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L'impatto delle politiche monetarie non convenzionali della Banca Centrale Europea sui mercati azionari dell'Eurozona.

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"The Impact of Unconventional Monetary Policy on European Equity Market"

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Abstract

Have the unconventional monetary policy measures deployed by the ECB influenced the European equity markets in the last years? Would it be correct to state that there is a casual connection between changes in the ECB's balance sheet and the returns that we see on the equity market? In order to answer to these questions, we estimated through a particular approach the structural relationship between three balance sheet items related to monetary policy actions, namely "MRO", "LTRO" and "Assets held for Monetary Policy purposes" (which account asset purchases for both SMP and OMT programs), and ten main equity indexes from ten different eurozone countries: Germany, Italy, France, Spain, Portugal, Austria, Belgium, Netherlands, Greece and Ireland. The investigation of these dynamics is complicated by the fact that market valuations and policy interventions are jointly determined and by the presence of omitted variable, that are responsible for co-movements in the observables. To overcome these problems, we employ a technique called "Identification Through Heteroskedasticity", developed by Rigobon and Sack. This approach uses the volatility present in the data as a probabilistic instrument that allow us to solve the identification problem without recurring to sign restrictions or volatility constraints otherwise difficult to justify. The outcomes we obtained indicate that the effects of Balance Sheet Policies on the European equity market are extremely weak or invisible, coherently with many studies that claim that the transmission mechanism of monetary policy in the euro-area is thwarted by the particular bank-centrist architecture of the economic system, by the bad health of many financial institutions and by the lack of a strong political commitment among the European Union. Nevertheless, the reliability of our results is unfortunately pretty weak, due to the controversial situation that markets have been experiencing since the beginning of the financial crisis, that has exacerbated the problems related to endogeneity and omitted-variables; hence, further analysis will be required in order to ascertain the veracity of this study's conclusions.

Contents

1 Introduction

Many central banks around the world have introduced Quantitative Easing (Q.E.) and more specifically Balance Sheet Policies as new policy tools in order to influence economic activity and inflation expectations. These kind of measures are currently at the center of a controversial debate within Europe, as the European Central Bank has launched the first large-scale asset purchase program with the purpose of fighting the deflation risk and to heighten the inflation expectations across the eurozone. Similar monetary measures have been previously adopted by other central banks, such as the US Federal Reserve, the Bank of England and the Bank of Japan. Overall, these measures seem to have had the desired effect in the home market, by stabilizing market liquidity and fostering credit growth.

However, there are still a number of open questions abut the effectiveness of Quantitative Easing and other policy measures in respect to its global impact, and to a cost-benefits trade off perspective. These policies have an impact that is in large part unknown on the stability of global financial markets, especially in the long run. At the same time, is very difficult to understand what is the real impact of these expansionary measures on different asset class: the impact on money market and sovereign bonds market seem to be plenty positive, while the impact on stock and corporate bond market is harder to understand.

This study aims to analyze the effects of the Quantitative Easing and other monetary policy action deployed by the ECB on the European Equity Market. In particular, thanks to the use of identification techniques that exploit the time-variation in volatility that usually accompanies policy interventions, we aim to identify if there is a true structural relationship between the course of equity variations and changes in ECB's balance sheet items related to monetary policy interventions. Looking at the universe of Equity markets, which is closer to the real economy trend, this work will shed light also on the effectiveness that monetary shocks have on the recovery process that European institutions have begun in order to put an end to the crisis in the Euro area, which last nowadays from almost six years. We also investigate whether these policies have a distinct effect on core versus non-core EU, thereby contributing to the current debate on the effectiveness of ECB policies to sustain the prospects of peripheral countries.

As it is well known, the identification of these dynamics is complicated by the fact that market valuations and policy interventions are jointly determined. Another issue is given by the presence of omitted-variables, that are responsible for co-movements in the observables. To overcome these problem, we employ a technique developed by Rigobon (2001) and Rigobon and Sack (2003), called "Identification Through Heteroskedasticity". This approach turn the hetheroskedasticity present in the data into a probabilistic instrumental variable that allow us to solve the identification problem avoiding sign restrictions or volatility constraints otherwise difficult to justify. The implementation of this technique requires to split the data set in different states (or regimes), among which the overall heteroskedasticity of shocks is supposed to change. The only assumption needed is that the transmission mechanism of the shocks remains constant across the various regimes. The selection of regimens is arbitrary, and results are proven to be reliable even if the states are miss-specified. We will select three different set of regimes: a first one, based on the variance observed in equity markets from 2009 to 2016. A second one, based on the observed variance on the residuals computed through a Vector Autoregressive Model regression on ECB's balance sheet variables and equity market. And, finally, a third set, defined on the basis of the announcements and main events occurred on the market during the considered time frame. The selected states are used to compose different variance-covariance matrix, which purpose is to provide additional information about the considered time window (more precisely, these different matrix allow us to dispose of a larger set of known terms and to heighten the number of degree of freedom in our identification system). Hence, the regimes are used to "normalize" the data in order to exalt changes in the Heteroskedasticity in a Generalized Method of Moment framework, . Standard errors are obtained by bootstrapping. The outcomes we obtained indicate that the effects of Balance Sheet Policies on the European equity market are extremely weak or invisible. This result is actually coherent with two main consideration about the Eurosystem suggested by the empirical evidence and supported by many studies: firstly, that the transmission mechanism of monetary policy in the EU is thwarted by the particular bank-centrist architecture of the economic system and by the bad health of many financial institutions. Secondly, that, how the same ECB sustained many times, in order to regain profitability in the Euro area and to unleash the true effectiveness of monetary measures, political commitment and structural reforms are needed in many countries. Although our final result is likely to be true, the statistical reliability and the economical significance of our framework is pretty weak, due to the complicated situation that markets have been experiencing since the beginning of the financial crisis, that has negatively affected the capability of the chosen identification approach to properly investigate the phenomena; hence, further analysis will be required in order to ascertain the veracity of this study's conclusions.

The topics treated in this paper are particularly relevant for the European economy, where unconventional monetary policy is playing a central role in order to heighten the expectation about inflation with the aim to foster the economic recovery in the context of a deeply controversial global financial environment. Moreover, this study can also be of interest for other countries that are and were using expansionary measures to overcome recessions or deflation risks.

The paper is structured as follows. Section 2 describes the main literature related to this area of research and a brief summary of the measures adopted by the ECB since fall 2008, Section 3 presents the research method used in this paper and the selected sets of regimes, Section 4 shows the results obtained, in Section 5 we perform some robustness tests of the baseline specification and we propose different time frame in order to better capture the structural relationship between the considered variables, Section 6 concludes.

2 Related Litterature

The influence of unconventional monetary policy measures on asset prices and real economy outcomes has always been subject of a complex dispute among economists. This paper draws from a wide theoretical literature about the capability of monetary policy to fulfill its purposes in a context characterized by a high degree of financial globalisation, the effect of unconventional monetary policy on asset prices and, more specifically, on stocks and bonds price fluctuations. Also very important is the literature about which identification technique should be adopted in order to estimate properly the existing dynamics between markets and monetary policy intervention from both a long and short-run perspective.

The debate about the most effective identification strategy for investigating the structural relationship between monetary policy measure and markets, has always been at the center of attention of economists. Many spent words on how to overcome the problem of endogeneity and omitted variables in structural vector auto-regressive analysis Good results were obtained by imposing variance or sign restrictions or long-run constraints or coefficient exclusion constraints e.g., Sims (1980), Amisano and Giannini (1997), Blanchard and Quah (1989), King, Stock, Plosser and Watson (1991), Faust (1998), Canova and De Nicolo'(2002), Uhlig (2005). Justifying these restrictions is however difficult and often controversial. Hence, part of the literature used statistical data properties for identification. In particular, using changes in the volatility of the shocks. Rigobon (2003) and Rigobon and Sack (2003) used successfully heteroskedasticity in several identification problems investigating the dynamics that regulates the relationships between assets market and policy makers. This of quite successful approach, called "Identification Through Heteroskedasticity", will be adopted in this work. The same approach was adopted by Lanne and Lutkepohl (2008) while Normandin and Phaneuf (2004), Lutkepohl and Maciejowska (2010), Bouakez and Normandin (2010) and Lanne, examine conditional heteroskedasticity for the identification of shocks. The idea behind both approaches is that by transforming the reduced form residuals is possible to extract informations about the structural shocks, with the difference that changes in volatility are used instead of conventional exclusion or sign restrictions. Additional restrictions for the model are also provided by assuming that the impulse-response mechanism remains unchanged even if the volatility of shocks changes. Rigobon and Sack (2003) configured the changes in heteroskedasticity of shocks as an instrumental variable of probabilistic nature. Lutkepohl (2012) discussed also a version of this approach that used a multivariate generalised autoregressive heteroskedastic model (MGARCH) for capturing movements in volatility and implemented the Markov-regime-switching mechanism in order to capture changes in residual volatility. Furthermore, Lutkepohl argued that using a Choleski decomposition of the residual covariance matrix (as in Rigobon and Sack's approach), is a shortcut that comes at some costs; namely, it requires further arguments to be justified, and in any case, does not lead to economically meaningful shocks. Thus, even if requirements regarding the existence and the heterogeneity of the changes in data can be investigate by statistical procedures, and even if full identification of the obtained structural shocks can be tested with statistical test, it is important to emphasize that shocks obtained in these kind of frameworks are not *pure*, but statistically identified or normalized. Hence, there is no guarantee that these shocks necessary correspond to economically meaningful shocks, and a careful comparison of the results with an empirical model becomes essential. Unfortunately, this mean that the cause behind disappointing results are difficult to investigate.

In the last few year, a large literature has grown about the effects of unconventional monetary policies announcements. Many studies have been conducted about the correct implementation of the event-study methodology in order to properly investigate the effects of unconventional monetary policies. We move from many of these studies in order to understand how investor react to announcement. A great number of effort have been spent to attempt to employ the conventional event-study approach to examine the investors' surprises to monetary policy announcements: some authors such as Doh (2010), Gagnon et al. (2011), Meaning and Zhu (2011), Neely (2010), Krishnamurthy and Vissing-Jorgenson (2011), Joyce and Tong (2012) and Swanson (2011), Luciu and Lisi (2015) have identified announcements that can be considered as *complete surprises*, and then simply added up the jumps in asset prices in short time windows bracketing these announcements. For what concern the Euro-area, the results showed a meaningful impact on Bond prices, an overall more narrow impact on the money market and a very weak impact on the equity market, with the exceptions of the OMT announcement in 2012. But this approach is not trustworthy. Indeed, most monetary policy announcements have been at least in part anticipated and automatically discounted by financial markets, as news usually comes out in a gradual manner before the announcement. Moreover, a rough forecast on the guidance of Central Banks has sometimes been pretty simple to do. An attempt to bypass this issue was offered by Joyce et al. (2011) and Cahill et al. (2013), by using the surveys about expectations periodically conducted between analysts and investors with the purpose to measure in a more realistic manner the market surprise to monetary policy announcements. However, due to the limited data availability of surveys, the latter approach can not be considered as enough reliable. A more effective approach, proposed by Rogers, Scotti and Wright (2014), turned out to be helpful in order to measure the effects of monetary measures on different asset prices relatively to changes in government bond yields and relies on a particular definition of *monetary policy surprise* centered on the *intraday* changes in government bond yields right after the announcement. This overtures, whose rationale origins from the works of Eggertsson and Woodford (2003) and Vissing-Jorgenson et al. (2013), is also endowed of the "Identification trough Heteroskedasticity" technique of Rigobon and Sack (2003) in order to avoid potential bias related to the miss-specification of the considered time windows, allow to sustain the thesis according to which unconventional monetary policies are more effective in changing prices in financial markets when policy rates are stuck at the zero lower bound. Furthermore, it is stated that it is possible to recognize an impact on equity markets although it is pretty low. However, according to the same study, this pass-through from bond yields into other asset prices seems to be way bigger for the US than for the eurozone. Another evidence suggested by these last results points also out that the impacts on financial condition of the purchase flow of securities by Central Banks may be more important than the amount of securities purchased.

Of course, our study is deeply related to the literature about the effectiveness of monetary policy interventions on the economic system. Fawley and Neely (2013) compared the measures adopted by the Federal Reserve, the Bank of England, the Bank of Japan and the European Central Bank, outlining how the Federal Reserve and the Bank of England had a greater freedom of action in contrast to the BoJ and, especially, the ECB, due to different economic conjunctures and political background. Speaking more specifically about the efficiency of balance sheet interventions by ECB, as we said before, different studies showed how these measures typically impact interest rates of both long and short term bonds; it remains way more difficult to capture the entity of spillovers on equity market since the number of determinants is much wider and the effects of monetary policy is difficult to disentangle from other influences (Joyce et al. 2011). Acharya et al. (2016) illustrated the different effects that ECB provokes acting as lender of last resort or as buyer of last resort. More specifically, has been demonstrated how the long term refinancing operations launched by the ECB helped banks to deal with the liquidity crisis, but at the same time increased the sovereign risk across peripheral countries in the eurozone. As a matter of fact, in the context of the European sovereign debt crisis, under capitalized banks had the incentives to increase holdings of risky domestic sovereign debt, in order to use those bonds as collateral at the European Central Bank for further refinancing operations. This moral-hazardous behavior segmented the market for eligible collateral by making domestic banks the dominant holder of these assets, thus implicating a further reinforcement of the bank-sovereign nexus. From a long run angle, the risks caused by these refinancing operations were not sustainable, and the market recognized it by skyrocketing the spreads of both core and non-core European countries' sovereign CDS. Hence, Archarya et al. found how only the buyer of last resort approach was able to reduce the sovereign risk across the eurozone meaningfully and in a sustainable manner, as the Outright Monetary Transaction programmer (introduced by Draghi's "Whatever it takes" speech in July 2012) significantly reduced the sovereign yields and CDS of Greece, Italy, Ireland, Portugal and

Spain, as non-GIIPS banks started buying GIIPS sovereign debt, lowering the segmentation in bonds market as well as the bank-sovereign nexus in the Eurosystem. In conclusion, either programs had temporary easing on bank funding risk, but only OMT led to a sustained improvement in both prices of sovereign bonds and bank funding conditions. This result is absolutely important for our study, because tell us that LTROs were perceived by many investors as risk driver. Similar considerations were made by Szcezerbowicz (2012), while Krishnamurthy et al.(2014) investigated the channels causing the reduction in sovereign bond yields also around the Securities Markets Program (SMP), demonstrating how this latter program worked in a similar way to OMT but with smaller impact. Finally Saka et al. (2015) found that the perceived commonality in default risk among peripheral and core eurozone sovereigns increased after the launch of the Outright Monetary Transaction program, partially reducing the shifts in sovereign bond spreads. For the reasons explained by Archarya et al. and Krishnamurthy et al., in section 5 we will conduct a study that considers only the observation collected after the introduction on OMT.

Another related strand of the literature analyzes the effectiveness of monetary policy in delivering price stability and positive stimuluses in a deeply globalized financial environment, such as the one in which the eurozone finds itself. The capability for the central banks to influence market sentiment was cleverly explored by Disyat and Rungcharoenkitkul, who moved from the positions of Rey (2013), Woodford (2010), Obstfeld (2014) and Kamin (2015) through a revisitation of the so called "Mundell - Fleming Trilemma". By sharply defining three notions (namely: the notion of *monetary autonomy* as "the central banks' ability to achieve desired targets of their instruments independently of whatever those instruments and target may be", the notion of *monetary dependence* as "the extent to which the actual setting for policy, as well as monetary conditions more broadly, are influenced by external financial developments" and the notion of *financial contagion* as "changes in domestic financial conditions driven by shifts in global risk appetites or preferences non linked to domestic fundamentals"). Disyat and Rungcharoenkitkul assess that the real issue posed by global financial integration is not monetary autonomy, but monetary dependence; the question is how much of the it reflects exposure to unpredictable changes in global risk appetite and preferences and how much this dependence arises naturally from common fundamentals among economically and financially integrated economies. Their approach, that exploits the use of the measures of the expected excess return from investing in a long-term bond over a short-term bond "cleansed" by the expected path of monetary policy and macroeconomic fundamentals, overcome most existing studies, downgrading the importance attributed to "world-wide" sovereign bond correlation (related to the so called *world business cycle*, which existence has been pointed by Kose et al. (2003)) Addressing its attention on both main and emerging economies, their paper concluded that the impact of financial integration on Central Banks' measures effectiveness is undeniable but is actually less severe than how it is commonly portrayed.

