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MEASURING THE IMPACT OF BREXIT ON BRITISH FINANCIAL INSTITUTIONS

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ABSTRACT

This study provides an empirical investigation of the impact of Brexit on the firms of the UK financial sector within the FTSE 100 market index. Brexit is treated as a general exogenous shock, causing high levels of political uncertainty, whose consequences are largely reflected by financial firms, because of some intrinsic features of this sector. In fact, since the single financial market in the EU became operative, firms providing banking and asset management activities have based their business models on the EU Directives and Regulations. Based on the principle of mutual recognition, these pieces of legislation give access to the passporting rights, which enable financial institutions to provide their services cross-border. The withdrawal from the EU would mean the loss of the passporting rights and the consequential consideration of the UK as a “third country”, which would strongly mitigate the access of British financial firms to the EU financial market, where specific rules exist. By employing the OLS framework, this paper aims to shed light on the abnormal returns caused by the result of the British referendum, measured as the residuals of the model, which can find explanation in the plausible loss of the passporting rights the financial institutions would incur.

INTRODUCTION

The 23rd June 2016 is a watershed for the EU. On this date, the United Kingdom expressed its will to leave the EU, via a referendum popularly known as “Brexit”. British people had to vote either to “leave” or to “remain” in the EU. Differently from the expectations, the secessionist campaign won the referendum with nearly 52 percent of the ballot, which sent the global markets into turmoil. Consequently, the Prime Minister David Cameron, who had called the referendum and campaigned for the United Kingdom to stay in the EU, resigned and the Government passed on in the hands of Theresa May, the leader of the Conservative Party, for a more efficient guidance towards the withdrawal from the EU. On the 29th March 2017, the triggering of Article 50 of the Lisbon Treaty formally started the process of negotiation of the terms to leave the EU.

All Member States of the EU are integrating part of the European single market, an area where goods, services and people can circulate freely, and businesses can operate cross-border on the principle of mutual recognition.

For the time being, the United Kingdom is still a member of the EU and it will remain as such until the formal transition period will be completed. This implies that the country must abide by the obligations derived from the EU pieces of legislation and ensure the continuity of the implementation plans of the legislations that have to come into effect, until the completion of the withdrawal.

In short, while talks are under way, at the expiry of the transitional period that began with the triggering of Article 50 of the Lisbon Treaty, the UK may incur different scenarios. In the light of the current EU legislation in the different areas of the financial services, the UK may ask to join the European Economic Area (EEA). Namely, this scenario is known as the Norway option. However, if “Brexit means Brexit”, this option may not be considered relevant on the table of negotiations. By joining the EEA, the UK would not lose the benefits of the passporting regime given by the numerous EU Directives and

Regulations. On the contrary, as it will be explained in the course of this paper, some of the major EU pieces of legislation regulating the different areas of financial services address the issue of third countries. Where provisions for third countries exist, once the UK will have completed its transition out of the EU, it will fall into this sphere. In simple terms, for some of the EU Directives, the UK will be considered a third country and its legal framework will allow the country to preserve access to the single market, at least to a certain extent. In fact, third country regimes (or equivalence regimes) do not provide for the same benefits Member States of the Union have, being part of the EU/EEA. Alternatively, the EU and the UK may come into an *ad hoc* bilateral agreement, along the lines of the relationship between Switzerland and the EU. In this way, the UK would have to negotiate the access to some specific areas of the single market. However, in return for EU market access, the UK would probably have to face the influence of the EU regulation in different areas.

Following the result of the Brexit referendum, a high degree of uncertainty looms over the future of the United Kingdom, and consequently the economic relation that will link the country with the remaining 27 Member States of the EU is worryingly at risk of downwards revision.

By the establishment of a market union, the EU has allowed each country to specialise in goods and services in which they have a comparative advantage. As a result of market integration, the United Kingdom is nowadays a great exporter of services, of which it runs a trade surplus. In particular, the UK has grown as a prominent country in the single market for financial services. In fact, the city of London has developed as a very important financial hub, which is considered by the Global Financial Centres Index, the leading global financial centre. However, its growth as a major world player is to attribute largely to the development of the European single market. In addition, thanks to an efficient legal system and an extremely dynamic business environment, the city of London has managed to attract expertise in financial services and financial-related professional

activities as well. For these reasons, half of the world's financial companies have established their headquarters for their European operations in the City of London, which contributed to increasing the importance of the financial sector on the national wealth, which nowadays accounts for 11 percent of the GDP. The interconnection between the UK and the EU financial services is very important: the UK holds 26 percent of the total European banking activity and the 22 percent of the total banking revenues is generated by wholesale and international activities connected to the EU. For what concerns the asset management industry, the UK holds a staggering 41 percent market share in the EU, and 26 percent of the total revenues of this sector is related to the EU. Hence, the role of the UK within the financial sector is undoubtedly prominent in the single market, but, by the same token, the advent of the single market in financial services and the unified legislation has brought undeniable benefits to the UK (Magnus, Margerit & Mesnard, 2016).

As an EU Member State, today UK financial firms are subject to EU legislation, and this will be the case until the completion of the procedure of withdrawal laid down in Article 50 of the Lisbon Treaty. Hence, the EU regulatory framework will still apply to financial firms headquartered in the United Kingdom. The single market freedoms that apply to financial service providers are included in a number of EU Directives and Regulations, some of which will be discussed in detail in the course of this paper.

For the UK, as well as for any other country of the EU, being a Member State of the EU gives access to a number of benefits, which non-EU countries, usually referred to as "third countries", are allowed to access to a certain extent, only in some areas of the finance where special provisions are in existence.

I will address the different treatment that EU Directives and Regulations applying to banking activities and asset management give to Member States and "third countries". In fact, financial firms located in one Member State of the EU can operate within the territories of the single market thanks to existence of a passporting regime, which

enables the freedom of services provision and the freedom of establishment of a branch across the border of its Member States. Because of the Brexit, unless an *ad hoc* agreement will be reached between the EU and the UK, the UK may fall into the “third country” category, to which a different framework applies: the equivalence regime. Differently from the preferential treatment given by the passporting regime, the equivalence regime puts in place some restrictions to the access to the EU single market in financial services. However, this regime only exists in some areas of the EU finance. For the purposes of this paper, particular attention will be focused on the plausible consequences of the withdrawal from the European Union, hence what the loss of the passporting rights would mean for the financial industry in the UK.

The description of the passporting and equivalence regimes will be the foundation for the quantitative study of this paper. Alongside the analysis of the works of previous scholars on the impact of exogenous shocks on stock price and the political uncertainty, the knowledge of the two regimes will provide a detailed insight on the reasons why the financial sector was affected to a greater extent by the result of Brexit. The assumption of the quantitative study of this paper is that in the light of a different treatment of the British financial institutions under the equivalence regime, the Brexit has largely affected the financial sector of the FTSE 100 UK and caused abnormal returns, in comparison with the market index.

This paper is addressed to investors in the British financial sector as well as to economists interested in the issue and future researchers on Brexit. In fact, as the referendum occurred only one year ago, this work leaves some questions open that can surely be investigated in the future, also according to the political outcome.

The rest of this paper is organised as follows: chapter I reviews the literature on political uncertainty and access to the EU financial market; chapter II briefly describes how the quantitative data is analysed; eventually, chapter III analyses the impact of Brexit on the financial sector, before and after the result of the referendum.

LITERATURE REVIEW

Over the years, the literature has deeply investigated the behaviour of the stock market in times of uncertainty. A large number of studies have dealt with the subject adopting different points of view. On one hand, some researchers have developed theoretical frameworks that provide insights into stock price reaction to exogenous shocks. On the other hand, a strand of literature has examined how some specific exogenous shocks have affected particular sectors of the economy of a country.

Several studies have examined the possible impact that political events may have on the economic activity of firms. Indeed, political uncertainty can come in different shapes and forms: sometimes it can be the mere result of political alternation but, other times, it can be the consequence of a governmental decision. Alongside levying taxes, enforcing laws and defining policies, governments can hold referendums as well. Similarly, referendums can lead to situations of uncertainty. This has been the case in the United Kingdom in 2016, where on the 23 of June the British were called to vote for leaving the European Union, in what is commonly referred to as Brexit.

Among the authors who contributed to widening the knowledge in the impact of political uncertainty on the stock market, Pastor and Veronesi (2012) have built a general equilibrium model in order to analyse how the stock market reacts to changes in government policies. In their study, a continuum of firms is considered within a finite time horizon and is exposed to an irreversible decision made by the government to change a policy. Their work focuses on denoting the impact a policy replacing an old one has on the average profitability of the sample of firms taken into consideration. Their theoretical model sets that the impact of the policy is uncertain. One of the key findings of their study is that the expected stock market returns are usually negative on the announcement day. Generally, returns larger than 2 percent are rare, whereas returns of about 8 percent are common. In addition, the authors point out that the positive returns tend to occur when

policy changes are widely anticipated, whereas negative returns are normally associated with policy changes that are not. Pastor and Veronesi conclude that higher levels of negative returns are correlated to higher levels of uncertainty about the policy change. Their study provides a great theoretical framework, but it lacks empirical work. Besides the theoretical study developed by Pastor and Veronesi, the literature offers other strands, in which the authors deal with the impact of political uncertainty on firms examining phenomena that occurred in the history.

For instance, Mei and Guo (2004) have examined one specific kind of uncertainty: political elections and transitions. Using a panel of emerging countries, the authors concluded that most of the financial crises happened during these periods, which suggests that political elections are a major source of political uncertainty. In their study, Mei and Guo have contributed to increasing the number of academic works supporting that political uncertainty negatively affects firms' returns and increases volatility. Criticising previous works, the authors built a regression model in which the data falling in the political election periods are marked by a dummy variable. Their main finding is that stock returns are more volatile in these periods.

Similarly to Mei and Guo' study, Chen, Bin and Chen (2005) have examined the impact of different political events on the performance of a specific segment of the stock market in Taiwan. Making use of market-adjusted as well as risk-adjusted techniques, they find that the stock market often reacts showing abnormal returns when political incidents occur that alter investors' view on political risk. This paper refers to such events that have strong implications for the politics of the country like political elections, policy changes and other events that may affect the asset prices. The rationale behind Chen, Bin and Chen's work is that major political events have an impact on the daily stock returns. According to this logical assumption, the authors consider political events as an exogenous factor that is often correlated to observable abnormal returns and increased levels of volatility. Abnormal returns are calculated as the difference between the return

for a stock and the market index return over the same period. The authors' methodology will inspire the one that will be used in this paper. In order to prove that major political events do cause abnormal returns with respect to a market index the stock may be related to, Chen, Bin and Chen estimate returns over a limited period. This takes into account the thirty days prior to the event window as well as thirty days after. Therefore, a sixty trading day window in total, surrounding the days in which the exogenous factor hits the stock market. The span of time used to measure the impact of the exogenous factor lasts three days. Their empirical study attempts to investigate the potential role that a specific segment of the stock market plays on stock price reactions to political uncertainty moments, and to estimate the likely impact of several relevant political events in Taiwan. Assuming risk homogeneity and equity return normality, Chen, Bin and Chen's results stemming from the OLS outline that in Taiwan, political elections and other events causing uncertainty reflect considerable abnormal performance in Taiwanese stock market. Chen, Bin and Chen's work represents a milestone in the development of this paper, as it inspires the event period methodology in order to examine the trend of specific sectors, with respect to a stock market index.

As it will be explained later on, the purpose of this work is to consider Brexit as an exogenous shock that causes political uncertainty and measure its impact on the British financial sector firms within the FTSE 100 UK. By the employment of the OLS to a large number of events, the causality between the exogenous factor and the stock market abnormal performance is thoroughly analysed in Chen, Bin and Chen's paper. Differently from their work, this paper will not attempt to examine the role of political uncertainty in general terms, but it will rather aim to examine the impact of one specific event on the stock market, assuming that because of some specific regulations that apply to the financial sector, the exogenous shock would hit this segment heavily.

Comparably, Bittlingmayer (1998) made his own contribution to the literature of stock volatility due to political uncertainty. Through his study, he sheds light on the relation

between stock volatility and political uncertainty; however, his work does not focus exclusively on this aspect. In fact, the author's results support that not only are political events the source of volatility, but also these affect the output. Bittlingmayer examines the issues stemming from political uncertainty with regard to the major political events that occurred in Germany between 1880 and 1940. Taking into account the political shift the country went through, shifting from empire to republic and dictatorship, the author finds that political stabilisation lead the country to declining levels of volatility, proving that politics can be looked at as an important factor for lowering uncertainty.

Pantzaalis, Stangeland and Turtle (2000) employ an event study methodology to examine the reaction stock market indices have around elections over a sample of 33 countries. Therefore, the span of time taken into account in the study is split into weeks, where the election week is defined as $t = 0$. The period the authors take into consideration includes the four weeks prior to the election week and the four after. One of the hypotheses of this study is that the stock market shows positive cumulative abnormal returns, which are calculated on a country-by-country basis as the mean-adjusted residuals. According to their study, the degree of uncertainty resolution is supposed to be greatest in the period immediately preceding the election week. Additionally, the observed returns are likely to be higher than average in those periods where no event causes uncertainty. Therefore, they claim that when political uncertainty is reduced, the stock prices rise as a consequence of a fall in the risk-adjusted expected returns. In addition to this, the authors claim that cumulative abnormal returns should be higher in connection to high-uncertainty events resolution and that positive returns are higher if these are in association with "bad" news events.

In a comparable way to the study of Chen, Bin and Chen, Pantzaalis et al. provide a reliable basis for the development of my study. First, the authors employ the uncertain information hypothesis (UIH) of Brown et al. (1988), which is a model made up of four different hypotheses that are consequently tested empirically. As previously stated,

political uncertainty looming over the elections might be resolved prior to the event. Given that some uncertainty is resolved, the first hypothesis of the UIH model states that cumulative abnormal returns should remain positive in the four weeks preceding the political event. This is justified by the expectation that the market may need additional information or time in order to assess the impact of the result of the vote. Secondly, the UIH model takes into consideration the four weeks after the election week. If there is significant uncertainty resolution following the event date, the model expects positive returns to be observed after the election. Again, the model hypothesises that cumulative abnormal returns in connection to unfavourable events are expected to be greater than those related to favourable events. Eventually, the model assumes that higher degrees of uncertainty are always associated with events whose outcome is less predictable. For instance, the expectations around a new government against the expectations around a government being re-elected are always characterised by greater uncertainty.

As opposed to Pantzalis et al. work, this paper will deal one specific case of political uncertainty, which has not been resolved neither in the weeks preceding the event, nor after. Indeed the UIH of Brown is a very valid model, but it fails to adapt to the analysis that will be subject of this study. This is mainly due to the fact that the study we have just gone through assumes uncertainty resolution, while what will be examined in this paper is an example of uncertainty irresolution. In fact, the political uncertainty stemming from the recent referendum to leave the European Union has several questions left open, above all with respect to the financial sector.

