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Institute of Economic Studies

MASTER'S THESIS

Interest rate pass-through in the Eastern Europe

Case of Albania – An empirical Analysis

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently; using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, January 4, 2016

Signature

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I dedicate my work and efforts to my family.

Abstract

The study of interest pass through has been on the core attention of researchers since it serves as an incentive to evaluate the accuracy of monetary policy transmission mechanism. Therefore there are a lot of studies conducted under this topic encompassing a large number of countries and data.

My aim, inspired by the great previous works, is to develop the same topic but by focusing on Balkan countries and more specifically on Albania. Being a developing country located on the heart of Balkan while aspiring the EU integration, Albania has gone under a considerable number of economic reforms which are also reflected on the degree and speed of transmission of policy rates to landing rates and on the determinants of such rates.

Crisis of 2008 had a global impact but yet several conducted studies revealed that Albania was not directly affected by it. My contribution to this thesis consists in measuring how the pass-through mechanism performance was affected by the crisis and the implications derived from it.

Keywords Interest rate, pass-through, estimation, monetary policy

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Acronyms

IR	Interest rate
PR	Policy rate
MP	Monetary Policy
ECM	Error Correction Model
M6D	6 Month Short term deposit rate
M36D	36 Month Long term deposit rate
M6C	6 Month Short-term credit rate
Y5C	3-5 Years long-term credit rate
GDP	Gross Domestic Product
ADF	Augmented Dickey Fuller Test
PP	Phillips-Peron test
KPSS	Kwiatkowski, Phillips, Schmidt, and Shin test
NBFI	Non Bankinf Financial Institutions

Master's Thesis Proposal

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Proposed Topic:

Interest Rate Pass-Through in the Eastern Europe: An Empirical Analysis

Motivation:

The study of interest pass through has been on the core attention of researchers since it serves as an incentive to evaluate the accuracy of monetary policy transmission mechanism. Therefore there are a lot of studies conducted under this topic encompassing a large number of countries and data.

My aim, inspired by the great previous works, is to develop the same topic but by focusing on Balkan countries and more specifically on Albania. Being a developing country located on the heart of Balkan while aspiring the EU integration, Albania has gone under a considerable number of economic reforms which are also reflected on the degree and speed of transmission of policy rates to landing rates and on the determinants of such rates.

Hypotheses:

Hypothesis 1. The 2008 global financial crisis has a small impact on the long run past through interest rate in developing countries of eastern Europe.

Hypothesis 2. The interest pass through from monetary policy rates to lending rates varies over time within the characteristics of a given economy.

Hypothesis 3. Foreign exchange flexibility regime, lower liquidity ratios, competitive banking sectors, inflation rate increase and better asset quality lead to a higher pass through rate.

Hypothesis 4. Interest pass-through tends to be low for overnight deposit rates, but becomes noticeably higher for short- to long-term deposit rates.

Methodology:

Since the crucial objective of this paper is to study interest rate pass through and to identify the determinants of the effectiveness of interest rate transmission, a VAR model—with interaction terms that will allow relationships between the endogenous variables in the VAR to vary with the potential determinants of the effectiveness of transmission—serves for this purpose.

The VAR model can then further be used to measure the impulse response functions that might vary based on different constellations of such factors. This strategy allows a better understanding of how the degree of pass-through might change—and by how much—if, for instance, a country successfully implements an economic strategy, improves its regulatory legislation or moves from a fixed exchange rate to a more flexible exchange rate regime.