2.1 Balance Sheet Policies deployed by the European Central Bank

The first set of monetary policy measures designed to actively make use of the Eurosystem balance sheet was called BSP1 and was launched in October 2008, right after the explosion of the U.S. subprime crisis, in order to support eurozone financial institutions in a moment of significant stress in worldwide financial markets, when many securities held in foreign currencies by investors from the United States were sold massively in order to face the scarcity of liquidity that hit the American market. Short after, with the liquidity crisis that was slightly moving to the European financial system, the European Central Bank announced a number of BSPs aimed at addressing persistent funding problems to ensure the effective transmission of the monetary policy stance to the real economy at a time of high uncertainty in financial markets. The Eurotower focused its action in particular in the money markets of the euro area banking sector, with the "fixed- rate-full-allotment tender procedure" (FRFA) for all liquidity-providing operations, enlarging the list of assets eligible as collateral for operations with the central bank, and with the provision of US dollar liquidity through EUR/USD foreign exchange swap tenders with full allotment. Seven months after, at the beginning of May 2009, with the deteriorating of the funding conditions in the eurozone, the ECB announced a second set of BSPs (called BSP2), consisting in three one-year long-term refinancing operations (LTROs) announced in combination with the CBPP1, the first covered bond purchase programme after the start of the crisis. By providing additional funding for a longer time and at more attractive conditions than the market to euro area banks, these measures were aimed at easing euro area banks' funding conditions more broadly and not only in the money markets, in order to lead to a broader easing in the financing conditions of the real economy. The third set of BSPs (BSP3), which consisted mainly of the Securities Markets Programme (SMP), was launched one year after, at the beginning of May 2010 in response to an intensification of tensions in some euro area sovereign bond markets, that foreshadowed what was to happen after, with the sovereign debt crisis in the European market. Under this programme, the Eurosystem balance sheet was envisaged to expand through purchases of public and private debt securities in order to address the malfunctioning of certain market segments which were hampering the monetary policy transmission mechanism. The ECB also reintroduced some other BSPs such as an over-hauled FRFA, new six-month LTROs and swap lines with the US Federal Reserve to avoid negative spillovers from domestic sovereign bond emitted in US dollars to other financial markets. The fourth set of Balance Sheet Policies (BSP4), which comprises the measures announced in the last quarter of 2011, was designed to make use of the Eurosystem balance sheet in a similar way to the second set of BSPs. The ECB launched a second covered bond purchase programme (CBPP2) and announced two three-year LTROs. For the first time, these measures were aimed to support and encourage directly bank lending to the real economy by easing euro area banks' funding conditions in a number of market segments (mostly money and covered bond markets). BSP4 increased significantly the size of the Eurosystem balance sheet; nevertheless the impact produced by this fourth set of monetary policy measures, was not satisfactory, witnessing the limits of the transmission mechanism of liquidity in the Eurosystem. Also in order to deal with this issue, but mainly to allay the effects of the sovereign bonds crisis, in the summer of 2012 the ECB announced a new program of Balance Sheet Policies (BSP5), which went by the name of Outright Monetary Transactions (OMT). OMT program, which was designed to preserve the singleness of monetary policy and to ensure the proper transmission of the monetary policy stance to the real economy throughout the euro area, was implemented through outright purchases on secondary markets of some euro area government securities to address severe distortions in government bond markets which originate from, in particular, fears on the part of investors of the reversibility of the euro. The launch of these measures was supported by a new and strong forward guidance strategy and the ECB efforts managed to partially restore the situation in sovereign bond markets and to appease investors about the resilience of the eurozone. Taking into account the deterioration in the outlook for inflation in the euro area, the ECB announced a sixth set of BSPs (BSP6) in June and September 2014. With the main policy rates at their effective lower bound, the ECB attempted to have a better control of the impact of its BSPs on the financing conditions of the real economy. BSP6 consisted of a series of eight targeted long-term refinancing operations (TLTROs) with a maturity of four years to take place on a quarterly basis between September 2014 and June 2016. Furthermore, two new programmes of private asset purchases (covered bonds and asset-backed securities) were also announced in September 2014. According to the ECB, the impact of the new BSPs was intended to be sizeable so as to help to steer the size of the Eurosystem balance sheet towards the level of early 2012 (i.e. EUR 3trnThe seventh and last set of BSPs (BSP7) included in this study was announced in January 2015. Because of the weaker-than-expected inflation dynamics and increasing evidence that the prevailing degree of monetary accommodation was insufficient to adequately address heightened risks of a too prolonged period of very low inflation, the ECB decided to launch the so-called expanded asset purchase programme (EAPP), named also Quantitative Easing. Differently from the previous monetary policies measures, primarily aimed at ensuring the provision on liquidity to the banking sector and repairing the bank-lending channel, the ECB's Quantitative Easing is envisioned to affect both financial variables and real economy through changes in interest rates on sovereign bonds and other financial instruments. Under this program, outright asset purchases were expanded to euro-denominated investment-grade securities issued by euro area governments and agencies and European institutions. The combined monthly asset purchases of public and private securities were designed to amount to EUR 60 billion. Purchases were intended to be carried out from March 2015 until the end of September 2016 and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with its aim of achieving inflation rates below, but close to, 2% over the medium term. This feature characterized the EAPP as the first ”open ended” program launched by the Eurotower. Under this ”Quantitative Easing” program, purchases are meant to be made roughly in proportion to the contribution in the ECB capital of each member central bank (though that guideline ”may not be strictly followed every month”), along the 2-30 years maturity spectrum. For Italy, this implies an estimated purchase of bonds around 150 billion euros (11.6% of total outstanding 2-30 tears bonds, around 30% of 2015-2016 estimated gross issues). The seven sets of BSPs have affected to varying degrees the balance sheet of the Eurosystem, with some BSPs having little or no impact at all on it (e.g. OMT). Whereas the Eurosystem balance sheet doubled its size from the beginning of 2008 to mid- 2012, this significant increase was mainly driven by BSP1 and BSP4. The size of Eurosystem balance sheet had been declining from mid-2012 to the end of September 2014, as no intervention had been conducted under the OMT (or BSP5) while at the same time its announcement may have contributed to significant advanced repayments of the liquidity support provided under BSP4 (i.e. mainly the two three-year LTROs). After having stabilized just above EUR 2trn following the announcement of BSP6 and the expiry of the two three-year LTROs, the Eurosystem balance sheet has started to expand again since the beginning of March 2015, mainly driven by the implementation of the EAPP (or BSP7).

Table 1: List of ECB announcement 2008 - 2015

Set of BSP	Date	Program Announced
BSP1	08/10/2008	FRFA Procedure for MROs.
	15/10/2008	FRFA Procedure is extended to LTROs and to dollar liquidity operations. The list of assets eligible as collateral is also extended.
BSP2	07/05/2009	Three one-year LTROs and first covered bond purchase program are announced (CBPP1).
	23/06/2009	Amount allotted in the first one-year LTRO: 442.26 Euro bn.
	29/09/2009	Amount allotted in the second one-year LTRO: 442.28 Euro bn.
	15/12/2009	Amount allotted in the third one-year LTRO: 96.95 Euro bn.
BSP3 (SMP)	10/05/2010	SMP is announced; FRFA is re-introduced for LTROs.
BSP4	06/10/2011	CBPP2 and two new one-year LTROs.
	08/12/2011	Two three-year LTROs and less strict rules for collateral for ABS are announced.
	20/12/2011	Amount allotted in the first three-year LTRO: 489.19 Euro bn to 523 banks.
	28/02/2011	Amount allotted in the second three-year LTRO: 529.53 Euro bn to 800 banks.
BSP5 (OMT)	02/08/2012	Outright Monetary Transaction are announced.
	06/09/2012	Further details on the implementation of the OMTs and measures to preserve the collateral availability for refinancing operations.
BSP6	05/06/2014	Two Targeted LTROs, MROs prolungation and temporary suspension of Fine Tuning Operation are announced.
	04/09/2014	ABS purchase program (ABSPP) and CBPP3 are announced.
	18/09/2014	Amount allotted in the first TLTRO: 82.6 Euro bn.
	11/12/2014	Amount allotted in the second TLTRO: 129.84 Euro bn.
BSP7 (EAPP)	22/01/2015	EAPP (as known as Quantitative Easing.)

3 Research Method

The goal of our research is to estimate the response of equity market to ECB's balance sheet policies inside the eurozone, in order to ascertain whether the measures deployed by the Eurotower are effective or not. However, the identification of these dynamics is complicated by the fact that market valuations and policy interventions are jointly determined. This is a recurrent and intricate problem in the literature about the effects of monetary policy interventions on asset prices, and goes by the name of endogeneity problem. As it is well known, policy makers decide what measures to adopt on the basis of the current macroeconomic scenario, the forecasted level of inflation, the expectations about the financial situation of a particular economic system. So, policy makers watch constantly at the various financial markets when it is time to decide which measures should be adopted and which should not; and given that often the equity market reflects the real economy in a better way than other markets, the attention of policy makers toward the latter is always very high. Of course, the same happens in the opposite direction: every investor (from banks and firms to simple individual savers) looks at the central bank as one of the more important source of information about the future and makes a large part of its decisions observing constantly to central banks's actions.

Unfortunately, this endogeneity problem resulted by what we can call as a "dualistic determination process" is not the only issue. As a matter of fact, shocks in the equity market and policy decisions are likely to be influenced by aggregate, potentially unobservable factors such as geopolitical issues or changing trends in risk preferences. From an econometric viewpoint, we face a system affected by two major problems: the presence of simultaneous equations and of omitted variables, which are responsible for co-movements in the observable. It is well known that the ordinary least squares (OLS) estimate of both equations would be biased, leading to incorrect interference.

As we said before in section 2, the problem of identification when the model includes endogenous variables has been studied for several decades, and several solutions have been proposed. The problem arises when the structural form cannot be directly estimated, and the parameters must be obtained from the reduced form, which has fewer equations than the number of unknowns. Hence, to solve for the original parameters, more information is needed. The typical solution is to impose constraints based on economic knowledge about the phenomena that is being studied. Several assumptions and restrictions have been very useful in numerous applied problems, i.e.:

- **Long Run Constrain**: if we include in the structural form lagged dependent variables, it is possible to force the sum of certain lagged coefficients to be equal to zero.

- **Exclusion Restriction**: we assume that at least one of our parameters of interest is equal to zero.

- **Sign Constrain**: it is possible to create an ad-hoc region of admissible parameters by imposing constrains on the slopes of the system's equations, in order to achieve partial identification. (Fisher 1976)

- **Variance Constrain**: it is possible to impose constrains on shock variances aiming to produce a constant relative variance between the equations or a relative variance equal to either 0 or infinity. This last assumption is among the most common underlying assumption of most event studies that regard macroeconomic issues.

However, these assumptions can not always be justified, especially in a framework characterized by omitted variables. Roberto Rigobon (2002) and Roberto Rigobon and Brian Sack (2003) present a method to solve the identification problem with much weaker assumptions. The technique, called "Identification Through Eteroskedasticity", is based on the heteroskedasticity that exists in the data and requires that the structural shocks have a known correlation (usually zero). If this assumption holds the problem can be solved by only relying on the heteroskedasticity of the structural shocks. The rationale behind this approach is easily summarized. Suppose we identify periods when the variance of policy shocks is higher than other times. Assume further that the variance of the other shocks in the system during these periods remains unchanged, and that the structural parameters governing the relation between asset prices and monetary tools are stable through time. Then the heteroskedasticity in the monetary policy shocks can serve as a probabilistic instrumental variable that allows the identification of the structural parameters. The intuition behind this approach is explained further. Full explanation of this identification technique is presented in this paper's appendix. This identification is obtained by first estimating a reduced-form Vector Autoregression Model (VAR), and then comparing the estimated variance-covariance matrix in the regimes using a General Method of Moments (GMM) methodology. Thus, the identification approach can be divided in three parts:

1. The specification of regimes.

2. Definition of general framework.

3. The identification through Generalized Method of Moments.

3.1 The specification of regimes

The very initial step in the estimation procedure is to determine the different volatility regimens. These regimens will be used in order to build several variance-covariance matrix (one for each selected regimens) that will provide us with additional known terms to be used in our identification system. The presence of additional known terms will increase the degrees of freedom of the system that we are trying to identify, allowing to fully identify the system.

According to Rigobon and Sack, even if the regimes are misspecified, the estimates of the parameters of interest are still reliable as long as the data exhibits heteroskedasticity and the regimes are not specified too poorly. As a matter of fact, because the covariance matrices of misspecified regimes are nothing else but linear combinations of the true covariance matrices, the system of equations given by the misspecified system has the same solution as those derived from a better specified set of regimes.

As admitted by Rigobon and Sack, the approach for defining the different regimes of the variance-covariance matrix is totally arbitrary. We are going to define three different set of regimes, computed in accordance with two methods to identify regimes: a "data driven" method, where regimes are selected on the basis of statistical characteristic exhibited by data, and an "event driven" approach, in which key events that are believed to have influenced the eurozone's economic situation are emphasized. The main purpose of the partition activity is to accentuate the shifts that occur in the variance of our data across time.

First Set of Regimes The purpose of this partition is to accentuate the shifts that occur in the variance of our data along the chosen time frame. For this reason, our two regime-selection methods both rely on shocks in observed variance. The first sub-sample configuration is obtained analyzing the path of variance in equity returns in a time frame that goes from fall 2009 to fall 2015. For each country, we are going to compute the rolling standard deviation for every fifty-two observations starting from the first one, thus constructing a variance matrix that covers a time frame of one year. The trend examination of these ten rolling variance series (one for each country) should give us important information in order to identify different volatility states during the considered time period. Applying the same method with 26 and 13 observations will allow us to perceive the real quality of our sampling method. For example, considering the series on italian equity market, we will have:

$$\sigma^2_{1,ITA} = \sqrt{\sum_{i=1}^{51} \frac{(x_i - \bar{x}_1)^2}{52}} \quad and \quad \sigma^2_{2,ITA} = \sqrt{\sum_{i=2}^{52} \frac{(x_i - \bar{x}_2)^2}{52}}$$

for the firsts two observation of the "variance" series, and then

$$\sigma^2_{N,ITA} = \sqrt{\sum_{i=N}^{N+50} \frac{(x_i - \bar{x}_N)^2}{52}}$$

for the Nth series. N will assume values from 1 to $k - 49$, where k equals the total number of observations. The regimes chosen according to this method are illustrated in Table 2 and Graph 1 in the Appendix.

The regimes convey what we have seen on the European equity market since early 2010.

Regimes selected by Equity Rolling Variance

Regime	Start	End	Variance
Average Volatility	18/09/2009	02/07/2011	0.001284
High Volatility	09/07/2011	25/11/2012	0.001829
Average Volatility	01/12/2012	18/05/2013	0.001134
Low Volatility	25/05/2013	05/07/2014	0.000736
Q.E. Launch and Grexit	12/07/2014	15/09/2015	0.001797

Table 2: Equity Returns on Weekly Data

First regime is characterized by a medium-high volatility, as one of the consequences of both the difficulties faced by the bank sector after the sub-prime American crisis and the bad outlooks about Greece sovereign debt sustainability and inflation in the eurozone. Volatility rises dramatically in the second regime, with the explosion of the European sovereign debt crisis which started with the Greek default declaration. Third regime comes after a period of high tension partially solved by the EU agreement on Greece Debt Swap and Mario Draghi's reassurances (with the famous "Whatever it takes" speech and a new kind of expansive monetary policy outlined by the implementation of OMT programs). It is still characterized by a medium level of volatility. The fourth regime shows relatively low volatility, with equity market that starts to show signs of recovery during 2014 and better conditions on sovereign bond market for both peripheral and core European countries. The fifth regime shows again high volatility because of the "Grexit" crisis and because of tensions generated by the so called "Chinese Bubble" during summer 2015.

In the construction of the variance-covariance matrices used for Identification Through Eteroskedasticity regime 1 and 3 (Average Volatility) will be jointly considered.

Second Set of Regimes The second set of regimes is obtained in a specular manner to the first one, thus using the same rolling variance approach. However, we want to analyze the patterns to the volatility of the shocks to stock market returns and the changes in the assets held by the ECB's for monetary policy purposes. Hence, we estimate the reduced form (2) and we compute the residuals. Periods of high variance are defined as when the fifty-two day rolling variance of the residuals is more than one standard deviation above its average for the majority of the series. Differently from the first method, regimes are constructed without a time-unity perspective, including in on regimes observation from different periods but with the same level of volatility. The covariance regimes identified by this second approach are illustrated in Table 4 and Figure 2 in Appendix.

Regimes

Regime	BSP Variance	Equity Variance	Frequency
Normal General Volatility	0.007	0.002	22.6%
High ECB's Balance Sheet Volatility	**0.049**	0.0008	35.5 %
High General Volatility	**0.018**	**0.009**	10.1%
High Equity Market Volatility	0.007	**0.041**	31.8 %

Table 3: Regimes.

We define four covariance states, according to the volatility shown by ECB related variables and equity related variables. The first regime includes observation characterized by with low volatily in both ECB's and Equity variables. The second one is constructed by combining observation characterized by high volatility in ECB's variables and low volatility in Equity Market. The third regime includes periods with high volatility in both ECB's and Equity variables. Finally, the fourth regime is constructed with periods distinguished by low volatility in the ECB related variables and by high volatility in the equity related variables.