The Brexit has passed to the history as a unique case of political uncertainty. Most of the issues are still left pending, and it will be UK and EU representatives' duty to address them and negotiate a future status. The purpose of this is not to provide any solution to the matter, but rather to consider this political event as a general exogenous shock and assess the entity of the impact on the financial sector, assuming the importance of the status quo the firms operating in this sector benefit from. As a result of the extensive

process of regulation, de-regulation and re-regulation at EU level of the different components of the financial sector, banks, and financial services providers have thrived under the EU directives.

In the following part of this literature review, we will go through the legal framework that allows European banks and financial services firms to conduct business within the EU, benefiting from minimal additional requirements, when the scope of the business is to expand cross-border, and what it would mean for the United Kingdom based businesses to lose this right.

The access to the financial market under EU legislation

Following the result of the Brexit referendum, in which the British voted in favour of leaving the EU, and the resulting activation of Article 50 of the Lisbon Treaty, the UK has made considerable steps towards its withdrawal from the EU, despite the negotiations with the EU are still far from an end. Until the expiry of the transitional period, during which the UK will negotiate the terms of its withdrawal from the single market, the country will be subject to the EU Directives and Regulations in effect. A number of European pieces of legislation regulates the activity of financial firms with their domicile within the territories of the EU. As it will be explained in the course of this section, the EU Directives and Regulations provide for rules on European financial firms and, only in addition to this, they may set out specific rules for the activity of non-EU financial firms.

The EU single market in financial services is built on the principle of mutual recognition, which ensures that any financial firm lawfully recognised in one EU Member State can be recognised in any other Member State. Two of the cornerstones upon which this principle is based are:

- Freedom of provision of services;
- Freedom of establishment of a branch.

In other words, from the moment a bank or a financial services firm has based its headquarter and is authorised in one EU Member State, there are two ways it can provide its services across the EU. It can open a branch in another EU Member State incurring minimal additional requirements, on one hand, or it can apply for the right to extend the provision of its services across its borders, on the other. The authorisation that allows financial service providers to access the single market from their EU headquarter is treated in several EU Directives. This framework is known as “passporting” and it applies to all the countries of the EEA, in accordance to the principle of free circulation of services and mutual recognition within the single market. In addition to the EU 28 Member States,

the EEA includes Norway, Lichtenstein and Iceland. Hence, the EU passporting rights are a legal mechanism that allows authorised financial services companies based in any of the EU regulated Member States to do business across the EU, based on the simple principle of mutual recognition between Member States.

The passporting regime only applies to financial firms having their headquarter in a Member State of the EU. Only some of the EU Directives and Regulations that apply to the different areas of financial services address the issue of “third countries”, *id est* non-EU countries. Where provisions for third countries exist, once the transition out of the EU will be completed, the UK will be subject to the rules of this category. In simple terms, with respect to some of the EU Directives and Regulations, the UK will be considered a third country and the legal framework will allow the British financial firms to preserve access to the single market, at least to a certain extent. In fact, third country regimes (or equivalence regimes) do not provide for the same benefits Member States of the Union have, being part of the single market.

Particular attention will be focused on the features of the passporting regime in force in four of the most important EU Directives and Regulations (CRD, MiFID, UCITS and AIFMD). Alongside the passporting regime, some of these pieces of legislation set specific rules with respect to third country firms, whose regime takes the name of “equivalence”. On one hand, the passporting regime is the pillar on which financial firms have based their business model for decades; on the other hand, the equivalence regime gives non-EU financial firms a restricted access to some areas of the single market

In short, the following two parts of this section will describe the features of the two regimes, discuss the aforementioned Directives and Regulations and point out the different treatment the UK financial firms may incur following the withdrawal from the EU, unless *ad hoc* agreement is found.

The passporting regime

The implementation of the passporting rights within EU Member States' financial firms was not straightforward. In fact, despite the Treaty of Rome established the European Economic Communities in 1957, it was only in 1992, after the adoption of the Maastricht Treaty, that the single market in financial services became operational. Following the financial crisis that hit the EU, the principle of mutual recognition underlying the passporting rights has been subject to intensive deregulation and re-regulation.

The passporting regime is based on the principle of "mutual recognition", which is a widespread approach in the EU financial sector. In fact, the use of this regime is prevailing in banks, investment firms, conventional and alternative fund managers, as well as in insurance and market infrastructure providers (not object of the analysis of this work). The system is based on a single registration by the competent authority of the home Member State of the firm which gives authorisation to provide services abroad.

The passporting regime is a legal framework that allows a financial institution to provide the full range of its services cross-border, *id est* to other Member States than the country in which the financial institution is established. In order to curb the burdensomeness of supervision, the passporting system establishes that it is duty of the competent authority of the home Member State of the financial institution to watch over the activity of the firm cross-border. Given that the passporting system rests on the principle of mutual recognition, cross-border financial services can be provided from a financial institution established in any Member State to another country of the single market, based on an "outbound" passport, and *vice versa* based on an "inbound" passport.

Throughout the EU Directives and Regulations that set the rules for financial firms the passporting system is referred to as "free provision of services" and "freedom of establishment". By the creation of the passporting regime, the legislator has created a

framework that allows firms operating in the financial sector of the EU to benefit from preferential terms.

The free provision of services and the freedom of establishment are the cornerstones of the passporting legal framework. In other words, a financial institution that has applied to the passporting rights in order to do business across its border is not required to establish a subsidiary in the host Member State. In fact, subsidiaries are considered as separate legal entities, subject to host country regulation and supervision. In addition, subsidiaries are required to have their own balance sheets, pay local taxes and meet much higher capital requirements. In light of this, the passporting system represents a cost-effective as well as time-effective alternative to provide financial services abroad.

However, in the EU legislation, there is no single EU passport covering all of the financial services across the industry, in fact, depending on the kind of financial institution and services provided, there are specific EU directives and legislations that apply, under which specific passports are obtained. Indeed, there are nine different passports, each of which covers different sorts of financial services. Under each passporting right system, the basic assumption is that banks and financial services companies should be treated as if they were authorised entities in any of the Member States, provided that these have been authorised and meet the legal standards in their own home Member State.

In spite of the fact that the EU legal frameworks' main objective is to regulate the institutions and their activity within the Union, in some specific cases financial firms from across the borders of the single market are allowed to operate in the Union, at least to a certain extent. In fact, some of the EU Directives and Regulations provide clauses to regulate the activity of the so-called "third-country" firms, which review and deem a country's legal framework and supervisory system as "equivalent", provided that this achieves the same objectives as the EU pieces of legislation. In order to understand the features of this right, the next part will be fully dedicated to its explanation.

For the sake of clarity, this work is going to describe those regulations that apply to financial institutions that are part of the sample for the quantitative study of this paper. Notably the Capital Requirements Directive (CRD), the Markets in Financial Instruments Directive (MiFID), the Undertakings for Collective Investments in Transferable Securities (UCITS) and, last but not least, the Alternative Investment Management Directive (AIFMD). Each of these Directives regulates different aspects of the EU financial sector. Such passporting regimes give major advantages to the financial institutions in terms of the provision of their financial services across their borders or via the establishment of a branch in the host Member State. Through the passporting regime, financial institutions can streamline the process of authorisation to operate across its borders and reduce both the complexity and the costs of doing business within the EU/EEA, in other Member States than the home Member State.

As it will be explained in the description of the sample, the EU Directives and Regulations object of this paper are chosen because they affect somehow the firms within the sample used to measure the impact of Brexit. In fact, since the EU financial market has brought the Member States to enhanced levels of entanglement, financial institutions have based their business model on this legal framework for a long time. Leaving the single market may bring about severe damages to the European financial sector, and British based financial firms would lose the passporting rights. Therefore, according to the current situation, financial institutions of the UK would fall into the “third country” category, which would give a mitigated access to certain areas of the EU finance, unless an alternative *ad hoc* agreement between the remaining 27 countries of the EU and the UK is found in the course of the two-year transitional period.

The equivalence regime

At present, the United Kingdom has full access to the EU single market, but this is strictly conditional upon its membership within the Union. The Brexit referendum has given rise to concerns that once the UK will have terminated its transitional period triggered by Article 50 of the Lisbon Treaty, the country will no longer be able to access the single market benefiting from the preferential treatment set under the passporting regime. It is up to the EU and UK representatives to negotiate the terms of withdrawal. The loss of the EU passports may affect the financial institutions both in the UK and in the EU, since their business models have relied on such rights for several years. However, some of the EU Directives and Regulations provide some rules in specific areas of business that mitigate the access and the activity of non-EU firms within the territories of the single market. As it will be explained in the description of the Directives and Regulations taken into account by this paper, these provisions allow third country firms to operate in the EU, only under some circumstances. This is possible where the legal framework and, in some cases, the supervisory system of the third country complies with the concept of “equivalence” set by the EU pieces of legislation. However, not all areas of financial services and activity have equivalence regime.

Until the country’s future relationship with the EU will be less blurred, under specific EU Directives, financial institutions will fall into the concept of “third country firms”. Generally, third country equivalence regime aims to treat non-EU financial institutions in a similar way to the EU financial institutions, despite the fact that the preferential treatment ensured to banks and financial services firms based in the single market is often not ensured at full.

Equivalence decisions are a fundamental element of the international strategy concerning financial services in the EU. First and foremost, the Commission aims to ensure European investor protection and financial stability. Secondly, by setting rules for

third countries, Europe pioneers the convergence of the regulatory systems around the international legal systems and aims to enhance the level of cooperation with the third country competent authorities in order to both set the responsibilities and to reduce overlaps in the supervision of financial institutions.

Primarily, the basis for a third country's jurisdiction to be deemed "equivalent" is given by the scope of its regulatory and (sometimes) supervisory frameworks. In the Directives in which the equivalence regime is provided, these are required to be conceived to achieve the same results of the corresponding provisions in the EU legislation. The recognition of third country equivalence is dealt with in several EU financial services legal acts. Each of the Directives and Regulations sets precise criteria, conditions and the extent to which a third country jurisdiction with respect to its regulation and supervision of a financial firm shall operate in situations that involve cross-border activity.

Secondly, the European Commission generally performs the assessment of equivalence. In some cases, this occurs with the support of the European Supervisory Authorities (EBA, ESMA and EIOPA). Typically, the recognition of equivalence involves the assessment of the legal framework of the third country. Once equivalence is recognised to a third country jurisdiction, the competent authorities of the third country and one of the bodies of the European Supervisory Authority are required to enter into a cooperation agreement for the exchange of information and coordination of the supervision, which is under the responsibility of the third country.

Thirdly, the implementation of the equivalence regime is often subject to reciprocity, despite the fact that in some cases the regime is provided based on unilateral recognition. From a third country perspective, the application of the third country equivalence regime is conditional to an effective mechanism for the recognition of the EU Directives, Regulations and supervisory frameworks. In the specific case that this paper aims to address, reciprocal recognition between the UK and EU jurisdiction would allow European financial firms to access the UK market after Brexit will be completed.

However, the access to the single market by third country financial firms does not give full benefit of the freedoms the EU financial firms have, as the scope of the single market access is generally limited to only some areas of the financial services. For instance, the MiFID/MiFIR does not ensure third country financial firms access to the EU/EEA market to the same extent as domestic companies. For what concerns this Directive and its annexed Regulation, it is stated that the provision of investment services cannot be extended to retail clients. In fact, according to the MiFID/MiFIR, only professional clients and eligible counterparties are included in the scope of a third country financial firm. Additionally, the latest amendment of this Directive, which comes into force at the beginning of 2018, explicitly declares that, in order to perform investment activities or to provide investment services to retail clients or to professional clients, with or without any ancillary services, a Member State may require the third country firm to establish a branch in its territory.

Finally yet importantly, while equivalence provisions are granted in some key areas of the EU finance, several financial services within the Union do not have measures that ensure access to the single market. Namely, the CRD regime for banking and the UCITS Directive do not provide for any measure of equivalence regime, which implies that without corresponding rights to ensure third country financial firms, no firm operating in the areas regulated by the CRD and UCITS can be ensured EU market access. Therefore, in the absence of the implementation of specific equivalence regimes in these areas as well, once the United Kingdom will have finally completed its transitional period to withdraw from the EU, only through an alternative arrangement between the parties, the UK may gain the right to operate in these areas of financial services.

Keeping the focus on the asset management industry, the AIFMD lays down specific requirements in the field of equivalence. As it will be pointed out in the following part, differently from the UCITS Directive, which does not lay down any third country provisions, the AIFMD distinguishes between EU Alternative Investment Funds (AIFs)

and Manager and non-EU AIFs and Manager. Under this Directive, the management as well as the marketing of an AIF are subject to specific provisions when these activities are conducted by a non-EU AIFM. In the case of a non EU-AIFM, the equivalence is not contingent on European Commission determination, but it is conditional to approval by one Member State. Therefore, the conferment of the equivalence takes place via a Member State, which states whether the non-EU AIFM is entitled to the management of EU AIFs or to the marketing of an EU/non-EU AIF across the Union.

The next part of this section provides a description of the main features of four of the major legal acts that regulate the financial services institutions. Namely the Capital Requirement Directive and Regulation (CRD/CRR), the Markets in Financial Instruments Directive and Regulation (MiFID/MiFIR), the Undertaking for Collective Investments in Transferable Securities (UCITS) and the Alternative Investment Fund Management Directive (AIFMD). Particular attention will be focused on the provisions that put in place the passporting regime and equivalence regime, where the latter exist.

The EU Directives and Regulations

CRD

In the banking sector, the CRD, which has gone under its fourth recast in 2013, represents one of the major Directives that governs the access to the single market in this area of business. Notably, the banking activities covered by the CRD are those of deposit-taking and other ancillary services, such as lending, payment services, financial leasing, participation in securities issues, trading for own or customers' accounts, portfolio management and advice, safekeeping and administration of securities, custody services and broking.

Under the CRD and its annexed Regulation, credit institutions are entitled to an EU passport. The principle of mutual recognition can be found in Articles 17, 33 and 39 of the CRD IV (the latest amendment of this Directive). The first of these three articles states that host Member States shall not require branches of credit institutions authorised in any other Member State either authorisation or capital endowment. Article 33 states that any credit institution can perform the activities regulated by the CRD in any Member State, either by free provision of services or by the establishment of a branch in the host Member State, provided that the credit institution is authorised and supervised by a competent authority and that its activities are covered by authorisation. Lastly, Article 39 sets the rules with respect to the notification procedure that any credit institution seeking to exercise the freedom to provide services within another Member State with which it has to comply. The firm shall notify the competent authorities of its home Member State of the CRD-regulated activities it intends to perform in the host Member State. Within a month of the receipt of the notification, the competent authorities shall send it to the host Member State. Templates and procedures are set out by the European Banking Authority (EBA), which has developed technical standards that shall be respected in the notification process.

Under the CRD, all banks established in the United Kingdom are able to provide the services regulated by this Directive throughout the EEA. However, once out of the EU (and the EEA), the United Kingdom will not be subject to this Directive any longer, therefore, banks with their head office in the country will not have the right to perform CRD-regulated activities in other countries of the EU. In fact, at least for what concerns the banking services, no corresponding third country (equivalence) regime is envisaged in the Regulation that would enable the UK-based credit institutions to operate under the CRD passport. On the other hand, as the Directive covers investment services as well, some provisions covering equivalence regime do exist, but these are regulated by the MiFID and its annexed Regulation.