Outline:

1. Introduction
2. Literature review
3. Interest rate pass through
   3.1 Comparative approach between Balkan Countries and Eastern Europe Countries
   3.2 Case study: Mechanism of Interest rate pass through in Albania
4. The Empirical Model
   4.1. Theoretical background
   4.2. Methodology framework and data
5. Model building and econometric framework

6. Long-run and short-run perspectives of interest pass through
7. Conclusion

Core Bibliography:

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2. “Impact of bank competition on the interest rate pass-through in the euro area“ Michiel van Leuvensteijn , Christoffer Kok Sørensen , Jacob A. Bikker and Adrian van Rixtel, 2008

3. “Interest Rate Pass-Through in South East Europe: An Empirical Analysis“, Goran Petrevski and Jane Bogoev, 2012

4. “Assessing the Determinants of Interest Rate Transmission Through Conditional Impulse Response Functions“, Christian Saborowski and Sebastian Weber, January 2013

5. “Exchange rate pass through in Albania“, Klodiana Istrefi and Valentina Semi, 2007

6. “Interest Rate Pass-Through in Central and Eastern Europe“ - Balázs Égert, Jesús Crespo-Cuaresma and Thomas Reininger

Author **Supervisor**

1 Introduction

Monetary policy is the core process through which the central bank authority defines the economic strategy that needs to be followed per country. Defining monetary policy therefore is one of the most important challenges of a central bank, since from its implementation depends the economic future of a country. If I would refer to monetary policy like Cuaresma, Egert and Reininger did in their paper I would state, "*Monetary policy has long been a Mecca of economic research as many economists had put pen to paper in an attempt to scrutinize its effect on the real economy*" 1. It is farther generally known that despite whether it might be effective or not in the long run, it definitely reshapes the effectiveness of economic activity in the short run. Thus, the importance of monetary policy is to such a degree that even the smallest of changes in the interest rate could result in larger changes in output.

Pass-through on the other side measures the degree of speed and efficiency to which monetary policy is transmitted to other banks and financial institutions and then afterward applied. In this context if monetary policy were the Mecca of the economy, pass-through rate would be the prophet itself spreading the good word from Mecca to whole humanity. As such after the monetary policy is defined, pass-through is the second most important thing after monetary policy itself, since the performance of

[1] "Interest Rate Pass-Through I new EU Member States: The case of the Czech Republic, Hungary and Poland" Jesus Crespo-Cuaresma, Balazs Egert and Thomas Reininger, 2004

this transmission mechanism whether being effective and reacting to changes on a high speed or not defines the economic shape of a country.

The country of my scope, Albania, located in the center of the Balkan, belonging to the group of developing countries and aspiring the EU integration, will go through the study of pass through for the first time. I will thus bring value to the topic by making the pass-through estimations for Albania inspired by the methodology used by Alexander Tieman in his paper: "Interest rate pass-through in Romania and Other Central European Economies". Moreover, I will further divide the data in before and after crisis by conducting a second estimation and measuring how the crisis has affected this small country in the heart of the Balkan - seen from the macroeconomic pass through perspective.

To have a full overview of my idea and of the conclusions that will be generated after the detailed research and data estimation, this thesis will be divided in few chapters.

After the introduction chapter that clarifies the concepts, the ideas behind the chosen country, and the aim of the study, the second chapter that follows afterward is literature review. Through the summaries of the previous works, this session gives light to the implications, impacts and the diversified responses to the speed of delegation and implementation of monetary policy depending from countries and time periods, seen from the time perspective of whether the financial system was operating under a financial crisis or economic boom.

The third chapter of my thesis will give an economic background overview of the country of scope, Albania, focusing mainly on the operating activities of Bank of

Albania, stressing out the monetary policy strategy and giving light to the economic performing activity of the country in terms of economic growth and developments.

The fourth chapter consists of methodology and data – a brief overview of the chosen macroeconomic variables and the methods used to effectively measure and clearly evaluate them is described at this stage of my study. The route of estimations for my model to succeed starts with unit root test for stationary including 4 tests, namely: 1) Augmented Dickey – Fuller test (ADF), 2) Phillips-Perron test (PP), 3) Dickey-Fuller GLS test (DF GLS) and 4) Kwiatkowski–Phillips–Schmidt–Shin test (KPSS)). Meanwhile for estimating the pass-through itself we used the co-integration method – Engle & Granger and Johansen tests – for the long-term relationship. ECM (Error Correction Model) helped us to further estimate the connection between the variables for the short-term relationship. Post estimation analysis gives light to the future performance of the series in terms of time, and therefore Autocorrelation is an easy way to be used in this case to further predict some future behavior of our data.