Third Set of Regimes The third set of regimes is obtained by observing the time line event in the eurozone from September 2009. We will split our data set into sub-samples in correspondence of important events. The purpose of this third set is to serve as a "control" set: we take advantage of the robustness of the estimates provided by Rigobon and Sack's technique in presence of regimes misspecifcation and we create this last set in the most easy way. We included in our first regime

Control Regimes

Regime	Start	End
1	Sep. 2009 - Start of obs.	July 2011 - PIGS Downgrade
2	Aug. 2011 - Euro sovereign crisis	Aug 2012 - "Whatever it Takes"
3	Sep. 2012 - ECB's "Unlimited support"	Jul. 2014 - Portugual Bailout complete
4	Aug. 2014 - Greece vs. Troika	Jun. 2015 - Grexit
5	Jul. 2015 - Grexit Resolution	Sept.2015 - "Chinese bubble"

Table 4: Regimes.

the weeks between the start of our data set and July 2011. This period exhibit various tensions on financial market: Maastricht's criteria are about to be failed by several countries. Greece and

Portugal are helped through substantial loans from the European Union and IMF. Ireland faces technical default. Countermeasures such EFSF and ESM are announced by the ECB, but investors do not seem to judge these measures as appropriate. As a matter of fact, the situation keep worsen and panic spread across markets as many Rating Agency cut drastically the rating of various European countries, such as Italy, Spain, Ireland, Portugal, Cyprus and Greece during the summer of 2011. Concerns are especially motivated by the high presence of bonds in many government account (i.e. France owned at that time more than 10% of the Greek debt) and domestic financial institutions. Therefore, the contagion risk is perceived so strongly that even the euro reversibility is called into question. This period, which coincide with the second regime of our third set, will end only in autumn 2012, after the successful negotiation between the IMF, the EU. and technically-defaulted countries and thanks to the big effort made by the European Central Bank in order to calm down markets. The turnaround point coincides with the famous "Whatever it takes" speech pronounced by Mario Draghi in London in July 2012. The announce of the new OMT program in September of the same year and the explicit commitment by the ECB in giving "unlimited support to all eurozone countries involved in EFSF and ESM" will definitely bring the situation under control.

Aided by a new-found stability, a period of weak but steady recover begins in the eurozone, driven mainly by the great performance of German economy, by the successful end of the Portugal Bailout program, and by a better market sentiment regarding the future path of inflation in the EU, supported also by the improvements achieved by the U.S. economy. This period coincide with the third in our set. In the second half of 2014 new problems arose when negotiations between the Greek government and the EU showed misalignments about the scheduling of the debt. This starts the fourth and last regime, distinguished by an overall high volatility also caused by QE launch and, more extensively, by Grexit and Chinese market tensions in summer 2015.

3.2 General framework

The main assumption required by the "Identification through Heteroskedasticity" approach is that the transmission mechanism of shocks stays constant during the considered time-frame. We suppose that the transmission mechanism is stable in case of extreme events. Therefore, we can study the connections across the different European equity markets in a linear framework. Our baseline model is the following:

$$AY_t = BX_{t-1} + \varepsilon_t + \Gamma Z_t \tag{1}$$

Where: Y_t contains our endogenous variables: the weekly returns of the main indexes of the following countries: Germany, France, Italy, Spain, Portugal, Austria, Belgium, Netherlands, Ireland, Greece. The vector X_t contains the following exogenus variables: weekly changes in VSTOXX, S&P 500, Nikkei Index and oil price. We think that these variables could influence the path of European equity markets. In X_t we also find the lags (from the first to the fifth order) of our endogenous variables. The covariates are entered lagged into the baseline equation in order to avoid possible endogeneity issues. Sample period goes from 20/10/2008 to 18/12/2015. We are interested in the A matrix estimation, and, as we said, the only way to get to it is to exploit the information present in the residuals η_t through the Rigobon's approach. We need the variance-covariance matrix of the system (Ω_z) to vary across the proposed time-line. In order to gain identification, we use the elements outside the diagonal of Ω_z. Of course, if we consider more than one variance-covariance matrix we will increase considerably the degree of freedom of our model. In fact, A matrix has $169 - 13 = 156$ elements (since we have 13 dipendent variables and we do not consider the diagonal), and we also have to estimate at least the diagonal arguments of the variance matrix of our system shocks, which are 13. So we have a total of 169 elements to estimate. Our variance - covariance matrix provides us with 13 variances and 169 intertwined covariances. But since variance - covariance matrices are symmetrical, we have a total number of 91 distinct element. Of course we cannot estimate 156 parameters with just 91 sample values. But if we assume to have more than one variance - covariance matrix, we achieve identification having more known sample values than unknown parameters.

The very first thing we need to do is to fit the reduced form VARX model:

$$Y_t = \sum_{j=1}^{5} \Phi T_{t-j} + \sum_{j=1}^{5} \Gamma X_{t-j} + \eta_t \tag{2}$$

and estimate the residuals η_t.
It is important to highlight that we do not need to estimate the residuals in an equation system. This would be necessary only if we wanted to conduct inferential analysis on the coefficients. But we are not interested in the coefficients of model (2): we just need the restricted form residuals to use as starting data for our estimation through General Method of Moments. Considering then the relation between structural and reduced form residuals:

$$A\eta_t = \varepsilon_t + \Gamma \tag{3}$$

We eventually obtain the variance:

$$A\Sigma A' = \Omega + \Gamma\Omega_Z\Gamma' \tag{4}$$

Z indicates whether common latent factors are present or not. Common latent factors are something that can not clearly be detected with a variable and that is supposed to be somehow responsible for common movements inside our dataset. Where

- Ω is assumed to be diagonal (structural shocks variance)
- Γ has unit values over the first row
- Ω_Z is assumed to be diagonal
- A has unit element over the main diagonal
- Σ is the only observable matrix (estimated from reduced form residuals)

3.3 Identification through GMM

From this point we have different forms of heteroskedasticity in the data, associated with regimes in the variances of the structural shocks. Consequently, the relation between the variances of structural and reduced form shocks (2) becomes:

$$A\Sigma_s A' = \Omega_s + \Gamma\Omega_{Z,s}\Gamma' \tag{5}$$

Where "s" identifies different regimes. Estimation is then performed by GMM (conditional on the knowledge of regimes timing) where the moment conditions are given as:

$$G = vech(A\Sigma_s A') - vech(\Omega_s) + vech(\Gamma\Omega_{Z,s}\Gamma') = 0 \tag{6}$$

Estimation is achieved by the following minimum problem

$$min_{A,\Omega_s,\Omega_{z,s},\Gamma} \quad G'WG \tag{7}$$

Estimation follows the standard feasible GMM estimation (first estimate with W = I, then estimate the optimal W, and re-estimate the parameters).

Standard errors are obtained by bootstrapping (within regimes). As a matter of fact, we cannot use the asymptotic expressions of GMM given that we would not have enough degree of freedom. Robust bootstrapping approaches might be considered in order to preserve any form of temporal dependence within regimes. The test for over identification is immediate in a GMM framework. Thus we expect our coefficients to have a positive sign, and we also expect to see some sort of "choral" behavior between indexes, apart from Greece and other pheripherical countries.

4 Results

First of all, it may be useful to understand which impact we should expect from our coefficients from a reasonable macroeconomic perspective. We know from the empirical evidence that the relationship between eurozone equity indexes is strongly positive: our ten equity indexes usually move together, with very rare exceptions. Accordingly, in table 5, we report the correlation matrix that shows the high degree of connection among European stock markets.

Table 5: Correlation between Equity Markets

	GER	ITA	FRA	ESP	POR	NET	AUT	BEL	GRE	IRE
GER	1.00	0.82	0.92	0.73	0.65	0.89	0.77	0.81	0.40	0.70
ITA		1.00	0.90	0.89	0.75	0.84	0.79	0.75	0.50	0.68
FRA			1.00	0.83	0.72	0.92	0.82	0.84	0.46	0.74
ESP				1.00	0.72	0.75	0.74	0.68	0.48	0.60
POR					1.00	0.68	0.66	0.62	0.51	0.55
NET						1.00	0.78	0.85	0.44	0.73
AUT							1.00	0.69	0.47	0.67
BEL								1.00	0.42	0.69
GRE									1.00	0.41
IRE										1.00

As we can see, correlation between countries is very high: the most influential countries are France and Germany. Other countries, such Portugal, Ireland and (most of all) Greece, are less correlated. This is the reflection of a partial independence shown by other countries relatively to Greece's troubles in these past years. Let's now briefly look at what is the correlation between shifts in ECB balance sheet and equity returns in table (6).

Table 6: Correlation between Equity Markets and ECB's Balance Sheet voices

	MRO	LTRO	SMP
GER	0.02	0.02	0.04
ITA	0.01	0.06	0.02
FRA	0.03	-0.05	0.00
ESP	0.06	-0.10	0.01
POR	0.00	-0.01	0.04
NET	0.02	-0.04	0.00
AUT	0.05	-0.08	0.01
BEL	0.04	-0.03	0.04
GRE	0.06	0.00	-0.01
IRE	0.05	0.02	-0.01

For what regards correlations between Equity Markets and ECB's balance sheet voices, MROs seem to be the only instrument with a positive relationship with all the indexes. SMP and OMT follows, with just two countries that show a negative correlation. LTRO seems to have positive effects only on Germany, Italy, Greece and Ireland. LTRO's effects discrepancy with macroeconomic theory could be explained by the long term nature of this kind of operation. At the same time, we have also to keep in mind that from the end of 2012 to the end of 2014, the ECB aimed to reduce Eurosystem balance sheet from 3 Euro trillions to 1.5 Euro trillion, thus inverting the trend observed from 2009 to 2012. By the way, this is only a simple arbitrary benchmark that will help us to understand whether the results that follow are to be considered reasonable or not.

4.1 No common latent factor

We are going to apply our identification procedure on the three sets of regimes specified in section 3.1. We start by not considering any common latent factor in the our model. So the value of Z in equation (1) is 0. We use data from 2009 to 2015. The obtained results are the following:

Table 7: GMM results for first Set of Regimes. No common latent factor considered.

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	-0.12	-0.02	**-0.14**		-0.09	0.34	0.03	0.14	0.24	0.03	0.08	0.01	0.16
ITA	0.02	0.61	**0.40**	0.06		**0.50**	**0.29**	0.14	0.15	0.12	-0.06	-0.08	-0.07
FRA	-0.01	**0.71**	1.12	**0.31**	**0.18**		0.09	0.00	**0.43**	0.02	0.01	0.00	-0.02
ESP	0.03	0.05	-0.02	0.29	0.25	-0.01		0.27	-0.04	0.08	0.22	0.01	-0.30
POR	1.80	0.09	1.03	-0.43	-0.06	0.41	-0.03		0.74	0.12	-0.03	0.08	-0.11
NET	-0.05	0.05	**0.84**	-0.13	0.08	**0.86**	-0.05	-0.08		0.00	0.17	-0.01	0.00
AUT	-0.09	0.95	**0.55**	0.34	-0.28	0.76	0.12	0.04	0.19		-0.02	**0.14**	-0.23
BEL	-0.02	0.30	0.74	0.24	-0.01	-0.03	0.02	0.04	0.23	0.15		0.08	-0.10
GRE	**-0.46**	-0.01	0.81	-1.49	1.85	1.62	-0.63	0.19	1.69	-0.52	-1.28		-0.56
IRE	0.03	-0.58	**0.68**	-0.55	-0.52	0.62	0.40	0.06	0.51	0.39	0.35	0.07	

Table 8: GMM results for the second Set of Regimes. No common latent factor considered

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	0.01	0.00	-0.02		-0.08	**0.94**	0.19	0.02	-0.09	0.09	-0.07	-0.03	-0.04
ITA	0.00	0.00	0.13	0.16		**0.71**	0.46	0.02	0.05	0.09	**-0.27**	0.01	0.00
FRA	0.00	**0.03**	0.01	**0.32**	0.39		0.09	**-0.08**	**0.25**	0.06	-0.01	-0.01	0.01
ESP	0.18	**0.20**	0.03	-0.40	**0.60**	**1.18**		-0.10	-0.06	0.21	-0.08	-0.02	-0.11
POR	0.01	0.03	-0.02	0.10	0.07	0.03	0.16		-0.17	0.22	-0.21	0.11	0.14
NET	-0.08	**-0.05**	-0.28	0.03	0.03	**0.52**	-0.03	0.05		0.05	0.13	-0.01	0.15
AUT	0.04	0.01	-0.28	-0.18	0.47	**1.10**	0.46	-0.58	-0.30		0.35	0.11	-0.13
BEL	0.00	0.00	-0.01	0.26	0.32	1.10	0.46	-0.58	**0.23**	-0.13		-0.01	-0.22
GRE	0.00	-0.01	0.02	0.29	0.19	-0.03	0.56	-0.19	-0.71	0.10	0.59		0.11
IRE	**-0.03**	-0.21	1.02	0.35	-0.15	-0.31	0.26	-0.15	-0.52	**0.52**	**0.88**	0.07	

Table 9: GMM results for the third Set of Regimes. No common latent factor considered

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	-0.05	-1.24	0.86		-0.06	1.04	-0.05	0.08	0.30	-0.08	-0.11	-0.04	-0.01
ITA	0.00	-0.02	-1.18	0.64		0.23	0.41	0.09	0.21	-0.18	**1.28**	-0.68	-0.95
FRA	-0.06	0.10	-0.14	**0.36**	0.12		0.06	0.02	0.36	0.05	0.01	0.00	0.00
ESP	0.05	-0.02	0.28	-0.08	-0.31	0.31		0.19	0.29	-0.05	0.37	0.06	0.23
POR	-0.02	-0.09	-0.26	-0.36	2.11	-0.75	-0.91		-0.68	0.56	-1.21	-0.22	0.57
NET	0.01	-0.15	0.00	0.17	-0.10	0.88	-0.07	-0.10		-0.01	0.15	0.02	0.01
AUT	0.51	0.17	0.01	0.24	0.20	0.42	0.22	-0.52	0.51		-0.39	0.06	0.36
BEL	0.10	1.05	-0.32	0.37	-1.09	0.55	0.40	0.27	0.43	-0.07		0.00	0.08
GRE	-0.92	0.08	0.03	1.81	3.57	0.44	**-3.75**	2.20	-2.03	0.25	-1.58		1.92
IRE	0.29	**-3.89**	**-0.74**	0.42	0.78	0.56	-0.96	0.10	0.38	-0.19	-0.43	0.15	

Each row of the tables correspond to an equation, while columns correspond to coefficients; i.e. in the table illustrated in table 7, the first row says to us that: Germany Equity Market Index's returns is positively influenced only by MRO (0.117, with weak significance) and SMP (0.141), is not influenced by SMP etc.. Coefficients are to be intended as percentage changes: a 1% increase in the balance relative to the SMP operations will ideally produce an increase of 0.141% in DAX30 on weekly basis, if the model is right. Bold coefficients are significant at a 0.05 confidence level, red coefficient at a 0.1 level. Coefficients that are neither red or in bold are not statistically different from zero. The results we obtained are generally poor. However the results obtained by different sets of regimes seem to be pretty close to each other, and this is a good point according to the assumptions made by Rigobon about regimes specification (illustrated in section 3.1). The number of significant coefficients is very low. The best outcome is the one illustrated in table 8, provided by the regime set defined on the basis of the residuals of the restricted form (equation (2)). From table 8 we see that a good number of significant coefficients describes an averagely positive relationship between European countries. Unexpected results are provided by the negative impact of Portuguese stock market on France market and German DAX30 on Spain's equity index. Also the negative impact between Netherlands and Belgium does not reflect the empirical evidence about these two indexes. From an ECB market impact, we see that LTRO, and SMP seem to have a weak yet positive impact on Italy, France and Spain, while MRO is significant only for Spain and Ireland, with negative impact in this last case. We summarize this first series of results in table (10):

From these results, we can not identify any significant impact provided by ECB's monetary policies to equity market. The quality of this round's estimates is low, and is summarized by Table 10. It is possible to infer that results are pretty similar to each other. Overall, the best outcome is given by Set number Two.