MiFID

Alongside the CRD, another set of rules to govern the financial sector is the Markets in Financial Instruments Directive, generally referred to using the acronym MiFID. This Directive has gone under a second recast, and will be fully in force by January 2018 (MiFID II). MiFID is associated with a Regulation as well (MiFIR), and it sets the rules for the administration of investment firms, market operators and data reporting services providers as well as third-country firms that provide investment services or perform some investment activities within the single market, through the establishment of a branch. The investment activities and services subject of this EU Directive are the reception and transmission of orders in regards to financial instruments. Other categories that are regulated by the Directive are dealing on own accounts, portfolio management, investment advice, the performance of orders on the side of the clients and eventually the underwriting of financial instruments.

Under the MiFID legal framework, credit institutions are not contemplated, as they are authorised under the CRD. However, credit institutions are subject to MiFID rules when these entities intend to perform investment activities and/or provide investment services.

Article 34 of chapter III of the MiFID ensures the freedom to provide investment services and perform investment activities across the territories of the single market, provided that the investment firm is authorised and supervised by the competent authority of a Member State. Also, it is stated that Member States have no right to impose additional requirements on the investment firms, in respect of the MiFID. Comparably to the notification procedure set out in the CRD, the MiFID lays down that any investment firm seeking to operate across its home country borders shall communicate to the competent authority of its Member State the country in which it intends to extend its business. In addition to this, a list of the services and ancillary services that are intended to be performed or provided in the host Member State is required. In this case, the surveillance body is the European Securities Markets Authority (ESMA), which sets the technical standards of templates and procedures to specify the information needed for notification purposes. In alternative to the freedom of services provision across Member States by an investment firm, Article 35 of the MiFID addresses the establishment of a branch in the territories of the single market. The prerequisites are the same as those listed in the free provision of services.

The MiFID does not provide for any specific corresponding third country regime within its set of laws. However, as it is stated in Article 39, it is at discretion of a Member State to require that an investment firm from across the single market borders intending to provide investment services and/or perform investment activities establish a branch in that Member State. Therefore, concerning the equivalence regime set out in the MiFID, the provision of services in the European Union by investment firms with their head office based outside the single market is subject to national requirements and regimes. This implies that those firms deemed equivalent by national authorities shall carry out their activities only within the boundaries of that Member State. According to this Directive, third country firms shall not benefit from more favourable terms than the investment firms of the Union. In addition to the second recast of the MiFID, the complementary Markets

in Financial Instruments Regulation (MiFIR) sets the rules for the provision of services and the performance of activities by third country firms, following equivalence decisions, with or without a branch within the territories of the Union. The Regulation sets that where the third country firm has not established a branch in a Member State it can provide investment services and/or perform investment activities to professional clients and eligible counterparties. The condition is that the firm is included in the ESMA register of third country firms. The equivalence decision by the European Commission depends on the legal and supervisory arrangement of the third country firm comply with the requirements in effect in the single market. In order to be deemed equivalent, the third country should ensure supervision on an ongoing basis of the investment firm and require that this has sufficient capital requirements. A cooperation agreement shall be reached between ESMA and the relevant competent authority of a third country on the exchange of information between these two and on the coordination of supervisory activity.

UCITS

In the asset management industry, the passporting regime is characterised by different features than those of the CRD and MiFID. In fact, the UCITS Directive provides for two types of passports. On one hand, a sort of “marketing passport”, on the other hand, a management passport, which allows UCITS management companies to carry out management activities and ancillary services throughout the single market, either under the principle of the free provision of services cross-border, or via the establishment of a branch in the host Member State.

UCITS are common funds of the open-ended type with the sole objective of investing collective capital in transferable securities, *id est* shares (or equivalent securities to shares) in companies, bonds and similar forms of debt securities, and any negotiable security carrying the right to acquire an underlying security. In addition to transferable

securities, UCITS funds can also invest in money market instruments. These funds enjoy good reputation across Europe and above the borders of the single market as well, as they are transparent and highly regulated.

Concerning the marketing of UCITS funds across the single market, the UCITS Directive sets the principles in Articles 91-96. According to the rules set out in these articles, host Member States shall ensure the marketing of UCITS funds within their territories without imposing any additional administrative procedures or requirements. Where a UCITS fund wishes to market its shares in a Member State other than its home country, it shall submit a notification to the competent authority of its domicile country, first. In the case of cross-border distribution of its shares, in addition to the notification to the home Member State competent authority, a UCITS fund shall enclose all the documentation including relevant information on the fund. Its fund rules, prospectus, key investor information and annual/semi-annual reports shall therefore be complementary to the notification submitted to the competent authority of the home Member State, which is in charge of transmitting the documentation to the competent authority of the host Member State within ten days from the receipt.

As previously mentioned, the passporting regime set out in the UCITS Directive includes provisions for the management of UCITS funds across the borders of the home Member State, and for the establishment of branches with the purpose of managing UCITS as well. A UCITS management company can be appointed in order to carry out management duties on behalf of a common fund. The UCITS Directive states that any management company authorised in the territory of a Member State can be designated under the principle of freedom of services provision to manage common funds. The management company is required to communicate to the competent authority of the home Member State of the location in which it intends to operate, a programme of the activities and services it seeks to perform, compensation schemes to protect the investors as well as a description of the risk management it puts in place. The

management company will have the right to begin operations, after the home Member State will have transmitted the documentation to the host Member State's competent authority. The procedure to get the authorisation to perform management activities of UCITS funds across the home Member State's borders generally takes up to a month.

Neither for the management passport nor for the marketing passport does the UCITS Directive provide for any clauses regulating third country equivalence regime. With some exemptions, UK targets the European investors through UCITS established in the "EU gateways": Luxembourg, Ireland and to a lesser extent Malta. These countries' legal system represent the hot spots for the distribution of UCITS shares across the borders. As a matter of fact, Brexit would cause the loss of the passporting rights for the UK, therefore management companies will no longer be able to provide their services from their UK offices, on one hand, while UK based UCITS funds will not be distributed to the remaining 27 Member States of the EU. According to an annual study of PwC, 11 of the top 53 management groups come from the UK. Unless an *ad hoc* agreement will be reached by the parties, the lack of third country equivalence provisions would cause profound changes in the UCITS asset management industry.

AIFMD

In addition to the UCITS funds, the asset management industry invests capital pooled among investors via an Alternative Investment Fund. The AIFMD is the EU Directive that applies to all funds that are not classified as UCITS funds, *id est* private equity funds, real estate funds and hedge funds. The enactment of the AIFMD is part of the effort to provide for additional regulation in the aftermath of the financial crisis.

Along the same lines as the UCITS Directive, the principle of mutual recognition typical of the passporting regime applies in two ways: as a marketing passport, on one hand, and as the right of cross-border management, on the other. However, in the AIFMD some differences arise, in comparison with the rules set out in the UCITS Directive.

First of all, the marketing of AIFs is distinguished into marketing of EU AIFs and marketing of non-EU AIFs to professional investors within the territories of the EU. As it was stated in Article 32 of the Directive, Member States of the EU shall ensure the cross-border marketing of EU AIFs by EU Alternative Investment Fund Managers (AIFM). As for the cross-border marketing of UCITS shares, the notification procedure shall be respected in order to get the authorisation by the competent authority to begin the distribution of shares in the territories of other Member States than that of where the AIF has its domicile. In respect of the principle of freedom of services provision and establishment of a branch, Article 33 of the Directive states that an AIFM shall be authorised to carry out its activity, subject to prior communication of the Member State where the AIFM seeks to manage AIFs, and a programme of the services to provide. Also, in the case of the establishment of a branch, further information on the organisational structure and the address of the branch shall be communicated to the competent authorities of the home Member State.

The AIFMD differs from the UCITS Directive because it provides for special rules addressing the matter of third country equivalence. For instance, under the provisions set out in Article 34, an authorised EU AIFM may manage non-EU AIFs that are not marketed in the EU, as long as cooperation agreements are in place between the surveillance authorities of the country deemed “equivalent” and the competent authority of the home Member State. In addition to this, the AIFMD seeks to address the conditions for the marketing in the territories of the EU of non-EU AIFs managed by an EU AIFM. Where some cooperation agreements exist with the purpose of an efficient exchange of information between the relevant competent authorities of the home Member State and the country with equivalent legal framework, an EU AIFM may market a non-EU AIF to professional investors across the Union, provided that prior authorisation is granted for the distribution of the non-EU AIF (Article 35). However, for EU AIFMs seeking to market/manage non-EU AIFs the equivalence regime does not consider the same

benefits present under the passporting regime. In fact, as opposed to what occurs in the passporting regime, under which Member States are not allowed to impose any stricter requirements, Article 36 of the AIFMD established that Member States have the right to impose further stricter restrictions to the marketing of non-EU AIFs, despite the management is carried out by a European AIFM.

Where a non-EU AIFM intends to manage communitarian AIFs and/or market them in the Union, the situation is different. Primarily, non-EU AIFMs seeking to manage EU AIFs shall get prior authorisation, and comply in full with the content of the AIFMD, to the extent that compliance with the EU Directive does not hinder compliance with mandatory provisions in their original legal framework. The ESMA shall conduct a review of the supervisory activities of the competent authority of the non-EU AIFM and the alignment of these procedures to those of the EU. It is paramount that the third country practices achieve the same objectives as those set out in the European Directive. In order to manage and market AIFs in the Union, non-EU AIFMs must have a Member State of reference, which is determined as the Member State where the AIF(s) is/are located, if this is communitarian, or where the non-EU AIFM manages the largest amount of assets under management. In the circumstance where the AIF is located in a third country, the Member State of reference will be the one where the effective marketing is developed, or one of the Member States of distribution, if the marketing takes place in several Member States.

Differently from the passporting regime provisions, which states unconditional mutual recognition across all of the Member States of the EU, Article 37 provides for clauses that allow Member States to disagree with the authorisation granted to non-EU-AIFMs and to demand the withdrawal of such authorisation. In fact, the picture concerning the management and the marketing of an AIF by a non-EU AIFM is different. The Directive sets the conditions both for the management activity and for the marketing, when these

activities are carried out by non-EU AIFMs. A non-EU AIFM may limit its activity to the management of the AIF, or extend it to the marketing of the AIF(s) it manages as well.

For what concerns the marketing activity, the distinction between marketing of EU AIFs and non-EU AIFs by non-EU AIFMs shall be discussed thoroughly. The AIFMD sets the rules concerning these two situations in Articles 39 and 40.

In the circumstance of a non-EU AIFM seeking to market the shares or units of an EU AIF, the manager shall notify the Member State of reference. The notification to the competent authority kicks off the 20-day period in which the non-EU AIFM will receive the authorisation to start marketing the AIF it manages. Where the non-EU AIFM seeks to market the AIF shares/units in other Member States of the single market, it shall notify the competent authority of the Member State of reference in which it seeks to start marketing the AIF (Article 39).

Instead, in the case of a non-EU AIF managed by a non-EU AIFM, Article 40 of the Directive sets out the conditions which apply to the management company wishing to market the non-EU AIF in the single market. First and foremost, Member States are required to make certain of the authorisation of the non-EU AIFM and the non-EU AIF. As set out in Article 42 of the AIFMD, in both the circumstances, Member States have the right to impose more severe rules on the marketing activity when this is carried out by a non-EU AIFM.

Cross-border management of AIFs by a non-EU AIFM is also hampered by the authorisation procedure. In fact, non-EU AIFMs can carry out their management activities only via single authorisation in an EU Member State (Article 41).

Therefore, along the same lines as the other EU Directives regulating third country equivalence regimes, the AIFMD imposes restrictions that would not allow financial firms to operate under the same conditions as EU firms within the single market

Differences between Passporting and Equivalence

In light of the features each of the passporting regimes bear and the existence of third country equivalence regimes under some of the EU Directives and Regulations, it is clear that some differences arise between the two legal frameworks.

First and foremost, the passporting regime is a right, while the equivalence can be interpreted as a sort of privilege. Although equivalence allows a third country to operate in the European single market, the conditions set under the different Directives impose several limitations and give a degree of authority to the single Member States, which can question the equivalence assessment of a country. The main downside of such regime is that it does not ensure a permanent situation. In fact, this privilege can be revoked at any time, even at short notice, which makes the regime very uncertain. Uncertainty is to impute to politics, as it is largely at discretion of the European Commission. In certain cases, the withdrawal of the registration of a firm in the third country register can occur if there is reason to think that the well-functioning of the EU financial market and/or investor protection is jeopardised. Considering this, it would be fundamental for the UK to develop a legal framework equivalent to that of the EU in order to ensure its access to certain areas of the EU finance.

Secondly, in comparison with the passporting regime, which stems from both EU Treaty and secondary law, the equivalence is only granted by secondary law. Differently from the right of free provision of financial services granted under the passporting regime, the rights the equivalence regimes give are barely defined in some articles.

Finally yet importantly, as it has been pointed out earlier in this paper, the scope of EU market access is limited in several areas of the financial services and sometimes equivalence regimes are not even set out.

RESEARCH METHODOLOGY

In light of the EU Directives and Regulations and in particular of the rules that set out the passporting and equivalence regimes, the issue this paper aims to address is how the British banks and the financial services companies have been affected by the result of Brexit. The ultimate objective of this study is to provide empirical evidence of the impact of the referendum on the financial institutions of the FTSE 100 UK, treating Brexit as a general exogenous shock. Before doing this, a few aspects shall be clarified; first, to date and to the best of my knowledge, it is not possible to quantify in direct terms the impact of Brexit on the financial sector. In fact, the issue is very recent and nebulous and the outcome of the negotiations between the UK and the EU is far from reaching a conclusion. Hence, this does not make it easy to give a clear dimension to Brexit. Secondly, the purpose of this research study is not to examine the causality between exogenous factors and stock price variation, nor between EU Directives and Regulations and stock price variation of the companies taken into consideration. In fact, in order to address the issue of causality, it would be necessary to consider several shocks caused by n events. Causality is better explained overtime.

In this paper, exclusive attention will be focused on Brexit, therefore one single independent political shock. This paper aims to shed light on the impact caused by the political uncertainty of this event.

In order to examine how the event has affected the financial firms whose activity falls under the regimes described previously, we will employ a linear regression model (OLS), in which the financial firms will represent the independent variable (x) and the market index will be the dependent variable (y).

In the next part, we will go through the features of the sample that will be used for the scope of this study, whereas in the following we will point out the details of the research methodology used to work on the sample.