In the fifth division of my thesis, the economic model is conducted by using the tests and the methods explained in the previous chapter. Moreover the results of the estimations are explained in details helping us to lead to the needed conclusions. To come to concrete outcomes, and at the same time to some good reasoning behind our choices and estimations, at this phase of the work of my thesis it is as well important to highlight the hypothesis around which our conclusions would vary and our estimations would depend. The two hypotheses chosen for estimating the econometric model of our study are:

1) *The 2008 global financial crisis has a small impact on the long run past through interest rate of Albania*

2) *Interest rate pass through is greater for credits and longer maturities than debit and shorter maturities.*

The thesis finalizes with the concluding remarks where the contribution given to the topic of scope is highlighted and the concluding points emphasized.

2. Literature Review

As interest rate pass through is an important feature of macroeconomic policy transmission mechanism, several studies are conducted under this topic. Therefore the literature review I am about to show below sees interest rate pass through on different perspectives.

One perspective of the papers develops the issue empirically by revealing through the data analysis what affects interest rate pass through and how it behaves under changing conditions on specific segment of time, starting from few months to several years. Another way interest pass through phenomena is seen is through the theoretical analysis of the economic background of different countries. As such, few of the several papers I went through for my topics of concern are summarized in three separate sub-sessions depending on the aspect of pass through that they cover. First of all we start with a general overview of pass-through concept and its behavior in Europe. Then we continue with relevant cases when the pas-through issue has been analyzed for the Albanian case, and finally we further tend to show the position of Albania during the crisis as per the studies already conducted on the topic.

2.1 Interest rate pass-through in Europe

Horvath and Podpiera (2009) in their paper “Heterogeneity in Bank Pricing Policies: The Czech Evidence” measured the pass through rate journey from the markets to bank interest rates through the use of panel co-integration methods. As such what they could find is that the pass through rate in the short term obviously depends

among banks, but in the long term it becomes stable and homogenous, proving this way the one price low. Continuing with their research the authors found out that among Czech banks exists a landing relationship, where stable banks require their compensation through a higher spread.

As the study focuses on the years up to 2008, the researchers also distinguished the potential impact the financial crisis of 2009 could have. According to them, there was the tendency of a slower pass through for several loan types and a higher heterogeneity of the rates assigned to the given loan. For the future they suggested to focus mainly on the domestic interest rates, from the short term ones to the bank ones.

Continuing with the previous contributions done under the same topic, among the most important ones to be mentioned and distinguished is of course the paper of Balazs Egert, Jesus Crespo-Cuaresma and Thomas Reininger (2006) "Interest Rate Pass-Through in Central and Eastern Europe: Reborn from Ashes Merely to Pass Away?" In their study what they highlight is a detailed understanding of interest pass through in the geographical zone of Central and Eastern Europe (namely Czech Republic, Hungary, Poland, Slovakia and Slovenia). Thus, the study revealed that for overnight rates the pass through is quite low compared to deposit rates as well as corporate rates which are more sensitive to the changes in policy rates.

Through this paper you can further have a better understanding of pass - through rate seen from different perspectives - this by having a critical approach even toward the previous studies done - in terms of empirical methods and econometrics estimations. Seen from the *changes in time* perspective, pass-through rate results to react with the

time passing by, being affected by the transition phase or even the development boom that financial and banking sectors went through with time.

As interest pass-through is a general phenomena, the paper of Nikoloz Gigineishvili (2011) "Determinants of Interest Rate Pass-Through: Do Macroeconomic Conditions and Financial Market Structure Matter?" adds value to our topic of concern and matters to be mentioned among the most important studies done for the topic, since it further explains the phenomena and helps us to be more precise and detailed in the path of study of the same topic.