Table 10: First round of GMM result

No common latent factor - Timeframe: Sept. 2009 - Sept. 2015			
	First Set	**Second Set**	**Third Set**
% of Significant Coeff.	14.62%	25.38%	15.38%
% of Positive Coeff.	57.69%	56.15%	55.38%
Mean of Est. Coeff.	0.039	0.030	0.024
Std. Dev. of Est. Coeff.	0.5355440	0.4434502	0.7998904

4.2 One common latent factor

We move on now changing the number of common latent factor in the system. Z is now equal to 1. The results are:

Table 11: GMM result for the first Set of Regimes. One common latent factor considered

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	-1.93	-0.49	-0.06		0.53	**1.27**	0.04	-0.41	-0.17	0.31	-0.54	0.10	-0.45
ITA	-2.25	1.72	**-0.28**	1.50		-2.17	-0.14	0.64	0.36	-0.58	1.11	-0.18	1.03
FRA	-1.31	-0.40	0.13	0.69	-0.46		-0.07	0.29	0.17	-0.27	0.51	-0.08	0.47
ESP	-1.79	1.07	0.10	1.95	-0.71	**-2.94**		0.92	0.23	-0.12	**1.70**	-0.28	0.93
POR	**1.97**	**-3.38**	0.41	-2.27	1.35	**3.37**	1.85		-0.65	0.97	**-1.95**	0.29	-1.22
NET	-1.69	-0.41	0.11	-1.45	0.97	**2.10**	-0.93	-0.62		0.57	-1.08	0.18	-0.35
AUT	-3.24	-0.19	0.25	2.47	-1.68	**-3.69**	3.28	1.12	0.24		**1.89**	-0.31	0.58
BEL	-2.74	-0.84	0.19	-1.36	0.92	**1.98**	-2.80	-0.58	**0.14**	0.52		0.17	-0.34
GRE	**1.31**	-0.94	0.24	4.39	-2.91	-5.56	-0.79	2.35	-0.24	-2.27	3.29		0.87
IRE	-3.42	2.16	0.08	-4.11	2.77	**5.95**	0.38	**-1.74**	0.12	**1.58**	**-3.02**	0.50	

Table 12: GMM result for the second Set of Regimes. One common latent factor considered.

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	**0.00**	0.01	0.05		**-1.08**	1.23	-0.21	0.38	0.31	0.34	-0.26	0.07	-0.05
ITA	0.00	0.00	0.29	-0.90		1.09	-0.21	0.35	0.33	0.31	-0.25	0.08	-0.05
FRA	-0.03	**-0.18**	0.33	0.81	0.87		0.18	-0.31	-0.24	-0.28	0.20	-0.06	0.04
ESP	0.17	-0.20	-0.41	-0.12	0.81	0.45		-0.09	-0.11	0.09	0.12	0.01	-0.08
POR	0.01	**-0.64**	0.02	1.06	0.59	-0.74	0.25		-0.43	-0.11	0.06	-0.02	0.14
NET	-0.10	-0.06	0.05	0.36	0.66	-0.38	0.00	-0.05		-0.08	0.34	-0.13	0.21
AUT	0.03	-0.03	0.37	0.47	0.99	0.48	0.39	-0.59	-0.76		0.56	-0.08	-0.03
BEL	0.00	0.01	-0.14	-2.86	**-2.93**	3.48	-0.69	1.09	1.05	0.87		0.22	-0.04
GRE	-0.19	-0.10	**0.14**	**12.17**	**13.26**	**-14.90**	2.82	-4.72	-3.94	**-4.13**	3.19		0.56
IRE	0.13	0.34	0.00	-2.06	-2.27	2.72	-0.69	1.07	0.72	0.85	-0.83	0.20	

Table 13: GMM results for the third Set of Regimes. One common latent factor considered.

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	0.06	0.01	0.00		-0.06	1.04	-0.05	0.08	0.30	-0.08	-0.11	-0.04	-0.01
ITA	0.49	-0.90	**0.09**	0.64		0.23	0.41	0.09	0.21	-0.18	**1.28**	0.01	0.01
FRA	0.10	**0.02**	-0.01	**-0.43**	0.12		0.06	0.02	0.36	0.05	0.01	0.00	0.00
ESP	0.07	0.21	0.04	-0.08	-0.31	0.31		0.19	0.29	-0.05	0.37	0.06	0.23
POR	0.01	0.36	-0.01	-0.36	2.11	-0.75	-0.91		-0.68	0.56	-1.21	-0.22	0.57
NET	**-0.01**	-0.01	-0.05	0.17	-0.10	0.01	-0.07	-0.10		-0.01	0.15	0.02	0.01
AUT	**0.03**	0.00	-0.05	0.24	0.20	0.42	0.22	-0.52	0.51		-0.39	0.06	0.36
BEL	0.00	0.02	-0.04	0.37	-1.09	0.55	0.40	0.27	0.43	-0.07		0.00	0.08
GRE	-0.01	-0.04	0.03	1.81	3.57	0.44	**-3.75**	2.20	-2.03	0.25	-1.58		1.92
IRE	0.02	**0.12**	**-0.02**	0.42	0.78	0.56	-0.96	0.10	0.38	-0.19	-0.43	0.15	

The first thing we notice is that considering $Z = 1$ in the GMM estimation increase in a considerable way the overall magnitude of the estimated coefficients. Most of coefficients are not coherent with our expectations and with what the empirical evidence suggests. For example, is crystal clear that many signs and impacts can not be justify. Even though it is the one with the lower amount of significant coefficients, the best outcome seems to be again provided by the second set of regimes table 12. Indeed, the relationships between Germany, Italy, Spain and France with seem to be almost probable. The few significant coefficients relative to ECB's variables are also acceptable. In every outcome very high values are observable for Greece's equation. This is probably due to the particular volatility path that the Greek index experienced during the considered timeframe. Any other speculation about these results is useless: to sum up, the addition of one common latent factor does not provide any improvement, worsening indeed the results from both a statistical significance and economic relevance point of view.

Table 14: Second round of GMM result

One common latent factor - Timeframe: Sept. 2009 - Sept. 2015			
	First Set	**Second Set**	**Third Set**
% of Significant Coeff.	20.77%	19.23%	16.92%
% of Positive Coeff.	52.31%	50.77%	56.92%
Mean of Est. Coeff.	0.025	0.011	0.018
Std. Dev. of Est. Coeff.	1.723099	1.944952	1.007816

4.3 Two common latent factor

The following results have been obtained considering two common latent factor. Z value in equation (2) now equals to 2. These are the three resulting GMM estimations:

Table 15: GMM results for the first Set of Regimes. Two common latent factor considered.

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	0.44	-0.43	-0.24		-0.20	0.70	0.10	0.22	0.62	-0.12	-0.37	-0.08	0.22
ITA	**-0.09**	-0.25	**-0.01**	0.41		-0.88	0.88	0.05	1.33	-0.14	-0.70	0.05	0.33
FRA	-0.83	0.06	0.29	0.50	-0.94		0.88	0.01	1.26	-0.15	-0.64	0.06	0.31
ESP	-0.37	-0.60	-0.29	-0.75	0.94	1.39		0.07	-1.29	0.18	0.59	-0.08	-0.31
POR	-1.14	0.75	0.11	1.63	0.39	-2.52	0.61		-1.18	0.20	1.19	0.25	-0.04
NET	0.46	-0.16	-0.28	-0.34	0.75	0.71	-0.68	-0.02		0.11	0.52	-0.04	-0.25
AUT	**-1.26**	-0.65	-0.19	-1.08	-1.59	2.57	**2.01**	-0.07	0.27		-1.63	0.03	0.63
BEL	0.10	0.59	-0.35	0.27	-1.33	-0.75	1.04	0.14	1.76	-0.15		0.03	0.43
GRE	-0.20	-0.22	0.50	-2.65	-2.47	**3.96**	1.26	0.63	2.07	-0.43	-1.52		0.75
IRE	-0.51	**0.61**	-0.01	-0.13	0.83	0.52	-1.18	0.27	-1.21	0.47	1.60	-0.01	

Table 16: GMM results for the second Set of Regimes. Two common latent factor considered

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	-0.01	-0.03	0.02		1.29	0.16	-0.61	-0.17	**-0.30**	**0.12**	**0.34**	-0.09	0.01
ITA	0.00	-2.21	**0.13**	-0.45		2.87	-0.22	**0.07**	**-7.10**	1.72	4.11	-0.10	0.28
FRA	0.00	**-0.08**	0.06	0.35	1.19		**0.05**	-0.35	-2.13	0.12	1.68	0.12	-0.03
ESP	-0.07	0.01	0.03	**6.91**	4.44	-5.80		-0.94	-7.23	-0.26	2.31	0.12	-0.07
POR	-0.02	0.00	0.18	1.40	**0.99**	**-6.81**	**0.06**		8.58	-1.01	-2.56	0.43	-0.44
NET	0.05	-0.01	**-0.12**	-1.79	0.47	2.20	-1.07	0.41		0.09	0.84	-0.15	0.07
AUT	**0.03**	0.00	**-0.07**	2.94	**-1.28**	-6.78	**2.33**	0.01	**4.76**		-1.03	0.16	-0.23
BEL	0.00	-0.07	0.17	-1.84	-0.68	4.60	**-0.54**	**-0.07**	-0.96	**-0.21**		0.17	0.08
GRE	**0.04**	-0.02	-0.04	7.39	-10.27	3.91	**7.81**	-2.80	-5.78	**-0.23**	1.37		**-2.45**
IRE	**0.11**	**-0.01**	**0.02**	-2.15	2.77	**1.63**	-2.65	1.43	**0.56**	-0.29	-1.75	0.21	

Table 17: GMM results for third Set of Regimes. Two common latent factor considered.

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	-0.01	-0.03	0.02		1.29	0.16	-0.61	-0.17	**-0.30**	**0.12**	**0.34**	-0.09	0.01
ITA	0.00	-2.21	**0.13**	-0.45		2.87	-0.22	**0.07**	**-7.10**	1.72	4.11	-0.10	0.28
FRA	0.00	**-0.08**	0.06	0.35	1.19		**0.05**	-0.35	-2.13	0.12	1.68	0.12	-0.03
ESP	-0.07	0.01	0.03	**6.91**	4.44	-5.80		-0.94	-7.23	-0.26	2.31	0.12	-0.07
POR	-0.02	0.00	0.18	1.40	**0.99**	**-6.81**	**0.06**		8.58	-1.01	-2.56	0.43	-0.44
NET	0.05	-0.01	**-0.12**	-1.79	0.47	2.20	-1.07	0.41		0.09	0.84	-0.15	0.07
AUT	**0.03**	0.00	**-0.07**	2.94	**-1.28**	-6.78	**2.33**	0.01	**4.76**		-1.03	0.16	-0.23
BEL	0.00	-0.07	0.17	-1.84	-0.68	4.60	**-0.54**	**-0.07**	-0.96	**-0.21**		0.17	0.08
GRE	**0.04**	-0.02	-0.04	7.39	-10.27	3.91	**7.81**	-2.80	-5.78	**-0.23**	1.37		**-2.45**
IRE	**0.11**	**-0.01**	**0.02**	-2.15	2.77	**1.63**	-2.65	1.43	**0.56**	-0.29	-1.75	0.21	

Again, the addition of a supplementary latent factor does not improve the results. We see a good rise in the number of significant coefficients in table 16. Unfortunately, these coefficients have signs and impact that are for sure wrong, as many countries seem to have negative and critically strong impact on other countries. Moreover, we see that the volatility of the estimated coefficients

Table 18: Third round of GMM result

Two common latent factor - Timeframe: Sept. 2009 - Sept.2015			
	First Set	**Second Set**	**Third Set**
% of Significant Coeff.	14.62%	46.15%	27.69%
% of Positive Coeff.	47.69%	49.92%	49.23%
Mean of Est. Coeff.	-0.094	-0.148	-0.059
Std. Dev. of Est. Coeff.	1.115426	2.684894	2.536790

has increased further. The number of negative coefficients increased as well. We can not consider these results as significant for the purpose of this paper.

4.4 Three and more common latent factor

In order to see whether at some point additional common latent factors could actually increase the quality of our outcomes, we report the summarizing table of two estimation rounds made under the hypothesis of $Z = 3$ and $Z = 4$.

Table 19: Fourth round of GMM round

Three common latent factors - Timeframe: Sept. 2009 - Sept.2015			
	First Set	**Second Set**	**Third Set**
% of Significant Coeff.	17.96%	23.34%	42.69%
% of Positive Coeff.	45.63%	48.25%	54.79%
Mean of Est. Coeff.	-0.538	-0.948	-0.009
Std. Dev. of Est. Coeff.	4.182476	3.927588	3.536791

Table 20: Fifth round of GMM result

Four common latent factors - Timeframe: Sept. 2009 - Sept.2015			
	First Set	**Second Set**	**Third Set**
% of Significant Coeff.	24.04%	20.77%	13.84%
% of Positive Coeff.	41.75%	42.98%	53.65%
Mean of Est. Coeff.	-0.260	-0.466	-0.026
Std. Dev. of Est. Coeff.	1.673458	2.647185	3.285191

As witnessed by the two tables above, there are not improvements. According to what we have seen so far, we can also register an on going rise in standard deviation of estimates.

5 Robustness

In the previous section, we run several estimations on the whole time-frame using three different sets of regimes and considering from one to more than three common latent factors. The results we obtained are controversial, and their true meaning is difficult outline. However, it is now possible to make some considerations above our progresses.
First of all, it is not possible to recognize any causal relationship between the considered ECB's balance sheet voices and the European equity market. Thus, speaking from a broader angle, our results do not provide any evidence about the presence of a positive impact produced by the ECB's BSPs on the European stock market. Secondly, we noticed that adding common latent factors seems only to worsen the overall quality of our estimates: indeed, as claimed in the previous section, a value of Z higher than 0 brings a smaller number of significant coefficients, rises the overall volatility and lowers the economic significance that is possible to attribute to the outcomes obtained from the GMM estimation process. About the three different sets of regimes that we have used so far, it is fair enough to state that they provide close results. More specifically, all the three sets led us to results that are almost equals, if considered for their general statistical significance and their overall economical meaning. Although these outcomes are similar, a closer look to the results allows us to say that the regime set computed accordingly to the analysis of the rolling variance of the residuals of the reduced form gave us the best results from a qualitative perspective. Finally and most importantly, the low quality of the results suggest that our identification technique is probably not sophisticated enough to properly solve the identification problem that we are facing, at least with the current conditions. For this reason, in this section we check the robustness of the previous results by investigating if the use of different time frames could change the shape or the quality of our outcomes. The rationales that back up this approach are to be sought amid these reflections: the use of weekly data combined with the great extensions and variety of the considered time-window could actually decrease the clearness of the switches in Heteroskedasticity across our time-series. Furthermore, the Eurotower approach toward the economic scenario has changed several time during the years, and this fact could also undermine the effectiveness of the particular GMM approach used in the chosen identification technique.

Having said that, we will run three additional estimation processes on different time-windows. Firstly, we will consider a narrower time-frame that excludes the first three years, focusing only on the the period of time that came after the implementation of the Outright Monetary Transactions and the new forward guidance strategy pursued from ECB's governor Mario Draghi after the summer of 2012. Then we will focus on the years that came right after the financial meltdown occurred after the sub-prime crisis in 2009 to the end of the sovereign bond crisis (summer of 2012). This period captures two main issues: the credit crunch experienced by the eurozone and the heavy hardness suffered by GIIPS's sovereign debt from the fall of 2010. In both cases, our results change in a meaningful manner. Given this fact, we will eventually perform a further time-frame restriction, considering only the observations collected after the beginning of 2013. At the end of the day, we will come to the conclusion that, even though the quality and the shapes of the estimates improves consistently, the latter will still not disclose details valuable enough to claim the presence of a relationship between the changes in ECB's assets and weekly returns in the equity market.

5.1 Buyer of Last Resort and Forward Guidance: a narrower time-frame suggestion: 2012-2015

As we have just said, an approach that could provide better results is to consider a narrower time-window, that namely includes observations from August 2012 to September 2015. Our theory is that if we exclude older observations, the results might change drastically, meaning that the transmission mechanism that regulates the dynamics between ECB's balance sheet and European Equity market has probably changed after the so called "Sovereign Bond Crisis", occurred between 2011 and 2012. We assume that the firm attitude shown by the ECB in the summer of 2012 changed radically the way in which markets looks at monetary policy announcements from that moment. At the same time, as claimed by Acharya et al. (2015), the introduction of BSP 5 and, more particoularly, of OMT in the third quarter of 2012 represent a turnaround point in the ECB strategy. In effect, the ECB shifted from a "Lender of Last Resort" role to "Buyer of Last Resort" one. This discontinuity in the ECB approach to the Eurosystem is further highlighted by the turning point represented by the famous "Whatever it takes" speech, which gave birth to a completely new kind of forward guidance, more firm and dedicated where total war is declared against speculator and total commitment is promised for the stability of economic conditions in the Euro area. Thus, we performed the estimation on this more recent time frame, using only the second set of regimes, given that has been providing the best results so far and since the distance with the other two regimes is not that high in term of the overall estimates meaning and quality. Again, we consider three cases: the first with no common shock, a second one with one common shock, and a third one with two common shocks. These are the results:

Table 21: Second Set · August 2012 - July 2015 · No common latent factors considered

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	**-0.02**	0.01	0.01		-0.49	**0.57**	**1.54**	**3.56**	**1.05**	-5.98	-4.19	**-3.02**	**4.90**
ITA	0.06	0.01	**0.06**	0.02		**0.88**	**-0.45**	**0.04**	0.97	-0.54	**0.22**	-0.32	**0.32**
FRA	0.03	**-0.01**	0.01	0.00	0.16		**-0.44**	**0.04**	**1.09**	**-0.17**	**0.00**	-0.32	**0.09**
ESP	**0.07**	-0.05	0.00	**0.01**	**0.01**	**0.02**		**0.20**	1.05	**0.01**	**-0.12**	**0.59**	**-0.22**
POR	0.71	-0.03	-0.12	0.00	**0.00**	0.12	**0.18**		**0.95**	**0.71**	-0.22	-1.00	0.63
NET	**-0.14**	**0.02**	0.00	**0.00**	**0.03**	-0.03	0.28	0.58		-0.05	**-0.05**	**0.12**	**0.23**
AUT	0.07	-0.05	0.05	**0.09**	0.09	0.16	0.63	0.50	**1.43**		**0.17**	**-1.20**	**0.07**
BEL	**-0.02**	**-0.05**	-0.08	**0.05**	0.08	-0.05	-0.02	**-0.15**	**-0.34**	**0.48**		**0.38**	**0.29**
GRE	**0.42**	0.05	0.04	**-0.03**	**-0.02**	**-0.08**	**0.30**	**-0.13**	**0.48**	0.26	**-0.17**		**-0.13**
IRE	-0.04	-0.01	**-1.24**	**0.04**	**0.01**	-0.22	**0.52**	**1.18**	**-0.43**	**0.39**	**-0.31**	-1.60	

Table 22: Second Set · August 2012 - July 2015 · One common latent factor considered.