Description of the sample

For the purposes of this paper, we measure the exogenous impact of Brexit on the firms operating in the financial sector and carrying out financial activities subject to the EU Directives and Regulations described in this work, included in the FTSE 100 UK. This market index gathers the companies with the highest capitalisation in the UK. The sample is made up of 9 companies, including banks, asset management companies, investment funds and financial services providers. In order to select the companies, I based myself on the classification by sector provided by the London Stock Exchange and collected the data regarding banks and general financial services companies. In addition to the data related to the 9 companies, which compose the independent variables (x), we collect the data of the FTSE 100 UK, which represents the dependent variable (y). Further details on both the companies and the market index can be found in the Annex I, at the end of this paper.

In order to build the sample for the research, the data was downloaded from Bloomberg. For every financial institution within the sample, I have downloaded the equity price listed on the London Stock Exchange. The sample takes into consideration a time series with respect to each of the firms and the FTSE 100 UK, starting on 31st May 2016 and ending on 6th July 2016 (included). Given the characteristics of the research model, which also consists in dividing the time series into shorter spans, it was very important not to reduce the number of observations for the events analysed, in order to build an OLS as reliable as possible. To increase the number of observations, I downloaded hourly data for each day and every firm within the sample and for the market index as well. Having available hourly data allows gathering nine observations per firm a day. For each day, the first observation is at 09.00, which coincides with the opening time of the London Stock Exchange, while the last one at 17.00, the close of business.

In correspondence of weekend days, there is a two-day gap between the last observation (17.00) of the day x and the first observation (09.00) of the following day $x + 1$.

The row data represents the stock price of each of the variables and is expressed in GBP currency. Since the pricing of the market index does not correspond to the pricing of the stock price within the sample, in order to control for different units of measurement and obtain standard values, the stock prices were converted into percentage variation:

$$\Delta x_t = \left(\frac{x_t - x_{t-1}}{x_{t-1}} \right) * 100$$

The ultimate objective of the study is to examine the returns of the firms of the financial sector and/or carrying out financial activities subject to the EU Directives and Regulations described in the previous chapter. To conduct this, it is important to take into consideration the stock price return of all the firms of the sample at the same time. In this respect, before employing the OLS, the last step is to compute the sample mean of the observations available:

$$\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n} = \frac{1}{n} \sum x_i$$

where $n = 9$

Once the sample mean is computed for every bunch of observations within the event study, I obtain the average variation of the “FINANCIAL SECTOR” as a whole, over the period analysed. The OLS is run in order to carry out the analysis on how the financial firms of the FTSE 100 UK have been affected with respect to the market index.

In total, the study contains 27 days, which corresponds to 243 observations, each of which is the result of the sample mean of the stock price variation of each financial institution.

Description of the model

Under normal conditions, the firms within a market index shall determine the trend of the market index in which they are included. In other words, the sample mean of the returns of the observations of the independent variable should equal that of the dependent variable. However, when political uncertainty or a general exogenous shock hits the market, some components may be affected more largely than others. This is the rationale behind the OLS model of this paper. The key assumption is that banks and financial services firms, which are subject to CRD, MiFID, UCITS and AIFMD have been affected to a greater extent by the result of the Brexit referendum. Therefore, around the Brexit, political uncertainty is supposed to surge, increase the volatility and affect the ability of the independent variable (the financial sector) to mimic the trend of the index. This should show in the model in the form of higher residuals, which could at least in part represent the abnormal stock price returns that Brexit might have generated.

In pursuance of the objective of this study, I will run an OLS, with the following general equation:

$$y = \alpha + \beta x + \varepsilon$$

where:

- y represents the market index, the FTSE 100 UK;
- x represents the sample, which is the mean of the stock price variation of the 9 financial institutions within the sample;
- ε represents the residuals.

By employing this regression model, in the two analyses I suggest, I will test the null hypothesis that the mean of the coefficient of the dependent variable assumes value 0, and investigate its statistical significance. This implies that the alternative hypothesis to test is that the mean of the coefficient assumes a value other than 0:

$$h_0: \beta_x = 0$$

$$h_1: \beta_x \neq 0$$

With regard to the hypothesis testing, I will run a Wald Test on EViews and comment the results to see if there is statistical significance.

We measure the abnormal returns as the residuals of the model. When the returns of a sample and the returns of a stock index match, the residuals tend to zero. Abnormal returns are expected to be caused by the result of the Brexit referendum and perhaps by the political uncertainty before and after the event. Therefore, I expect higher residuals in the model, which show as abnormal peaks, where it is supposed that the financial institutions (the dependent variable) go through a period of uncertainty, therefore close to the Brexit.

The residuals of a regression are calculated as the difference between the observed values (y) and the fitted/estimated/predicted (\bar{y}) values of the variable:

$$\varepsilon = y - \bar{y}$$

The research will provide two separate (but related) analyses.

First, it is important to define whether Brexit can actually be defined as exogenous shock that impacts the quantitative model. Empirically, I will employ an OLS on the full size of the sample and verify if the linearity of the model is affected by the exogenous shock. In order to verify empirically whether Brexit represents a factor of disruption, I will perform a stability test of the model, in order to find evidence of the existence of a structural break. In fact, sometimes, the reliability of a model can be affected by a sudden unexpected shift in the stability of the coefficients of the time series, which can lead to forecasting errors. One possible test to run to experiment with a structural break within

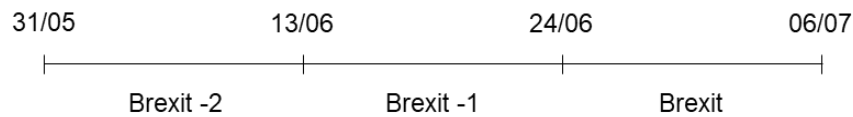
the OLS is the Bai-Perron, which tests whether at one moment in time occurs a break. Differently from other tests (such as the Chow test), the Bai-Perron test does not assume the structural break is known *a priori*. For this reason, the test is run on the whole sample and aims to find whether there is a change in the time series and where this occurs exactly. The result of this test will suggest whether the insertion of a dummy variable is necessary to improve the reliability of the model and where the structural change is registered, if there is one. In order to run this test, I will make use of the software EViews.

Following the performance of the Bai-Perron test, the two models will be compared to verify whether the insertion of a dummy variable corresponds to enhanced levels of reliability of the model. For the sake of clarity, a dummy variable is an indicator that shows the presence or the absence of an effect that is expected to change the structure of a model, and it takes the value 0 or 1. I will compare the two models, to verify both whether the coefficients benefited from the insertion of the dummy variable and the residuals. For each model, the residuals will be analysed for autocorrelation, heteroscedasticity and normality. In order to investigate whether the residuals of the model are affected by serial correlation, the Durbin-Watson statistic is a test that proves useful. The values of this test can be comprised between the value 0 and 4; where the Durbin-Watson assumes a value around 2, we say that the residuals are not affected by autocorrelation. Instead, heteroscedasticity is investigated with the support of the Breusch-Pagan-Godfrey test; this is a test that considers the residuals as the dependent variable of the model and verifies that there is homogeneity in the variance of the residuals. Where there is homoscedasticity, therefore residuals with constant variance, the null hypothesis of the Breusch-Pagan-Godfrey test ($\mathbf{h}_0: \mathbf{b} = \mathbf{0}$) is not rejected. Finally yet importantly, a normality test will be run in order to examine if the residuals are normally distributed, which implies that these have mean 0 and variance 1. In order to test the normality of the residuals, I will make use of the Jarque-Bera test. This statistical test proves useful to determine whether the series has normal distribution. It computes

the difference between the skewness and the kurtosis of the residuals considered. The null hypothesis of this statistical test assumes that the series is normally distributed. Therefore, $h_0: \mathbf{b} = \mathbf{0}$ is rejected for probability values lower than 5 percent. All the tables related to these tests are included in the Annex II.

Following this first analysis, I will suggest an alternative method, in order to examine the effects of political uncertainty before and after the result of the Brexit referendum and examine how this has affected the trend of the financial sector with respect to the FTSE 100 UK. Differently from the first analysis, the method I will employ investigates empirically the two periods independently. Therefore, instead of placing a dummy variable in the model, I will simply break the length of the sample into three separate independent sections and analyse them accordingly. The adoption of this method follows the example of the studies of Pantzalis, Stangeland and Turtle (2000) and Chen, Bin and Chen (2005) who employ an event study methodology to examine the reaction that market indices have around political events.

As the sample covers the time between the 31st May 2016 and 6th July 2016, I will split the sample into three equally long time spans, where the opening of the London Stock Exchange (h 09.00) on 24th June 2016 (the result of the Brexit referendum) represents the “watershed”. This observation marks the first observation of the time span that I will name “Brexit period”. Each of the time spans will be 81 observations long. All the observations before the “watershed” will be grouped into the time spans to which I will refer as “Brexit-1” and “Brexit-2”, The former time span goes from the 23rd June 2016, the day before the result of Brexit, or the day of the vote, back to the 13th June 2016. Instead, the latter begins on the 10th June 2016 (17.00) and goes back until the 31st May 2016 09.00. The size of these time spans was chosen, in order to have 3 periods of the same length in total, taking into account that Brexit should be positioned on one extreme and that the objective is to consider at least the whole month of June. Where weekend days fall in the events, this is visible as a two-day gap.



With the support of EViews, I will go through the characteristics of the two samples and, by running three independent OLS, I will aim to show empirically that political uncertainty might have caused abnormal returns in the stock price of the banks and the general financial services providers included in the FTSE 100 UK. As previously mentioned, the abnormal returns are measured as the residuals of the model, and I expect to find higher levels of unexplained variation of the model close to the Brexit, as well as higher volatility around this date, as the financial sector would face major issues because of the loss of the passporting rights.

In the following section, we will go through the analysis of the data, following the methodology laid in this chapter.

DATA ANALYSIS

In order to examine the behaviour of the banking and financial services sectors in the time of Brexit and their trend with respect to the FTSE 100 UK, I will make use of the software EViews. Any table, graph and result I generated comes from this statistical and econometric tool.

First and foremost, I run an OLS on the sample including all the observations on the 9 financial institutions. According to the results of this regression model, the R^2 shows that almost 77 percent of the total variation of the FTSE 100 UK is explained by the fluctuations of the sample mean of the firms of the financial sector. For the sake of clarity, for convenience, I refer to all the firms of the sample using “FINANCIAL_SECTOR” on the EViews tables, which includes both the banking sector and the general financial services providers, listed on the London Stock Exchange.

Dependent Variable: FTSE_100
 Method: Least Squares
 Date: 10/19/17 Time: 09:10
 Sample: 5/31/2016 09:00 7/06/2016 17:00
 Included observations: 243

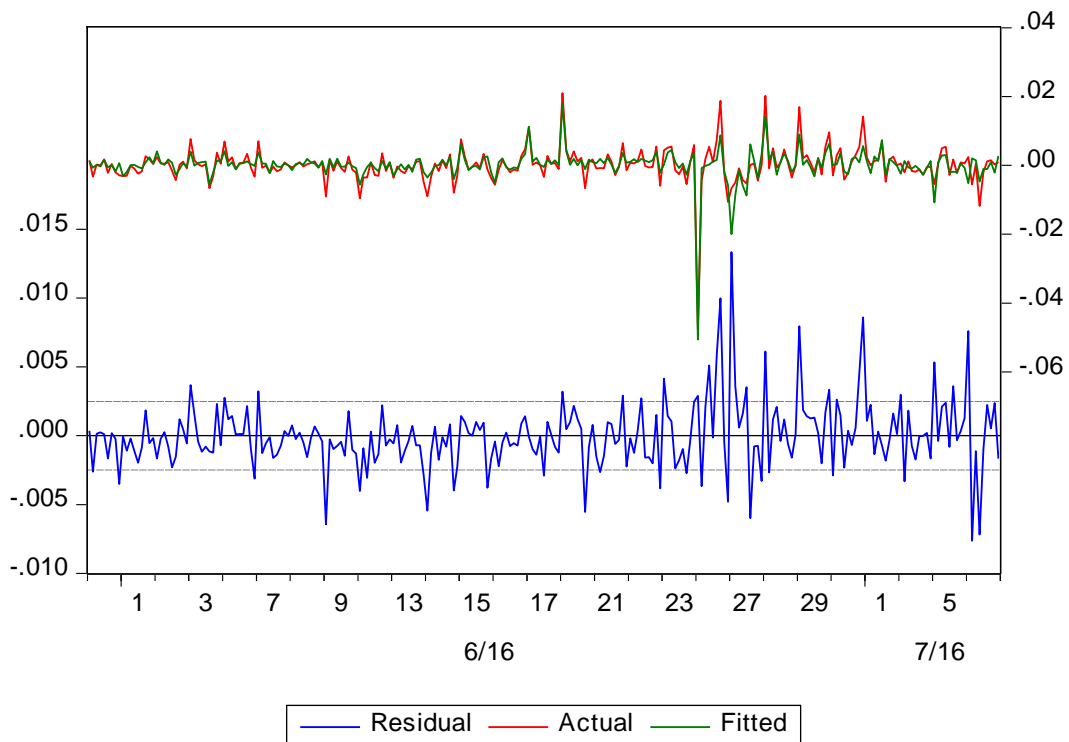
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000453	0.000160	2.834923	0.0050
FINANCIAL_SECTOR	0.405385	0.014112	28.72620	0.0000
R-squared	0.773963	Mean dependent var		0.000138
Adjusted R-squared	0.773025	S.D. dependent var		0.005220
S.E. of regression	0.002487	Akaike info criterion		-9.147241
Sum squared resid	0.001491	Schwarz criterion		-9.118491
Log likelihood	1113.390	Hannan-Quinn criter.		-9.135661
F-statistic	825.1948	Durbin-Watson stat		1.948338
Prob(F-statistic)	0.000000			

Own elaboration from EViews

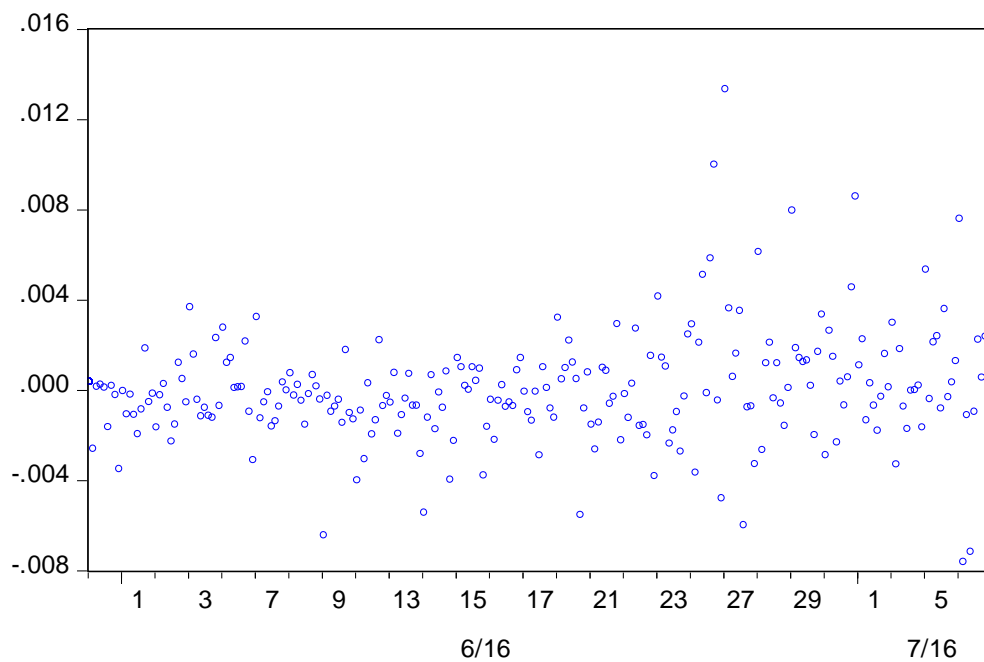
Testing the null hypothesis $h_0: \beta_x = 0$, it appears that the coefficient of the independent variable is statistically significant, with a significance level $\alpha = 0,050$, therefore the null hypothesis can be rejected in favour of the alternative hypothesis. In fact the p-value is lower than the 5 percent.