According to Gigineishvili it is important to have an all-inclusive coverage of the study of interest rate in terms of numbers of countries included to the study as well as of the level of development. Thus, with the aim of measuring the level of heterogeneity of interest rate the author of the paper made a cross-sectional study by including data from around 70 countries, from all economic level with extremes like "very low" and "highly developed" countries included. As "study parameters" to evaluate the degree of strength of interest rate pass-through he used the financial as well as macroeconomic structural variables. As such, he divided these variables in two groups: 1) the variables that have a positive relationship with pass through rate are: Inflation, interest rate, GDP/capita, credit quality etc; 2) the variables to have a negative relationship with pass through rate are (especially) the excess liquidity and the volatility of market. These studies resulted to be very crucial for structuring the monetary framework of a country, closely related to the degree of strength of the pass through rate. In other words, this means that by knowing a specific country features

(large or small, conservative or tolerant economy etc,) we can adopt the policy that better serves the country to have a strong pass-through transmission mechanism.

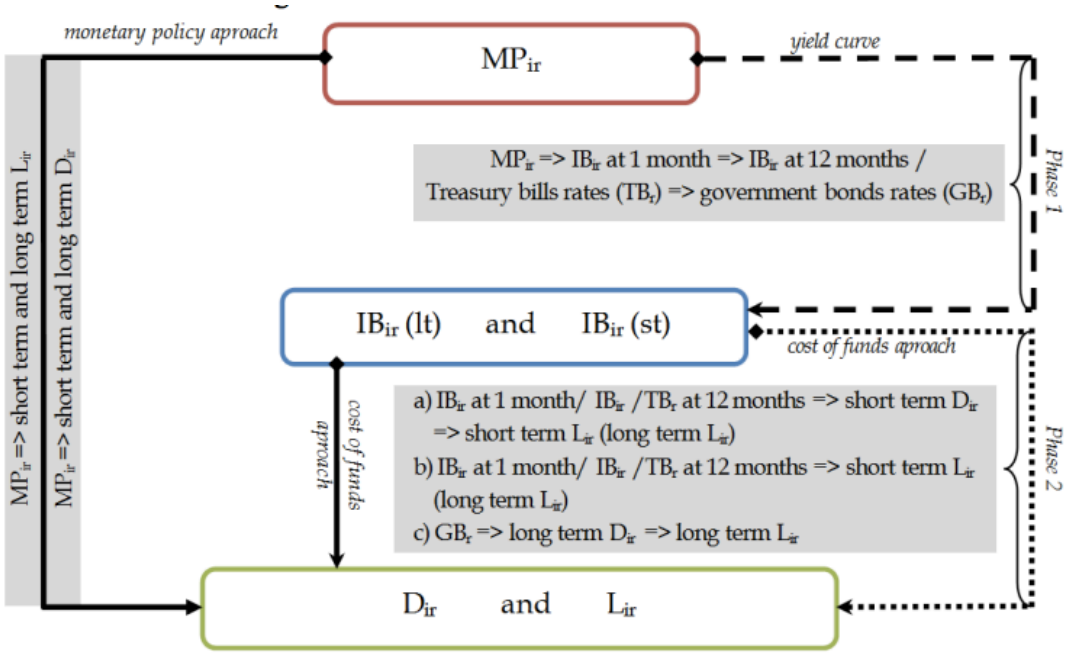
The pass-through transmission mechanism in itself is very important because the stronger the pass-through rate the better does a central bank achieve its goals. Thus, among other things a good transmission mechanism of pass-through rate skips the difficulties of a direct communication through the policy framework of central banks to other banks and financial institutions would conclude the author.

