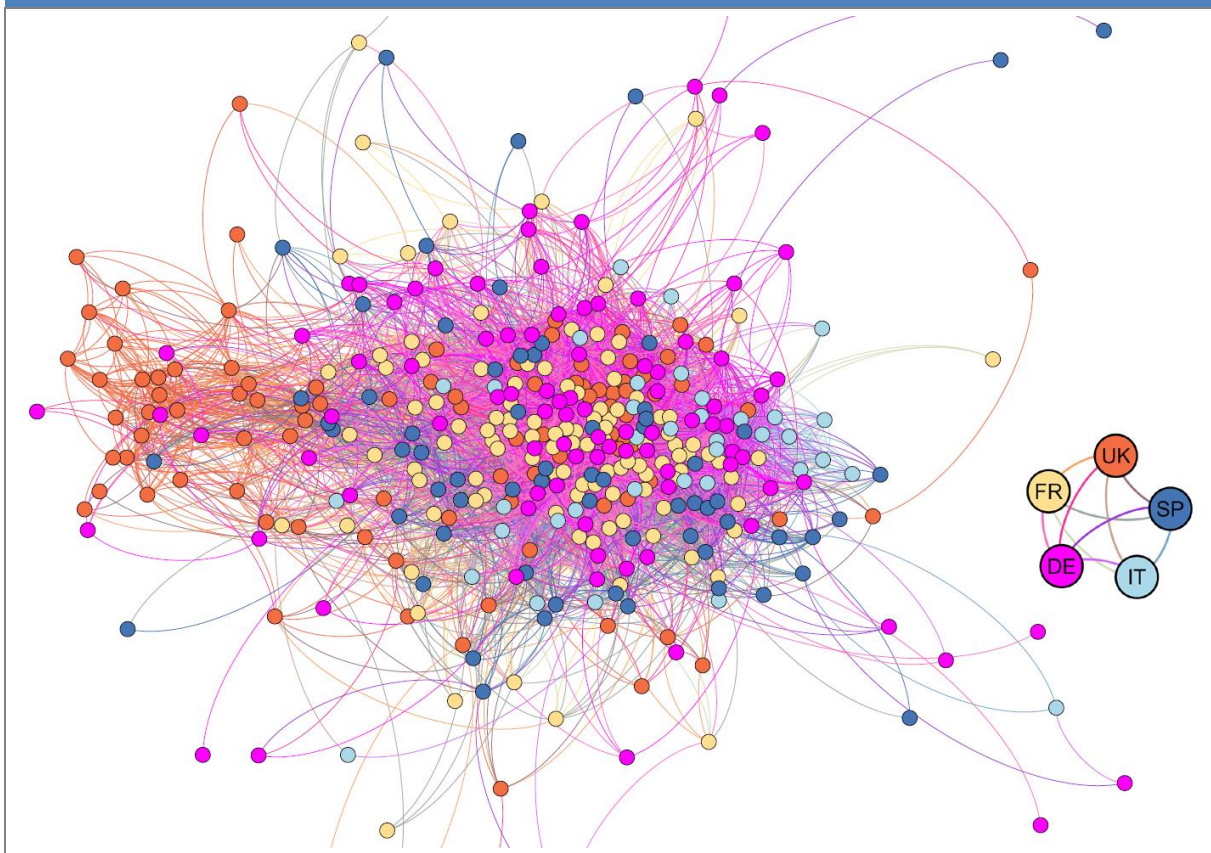
Nodes represent stocks and edges represent filtered correlations with a value larger than 0.65. The nodes are color coded according to the legend on the right. The 2-dimensional representation of the correlation matrix is based on an algorithm that positions stocks with a high similarity in price movements close to each other. We observe that most of the European stocks behave very similarly (sse the central cluster) with noticeable exceptions of some UK stocks (separate cluster on the left), some Italian stocks (tending to the right part of the figure) and smaller Spanish companies (scattering around the center).

represent (filtered) correlations between pairs of stocks with a value larger than 0.65. The 2-dimensional representation of this network has been generated with the repulsion based algorithm by Hu (2005).

One finds that most of the European stocks form one giant cluster in the middle of the figure, which means that these stocks's prices developed very similar in the last month. Stocks from the same country are shown as nodes with the same color. One can deduct that some segmentation between the different markets remains, since we observe clusters of nodes with the same color. The stocks from Italy for example (bright blue) are mostly positioned a bit to the right of the giant cluster. About half of the stocks from the UK form a small group on their own on the left part of the figure. The other half of the UK stocks appear in the middle of the plot. These differences in behavior among UK stocks with respect to other European markets can also be found before the Brexit vote, it has however intensified since then.

This finding might stand as a good example for the general question of the economic ties between the UK and the rest of the EU. Although some differences between the markets exist, large parts of the UK market behave very European, and even the parts which behavior differs slightly are closely connected to the rest of the EU.

V.   CONCLUSIONS

The Brexit vote had similar effects in Germany, France, Spain and Italy. The stock prices declined sharply and returned close to their previous levels within 3 weeks. In the UK and Italy the volatility after the vote peaked highest. Although the Italian market is the one least connected to the UK under normal circumstances, the strong downward movement of Italian stocks from the financial sector make this market stand out in its reaction to the referendum. Spikes of volatility of financial stocks in Italy long before the Brexit vote indicate that uncertainly was present in the market before but that this uncertainty has manifested itself ever since.

But also in other countries, and foremost in the UK, the prices of stocks from the financial sector have only recovered partly. Uncertainty about necessary changes in the future EU financial infrastructure remains, together with very pragmatic questions about the market access of UK-based financial institutions to the EU.

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APPENDIX: DATA USED

Table A1: Summary of data used in this analysis	United Kingdom UK FTSE100	Germany DE DAX30	Italy IT FTSE MIB	Spain SP IBEX 35	France FR CAC 40
Total stocks	**100**	**112**	**38**	**77**	**101**
Energy	5	4	4	4	0
Basic Materials	9	8	2	9	16
Industrials	13	27	4	16	16
Consumer Cyclicals	24	25	7	10	20
Consumer Noncyclicals	11	6	1	2	4
Financials	23	17	14	19	18
Healthcare	6	8	1	6	10
Technology	2	9	1	2	9
Telecommunication Services	2	5	1	3	4
Utilities	5	3	3	6	4

The stocks used are those listed in the respective index. For Germany we added the next largest companies from the CDAX, for France we added the next largest companies from the SBF, for Spain we added the next largest companies from the IGBM. The time series span from 1 July 2015 until 22/26 July 2016.

Source: **Data has been obtained from Thomson Reuters Datastream.**

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