However, the purpose of this study is to pay particular attention to whether abnormal returns were recorded by the firms operating in the financial sector. To do this, observing the residuals of the OLS model is fundamental to understand if the surge of political uncertainty around the outcome of the Brexit referendum has caused abnormal returns. In light of the rules set out in the EU Directives and the importance of the financial sector for the economy of the UK, the assumption is that Brexit has affected the financial sector largely. Therefore, around the event, the stock price variations of the financial sector are supposed to “lose grasp” on the trend of the FTSE 100 UK.

The observation of the residual on the full size of the sample shows that the hypothesis is well founded. In fact, as the graphs hereunder shows, the closer we get to the Brexit, the higher the residuals of the model.



Own elaboration from EViews



Own elaboration from EViews

This graph gives an intuitive insight into the increased lack of ability of the financial sector to explain the trend of the FTSE 100 UK, from the moment of the verdict of the Brexit referendum. In fact, besides the outlier registered after the opening of the London Stock Exchange on the 24th June 2016, where the residual dot is above 0.012, the mean of the residuals is sensibly higher than the period before the verdict. In order to focus on the period before the Brexit and the days after the result, the next analysis provides separate insights on these time spans. However, by analysing the full period, we have a clear overview of the situation and the increased levels of political uncertainty that hit the model in correspondence of the Brexit. In fact, while in the weeks prior to the referendum the OLS gives lower residuals, mainly concentrated between -0,004 and 0,004, where only some scattered outliers affect the model, the break date coinciding with the Brexit is clear. In the first stages of the time series, low residual levels witness that there is no significant abnormal return in the stock price variation of the financial sector. From the 24th June, the residual plot highlights a more scattered distribution of the residuals, which is evidence of the increased distance between the stock price variation of the financial sector and that of the market index. The widening of the residual plot stands for the

abnormal stock price returns that affect the financial sector at this time, with respect to the FTSE 100, which keeps a steadier trend, despite being impacted by the exogenous shock as well. In addition, in order to validate the OLS model, the residuals were examined with respect to autocorrelation, heteroscedasticity and normality. As it appears in the table above, the Durbin-Watson gives an encouraging result with respect to autocorrelation. In fact, it is equal to 1,95, which means that no autocorrelation affects the residuals. The Breusch-Pagan-Godfrey test is run to examine whether the residuals are affected by heteroscedasticity, therefore non-constant variance over time. This statistical test confirms that the residuals are heteroscedastic; in fact, the null hypothesis $h_0: b = 0$ is rejected, since the p-value is below 5 percent (0,0382). This supports the fact that periods marked by uncertainty tend to be followed by uncertain periods, just as much. Eventually, the normality test shows that the values tend to be all around the mean =0. However, the p-value of the Jarque-Bera test indicates that the series of residuals is not normally distributed; in fact, the probability of the test is equal to 0, which is lower than 5 percent. Therefore, the null hypothesis that the series is normally distributed is rejected. The full tables of the results of these tests can be found in the Annex II, at the end of the paper.

Taking note of the behaviour of the OLS model in correspondence to the Brexit, I have examined if this political event can be categorised as an exogenous shock that affects the stock price returns abnormally. In fact, the residuals of the previous suggest that the Brexit undeniably affects the structure of the model. In order to investigate this, I have run a stability test (Bai-Perron test) on EViews. The result of the test confirmed that the effect of the Brexit referendum is tangible and that it caused an unexpected abnormal shift in the OLS model. As it is noticeable in the following table, one break date is found between the closing of the London Stock Exchange on the 23rd June and its opening on the 24th June. The negative shift of the stock price returns of the financial sector shook the entire market, as the outcome of the referendum was not expected. In fact, the odds

of the referendum were in favour of a positive outcome, therefore in favour of the UK remaining in the EU. Clearly, as it is shown by the structural break, this did not happen and the effects of the result are quantitatively measurable. The break date suggests that Brexit does represent an impactful exogenous shock within the regression because the linearity of the model is 'broken'. This suggest that the issue can be addressed with the insertion of a dummy variable in the OLS model to indicate the presence of an abnormal event starting on the 24th June 2016. By the inclusion of the dummy variable coinciding with the opening of the transactions at the London Stock Exchange on the 24th June 2016, the regression model gains efficiency.

Multiple breakpoint tests
 Bai-Perron tests of L+1 vs. L sequentially determined breaks
 Date: 10/19/17 Time: 09:30
 Sample: 5/31/2016 09:00 7/06/2016 17:00
 Included observations: 243
 Breaking variables: C FINANCIAL_SECTOR
 Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Sequential F-statistic determined breaks:			
			1
Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	17.72124	35.44248	11.47
1 vs. 2	5.344368	10.68874	12.95

* Significant at the 0.05 level.

** Bai-Perron (Econometric Journal, 2003) critical values.

Break dates:

	Sequential	Repartition
1	6/23/2016 17:00	6/23/2016 17:00

Own elaboration from EViews

Thanks to the insertion of a dummy variable to indicate the presence of an abnormal factor within the model, the results should show enhanced levels of interpretation of the regression model, which means that the model with dummy variable is characterised by improved linearity. Following the generation of the dummy variable, which takes value 0 from the beginning of the time series until the 23rd June and 1 from the 24th June onwards, I have regenerated an OLS, which proves that the dummy variable brings

significant changes in the structure, with respect to the model without dummy variable. In fact, by “helping” the OLS detect the Brexit as a sudden shift in the linearity of the model, that represents an abnormal behaviour of the independent variable at a specific moment in time, the variation of the FTSE 100 UK explained by the model increases from 77 percent to 80 percent, as shown in the table hereunder.

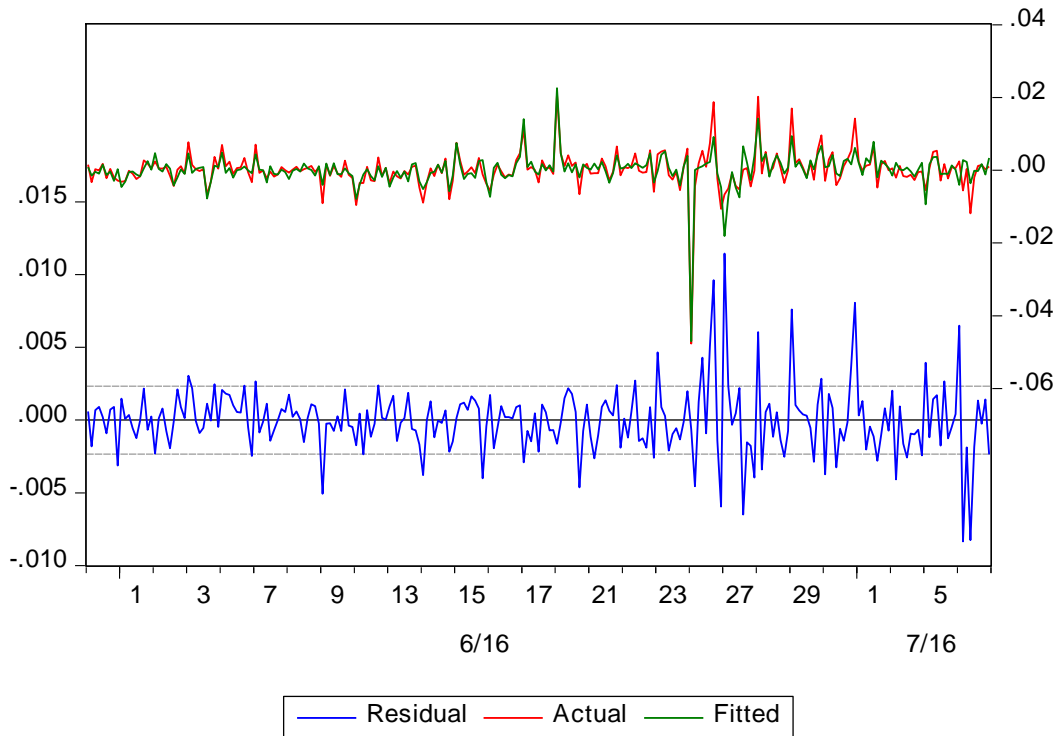
Dependent Variable: FTSE_100
Method: Least Squares
Date: 10/24/17 Time: 09:28
Sample: 5/31/2016 09:00 7/06/2016 17:00
Included observations: 243

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DUMMY	0.001256	0.000320	3.931083	0.0001
DUMMY*FINANCIAL_SECTOR	-0.144743	0.033781	-4.284716	0.0000
FINANCIAL_SECTOR	0.528480	0.030360	17.40710	0.0000
C	5.66E-06	0.000183	0.030877	0.9754
R-squared	0.803038	Mean dependent var	0.000138	
Adjusted R-squared	0.800566	S.D. dependent var	0.005220	
S.E. of regression	0.002331	Akaike info criterion	-9.268469	
Sum squared resid	0.001299	Schwarz criterion	-9.210970	
Log likelihood	1130.119	Hannan-Quinn criter.	-9.245309	
F-statistic	324.8104	Durbin-Watson stat	2.074254	
Prob(F-statistic)	0.000000			

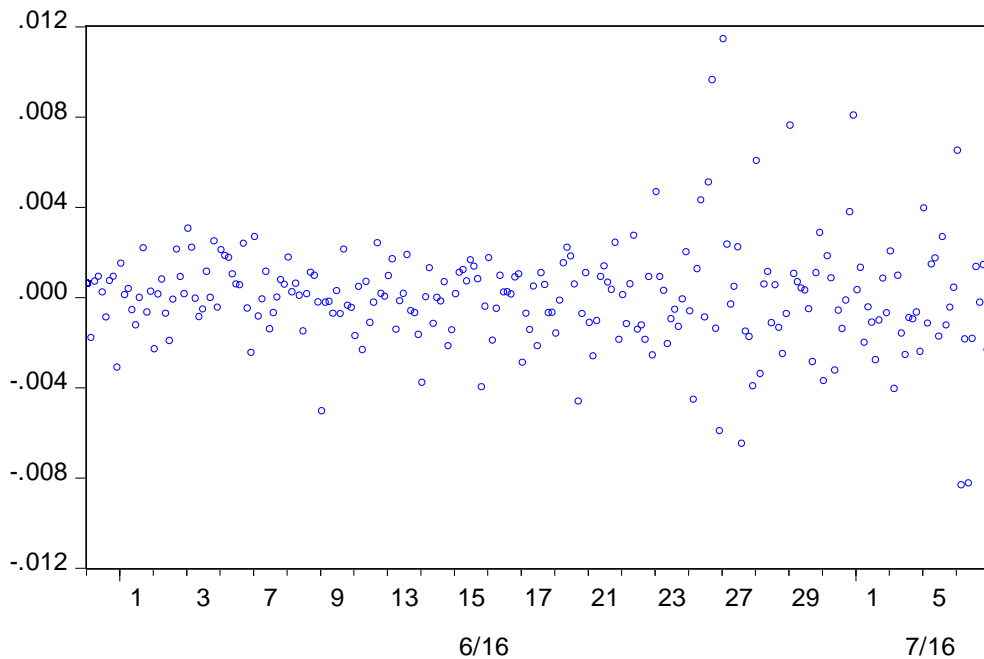
Own elaboration from EViews

In this case, the variables preserve statistical significance, as the null hypothesis $h_0: \beta_x = \mathbf{0}$ can still be rejected, as the p-value is lower than 5 percent. In addition to this, I verify whether there are significant changes following the insertion of the dummy variable within the model that affect the residuals. Despite this is not immediately visible from the residual graphs attached hereafter, the test for heteroscedasticity shows that by including the dummy within the OLS, the residuals become homoscedastic. In fact, the p-value of the coefficients of the Breusch-Pagan-Godfrey test is greater than 5 percent; therefore, the null hypothesis $h_0: b = \mathbf{0}$ cannot be rejected, which implies that the residuals are homoscedastic. The normality test shows that the Jarque-Bera is lower than in the previous case and the null hypothesis is still rejected at a 5 percent significance level. In fact, the p-value of the statistical test is equal to 0. The graphs related to the normality test and the table of the heteroscedasticity test are included in

the Annex II. Overall, the insertion of the dummy variable within the OLS makes the model more reliable and corrects the heteroscedasticity affecting the residuals. In addition to this, the dummy variable improves the linearity of the regression model, which is noticeable in the reduction of the distance of the residuals from the regression line.