Anamaria Illes and Marco Lombardi (2013) on their paper "Interest rate pass-through since the financial crisis" showed a detailed study of pass through from the last financial crisis of 2009 and on. The aim of their study consisted in evaluating the policy rates on the main European countries by further measuring how efficiently the implementation of the after crisis policy and measurements were reflected on the pass through rate. They further investigated whether the pass-through ability from central banks deteriorated or improved. As such, they concluded that within the European union area, despite the somehow homogenous approach of the European Central Bank measures, there was still difference within the central bank policy framework followed on country level. Italy and Spain were the countries that were still facing high banking cost, even due to the fact that the crisis was felt on a relatively higher degree in these two countries. Meanwhile, on the other side, Germany and France showed a decrease in the landing rates with the passing of the years from the crisis and on. At the end Illes and Lombardi concluded that these diversified courses of landing rates are an obvious hint of the way monetary policy should be structured.

Another interesting perspective through which interest rate pass-through is seen is bank competition. It is exactly this phenomenon that the working paper series of IMF (2008) "Impact of bank competition on the interest rate pass-through in the euro area" reveals. In other words, what the authors wanted to emphasis in this paper is the way the degree of competition affects the pass through rate transmission speed. Based on the found evidence, the authors stated that when there is high competition the spread between the bank rate and market rate is lower. Further they showed that banks tend to put higher prices to the loans in the countries where the bank competition is also higher. And, when the competition of loan market is higher the bank spread on time deposit and current account is higher as well. These results lead to important policy implications and as such must be taken into account since they give hints that the increase of competition in European banking sector will increase the effectiveness of transmission mechanism.

While keeping the same focus but seeing it from different perspecitves, the paper of Dan Chirlesan and Marius Constantin Apostoaie (2012) "The Interest Rate Pass-Through from Policy rates to Interbank Rates in the Romanian Financial System" is among the ones I choose as a good point of reference for two reasons, first of all it focuses in pass-through behavior in Romania, being a transition country in between south eastern Europe and Balkan, two areas of our concern, and further measures the pass through from the Interbank perspective. As such the authors state that the fluctuations of interest rate was different under different economic conditions. Thus, interest rate they would find out was quite slow from 2003 until 2008 when the crisis directly had its impact all over the country. After the crisis, the interest rate according to them resulted to be quite violent. Under these specific conditions, where crisis had

its huge impact on monetary policy implementation and behavior for this country, among the most important factors that lead to such a violent performance were missing financial resources, the lost of importance of economic indicators, especially the macro one as well as the lost of trust among the institutions. A final point of the paper worthy to be pointed out is the way the authors calculated the development of pass through in terms of the different interest rates from money rates to bank rates for short as well long terms as below stated from the picture taken from the paper and structured by the authors themselves:



One of the latest papers of Euroean Central Bank belonging to summer estimations, Matthieu Paries, Diego Moccero, Elizaveta Krylova and Claudia Marchini (August 2014) ”The retail bank interest rate pass-through, the case of of the Euro area during the financial and sovereign debt crisis” finalizes my literature review for Euro Area and the interest rate perspective in term of years and location. Thus, the paper is important to conclude the saga of reviews for this topic because fully covers the issue

with the latest updates, and of curse largely highlights the crisis and post crisis behavior of the Euro zone, as a crucial part of the economic reality in terms of pass-through since the financial crisis fully redimensioned the interst rate behavior and its implications.

With all this being said, this last summer report observed the euro area in a long term perspective where the crisis of 2008 and the sovereign debt crisis of 2010 despite few periods of reccessions also reveal about the performance of business cycles as well as multidimensional perceptions of risk especially the credit one. Since the observations of the Central Bank included the four largest euro zones, the adjustment and precautions of the Euro central bank resulted to lead to a decrease of banking rates. Financial shocks as well have been quite present in this perspective for the amplification of the business cycles in the euro zone. Under this reality ECB followed the macro policy of standard as well as non-standard measures that would help to deteriorate the limitations as well as the risk arising from the non-proper disordered function of the banks. In other words, the authors would conclude that fragmentation of the credit market especially would be reduced and banks performance would be strengthened accordingly.

2.2 Interest rate pass-through in Albania

As Albania is the country on the core attention of my research, some important analysis done on the topic for this country needs to be summarized as well.