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	**-1.33**	-0.40	-0.18		0.92	3.49	-2.09	4.78	-3.56	-1.09	1.62	-1.31	0.21
ITA	-2.35	-0.30	**-0.19**	-0.16		-2.84	1.19	0.58	2.00	0.98	-1.07	-0.21	0.25
FRA	0.85	0.34	-0.14	4.61	-0.43		0.53	0.07	0.69	-0.27	0.06	0.05	-0.08
ESP	2.28	**-0.73**	-0.09	1.03	-0.31	-1.01		0.30	0.91	**0.11**	-0.07	0.06	-0.07
POR	-0.09	-0.39	-0.09	-0.87	6.96	**-8.12**	-1.24		7.81	-3.18	-3.01	-0.03	1.55
NET	-1.08	0.34	**0.06**	**4.09**	2.11	**0.01**	0.09	-0.05		0.32	0.25	0.14	0.57
AUT	2.61	0.22	-0.08	0.52	-1.81	**4.61**	0.46	0.52	-1.54		-2.24	0.07	-0.32
BEL	-1.88	-0.54	0.05	-2.10	-2.23	6.57	-0.22	0.06	-1.41	-0.18		-0.09	1.49
GRE	**0.34**	-0.55	-2.88	5.10	1.57	**-7.75**	1.23	-1.66	0.29	0.26	0.95		0.24
IRE	0.22	**-0.54**	**-0.72**	2.14	2.15	-2.64	-0.93	-0.48	2.47	1.20	-2.16	-0.07	

Table 23: Second Set · August 2012 - July 2015 · Two common latent factors considered

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	0.30	-0.04	-3.28		0.83	**4.62**	-0.42	-0.55	**-3.30**	-1.26	-0.29	0.29	0.26
ITA	-1.32	3.60	**4.18**	**5.23**		-4.03	1.65	-1.63	**-7.32**	0.57	**4.67**	0.42	1.34
FRA	0.68	-3.22	-2.59	0.79	0.41		-0.07	-0.22	-0.05	-0.06	-0.34	-0.04	0.30
ESP	1.31	-2.66	0.93	0.13	0.73	-0.22		-1.42	3.97	-0.44	-0.48	0.60	-1.05
POR	-0.57	**1.61**	0.51	**-9.34**	-3.43	6.92	0.24		8.81	-0.29	-2.08	-0.89	-1.62
NET	-0.01	2.08	**0.84**	0.86	0.33	-0.60	-0.11	0.00		0.07	0.37	0.00	-0.03
AUT	3.93	0.42	**1.99**	1.61	0.23	-1.07	0.20	0.38	-1.18		1.03	-0.10	0.35
BEL	-0.84	5.96	2.81	-2.18	-1.65	3.11	-0.66	0.48	**2.22**	-0.18		0.05	-0.06
GRE	2.01	-3.16	-2.57	-6.17	4.80	**-9.34**	**6.49**	-0.09	-5.54	2.78	2.05		2.72
IRE	**1.45**	**3.81**	1.66	-4.90	**-9.00**	-8.39	4.14	0.35	-6.50	0.69	**-6.30**	-0.21	

As we can see, with this new time-frame the number of significant coefficients rise when we do not consider common shocks. Coherently with what we have seen so far in previous attempts, common shocks presence seem to worsen the overall significance and quality of the estimated coefficients, that show very uncommon results, high overall standard deviation, incorrect signs. Focusing on the

Table 24: Sixth round of GMM result

Timeframe: Aug. 2012 - Sept.2015 · 165 Observations			
	Z=0	**Z=1**	**Z=2**
% of Significant Coeff.	68.46%	15.38%	18.46%
% of Positive Coeff.	55.38%	46.92%	47.69%
Mean of Est. Coeff.	-0.023	0.031	-0.133
Std. Dev. of Est. Coeff.	0.928447	2.119240	2.988451

results reported in table 21, we see that a greater number of significant coefficients has a positive sign. At the same time we notice that a not negligible number of hardly explainable coefficients remains, such as the great impact that Ireland and Spain have on German Equity Index. Italy equation seems to be almost likely: positive impacts are brought by every country aside Austria, Greece (and this can be explainable) and Germany (very difficult to explain). The Austrian and Greek non-significant impacts are easy to explain, given the small dimension of the ATX 20 index and the troubles that affected Athens in the recent years, which have characterized the Greek index as a not very influential one across Europe. Spain equation seems to be likely, even if doubts remain about the sign of Belgian and Irish coefficients. Other equations are more or less likely. What does not completely make sense is the low impact and significance of the German and the French coefficients on other countries, despite it is well know that both CAC 40 and DAX 30 are leading indexes for eurozone financial market. We expected also less significant coefficients for Greek coefficients. In any case, for what concerns the dynamics between equity markets, these results are a notable improvement from both a statistical and economic significance perspective. Unfortunately, we cannot say the same if we focus our attention on the impacts of the Balance Sheet Polices, where only few remarkable results are recognizable. As matter of fact, we have only ten strongly significant coefficients. Securities Market Programme and OMT have a positive impact only on Italy, and a big, negative impact on Ireland. LTROs worked only for Netherlands. MRO was slightly more effective, with positive impacts on Spain an Greece. If we consider our results as reliable (a pretty weak hypothesis), we can claim that no evidences of a real relationship between ECB's balance sheet policies and equity market are recognizable so far.

5.2 Looking at the past: 2009-2012

Let see now what are the results if we consider the first half of our dataset, using again the Second Set of Regimes on the data from 2009 to 2012 (with a total of 160 Observations). We perform this estimation since we think that the attitude of the European Central Bank during this period was substantially different from the one showed after the sovereign bonds crisis.

Table 25: Second Set · August 2009 - September 2012 · No common latent factors considered

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	**-0.17**	**0.01**	0.01		1.05	0.10	0.46	-0.07	**-0.20**	**0.02**	**0.49**	0.01	0.10
ITA	**0.01**	**0.087**	**0.09**	**0.15**		0.63	-0.06	**0.02**	**1.67**	0.51	**1.29**	-0.16	0.10
FRA	-0.01	0.09	0.12	0.13	0.51		-0.14	**-0.58**	0.05	0.62	0.08	-0.34	-0.18
ESP	**0.00**	0.08	0.09	**1.70**	1.55	**-1.38**		**0.33**	**-1.76**	**-0.09**	**0.77**	0.20	0.02
POR	**0.01**	**-0.08**	**0.21**	**0.49**	**0.42**	**-1.88**	**0.02**		**-2.06**	**-0.41**	**0.87**	0.14	**-0.20**
NET	0.01	**-0.06**	**-0.07**	**-0.43**	**0.01**	0.63	-0.23	0.01		0.03	**0.19**	0.00	0.00
AUT	**0.01**	0.06	0.08	-0.87	**0.38**	-1.43	**0.67**	0.00	1.06		-0.31	0.07	-0.07
BEL	0.00	0.08	**0.10**	**-0.65**	**-0.25**	-1.21	**0.16**	1.55	0.48	-0.08		0.06	0.03
GRE	0.01	**-0.06**	0.07	-1.80	-2.06	0.70	**1.74**	-1.38	-1.88	-0.06	0.33		**0.03**
IRE	0.06	-0.09	-0.13	**-0.72**	**1.03**	**0.00**	0.07	0.01	0.15	-0.30	-0.57	0.07	

Table 26: Second Set · August 2009 - July 2012 · One common latent factors considered

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	0.00	0.10	0.47		-8.49	6.70	-1.47	3.13	**1.83**	**2.53**	**-2.05**	0.75	-0.01
ITA	0.00	-0.02	**3.39**	8.51		-7.71	-1.68	**4.44**	**-2.22**	3.11	-2.28	0.02	-0.20
FRA	-0.01	**1.43**	3.12	-7.02	7.65		**1.33**	-2.07	-1.45	-2.30	1.68	0.11	-0.01
ESP	0.14	-1.56	-4.37	**-1.05**	9.81	3.12		-0.84	-0.68	0.90	0.98	0.03	-0.35
POR	0.01	-3.51	0.15	6.32	**4.01**	**-5.30**	**-1.32**		-1.94	-0.77	0.33	-0.24	-0.17
NET	-0.08	-0.42	**0.38**	2.63	4.86	-2.01	-0.01	-0.34		-0.58	2.58	-0.64	0.89
AUT	**0.11**	-0.26	**-3.62**	4.14	**9.09**	3.17	**2.96**	-7.11	**-4.71**		0.00	-0.24	-0.23
BEL	0.00	0.09	-0.95	-0.51	-1.76	1.55	**-3.86**	**6.79**	5.99	**5.80**		0.94	-0.16
GRE	**0.03**	-0.72	1.46	1.01	1.34	-1.01	**0.21**	-0.02	-1.31	**-1.55**	0.13		**-0.38**
IRE	**0.19**	**0.00**	**-0.01**	1.72	-0.19	**0.15**	-5.15	-8.01	**4.37**	0.70	-0.02	0.21	

Table 27: Second Set · August 2009 - July 2012 · Two common latent factors considered

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	-0.03	-1.66	-0.53		**-0.06**	-0.36	-0.10	-3.87	4.40	-7.58	0.00	0.01	-0.01
ITA	0.00	-0.01	-0.10	**0.38**		0.09	-0.45	0.00	0.10	0.01	0.86	-0.21	-0.08
FRA	0.29	-0.31	0.62	-1.37	-0.49		-0.30	-0.07	-2.24	-0.14	0.03	-0.01	0.00
ESP	0.17	-0.01	0.20	-0.30	-0.11	-0.04		-0.18	-0.18	-0.01	**0.16**	**-0.07**	-0.12
POR	0.06	-0.89	0.94	0.07	-4.26	3.24	0.72		-0.54	-1.22	0.19	0.04	0.11
NET	0.00	-0.08	3.55	0.29	-0.09	1.01	-0.05	-0.10		0.00	-0.04	-0.02	0.00
AUT	0.50	-0.09	0.07	-1.41	-0.08	1.09	**0.02**	0.20	-0.43		-0.37	0.13	-0.14
BEL	0.19	1.19	-0.61	0.28	**2.33**	2.32	0.41	-0.38	1.88	-0.01		-0.01	-0.09
GRE	4.28	-0.18	**-0.01**	**-0.51**	-2.37	-6.65	13.62	**-0.77**	**0.96**	**0.07**	0.69		**-2.75**
IRE	0.33	0.08	-2.89	4.30	-9.10	-5.93	-7.22	1.34	5.05	-2.60	-4.62	1.70	

Table 28: Seventh round of GMM result

Timeframe: Aug. 2009 - Sept.2012 · 168 Observations			
	Z=0	**Z=1**	**Z=2**
% of Significant Coeff.	66.15%	45.62%	16.92%
% of Positive Coeff.	65.40%	51.54%	47.69%
Mean of Est. Coeff.	0.052	0.177	-0.048
Std. Dev. of Est. Coeff.	0.717865	3.095683	2.327255

The results are similar to the ones obtained from the sixth round, with a little increase in the number of positive coefficients. This last fact is probably given by the significant enlargement of the ECB's balance sheet, pushed by the large use of MROs and LTROs operations since 2009. Again, common latent factors are not helpful. For $Z = 0$, we observe a more pronounced significance on the ECB variables coefficients. Slightly positive effects are found in Italy, Portugal, Spain, Austria and Belgium equations. However, only nine positive coefficients are significant for a 5% confidence level (the number rise to fourteen for a 10% confidence level). The remaining twenty-one are either negative or non significant. Hence, is still not possible to say whether the ECB's measure can actually be considered influential for equity markets.

5.3 A further narrower time-frame: 2013-2015

We have seen that by narrowing the considered time frame the overall significance of the estimated coefficients tends to rise. The interpretation that we could give to this evidence is that the GMM estimation works better if launched on shorter time periods where the shifts in the relative variance associated to data stand out in a more evident way. From this assumption we built an ad-hoc regime set, that puts in contrast a period of relative stability generated by the combination of Forward Guidance, BSP 5 and OMT at the beginning of 2013 and a period of higher volatility generated by the introduction of the BSP6 (namely, the Quantitative Easing) and by the renewed frictions between Greece and the IMF in the autumn of 2014. This assumption is also reinforced by the rolling variance analysis of the VAR residuals of the restricted form, which graph is showed in Figure 3. The results are the following:

Table 29: Second Set · February 2013 - September 2015 · No common latent factor.

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	**0.01**	0.01	-0.02		**0.20**	**1.05**	0.01	**-0.12**	**0.59**	**-0.22**	**-0.48**	**0.03**	-0.31
ITA	0.00	0.00	**0.12**	-0.18		**0.95**	**0.71**	**0.22**	**-1.00**	**0.63**	**-0.39**	**-0.10**	**0.03**
FRA	0.00	**0.03**	0.00	**0.28**	**0.58**		**0.05**	-0.05	0.12	**0.23**	-0.07	**-0.02**	-0.17
ESP	**0.09**	0.09	0.16	**0.63**	**0.50**	**1.43**		0.17	**-1.20**	0.07	**-0.35**	-0.04	**-0.46**
POR	**0.06**	**-0.08**	-0.05	0.02	-0.15	**-0.34**	**0.48**		**0.38**	**0.29**	0.44	**-0.16**	**-0.18**
NET	**-0.03**	-0.02	**-0.01**	**0.30**	-0.13	**0.48**	**0.26**	**-0.17**		**-0.13**	**0.62**	**0.09**	**-0.24**
AUT	**0.04**	-0.01	**-0.22**	**0.52**	**1.19**	**-0.43**	**0.39**	**-0.31**	-1.60		**-0.54**	**-0.01**	**0.95**
BEL	0.00	0.02	-0.09	**1.22**	**-0.72**	**-0.45**	**0.55**	-0.01	**0.79**	**-0.36**		0.07	**-0.15**
GRE	**0.12**	-0.04	-0.17	-0.16	0.38	**0.92**	0.11	**0.89**	0.14	-0.73	0.05		**-0.22**
IRE	**-0.07**	**0.22**	-1.50	**0.75**	-1.63	**-5.15**	**0.97**	**2.01**	**-0.85**	-0.16	**3.63**	-0.04	

Table 30: Second Set · February 2013 - September 2015 · One common latent factor.

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	0.04	-0.20	-0.20		**-1.17**	**1.97**	**0.66**	-0.19	0.01	-0.16	0.38	0.09	-0.32
ITA	-0.30	-0.09	0.00	-0.90		1.73	0.56	-0.16	0.04	-0.15	0.32	0.08	-0.28
FRA	**0.22**	0.17	0.02	0.52	0.57		-0.32	0.09	-0.02	0.09	-0.19	-0.05	0.16
ESP	-0.06	-0.31	-0.01	1.64	1.80	-3.14		0.30	-0.07	0.28	-0.59	-0.15	0.50
POR	-0.43	0.03	**-0.03**	**-5.50**	**-6.09**	**10.56**	**3.39**		0.21	-0.93	1.98	0.49	**-1.68**
NET	-0.56	0.09	-0.34	0.62	1.35	-1.67	-0.25	0.28		0.14	-0.01	-0.17	0.45
AUT	-1.17	-0.12	-0.22	-0.78	-1.52	1.91	1.38	-0.05	0.41		1.25	0.19	-1.11
BEL	0.00	0.04	-0.01	2.15	**3.03**	-3.29	-1.62	0.06	**-0.52**	0.28		-0.17	0.51
GRE	0.14	-0.53	**-0.02**	3.53	3.57	-6.26	-1.79	0.10	-0.08	0.63	-0.85		0.88
IRE	-0.04	-0.04	-0.51	-2.33	-1.85	4.04	0.28	-0.12	-0.39	0.15	1.59	0.17	

Table 31: Second Set · February 2013 - September 2015 · Two common latent factor considered.