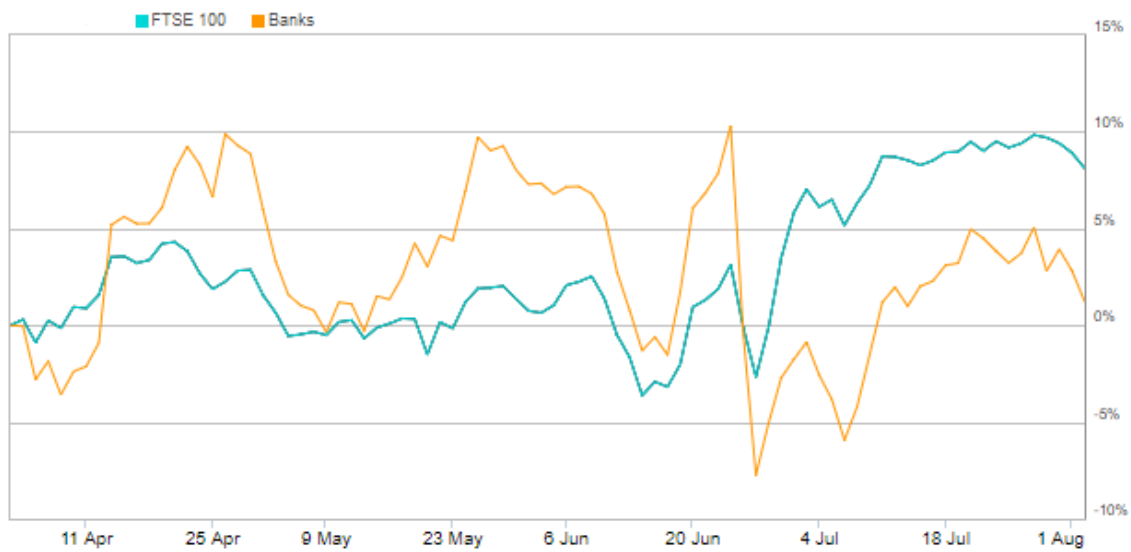


Own elaboration from EViews

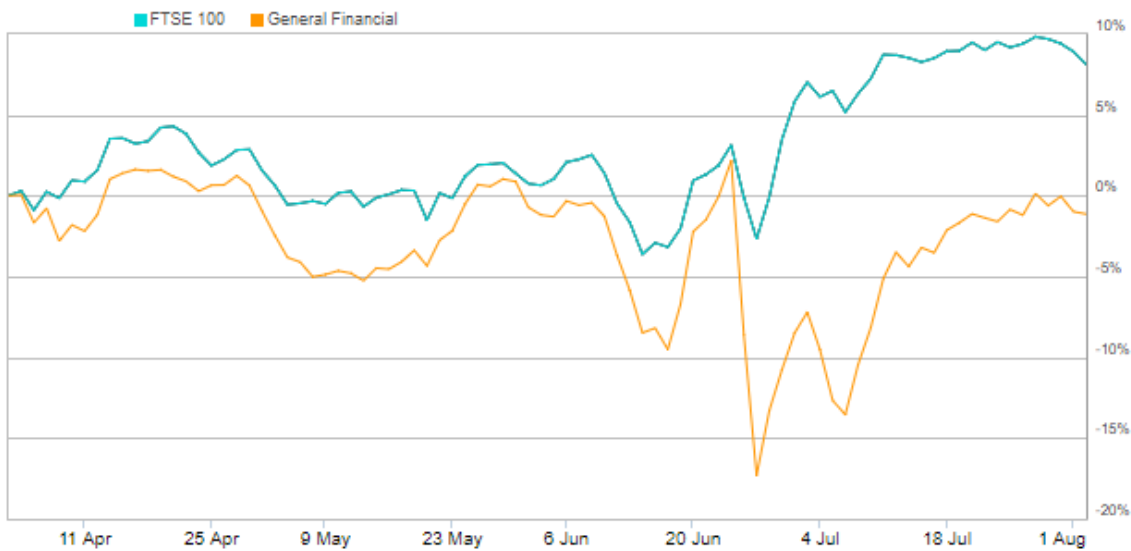


Own elaboration from EViews

In order to examine into detail the behaviour of the British banking sector and the general financial services sector in regards to the impact of the result of the Brexit referendum, it may be useful to break the sample into shorter time-spans. Before that, an intuitive proof of the fact that the firms within these two sectors have been affected more largely than others in the same market index by the outcome of Brexit is given by the graphs hereinafter.



London Stock Exchange



London Stock Exchange

The observation of these graphs suggests that, in the weeks prior to the result of the Brexit, the banking sector was a constituent of the FTSE 100 UK with higher returns on average, even though these are characterised by an unstable pattern, probably due to

the political uncertainty to which speculation over the outcome of Brexit has given rise. The situation is different for what concerns the general financial services providers, whose trend is marked by lighter fluctuations, apart from the last stage before the outcome of Brexit. Even in this case, the result of Brexit has caused abnormal returns, far below those of the market index. In both the cases, it is evident that towards the vote, the uncertainty looming over this political event seemed to be wiped out, in favour of a positive outcome, as the returns of both the sectors surged to record-highs in regards of the period shown.

These graphs suggest that running separate OLS on shorter time spans can give interesting insights into how stock price returns have evolved around the Brexit. For this reason, as it is explained in the research methodology, I split the size of the sample into:

- Brexit -2 (31/05 – 10/06)
- Brexit -1 (13/06 – 23/06)
- Brexit (24/06 – 06/07)

Brexit -2

Focusing the attention on the first period, the regression model explains nearly 76 percent of the total variation of the FTSE 100 UK. In addition, in this case, the p-value of the coefficient of the independent variable is equal to 0. This shows that it has statistical significance, as the null hypothesis $h_0: \beta_x = 0$ is rejected.

Dependent Variable: FTSE_100
Method: Least Squares
Date: 10/19/17 Time: 10:35
Sample: 5/31/2016 09:00 6/10/2016 17:00
Included observations: 81

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000183	0.000157	1.163233	0.2482
FINANCIAL_SECTOR	0.581279	0.037066	15.68230	0.0000

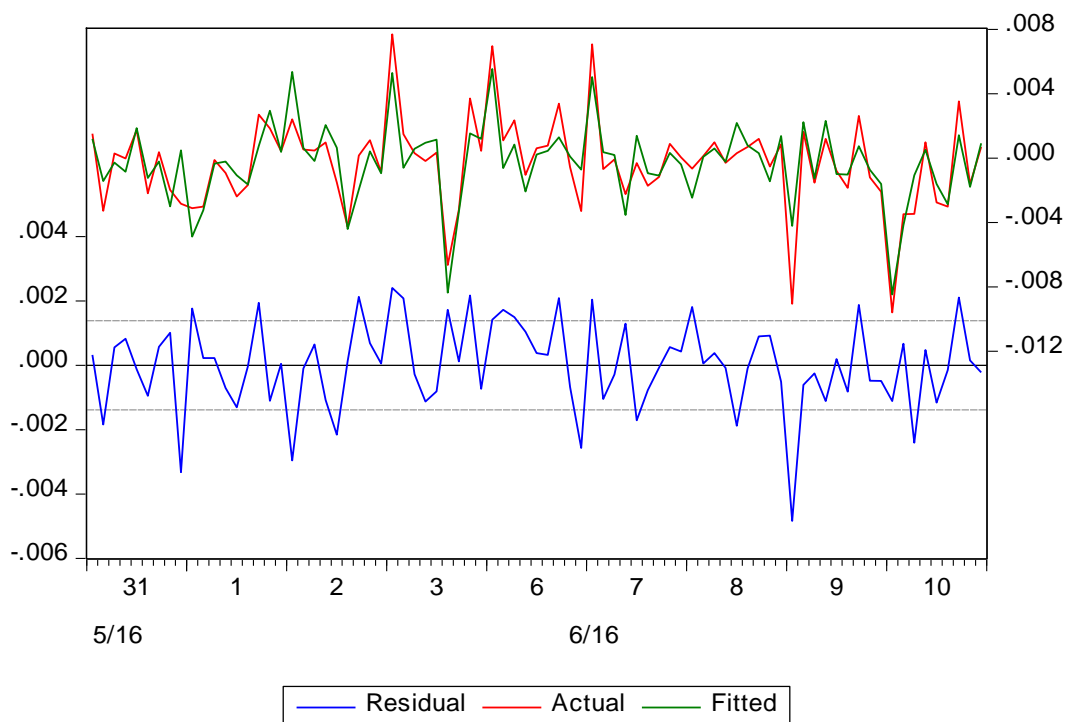
R-squared	0.756874	Mean dependent var	-0.000305
Adjusted R-squared	0.753796	S.D. dependent var	0.002792
S.E. of regression	0.001385	Akaike info criterion	-10.30121
Sum squared resid	0.000152	Schwarz criterion	-10.24209
Log likelihood	419.1991	Hannan-Quinn criter.	-10.27749
F-statistic	245.9344	Durbin-Watson stat	2.057753
Prob(F-statistic)	0.000000		

Own elaboration from EViews

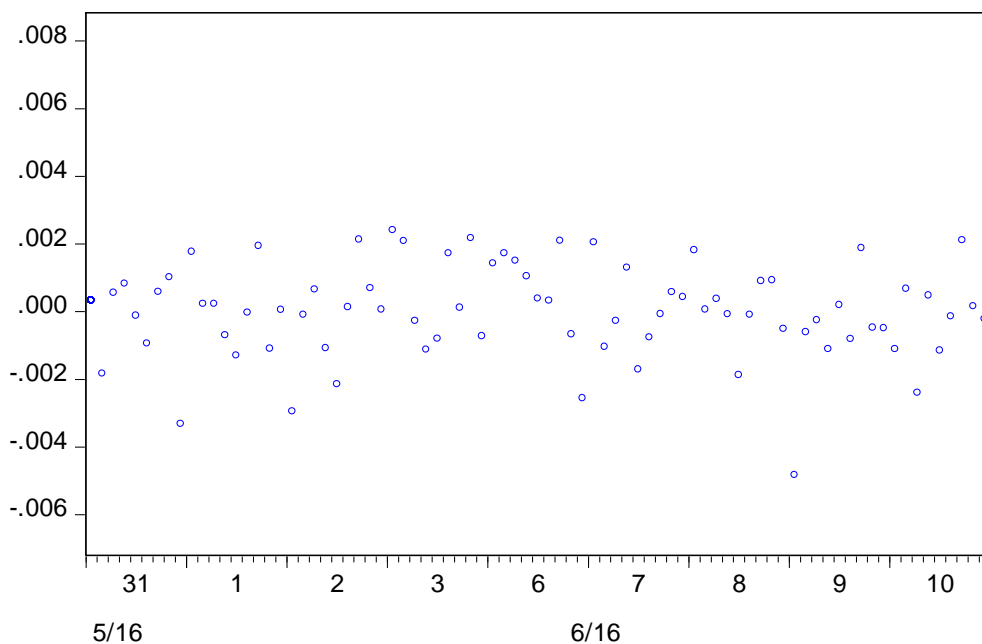
In this first period, both the mean of the average stock price return of the financial and that of the FTSE 100 UK are negative, but their difference shows that the yields are very close, in fact the percentage difference between the mean of the index and the financial sector amounts to 0,053 percent. In addition, the volatility of the financial sector is very similar to the volatility of the index, as the difference between the two amounts to -0.139 percent.

Further details on the descriptive statistics can be found in the Annex II.

The residuals of the model do not show particular signs of irregularity over this period, as they are mainly comprised between -0,002 and 0,002, apart from an outlier registered by the end of the time span. This proves that, at about two weeks from the referendum, the political uncertainty looming over Brexit generated fluctuations in the stock price returns of the financial sector that are largely replicated by the market index as well.



Own elaboration from EViews



Own elaboration from EViews

In order to complete the study of the residuals of this period, it is important to test the heteroscedasticity, autocorrelation and normality. As the Breusch-Pagan-Godfrey test shows, the residuals of this time span are homoscedastic; in fact, the p-value of the coefficient is equal to 0,9159 which is above the 0,5 critical value. The Durbin-Watson

test makes clear that no autocorrelation affects the model (2,05). Lastly, the normality test shows that the residuals are negatively skewed and that they are mainly concentrated around the mean. The null hypothesis of the Jarque-Bera statistical test is rejected. As the p-value is equal to 0,14, which is lower than 5 percent, it means that the residuals are not normally distributed. The full tables and graphs in the Annex II provide complementary details on the residual analysis.

Brexit -1

If we move on to the examination of the 9 days before the outcome of Brexit, the OLS model shows additional reliability than the previous one; the R^2 rises to 85 percent. Similarly, the coefficient of the dependent variable highlights the statistical significance of the term, as the null hypothesis can be rejected in this case as well.

Dependent Variable: FTSE_100
Method: Least Squares
Date: 10/19/17 Time: 10:28
Sample: 6/13/2016 09:00 6/23/2016 17:00
Included observations: 81

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000114	0.000181	-0.629794	0.5306
FINANCIAL_SECTOR	0.516288	0.024385	21.17259	0.0000
R-squared	0.850174	Mean dependent var		0.000449
Adjusted R-squared	0.848278	S.D. dependent var		0.004128
S.E. of regression	0.001608	Akaike info criterion		-10.00328
Sum squared resid	0.000204	Schwarz criterion		-9.944153
Log likelihood	407.1326	Hannan-Quinn criter.		-9.979555
F-statistic	448.2787	Durbin-Watson stat		1.901348
Prob(F-statistic)	0.000000			

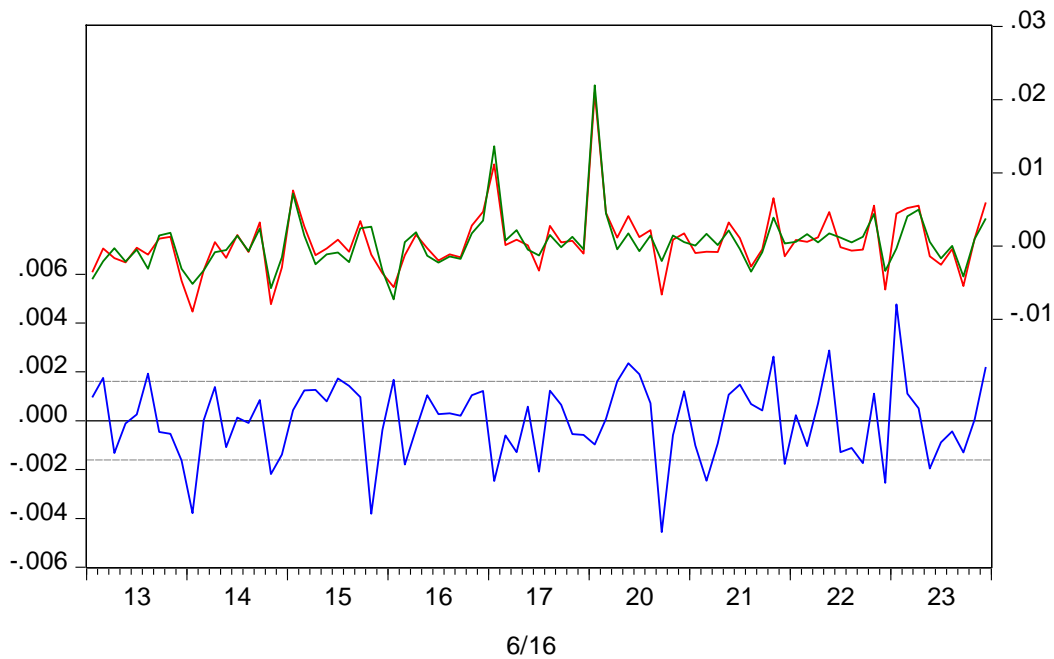
Own elaboration from EViews

After a steep downturn registered between the end of the first time span and the beginning of the second one, growing confidence in the positive outcome of the referendum pervaded the market and both the stock price returns of the banking sector and the general financial services sector soared to record-highs. The restoration of the confidence was largely felt by these two sectors, whose returns grew steadily to get to higher levels than the average of the FTSE 100 UK. The additional tables included in the

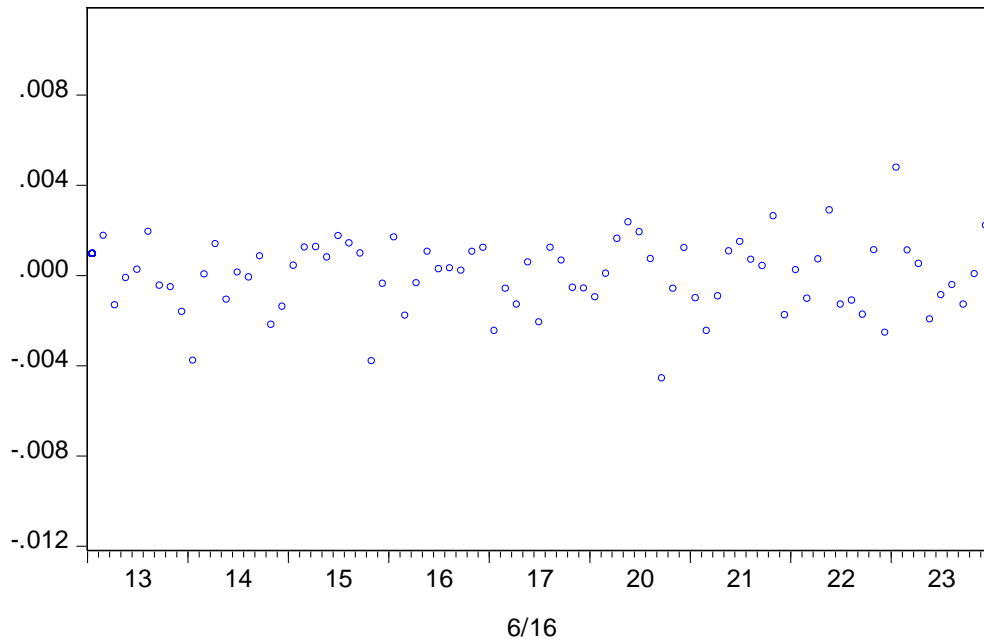
Annex II show the difference between the means of the index and that of the financial sector amounts to -0,064 percent. The political uncertainty caused higher levels of volatility as well, which is a reflection of the imminence of the referendum.