Istrefi and Semi (2007) in their study paper “Exchange rate pass through In Albania” gave light to the importance of exchange rate for the pass through mechanism

operating in the mentioned country. In this context, the first reason why this rate is quite important in the transmission mechanism derives from the fact that Albania uses its own currency ALL within its geographical border. Meanwhile, the EU aspiration and the favorable geographical location make the euro-lek trade quite intensive and noticeably higher compared to the trade with other currencies. Under this framework this exchange rate channel serves as well as a good tool in explaining the inflationary movements and effects In Albania, all in all together affecting the policy rate transmission mechanism in this country.

In this paper, the use of VAR models and the impulse response revealed important results in terms of pass through ability. So, while keeping almost the same trend as the results of other countries, the pass-through in Albania, according to the authors of the paper, for the period 1994-2004 was quite complete even though following a decreasing trend.

The decline of pass through in time was also considered to be in line with the empirical results of other countries falling on the same category as Albania still does – developing countries. Still under the exchange rate category estimation the pass-through rate falls in two categories: 1) higher when Albanian lek depreciates toward the foreign currencies, and 2) lower when Albanian lek appreciates toward the foreign currencies.

Ilda Malile (2013), in her paper “Is Interest Rate In Albania non-linear” measures the linearity of interest rate pass-through for a period of 11 years 2002-2013 using monthly data. The author of the paper develops this topic along with the other issue before held studied regarding the asymmetry of interest rate. Based on her findings

we can state that for the defined period the short run T-bills of 6m and 12m have a linear relationship with the policy rate, implying that the pass-through is proactive toward the policy rate defined. Meanwhile, in long term she finds a non-linear relationship between policy rate and interest rate, implying that the pass-through is not that effective for a longer time perspective.

Marta Muco, Peter Sanfey and Anita Taci (August 2004) in their paper "Inflation, exchange rates and the role of monetary policy in Albania" focus on the transmission mechanism and monetary policy strategy during the transition period from the fall of communism in Albania and further. Therefore their study is important in understanding the initial macroeconomic conditions of a new democratic country and the challenges it went through - to better understand the effectiveness of monetary policy of the bank of Albania today. In their work they were focused on how four important nominal variables – exchange rates, interest rates, credit rationing and inflation expectations – could really affect the economy. What they found was that exchange rate would always be a crucial indicator regarding inflation expectations, and therefore exchange and price stability would be closely related. Their estimations revealed that during the first decade of democracy in Albania, the central bank used a forward-looking policy as an instrument that would have a moderate stabilizing effect toward the financial markets and institutions.

Koka, Bozdo and Cuci (2012), focuses its attention on the reshape of the interest rate policy during the crisis. On their paper "The impact of the interest rate policy on the Albanian economic growth" they measure the impact of interest rate on Albanian economy before, during and after the crisis to give this way light to the impact the

financial crisis of 2008 had on the Albanian economy. In their study they would find out that indeed Albania had unexpected shocks due to the crisis of 2008, but it was not felt any overall collapse of the pillars of the economy due to it. Based on the authors of the paper this somehow tiny impact of the global crisis on a small country like Albania is was somehow expected for several reasons. First of all the global crisis emerged on a very developed country like America, impacting directly all the developed countries having similar pillars of financial institutions like America does. In other words, Albania, a small open economy not with a very developed banking and financial system did not have the channels to feel the shocks of the global crisis. Anyway, regardless of this reality, Albanian economy created an anti-crisis package that would encompass several measures to prevent a further deterioration of the economy due to this global crisis. On the spot of the anti-crisis package was of course the interest rate. To encourage an expansion of the economy the monetary policy strategic approach was expansive stimulating this way the reduction of the basic interest rate as a mean that would boost the economy.

These studies are among the first ones to be done on the topic. Taking hints from the analysis and methodology approach used, based on the data of the Central Bank of Albania I will further continue with a long term pass-through estimation in terms of lending rates and deposit rates.