	MRO	LTRO	SMP	GER	ITA	FRA	ESP	POR	NED	AUT	BEL	GRE	IRE
GER	0.00	0.00	-0.01		**5.46**	-2.61	0.20	**-1.06**	-1.83	-0.39	1.24	-0.14	0.34
ITA	0.01	0.00	**0.34**	**5.34**		**-9.15**	**3.35**	0.14	-0.47	1.18	-0.06	0.00	0.49
FRA	0.00	**0.07**	-0.01	**0.29**	0.48		-0.17	-0.32	0.98	-0.11	-0.09	0.06	-0.18
ESP	**-0.53**	0.05	-0.08	**7.80**	**3.15**	**-10.36**		0.58	**-4.43**	0.52	1.82	-0.05	**1.93**
POR	**0.05**	0.07	-0.03	-0.23	0.02	0.82	0.20		-1.62	0.54	-0.16	0.08	0.54
NET	0.22	-0.02	-0.03	-0.13	-0.76	1.68	0.31	0.04		-0.15	0.02	0.03	0.11
AUT	0.08	0.01	-0.30	0.27	-0.75	0.61	0.85	0.24	-2.83		1.66	**0.17**	0.32
BEL	0.00	0.00	0.03	1.90	0.61	-3.05	0.74	0.39	-0.68	**-0.63**		-0.06	**1.49**
GRE	**-2.75**	-0.01	-0.06	-1.88	0.04	2.39	-0.17	-1.01	3.14	-0.39	0.10		1.29
IRE	0.04	0.15	-0.96	-0.16	1.56	-0.11	-0.93	-0.16	1.17	-0.11	-0.82	-0.03	

Table 32: Eighth round of GMM result

Timeframe: Aug. 2009 - Sept.2012 · 168 Observations			
	Z=0	**Z=1**	**Z=2**
% of Significant Coeff.	73.08%	16.92%	27.69%
% of Positive Coeff.	56.92%	45.38%	47.69%
Mean of Est. Coeff.	0.132	-0.030	-0.045
Std. Dev. of Est. Coeff.	0.790662	1.718820	1.885142

In table 29 we see the best results for this eighth round. The overall significance of the coefficients is not poor, but we see an higher number of negative and unexpected signs among the countries relationships if compared with table 21. However, at least we can see an higher number of significant coefficients in the section on MRO, LTRO and SMP impacts. According to the results, the overall impact of ECB monetary policy is cramped and non homogeneous across countries. MRO seem to generate positive but small impact on Germany, Spain, Portugal, Austria and Greece. At the same time, Ireland and Netherlands equity markets seem to suffer the increases in the amount of money held by the ECB in the context of Main Refinancing Operation programme. Speaking about Long Term Refinancing programme, effects are difficult to express, as only France and Ireland show to be positively influenced, while other countries are non influenced at all (with the exception of Spain affected by weakly significance, and Portugal, negatively influenced). SMP has positive repercussions only on Italy. To summarize,even this framework give us scarce information about the real impact of ECB's BSPs on European equity market.

6 Conclusions

Even if some improvement have been obtained by modifying the considered time-frame or the regimens' configuration, the overall outcome from our estimates does not change: we are not able to prove the existence of a real casual relationship between the ECB's BSPs and the European equity market. At this point, different considerations could be derived.

First of all, this result can be due to problems related to our identification technique, given that the endogeneity and the number of potentially omitted variables have a decisive impact on the correct functioning of our identification system, especially in such a complicated and stressful period as the one that markets have been living in these last six years. This is a recurrent problem when it comes to determine how monetary policy influences the market or how policy makers' decisions are influenced by investors behavior. Furthermore, this problem is amplified by the unique nature of the eurozone, where many big and different economies are subjected to one central bank. Most of the provided results have an unsatisfactory level of statistical significance and suffer the lack of a choral economic significance: in short, they tell us the same things, through results that are however very different to each other. Many elements, such as illogical coefficients signs or unlikely impact magnitudes hint that our model can hardly be considered reliable. Besides, the comparison with the empirical evidence is complicated, given that equity markets have shown a controversial path in the last years. Moreover, the use of weekly data could have led to a loss of significant information in our model over the use of daily data.

Having said that, there are chances that our results may actually hint that the ECB's balance sheet policies have not a causal relationship with equity markets' returns. An explanation for the lack of results, could indeed be related to the actual effectiveness of Balance Sheet Policies on the eurozone economy. Of course, ECB's measures helped in several occasions many countries, relaxing markets during period of high uncertainty, providing banks with liquidity at extremely good conditions, operating on the euro/dollar exchange rate in order to achieve better conditions for EU exports, easing money market and lending conditions and lowering the debt financing conditions for every countries in the EU. A great result of the combined action of expansionary measures and forward guidance was to conquer market faith about the actual ECB "fire-power" and the euro solidity. Thus, even if inflation in the euro-zone is still lower than the desired level indicated in the ECB mandate (namely, an inflation level close but lower than 2%), the Eurotower made its part in order to improve the situation in European financial markets. Quantitative Easing also helped to eliminate the deflation risk in the euro-zone, and the renewed confidence boost market returns in the first four months of 2015, as stated in April 2015 by Mario Draghi. Generally speaking, many countries displayed signs of growth after a long period of recessions. So, not only saying that ECB's unconventional monetary policy measures did not have any effect on Europe economy is absolutely wrong, but also affirming the same on equity markets is not correct.

But, according to the empirical evidence and to our results, admitting the existence of a punctual mechanical relationship between ECB balance sheet and Equity markets might be not possible. Any direct effect provoked by the ECB on equity market seem to be amenable only to markets expectations. It is basically all about the ability of Mario Draghi to surprise markets. During the majority of the ECB's press conferences, investors look confidently to the new measures deployed, but other macroeconomics elements prevent the changing of the overall market sentiment. These negative situations are brought by a vast spectrum of sources, such as tensions in the Chinese market, the oil prices crisis, the uncertainty about the potential effects of a rise in FED policy rates, the "Brexit" referendum, the migrant-crisis, the meaningful sufferings that the so called emerging economies are experiencing, which have provoked a global capital flight toward safer assets, lowering the overall risk appetite and increasing the cost of financing for companies listed in financial markets. At the same time, European banks are struggling with a great amount of non-performing-loans, difficulties in reaching patrimonial requirements or with critical exposures on derivatives. In view of these facts, businesses in the European economic system, which is a bank-centrist system, cannot access to the proper amount of new funds needed in order to create proper conditions for a choral recovery of the economic situation. This of "short circuit" in the eurozone's monetary policy transmission mechanism can be thought as a sort of "watertight compartment" where liquidity is trapped without being able to get where the European Central Bank want it to be, namely, where it could be translated into profitability for businesses of the EU. This problem is also responsible for the steady decrease of sovereign yields, that have been in negative territory since the introduction of BSP6 in early 2015: as we know, according to this program, the ECB act as buyer of last resort for every sovereign security, implying the decrease of their risk. Hence, banks and financial institutions use part of the liquidity received from the ECB to purchase these risk-free government bonds, which now offer negative yields as a consequence of the ongoing increase of their demand. This undeniable trend in sovereign exert some consequences amid the equity market: after BSP6 and EAPP announcements, the sovereign-risk component has moved from bond to stock market (Acharya et al. 2015). This very element increased partially the volatility suffered by the equity market during 2015. As a matter of fact, sovereign CDS spreads reacted in a pretty limited manner to tensions provoked by Grexit during the summer of 2015, while equity indexes showed a stronger and more nervous reaction (possibly amplified by the contemporaneous downfalls of Shanghai's and Shenzhen's Indexes).

Accordingly, is almost superfluous to state the main problem is related to difficulties in changing investors' expectations, as it is also well-proved by the Euro area's yield curve structure, according to which 8 years will be necessary to see positive interest rates again. Investors look more and more nervous as the time passes without a true improvement about the inflation expectation side. The partial ineffectiveness of the more recent European Central Bank measures are putting a lot of strain on the Eurotower, forcing his governor, Mario Draghi, to steadily raise the stakes in order to not disappoint investors. It is a very difficult situation for the ECB board: when market's expectations are not matched, the consequent shortfalls are heavy, such as the one triggered by the disappointing Draghi's press conference on the 3rd of December 2015, which gave birth to a downside trend that melted away in about 20 trading days almost the entire capitalization gained by European markets during the 2015. At the same time, market skepticism about the effectiveness of ECB's QE has risen severely at the point that not only it is very difficult to convince markets, but is also tricky to announce new measures without creating further panic or skepticism. In fact, as rumors rose about the implementation of other approaches (such the so called "Helicopter Money") witnessing the lack of faith in the EAPP, investors started to react badly to further measures, interpreting them as a sign of the severity of a situation that the ECB does not seem to know how to limit effectively. This is what happened when the ECB announced, during the press conference on March 2015, a new set of LTROs and that corporate bonds were going to be included in the list of purchasable securities by the Eurotower, in the ambit of CSPP (Corporate Sector Purchase Program), enlarging also the amount of expandable liquidity from 60 to 80 billion per month, and, in so doing, the potential impact on the economy of the original BSP6 program. At first, markets reacted well, with a rise of about 4 percentage point in every European index in less than an hour. But short after, also because of the decision of not touching the key rates, indexes fell rapidly, bringing the returns slightly under the parity. In the following days Euro area's markets gained around 5 percentage points, losing eventually more than 8 points two weeks after, due to a new collapse in oil prices and tensions resulting from the ECB's checks on the European banking system, inflation rate forecasts and bad rumors about Deutsche Bank's financial stability.

The Quantitative Easing blended architecture is also source of concerns for many investor. First of all, doubts has been risen about the risk pooling system that was set up by the ECB (under the strong pressure of the German government) to back up the purchases of sovereign bonds, that wants the National Banks to provide for 80% of possible losses. But the most critical aspect is given by the impacts that negative interest rates can have on the financial economy of the eurozone. Pension funds and insurance companies are already struggling in order to come up with a viable solution for their long term-passive portfolios. In addition, the paradox is the negative yield offered by sovereign bond market are so low that they can not even be purchased by the European Central Bank according to BSP6 regulation. Extremely relevant in the context of the economic crisis and ECB action is the political instability that affect the European Union. In the current scenario, the political union from both a choral and a country-based perspective is terribly weak. The geopolitical situation in the EU showed that a very wide range of positions is present among the various countries. That was already evident during the Ukrainian crisis, and no progress were made so far, as the "Grexit" demonstrated and as the migratory crisis is showing nowadays. At the same time, political issues as "Brexit" put many question marks about the future and the long term strength of the union both from a political and economic angle. The political, economical and fiscal asymmetries often fueled by the high pressure that Germany exert on Bruxelles is not functional to a fast recovery in the eurozone. Hopefully, these are going to be further reduced in the next years,but the strain of obstacles on the path that the ECB is trying to tread to fulfill its mandate is not small enough to cease investors' skepticism. On the other hand, many countries in the EU still show meaningful deficits amid their normative and juridical system, suppressing a large part of benefits that monetary policy measures could give. And this brought us to the main points; as stated numerous times by Mario Draghi, monetary stimulus is not going to solve the crisis which the Euro area is dealing with, but only to facilitate the establishment of the conditions that can allow governments to re-qualify public spending and forge structural reform capable to increase the overall competitiveness in the EU. In particular, in order to increase investment, boosting job creation and raising productivity, both the implementation of product and labor market reforms and actions to improve the business environment for firms need to gain momentum in several countries. A swift and effective implementation of these reforms will not only lead to higher sustainable growth in the euro area but will also help ECB to achieve its most difficult goal: raise expectations of inflation. These positive expectations will encourage both households to expand consumption and firms to increase investment today, thus reinforcing the current economic recovery. However, governments are not allowed to act freely on the fiscal side, even though the strict terms of the "Stability and Growth Pact" are one of the main constraints to governments action. Full and consistent implementation of the Pact is considered by ECB as a key for confidence in the European Union fiscal framework, even if it comes at high costs. Above all, the eurozone remains beset by substantial political risks, difficult to overcome.

To summarize, we are not able to see any relationship between changes in the European Central Bank balance sheet and the European equity market because, first of all, there are no relationships, from an accountant point of view, between these two measures: the liquidity released by the ECB are used to buy securities different from equity assets, such as sovereign bonds and, from June 2016, low risk corporate bonds. Secondly, investor expectations are incredibly difficult to change. Indeed, because of the many economic, technical and normative obstacles that it has to face, related mainly to the degree of bank-centrism in the European economic system, at the moment the Q.E. (or the sixth Balance Sheet Policy program) does not seem to be able (although after a cheering start in the first quarter of 2015) to compensate the negative influences to which markets have been exposed in these recent months, such as the unknowns related to the oil price, the dynamics involved by negative interest rates, the slowdown of the Chinese economy, the possible strategic pattern of the FED, the low solidity of the bank system in many European countries, political divergences inside the EU, the so called "Brexit" and other minor issues such as the capital flight from BRICS and other emerging countries. Moreover, there are high risks that the shy recovery sighted in the Eurosystem after the introduction of EAPP could turn into a double-dip. In fact, many of the current drivers of growth are likely to dissipate by the end of 2016. The euro has been stable for more than a year now, while oil prices have risen in 2016. The one-off boost from lower interest costs should also start to wear off. Meanwhile, the Euro area is unlikely to get much of a boost from elsewhere, given the poor global growth forecasts. Due to these facts, the overall market sentiment in the European market, and especially in the equity market, is low, as well as the expectations of inflation and growth of profitability. The effects of the announcement of new measures are narrow too, and, from a time perspective, the last no more than a week. And this bring us at the third point: the investor confidence toward Mario Draghi future moves is put to test month after week. The new liquidity, trapped into bank's accounts, can not be invested in activities that offer a satisfactory trade off between risk and returns. Moreover, even the effects of the announcement of new measures are limited and, from a time perspective, they last no more than a week. And this bring us at the third point: the investor confidence toward Mario Draghi's future moves is increasingly put to test. The new liquidity, trapped into bank's accounts, can not be invested in activities that offer a satisfactory trade off between risk and returns, and a new propagation channel of the monetary policy is required. At the same time, investors also see that Eurotower's effort is not being supported by trustable political reforms, particularly by those countries whose labour and credit markets are suffering the most. However, many are the critical issues that affect governments activity, like the Stability and Growth Pact or the difficulties in requalifying the public expenditure in a weak economic environment.

Further uncertainty is provided by other implications: Quantitative Easing long term effects can be deleterious, especially because of persistent negative interest rate. Many banks have big patrimonial issues that are not resolvable in the short term, and new stricter regulations on governments contributions are adding uncertainty. Moreover, financial fragmentation might still be an issue across the eurozone, although not for all financial segments. As a matter of fact, since the peak of the sovereign debt crisis, the degree of cross-country heterogeneity has declined, although partially, in stock markets and bond markets, presumably due to lower disparity in economic sentiment across euro area countries, as well as progress on structural reforms, the ECB's policy actions and global liquidity conditions which triggered a search-for-yield behavior. Furthermore, even bigger and more stable financial institutions are facing troubles, since the number of non-performing-loans in the financial system is very high, as well as the contagion risk. Deutsche Bank exposition on these kind of debts (amplified by derivative financial instruments) is so high that only an arbitrary valuation of certain assets can avoid devastating losses. And even with these measures, Deutsche Bank's CDS skyrocketed to an extremely high level. Public debt among the Euro area is now more under control than in the past years, given that many countries had no problem in issuing sovereign bond at negative interest rate. Anyhow, the absence of inflation weighs on debt previously issued. These factors dissipate the efficiency of the ECB's moves and outline a context in which expectations of growth and inflation are awfully difficult to influence. In this final consideration lies the reason behind the substantial lack of impacts of the Balance Sheet measures in the equity market. In conclusion, the efforts of the European Central Bank have been for sure helpful to ease funds market conditions and to alleviate tensions in sovereign bonds market, strengthening the non-reversibility of the euro and allowing the Eurosystem to avoid the risk of deflation. But the adverse political, economical and structural conditions prevented the effective transmission of the unconventional monetary policy on real economy and, more specifically, on equity markets.

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Appendices

A The Rigobon and Sack's Approach

To understand how Heteroskedasticity helps solve the problem of identification, let's consider the following typical example: assume that in the standard supply and demand problem we want to estimate the slope of the demand curve. If we try to estimate the parameters of the curve running with the OLS method, our estimates will be biased. This problem can be solved using an instrumental variable that shifts the supply schedule without affecting the demand curve. This will allow us to measure the slope of the demand without bias. The heteroskedasticity of the structural shocks works in a very similar way.