Evidence of the unexplained variation of the FTSE 100 UK by the banking and the general financial services sectors is represented by the residual analysis in this case as well. As the graph hereunder shows, it appears that the financial sector tends to largely reflect its trend into the FTSE 100 market index, apart from a few exceptions, the closer we get to the day of the Brexit. In fact, the height of the residual spikes increases the closer we get to the end of the time span considered. This is evidence of the fact that there is a greater difference between the actual values of the dependent variable and the estimated values.

The graphs hereinafter give an intuitive insight into the matter.



Own elaboration from EViews



Own elaboration from EViews

In order to provide a complete study of the residuals, even in this case I run heteroscedasticity, autocorrelation and normality tests. With respect to the first test mentioned, as the p-value of the coefficient of the independent variable is equal to 0,5548, the null hypothesis is not rejected, which implies that the residuals are homoscedastic. However, the lower p-value in comparison with the previous period suggests that higher levels of volatility affected the model. Indeed, in times of uncertainty, heteroscedasticity is often registered, due to increased volatility. The impact of heteroscedasticity on the model generally affects the regularity of the variance of the residuals. Lastly, the normality test of the residuals shows that there is some degree of irregularity in the distribution of the values of the residuals; despite this, the p-value of the Jarque-Bera test is equal to 0,35, which is greater than 0,05 and implies that the residuals of this period are normally distributed. Further details on heteroscedasticity and normality test can be found in the Annex II.

Brexit

On the 24th June 2016, the result of Brexit sent the market into turmoil, as the expectations of a positive outcome were defeated by the “leave” campaign. In the last OLS model of this analysis, this study provides empirical evidence of the fact that the financial sector was affected more largely by the outcome. By running a regression model on the time span from opening of the transactions on the FTSE 100 UK on the 24th June 2016 until the 6th July 2016, we notice that there are abnormal stock price returns, visible as higher outliers in the model. In addition, higher average of the residuals is registered in comparison with the two previous time spans. This is a fair reflection of the chute of the stock price on one hand, but also it provides an unquestionable proof of the stronger impact of the referendum decision on banks and financial services providers.

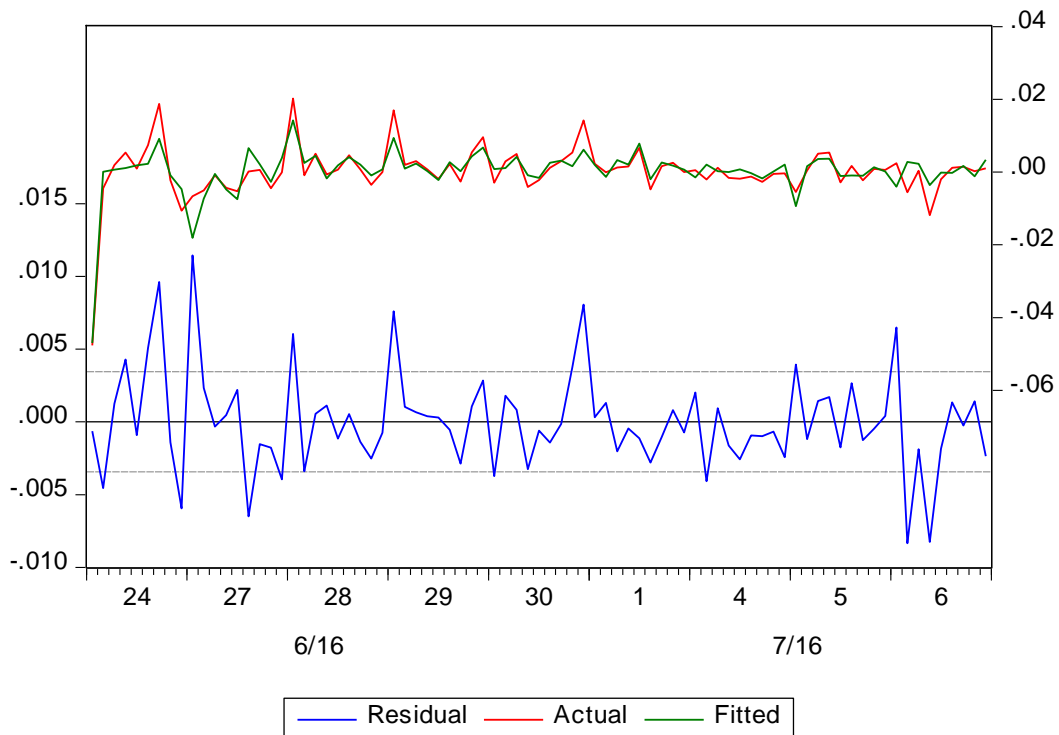
Hereafter, the table representing the results of the OLS on this period show that the high level of reliability of the regression is preserved; in fact, the R^2 shows that the model explains 79 percent of the total variation of the market index. In addition, if we test the null hypothesis $h_0: \beta_x = \mathbf{0}$ on the coefficient of the dependent variable, this is rejected in favour of the alternative hypothesis, as the p-value is lower than 5 percent.

Dependent Variable: FTSE_100
 Method: Least Squares
 Date: 10/19/17 Time: 10:20
 Sample: 6/24/2016 09:00 7/06/2016 17:00
 Included observations: 81

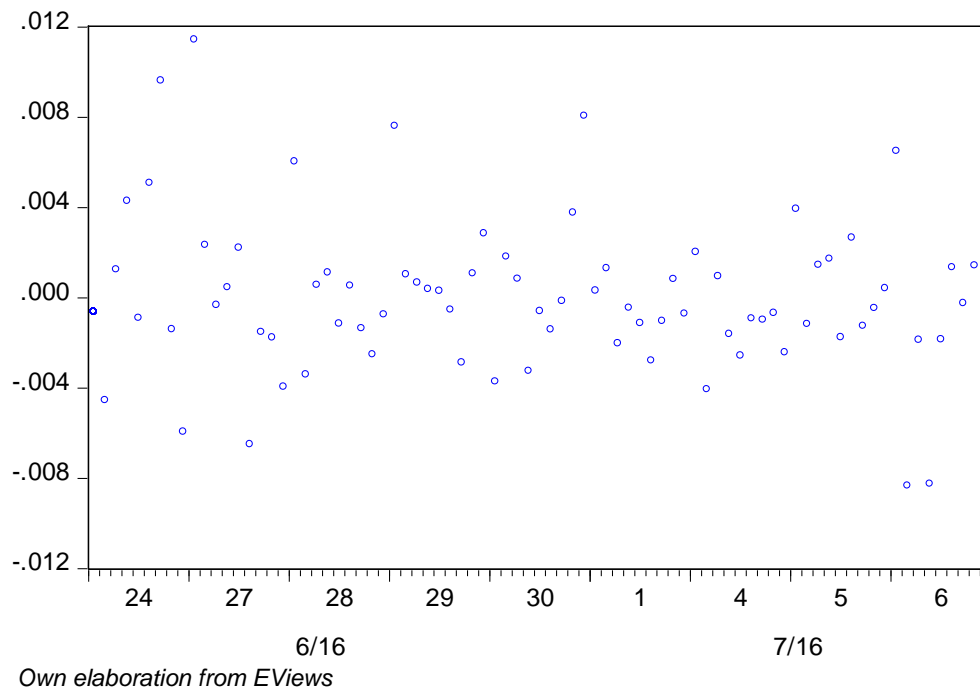
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001262	0.000387	3.264699	0.0016
FINANCIAL_SECTOR	0.383737	0.021868	17.54793	0.0000
R-squared	0.795829	Mean dependent var		0.000271
Adjusted R-squared	0.793244	S.D. dependent var		0.007569
S.E. of regression	0.003441	Akaike info criterion		-8.481466
Sum squared resid	0.000936	Schwarz criterion		-8.422344
Log likelihood	345.4994	Hannan-Quinn criter.		-8.457746
F-statistic	307.9297	Durbin-Watson stat		2.115502
Prob(F-statistic)	0.000000			

Own elaboration from EViews

Prior to the outcome of the Brexit, some signals show that confidence in the positive result of the referendum swapped with the fear of seeing the UK out the EU. This caused an escalation of the volatility. When the London Stock Exchange opened on 24th June, panic invaded the market, because of the win of the “leave campaign”. The result of this residual analysis provides empirical evidence that banks and the general financial services firms suffered more largely, taking into consideration the FTSE 100 UK as the benchmark. The result of the referendum created panic and only in the first hour of exchanges, on average, the stock price returns of the financial sector plunged by 12,58 percent, about 8 percent more than the FTSE 100 UK, which proves that other sectors within the same market index were not as affected by the outcome as the financial sector. Over the 9 days of the “Brexit period”, the financial sector plummeted and the returns fell by about 21 percent. Instead, over the same period, the FTSE 100 went up by nearly 3 percent. As the residual analysis aims to show, the distance between the observed levels of the FTSE 100 and the predicted is much larger in this period, which is evidence of the abnormal returns generated by the impact of the exogenous shock, *alias* Brexit.



Own elaboration from EViews



The outbreak of the residuals is evident, in particular immediately after the result of the referendum. On average, the residuals are much higher than in the previous two periods. In this period, both higher maximum values and minimum values are registered and they are both greater than in the two periods before.

For completion, also the residuals of this time span underwent additional residual analysis and they appear homoscedastic and not affected by serial correlation. In fact, on one hand, the heteroscedasticity test proves that the null hypothesis is not rejected, since the p-value of the coefficient is equal to 0,8310. On the other hand, the Durbin-Watson test is equal to 2,16, which implies no autocorrelation among the residuals exists. The normality test shows that the distribution of the values is positively skewed. The null hypothesis that the residuals are normally distributed is rejected, as the p-value is lower than 5 percent. Additional information on these tests can be found at the end of this paper, in the Annex II.

CONCLUSIONS

This paper provides empirical evidence of the impact of the Brexit referendum on the financial sector of the FTSE 100 UK. Due to the impossibility to measure the impact of Brexit in quantitative terms, this study gives it a dimension by monitoring the outbreak of the residuals of the OLS model. In fact, the residuals represent the abnormal stock price returns that banks and financial services providers incurred.

The adoption of the OLS and the performance of a residual analysis proves successful in determining the effect of Brexit on the stock price returns of the financial sector. The results of this study are consistent with the expectations that this political event has affected financial institutions to a greater extent.

In both the analyses proposed in the course of this study, it is evident that the political uncertainty around the referendum is translated in the model as increased levels of volatility and inability for the financial sector to mimic the trend of the FTSE 100. If, on one hand, the period prior to the 24th June 2016 is an echo of increased volatility due to speculation around the outcome, on the other hand, the period following the result of Brexit is the clear picture of what a future with restricted access to the single market for financial services would look like. In fact, it is in this period that abnormal returns are registered, as a fair reflection of higher residuals within the model. Considering the FTSE 100 UK index as the benchmark, it is evident that the financial sector has suffered to a greater extent from the outcome of Brexit. The underlying reason of the fall of the financial sector has to be interpreted as the fear of forfeiting the passporting regime to which the EU Directives and Regulations give right. In fact, by leaving the EU, the access to the single market for financial services would not be granted. Similarly, where special rules are provided, the third country regime would not allow British financial institutions to provide their services as if they were EU-based companies. The future of banking and financial services sectors is blurred and contingency plans are being prepared, in order

to not be caught by surprise, particularly in case of a hard Brexit. Given the importance of the financial sector on the wealth of the UK, this work provides an insight into the popular negative feeling around the withdrawal of the UK from the EU.

This work leaves room for future improvement. In fact, the exogenous impact of Brexit on the financial sector can be furthered, when the negotiations will have made some progress. In fact, in the future, the insertion of a dummy variable within the regression model could be repeated at several times in order to explore whether the impact of Brexit is significant overtime. Additionally, further examination could be made in order to investigate the impact Brexit has had on the financial sector in comparison to other sectors that have also been affected by this political event.

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ANNEX I

FTSE 100

Stock Price Returns

MAX	2,10%
MIN	-4,76%
AVERAGE	0,01%

Own elaboration from Excel

BARCLAYS

Stock Price Returns

MAX	6,43%
MIN	-20,14%
AVERAGE	-0,12%

Own elaboration from Excel

ROYAL BANK OF SCOTLAND

Stock Price Returns

MAX	7,88%
MIN	-16,69%
AVERAGE	-0,20%

Own elaboration from Excel

LLOYDS BANK

Stock Price Returns

MAX	5,28%
MIN	-18,48%
AVERAGE	-0,16%

Own elaboration from Excel

HSBC

Stock Price Returns

MAX	2,60%
MIN	-2,72%
AVERAGE	0,01%

Own elaboration from Excel

STANDARD CHARTERED

Stock Price Returns

MAX	4,25%
MIN	-6,17%
AVERAGE	0,02%

Own elaboration from Excel

STANDARD LIFE ABERDEEN

Stock Price Returns

MAX	3,68%
MIN	-17,59%
AVERAGE	-0,10%

Own elaboration from Excel

SCHRODERS

Stock Price Returns

MAX	3,80%
MIN	-11,80%
AVERAGE	-0,08%

Own elaboration from Excel

HARGREAVES LANSDOWN

Stock Price Returns

MAX	5,78%
MIN	-11,23%
AVERAGE	-0,07%

Own elaboration from Excel

3I GROUP

Stock Price Returns

MAX	6,44%
MIN	-8,36%
AVERAGE	0,00%

Own elaboration from Excel

ANNEX II

SAMPLE: 31/05/2016 – 06/07/2016:

Heteroscedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	4.345344	Prob. F(1,241)	0.0382
Obs*R-squared	4.303806	Prob. Chi-Square(1)	0.0380
Scaled explained SS	15.21534	Prob. Chi-Square(1)	0.0001

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 10/19/17 Time: 09:26

Sample: 5/31/2016 09:00 7/06/2016 17:00

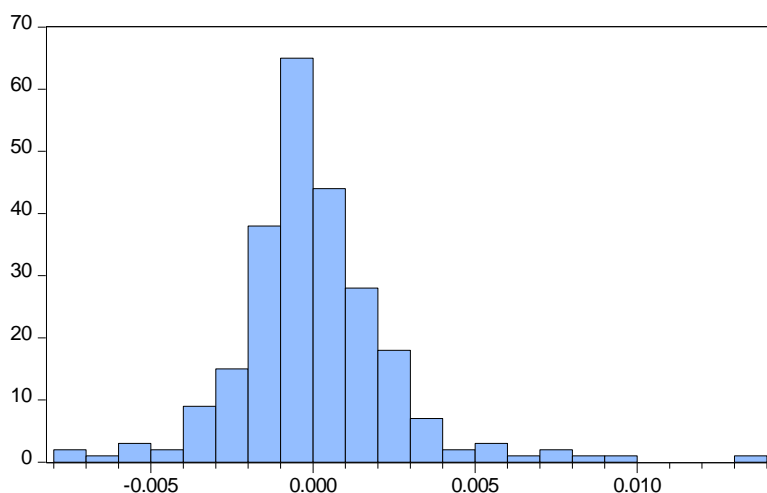
Included observations: 243

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.98E-06	1.05E-06	5.685403	0.0000
FINANCIAL_SECTOR	-0.000194	9.29E-05	-2.084549	0.0382

R-squared	0.017711	Mean dependent var	6.13E-06
Adjusted R-squared	0.013635	S.D. dependent var	1.65E-05
S.E. of regression	1.64E-05	Akaike info criterion	-19.19421
Sum squared resid	6.46E-08	Schwarz criterion	-19.16546
Log likelihood	2334.096	Hannan-Quinn criter.	-19.18263
F-statistic	4.345344	Durbin-Watson stat	1.749227
Prob(F-statistic)	0.038163		

Own elaboration from EViews

Normality test



Series: Residuals
 Sample 5/31/2016 09:00 7/06
 /2016 17:00
 Observations 243

Mean 1.78e-19
 Median -0.000220
 Maximum 0.013341
 Minimum -0.007615
 Std. Dev. 0.002482
 Skewness 1.057678
 Kurtosis 8.188485

Jarque-Bera 317.8755
 Probability 0.000000

Own elaboration from EViews

SAMPLE 31/05/2016 06/07/2016 WITH DUMMY VARIABLE:

Heteroscedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	8.547486	Prob. F(3,239)	0.0000
Obs*R-squared	23.54542	Prob. Chi-Square(3)	0.0000
Scaled explained SS	79.61820	Prob. Chi-Square(3)	0.0000

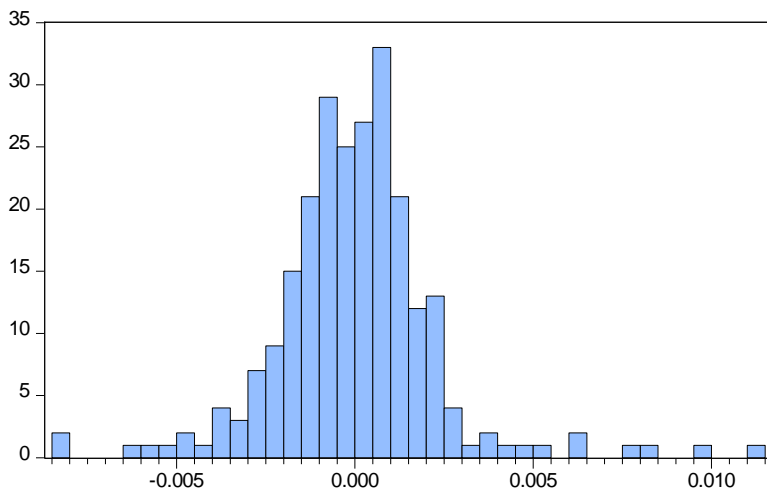
Test Equation:
 Dependent Variable: RESID^2
 Method: Least Squares
 Date: 10/24/17 Time: 09:40
 Sample: 5/31/2016 09:00 7/06/2016 17:00
 Included observations: 243

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.24E-06	1.06E-06	2.106087	0.0362
DUMMY	9.23E-06	1.86E-06	4.971142	0.0000
DUMMY*FINANCIAL_SECTOR	-3.95E-05	0.000196	-0.201092	0.8408
FINANCIAL_SECTOR	8.29E-06	0.000176	0.047009	0.9625

R-squared	0.096895	Mean dependent var	5.35E-06
Adjusted R-squared	0.085559	S.D. dependent var	1.42E-05
S.E. of regression	1.35E-05	Akaike info criterion	-19.56500
Sum squared resid	4.38E-08	Schwarz criterion	-19.50750
Log likelihood	2381.147	Hannan-Quinn criter.	-19.54184
F-statistic	8.547486	Durbin-Watson stat	1.846706
Prob(F-statistic)	0.000021		

Own elaboration from EViews

Normality test



Series: Residuals	
Sample 5/31/2016 09:00 7/06/2016 17:00	
Observations 243	
Mean	-7.14e-21
Median	2.28e-05
Maximum	0.011442
Minimum	-0.008337
Std. Dev.	0.002317
Skewness	0.636660
Kurtosis	7.991215
Jarque-Bera	268.6524
Probability	0.000000

Own elaboration from EViews

SAMPLE 31/05/2016 – 10/06/2016 – BREXIT -2

Heteroscedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.011228	Prob. F(1,79)	0.9159
Obs*R-squared	0.011511	Prob. Chi-Square(1)	0.9146
Scaled explained SS	0.016223	Prob. Chi-Square(1)	0.8986

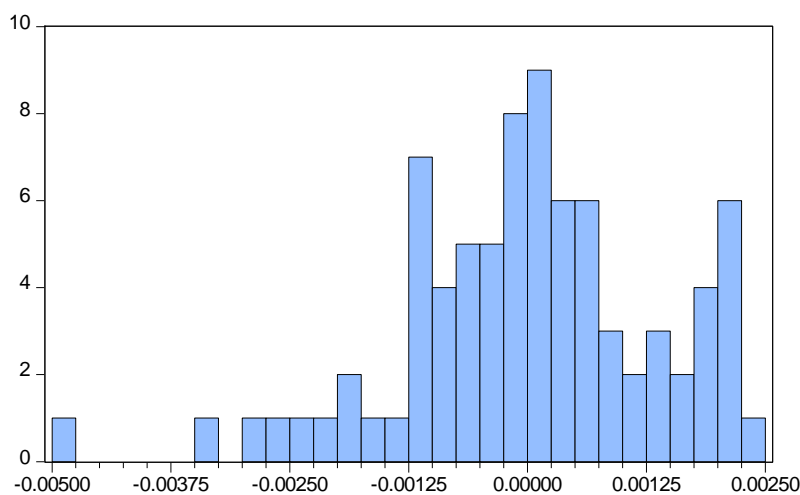
Test Equation:
 Dependent Variable: RESID^2
 Method: Least Squares
 Date: 10/19/17 Time: 10:45
 Sample: 5/31/2016 09:00 6/10/2016 17:00
 Included observations: 81

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.88E-06	3.70E-07	5.082275	0.0000
FINANCIAL_SECTOR	9.25E-06	8.73E-05	0.105962	0.9159

R-squared	0.000142	Mean dependent var	1.87E-06
Adjusted R-squared	-0.012514	S.D. dependent var	3.24E-06
S.E. of regression	3.26E-06	Akaike info criterion	-22.40350
Sum squared resid	8.41E-10	Schwarz criterion	-22.34438
Log likelihood	909.3418	Hannan-Quinn criter.	-22.37978
F-statistic	0.011228	Durbin-Watson stat	2.253344
Prob(F-statistic)	0.915881		

Own elaboration from EViews

Normality test



Series: Residuals	
Sample 5/31/2016 09:00 6/10/2016 17:00	
Observations 81	
Mean	1.34e-20
Median	5.64e-05
Maximum	0.002399
Minimum	-0.004839
Std. Dev.	0.001377
Skewness	-0.630185
Kurtosis	3.963363
Jarque-Bera Probability	8.493532
	0.014310

Own elaboration from EViews

SAMPLE 13/06/2016 – 23/06/2016 – BREXIT -1

Heteroscedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.351730	Prob. F(1,79)	0.5548
Obs*R-squared	0.359036	Prob. Chi-Square(1)	0.5490
Scaled explained SS	0.445623	Prob. Chi-Square(1)	0.5044

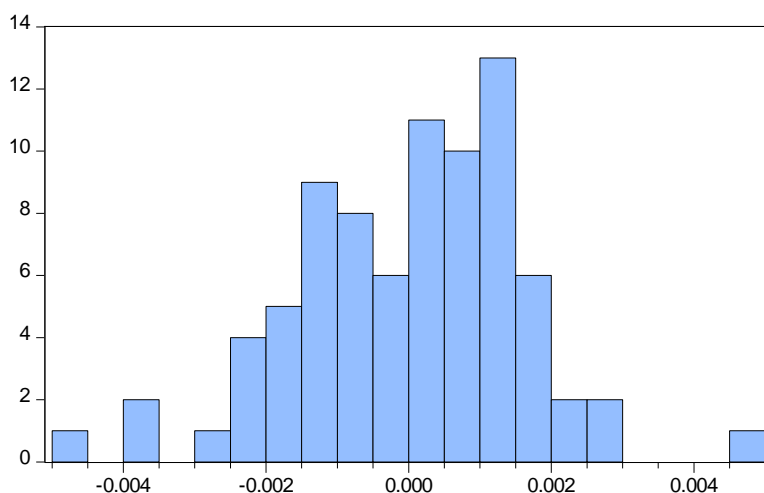
Test Equation:
 Dependent Variable: RESID^2
 Method: Least Squares
 Date: 10/19/17 Time: 10:32
 Sample: 6/13/2016 09:00 6/23/2016 17:00
 Included observations: 81

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.56E-06	4.62E-07	5.541527	0.0000
FINANCIAL_SECTOR	-3.70E-05	6.24E-05	-0.593068	0.5548

R-squared	0.004433	Mean dependent var	2.52E-06
Adjusted R-squared	-0.008170	S.D. dependent var	4.10E-06
S.E. of regression	4.12E-06	Akaike info criterion	-21.93905
Sum squared resid	1.34E-09	Schwarz criterion	-21.87993
Log likelihood	890.5317	Hannan-Quinn criter.	-21.91533
F-statistic	0.351730	Durbin-Watson stat	2.104902
Prob(F-statistic)	0.554830		

Own elaboration from EViews

Normality test



Series: Residuals	
Sample 6/13/2016 09:00 6/23/2016 17:00	
Observations 81	
Mean	-1.61e-19
Median	0.000204
Maximum	0.004765
Minimum	-0.004558
Std. Dev.	0.001598
Skewness	-0.251734
Kurtosis	3.609606
Jarque-Bera	2.109709
Probability	0.348243

Own elaboration from EViews

SAMPLE 24/06/2016 – 06/07/2016 – BREXIT

Heteroscedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

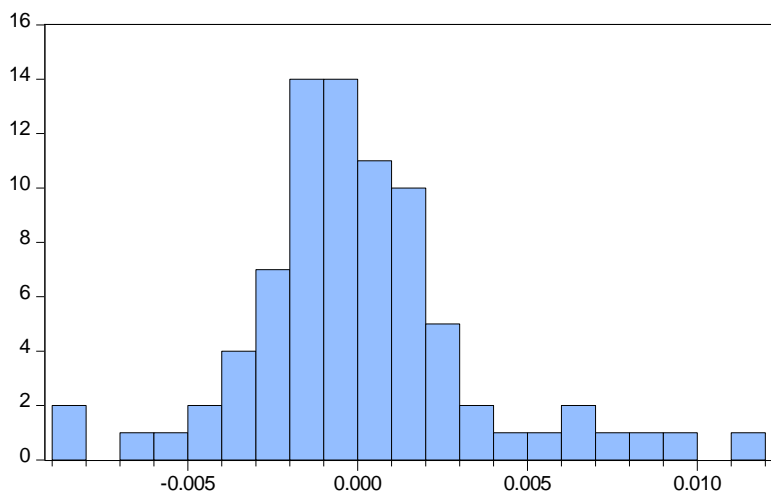
F-statistic	0.045849	Prob. F(1,79)	0.8310
Obs*R-squared	0.046982	Prob. Chi-Square(1)	0.8284
Scaled explained SS	0.085791	Prob. Chi-Square(1)	0.7696

Test Equation:
 Dependent Variable: RESID^2
 Method: Least Squares
 Date: 10/19/17 Time: 10:25
 Sample: 6/24/2016 09:00 7/06/2016 17:00
 Included observations: 81

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.15E-05	2.57E-06	4.457464	0.0000
FINANCIAL_SECTOR	-3.12E-05	0.000146	-0.214124	0.8310
R-squared	0.000580	Mean dependent var	1.16E-05	
Adjusted R-squared	-0.012071	S.D. dependent var	2.28E-05	
S.E. of regression	2.29E-05	Akaike info criterion	-18.50548	
Sum squared resid	4.15E-08	Schwarz criterion	-18.44636	
Log likelihood	751.4719	Hannan-Quinn criter.	-18.48176	
F-statistic	0.045849	Durbin-Watson stat	1.821536	
Prob(F-statistic)	0.831002			

Own elaboration from EViews

Normality test



Series: Residuals	
Sample 6/24/2016 09:00 7/06 /2016 17:00	
Observations 81	
Mean	5.84e-19
Median	-0.000463
Maximum	0.011442
Minimum	-0.008337
Std. Dev.	0.003420
Skewness	0.671619
Kurtosis	4.839311
Jarque-Bera	17.50733
Probability	0.000158

Own elaboration from EViews

MEAN AND STANDARD DEVIATION OF THE 3 PERIODS

MEAN			
	FTSE	FIN SECTOR	DIFFERENCE
BREXIT	0,000271	-0,002583	0,285%
BREXIT-1	0,000449	0,001091	-0,064%
BREXIT-2	-0,000305	-0,000839	0,053%

Own elaboration from Excel

STD DEV			
	FTSE	FIN SECTOR	DIFFERENCE
BREXIT	0,007569	0,017595	-1,003%
BREXIT-1	0,004128	0,007373	-0,325%
BREXIT-2	0,002792	0,004179	-0,139%

Own elaboration from Excel

RESIDUALS OF THE 3 PERIODS

RESIDUALS - BREXIT	
MAX	0,011442
MIN	-0,00834

Own elaboration from Excel

RESIDUALS - BREXIT-1	
MAX	0,004765
MIN	-0,00456

Own elaboration from Excel

RESIDUALS - BREXIT-2	
MAX	0,002399
MIN	-0,00484

Own elaboration from Excel