Assume that our data sample can be split in two sub-samples. Also assume that in the second sub-sample the variance of the supply shock is larger than in the first one. The residuals are now distributed along a wider cloud ellipse, and the shift in the variance implies a rotation in such ellipse, giving us enough information to estimate the slope of the demand curve. This is equivalent as having a "probabilistic" instrumental variable; we know that in the second sub-sample the shocks to the supply curve are more likely to occur. In the limit, if the variance of the supply shocks goes to infinity, then the demand curve can be estimated by OLS. This intuition was firstly introduced by Philip Wright [1928] and Sewall Wright [1921, 1923]. This paper extends the original methodology to the case in which the shifts in the variances are finite, and when the form of the heteroskedasticity is unknown. The identification through heteroskedasticity identifies the problem the relative importance of the shocks changes even if the shifts in the variances are finite, and the form of the heteroskedasticity is unknown.

A.1 Identification Procedure

Let's consider this simultaneous equations system: (1) (2) We have the demand equation:p_t

$$p_t = \beta q_t + \varepsilon_t \tag{8}$$

and the supply equation:

$$q_t = \alpha p_t + \eta_t \tag{9}$$

Where p_t and q_t are price and quantity, and ε_t and η_t are the structural shocks; α and β are the parameters we want to estimate while σ_ε^2 and σ_η^2 are the shocks variances. We can estimate (8) and (9) only if α and β equal to zero, otherwise we would need further information in order to estimate the two parameters consistently. At this point, the only thing that we can estimate is the variance-covariance matrix of the reduced form ($\hat{\Omega}$):

$$\hat{\Omega} = \frac{1}{(1-\alpha\beta)^2} \begin{bmatrix} \beta^2\sigma_\eta^2 + \sigma_\varepsilon^2 & \beta\sigma_\eta^2 + \alpha\sigma_\varepsilon^2 \\ . & \sigma_\eta^2 + \alpha^2\sigma_\varepsilon^2 \end{bmatrix}.$$

The covariance matrix only provides three moments (the variance of p_t , the variance of q_t , and the covariance between p_t and q_t) but we have four unknowns: α, β, σ_η^2, σ_ε^2. Here comes our identification problem: the unknowns moments are more than the known moments. As we said before, this problem has been solved with the imposition of additional parameter constraints: long run, sign exclusion and covariance restrictions and so on.

1. If we include in the structural form lagged dependent variables, it is possible to force the sum of certain lagged coefficients to be equal to zero. This assumption is called **long run constrain**.

2. According to **exclusion restriction** we should assume either $\alpha = 0$ or $\beta = 0$.

3. It is also possible to **constrain the sign** on the slopes of our equations in order to create an ad-hoc region of admissible parameters. This kind of imposition should bring us to achieve partial identification. (Fisher 1976)

4. We could also choose to act on the variances i.e. imposing that σ_η^2 or σ_ε^2 aiming to produce a relative variance equal to a constant or equal to either 0 or infinity. This last assumption is among the most common underlying assumption of most event studies that regard macroeconomic issues.

All these restrictions proved themselves to be very useful in many works, but there are important economic problems in which none of them can be rationalized.

A.2 Identification Under Two Regimes

Assume to observe two sub-samples characterized by different behaviors of the structural shocks' variance delineating two different regimes: the first one where we have high and a second with low volatility. Furthermore, assume that our parameters are stable across these two regimes. Under these conditions the two reduced form covariance matrices have the same structure as before:

$$\hat{\Omega}_s \equiv \begin{bmatrix} \omega_{11,s} & \omega_{12,s} \\ . & \omega_{21,s} \end{bmatrix} = \frac{1}{(1-\alpha\beta)^2} \begin{bmatrix} \beta^2\sigma^2_{\eta,s} + \sigma^2_{\varepsilon,s} & \beta\sigma^2_{\eta,s} + \alpha\sigma^2_{\varepsilon,s} \\ . & \sigma^2_{\eta,s} + \alpha^2\sigma^2_{\varepsilon,s} \end{bmatrix}, \tag{10}$$

where each regime is denoted as $s \in \{1, 2\}$ and the variances of the structural shocks in regime s are given by $\sigma_{\varepsilon,s}$ and $\sigma_{\eta,s}$ and where $\hat{\Omega}_s$ indicates the covariance matrix in regime s. To summarize, in this new system of equations we have six unknowns terms: α, β, $\sigma_{\varepsilon,1}$, $\sigma_{\varepsilon,2}$, $\sigma_{\eta,1}$ and $\sigma_{\eta,2}$. We also have two covariance matrices that provide a total six equations! Hence, since we have the same number of known and unknown terms, if the equations are independent the problem of identification can be solved. As we have said before, the needed conditions are (i) that the parameters are stable across the regimes, and (ii) that the structural shocks are not correlated. Solving for the variances in equations (10), α and β satisfy the following non-linear system of equations:

$$\beta = \frac{\omega_{12,s} - \alpha \cdot \omega_{11},s}{\omega_{22,2} - \alpha \cdot \omega 12, s}, \qquad s \in \{1, 2\}. \tag{11}$$

The solution for α, provided by Rigobon, solves the following quadratic equation:

$$[\omega_{11,1}\omega_{12,2} - \omega_{12,1}\omega_{11,2}]\alpha^2 - [\omega_{11,1}\omega_{22,2} - \omega_{22,1}\omega_{11,2}]\alpha + [\omega_{12,1}\omega_{22,2} - \omega_{22,1}\omega_{12,2}] = 0 \tag{12}$$

For equation (12) there are two solutions: If we solve for α, β is a solution to the system of equations, then $\alpha^* = 1/\beta$, $\beta^* = 1/\alpha$, is the other solution. Indeed, the solutions are the two possible ways in which the structural form can be written. In other words, the system is identified up to row permutations of the original model.

Proposition 1 (Rigobon 2003) *Let p_t and q_t be described by equations (8) and (9), where the parameters (α and β) determining the law of motion are stable, and where the disturbances have finite variance, are not correlated, and exhibit heteroskedasticity that can be described with two regimes. Then, if the covariance matrices satisfy*

$$det \left| \Omega_2 - \tfrac{\varpi_{11,2}}{\varpi_{11,1}} \Omega_1 \right| \neq 0 \tag{13}$$

the structural form is just identified: α, β are consistently estimated from the two estimable covariance matrices. (Rigobon 2003 BC, dimostration too in appendix)
Equation (13) is equivalent to:

$$\varpi_{11,1}\varpi_{12,2} - \varpi_{11,2}\varpi_{12,1} \neq 0 \tag{14}$$

Note that conditions (13) or (14) are basically equivalent to test whether the rank condition is satisfied or not when the order condition (the one related to the number of equations) has already been satisfied. The order condition requires the number of equations to be larger or equal than the number of unknowns. The rank condition requires the number of linearly independent equations to be larger or equal than the number of unknowns. In a linear system of equations we can verify if these conditions are satisfied by computing the rank of the matrix. But given that the system that we are considering is non-linear, the rank condition is expressed by equation (13). Equation (13) is not satisfied if the two covariance matrices are somehow proportional. Thus, we will not have any identification from heteroskedasticity if the relative variances are constant across regimes. Therefore, even if we have six equations and six unknowns, the system is not identified if the equations are not independent. The ellipse of realization enlarges along one of the two structural equations only when there is a shift of the relative ratio of the variances, because of the change in the heteroskedasticity in the region in which the errors are distributed. We can estimate this rotation in the ellipse from the reduced form covariances, and this permits to obtain the slope of the curves. The analysis of the case in which the variance changes for only one shock should give us the idea behind how we reach identification. Let's assume that it is known that at some point in time there is an increase in the variance of the supply shocks. The change of the ellipse across the two samples allows one to determine the slope of the demand curve. Furthermore, since we have assumed the correlation of the structural shocks to be equal to zero, then there is enough information to estimate the slope of the supply curve too. From an instrumental variables viewpoint, the rise in the variance of the supply shocks becomes a probabilistic instrument by boosting the likelihood that the supply equation moves. Moreover, it is not necessary to know which shock becomes more important across the regimes, because there if both variances shift there is an expansion along both schedules. If there is a change in the relative variances, then the problem is solved for both equations. It is important to underline that if the parameters shift, or if the correlation of the structural shocks changes, then the system of equations is not identified or the estimates are biased.

A.3 Identification Under More Than Two Regimes

It is not too difficult to extend the previous considerations to the case where there are more than two regimes. Assume to have multiple finite heteroskedasticity regimes indexed by $S \in \{1, .., S\}$. For each regime, the covariance matrix is:

$$\Omega_s \equiv \begin{bmatrix} \omega_{11,s} & \omega_{12,s} \\ . & \omega_{21,s} \end{bmatrix} = \frac{1}{(1-\alpha\beta)^2} \begin{bmatrix} \beta^2\sigma^2_{\eta,s} + \sigma^2_{\varepsilon,s} & \beta\sigma^2_{\eta,s} + \alpha\sigma^2_{\varepsilon,s} \\ . & \sigma^2_{\eta,s} + \alpha^2\sigma^2_{\varepsilon,s} \end{bmatrix}. \tag{15}$$

This forms a system that has three equations (one covariance matrix per regime) and two plus two unknowns: $S \times 2$ structural variances for each regime, plus two parameters (α and β). In this case, the order condition will be satisfied for any S larger or equal than two. The rank condition, takes the same form as equations (13) or (14) for any pair of regimes. Indeed, the overidentification of the system occurs if there are at least three regimes that satisfy the rank condition for all combinations. For S larger than two the system has more equations than unknowns, which can have two interpretations:

Firstly, those equations can be thought as overidentifying restrictions. For example, the underlying assumption that α and β are stable through time can be tested. The estimation has a minimum distance interpretation, either as a NLS or as a GMM. In fact, each heteroskedastic regime can be thought as an instrument - where equation (11) is used as the moment condition. Secondly, it can be a factor regression model where the left hand side variables of equations (15) are the estimates (or observable), the variances (σ_η^2 and σ_ε^2) are the unobservable factors, and the coefficients are the weights or factor loadings. In this study, we used the GMM in the empirical application.

A.4 Identification With Common Shocks

The inclusion of common shocks in the model is equivalent to relaxing the assumption on the correlation of the structural shocks. In this case, each regime in heteroskedasticity adds three equations, but also three unknowns, leaving the problem of identification unsolved. For this reason, it is mandatory to impose some conditions on the covariances to be able to use the variation in the second moments to solve the problem of identification. Assume that there are N endogenous variables, K common unobservable shocks, and $S \in \{1, .., S\}$ possible regimes or states. Denote the structural form as follows:

$$A_{NxN} \begin{bmatrix} x_{1,t} \\ \vdots \\ x_{N,t} \end{bmatrix} = \Gamma_{NxK} \begin{bmatrix} z_{1,t} \\ \vdots \\ z_{K,t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \vdots \\ \varepsilon_{N,t} \end{bmatrix}. \tag{16}$$

Where all the shocks are assumed to have zero correlation at all leads and lags,

$$E[z_{i,t}, z_{j,t}] = 0 \quad \forall_i \neq j, \quad i,j \in \{1, K\}$$

$$E[\varepsilon_{i,t}, \varepsilon_{j,t}] = 0 \quad \forall_i \neq j, \quad i,j \in \{1, N\}$$

$$E[z_{i,t}, \varepsilon_{j,t}] = 0 \quad \forall_i \neq j, \quad i,j \in \{1,K\} \ i,j \in \{1,N\}, \tag{17}$$

and where $x_{n,t}$, $n \in 1, ..., N$ are the N endogenous (row vector) variables; where $z_{k,t}$, $k \in 1, ..., K$ are the K unobservable common shocks, assumed to have no correlation, but not identically distributed, with variance $sigma_{z,k,s}$ in state s; and where $\varepsilon_{n,t}$ are the structural shocks, assumed to be not correlated, but not identically distributed, with variance $\sigma_{\varepsilon,n,s}$ in state s. A $N \times N$ is the matrix that describes the contemporaneous parameters,

$$A_{N\times N} = \begin{bmatrix} 1 & a_{1,2} & \cdots & a_{1,n} \\ a_{2,1} & 1 & \cdots & a_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n,1} & a_{n,2} & \cdots & 1 \end{bmatrix}, \tag{18}$$

Where the assumption of normalization has been already imposed (coefficients along the diagonal are equal to one). And $\Gamma_{N\times K}$ are the parameters from the common shocks, where normalization is also assumed; in this case, it implies a unitary impact on the first equation,

$$\Gamma_{N\times K} = \begin{bmatrix} 1 & 1 & \cdots & 1 \\ \gamma_{2,1} & \gamma_{2,2} & \cdots & \gamma_{2,k} \\ \vdots & \vdots & \ddots & \vdots \\ \gamma_{n,1} & \gamma_{n,2} & \cdots & \gamma_{n,k} \end{bmatrix}. \tag{19}$$

Proposition 2 (Rigobon and Sack 2003) *A multivariate system of N equations, with K unobservable common shocks, described by equations (16), (17), (18) and (19) is identified if and only if, for $N > 1$,*

- *the number of states (s) satisfies,*

$$S \geq 2\frac{(N+K)(N-1)}{N^2 - N - 2K} \tag{20}$$

- *if there is a minimum number of endogenous variables (or maximum number of common shocks) that satisfies*

$$N^2 - N - 2K > 0 \tag{21}$$

- *and if the covariance matrices constitute a system of equations that is linearly independent.*

Equation (21) indicates in which conditions one additional regime in the variance-covariance adds more equations than unknowns. Solving for K it is found that identification requires $N < \frac{N(N-1)}{2}$, where the right hand side of this inequality is exactly the number of all possible contemporaneous correlations among structural shocks. There are important implications of proposition 2: First, in the absence of common shocks only two states are required to achieve identification, independently of the number of endogenous variables N. Second, if $K > 0$ and N is finite, the number of states required to achieve identification is always larger than two. The estimation of this model is performed by GMM where the moment conditions are

$$A\Omega_s A' = \Gamma\Omega_{z,s}\Gamma' + \Omega_{\varepsilon,s} \tag{22}$$

where Ω s is the covariance matrix that can be estimated in the data from the observed variables (x_t) in regime s,$\Omega_{z,s}$ is the covariance matrix of the common unobservable shocks in regime s, which given the assumptions in equation (17) is a diagonal matrix, and $\Omega_{\varepsilon,s}$ is the covariance matrix of the structural shocks in regime s, which given the assumptions in equation (17) is also diagonal. The parameters of interest are A and Γ.

A.5 Consistency Under Misspecification of the Heteroskedasticity.

An important question that arises from the previous derivation is the issue of consistency when the heteroskedasticity is misspecified. This section shows that the estimates are consistent even though the regimes might be misspecified. The intuition is that the misspecified covariance matrices are linear combinations of the true underlying ones. Therefore, the misspecified system of equations is a linear transformation of the original problem. If this linear transformation does not drop the rank of the system, the same solution is obtained. It is not proven in this section, but it should be intuitively obvious that the misspecification reduces the power of the test by eliminating the differences across regimes. In this section two cases are evaluated: (i) when the windows of the heteroskedasticity are wrongly specified but the number of regimes is correct, (ii) and when the data has more regimes than the ones assumed in the specification. Without loss of generality, only the bivariate case in which there are no common shocks is discussed.

Misspecification of the windows. Assume that the system is described by equations (8) and (9), and that the data exhibits heteroskedasticity with only two regimes. If the windows are misspecified, the computed covariance matrices are linear combinations of the true underlying covariance matrices. Denote

$$\Omega_{r1} = \lambda_{r1}\Omega_1 + (1 - \lambda_{r1})\Omega_2,$$

$$\Omega_{r2} = (1 - \lambda_{r2})\Omega_1 + \lambda_{r2}\Omega_2,$$

where Ω_1 and Ω_2 are the true covariance matrices describing the heteroskedasticity, Ω_{r1} and Ω_{r2} are the estimated covariance matrices, and λ_{r1} and λ_{r2} are weights indicating how correct the windows are; when they are equal to one, the windows coincide with the true regimes.

Proposition 3 (Rigobon 2003) *Assume the original system satisfies the rank condition (13). If the misspecified heteroskedasticity satisfies the rank condition (13) then the model is identified and its estimators are consistent.*

In other words, if the computed covariance matrices satisfy the rank condition, then the estimates are consistent even if the regimes have been slightly misspecified. On the other hand, if the misspecification is large enough such that the system fails the rank condition, then the coefficients are not identified. Hence, the estimated consistent for small perturbations of the regime definitions coefficients should be consistent for small perturbation of the regime definitions.

Under-specified number of regimes Assume the system is described by equations (8) and (9), and that the data exhibits heteroskedasticity with S^* regimes, where there are no restrictions to the form of the heteroskedasticity. For simplicity denote the variances of the structural shocks in each regime as follows:

$$\sigma^2_{\eta,s} = (1 + \delta_{\eta,s})\sigma^2_{\eta,0} \ \ \forall \neq 0$$

$$\sigma^2_{\varepsilon,s} = (1 + \delta_{\varepsilon,s})\sigma^2_{\varepsilon,0} \quad \forall \neq 0$$

where $\sigma^2_{\eta,s}$ and $\sigma^2_{\varepsilon,s}$ represent the variances of the idiosyncratic shocks in regime s, and $\delta_{\eta,s}$ and $\delta_{\varepsilon,s}$ are the changes of those variances relative to the variances in regime s = 0. Assume that only two regimes are used in the estimation. Without loss of generality assume that the first window corresponds to the first set of $\hat{s} < S^*$ regimes, and the second window corresponds to the second set of $S^* - \hat{s}$ regimes. The covariance matrices of each of the misspecified periods are given by:

$$\Omega_{r1} = \frac{1}{(1-\alpha\beta)^2}\begin{bmatrix} \beta^2 \frac{1}{\hat{s}} \sum\limits_{s<\hat{s}} \sigma^2_{\eta,s} + \frac{1}{\hat{s}} \sum\limits_{s<\hat{s}} \sigma^2_{\varepsilon,s} & \beta \frac{1}{\hat{s}} \sum\limits_{s<\hat{s}} \sigma^2_{\eta,s} + \alpha \frac{1}{\hat{s}} \sum\limits_{s<\hat{s}} \sigma^2_{\varepsilon,s} \\ . & \frac{1}{\hat{s}} \sum\limits_{s<\hat{s}} \sigma^2_{\eta,s} + \alpha^2 \frac{1}{\hat{s}} \sum\limits_{s<\hat{s}} \sigma^2_{\varepsilon,s} \end{bmatrix}$$

for the first window, and

$$\Omega_{r2} = \frac{1}{(1-\alpha\beta)^2} \begin{bmatrix} \beta^2 \frac{1}{S^*-\hat{s}} \sum\limits_{s>\hat{s}} \sigma^2_{\eta,s} + \frac{1}{S^*-\hat{s}} \sum\limits_{s>\hat{s}} \sigma^2_{\varepsilon,s} & \beta \frac{1}{S^*-\hat{s}} \sum\limits_{s>\hat{s}} \sigma^2_{\eta,s} + \alpha \frac{1}{S^*-\hat{s}} \sum\limits_{s>\hat{s}} \sigma^2_{\varepsilon,s} \\ . & \frac{1}{S^*-\hat{s}} \sum\limits_{s>\hat{s}} \sigma^2_{\eta,s} + \alpha^2 \frac{1}{S^*-\hat{s}} \sum\limits_{s>\hat{s}} \sigma^2_{\varepsilon,s} \end{bmatrix}$$

for the second one. The two matrices can be rewritten as

$$\Omega_{r1} = \frac{1}{(1-\alpha\beta)^2} \begin{bmatrix} (1+\delta_{eta,r1})\beta^2\sigma^2_{\eta,0} + (1+\delta_{\varepsilon,r1})\sigma^2_{\varepsilon,0} & (1+\delta_{\eta,r1})\beta\sigma^2_{\eta,0} + (1+\delta_{\varepsilon,r1})\alpha\sigma^2_{\varepsilon,0} \\ . & (1+\delta_{\eta.r1})\sigma^2_{\eta,0} + (1+\delta_{\varepsilon,r1})\alpha^2\sigma^2_{\varepsilon,0} \end{bmatrix}$$

$$\Omega_{r2} = \frac{1}{(1-\alpha\beta)^2} \begin{bmatrix} (1+\delta_{eta,r2})\beta^2\sigma^2_{\eta,0} + (1+\delta_{\varepsilon,r2})\sigma^2_{\varepsilon,0} & (1+\delta_{\eta,r2})\beta\sigma^2_{\eta,0} + (1+\delta_{\varepsilon,r2})\alpha\sigma^2_{\varepsilon,0} \\ . & (1+\delta_{\eta.r2})\sigma^2_{\eta,0} + (1+\delta_{\varepsilon,r2})\alpha^2\sigma^2_{\varepsilon,0} \end{bmatrix}$$

where

$$\delta_{\eta,r1} = \frac{1}{\hat{s}} \sum_{s<\hat{s}} \delta_{\eta,s}, \qquad \delta_{\eta,r2} = \frac{1}{S^*-\hat{s}} \sum_{s>\hat{s}} \delta_{\eta,s} \tag{23}$$

$$\delta_{\varepsilon,r1} = \frac{1}{\hat{s}} \sum_{s<\hat{s}} \delta_{\varepsilon,s}, \qquad \delta_{\varepsilon,r2} = \frac{1}{S^*-\hat{s}} \sum_{s>\hat{s}} \delta_{\varepsilon,s} \tag{24}$$

Proposition 4 (Rigobon and Sack 2003) *Assume the true heteroskedasticity is described by S^* regimes, and that those covariance matrices satisfy the rank condition (13). Assume that only two regimes have been used in the estimation, then if the following conditions are satisfied the system is identified and its estimates are consistent:*

1. *The misspecified covariance matrices have to exhibit heteroskedasticity: $\Omega_{r1} \neq \Omega_{r2}$*

2. *The misspecified covariance matrices satisfy the rank condition (13).*

It is important to mention that if the number of true regimes is smaller than the number of regimes used in the estimation, then the system of equations does not satisfy the rank condition. In other words, there is not enough independent equations to identify the system. It should be clear that in those cases the estimates are inconsistent, and the confidence intervals are infinitely large. The two cases analyzed in this section are probably the most common forms of misspecification. However, they are not exhaustive. Depending on the particular application in which the identification is used, and the possible misspecification problems that could be encountered, the consistency of the methodology should be explored further.

B Data Sources

Equity market data are taken from Thomson Reuters Datastream in weekly format, as well as any other variable used as exogenous in the reduced form VAR. ECB's balance sheet data are taken from the European Central Bank Statistical Warehouse. Information about allotments and timing of different monetary announcements have been obtained from the ECB's official internet site, under the section "Press Conference".

C Graphs

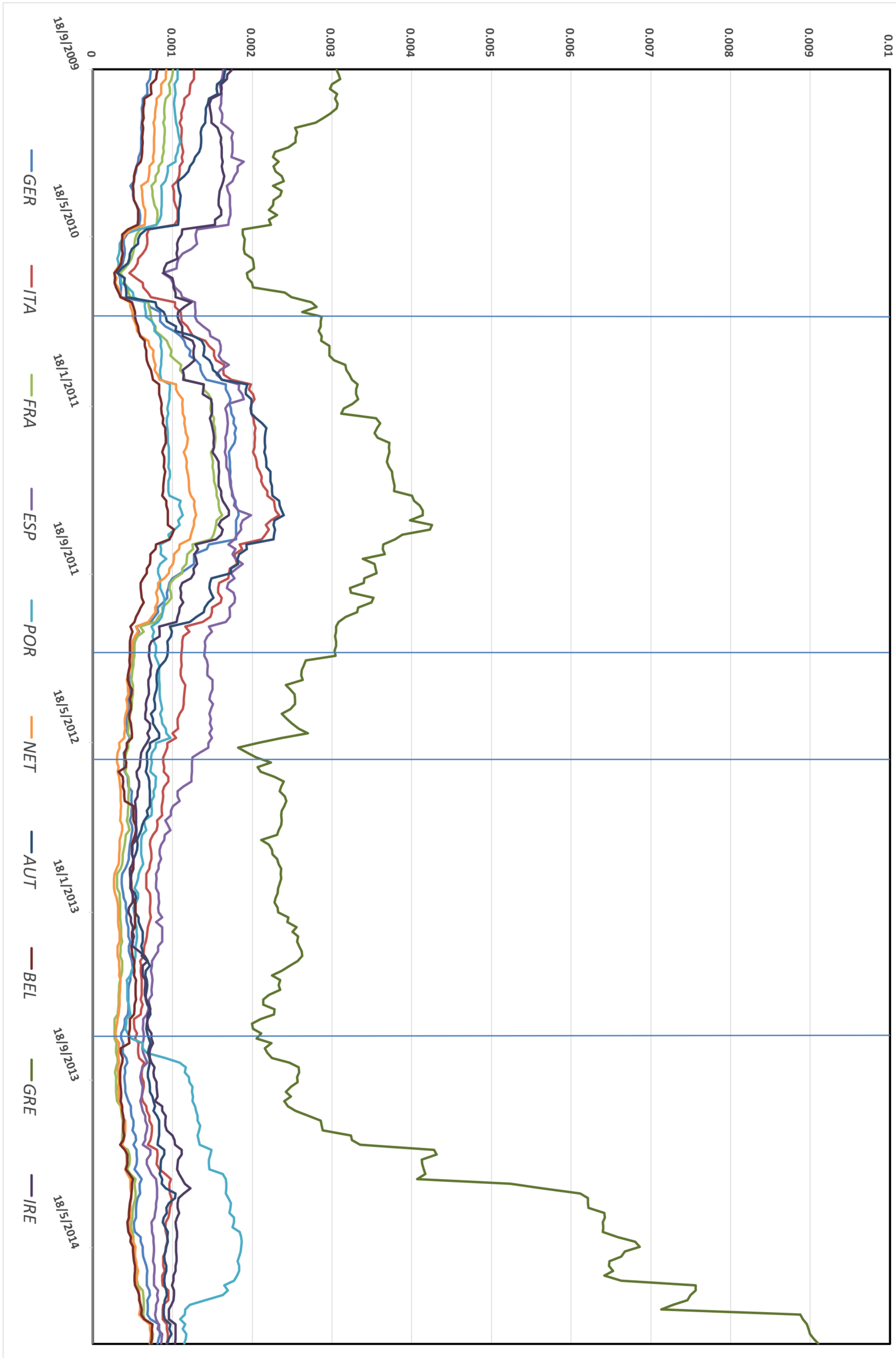

Figure 1: Regimes Selected through Variance present in Equity Returns

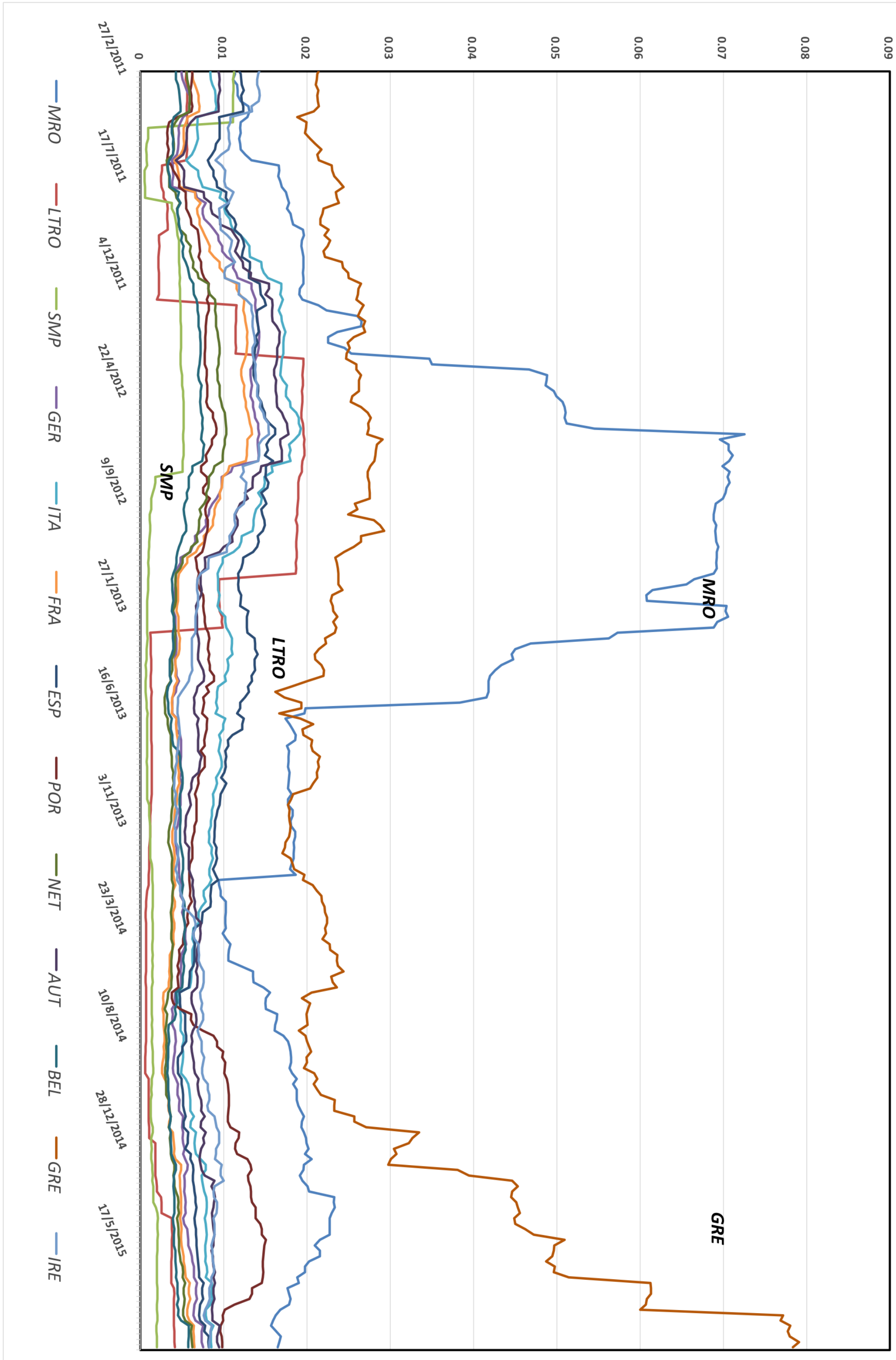

Figure 2: Regimes Selected through Restricted Model Residuals

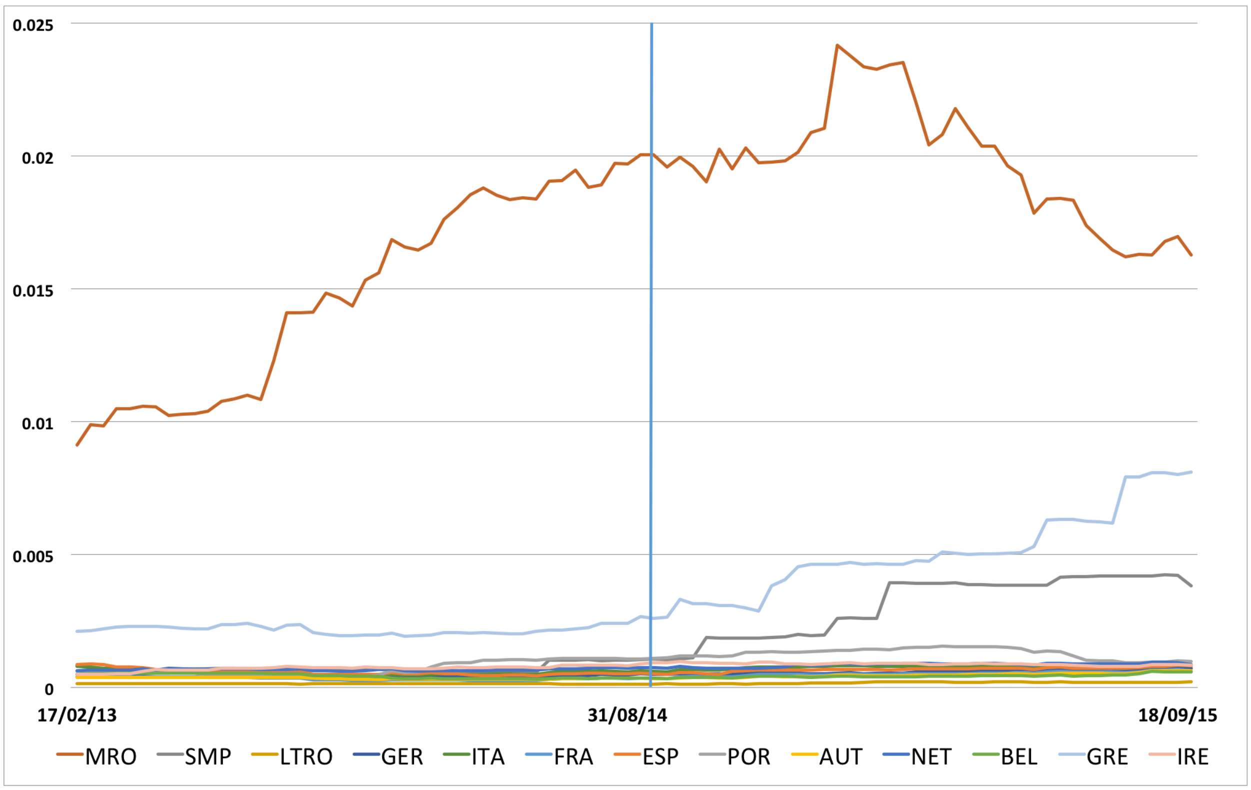

Figure 3: First regime (right) and second (left) · Feb. 2013 - Sept. 2015 · 93 Observations