As a summary of the previous contributions done to my topic of interest I would conclude that the interest rate pass-through seems to be among the most important mechanisms, which through its measures give light to the economic performance of a

country and to the speed of adjustment to changes and other ad hoc decisions taken respective to economic crises or other sudden financial changes.

Since one of the hypothesis of the econometric model consists in the impact of the global crisis of 2008, some previous analytical study related to the strength of the Albanian Financial system and the degree of weight of the global crisis toward it better helps in the understanding of the phenomena, and are a good background for the estimations we will further make and the conclusions we will state.

2.2.1 The impact of the global crisis of 2008 in the Albanian financial system

Global crisis of 2008 shocked the economic pillars of the global economy. As such it lead to an emergency of precautions and further after crisis preventive measures to be taken, and to a need of the reshape of the market policy. Albania, a small country in the central of the Balkan, yet could avoid the crisis impact to some extent.

Meka and Meka (June 2012) in their paper "Albanian Financial System in front of global & financial crisis", explain that because of the financial crisis of 2008 Albania was exposed to systemic risk mainly because of the fact that the country is almost a one pillar functional economy- where bank system is the main system to provide funds and to serve as an intermediation tool in the economy. Despite that, the authors believe that Albania was almost uncrippled by this recent global crisis since the traditional business operating in the country made it hard for the crisis of the developed countries to spread even in such a system. Thus, according to them, the country met with the impact of the shocks quite tangentially. The tangent point with

the crisis was reflected at the decrease of remittances, lower degree of investment, decrease in liquidity as well as increase in inflation, which at some point lead to higher interest rates.

As the economic impact we are talking about was a consequence of the crisis itself that was transmitted to Albania through the economic cooperation or communication with the developed countries somehow destroyed by the crisis, for this literature review is also chosen a study regarding the impact of the Greek crisis only – the major explosion of the global crisis of 2008 in Europe – in the Albanian economic system.

Albanian Centre for Competitiveness and International Trade, ACIT, (2012) on their paper "Study of the Economic Impact of the Greek Crisis in Albania" show that a range of Albanian performance indicators from business parameters to services, material refinement and commerce, by the year end 2009 had the worst scales so far. But still the immediate decrease of remittances was the first alarm bell that knocked the Albanian economy. These weaknesses in performance of course lead to a wide range of supportive and protective means by the economic authorities of the country to prevent further deterioration and to encourage further boosting of the economic activity. This way Albanian economy continued with growing parameters in the following years regardless of the global crisis.

London School of Economics, LSE, (November 2010) on their publication "South Eastern Europe after the Crisis" dedicate a whole session to Albanian case on the topic. Basically the approach goes toward the same direction, where the crisis would not directly harm Albania, but still the country would have some indirect effects

because of it, and therefore some precautions were important to be taken. As such, one of the main reforms of dealing with the crisis was the incentive of providing liquidity at reduced costs by cutting the interest rates by ½ percentage points as well as tightening the regulations regarding supervision.

Beside all the analytical framework of the case, I will bring value to the topic by making an empirical estimation of the pass through rate fluctuations before and after the crisis and further conclude on how pass through rate behaved in such a situation.

3. Transmission Mechanism in Albania – Country overview

3.1 National Bank of Albania

The Bank of Albania was established almost twelve years ago in 1992 and it enjoys the attributes of a modern central bank. However the history of the Bank of Albania and the credit and monetary system in Albania is a history closely linked with the preceding monetary institutions, such as the National Bank of Albania founded in 1925 that later on, during the Communist Regime, would be transformed into the State Bank of Albania. [2]

But, the first Albanian National Bank was established on the fourth of October 1913. The head of the State of that time, Ismail Qemal bej Vlora, signed the concession. He further envisioned that Albanians' first Financial Institutions would carry its activity conform the European Standards of the other International Banks. Despite the modern approach of that time, in its beginning, the National Bank of Albania was not seen as a financial Institution that aimed at the profit but rather at the country's development, since it was established in within one year of the Independence.[3]

As already stated at the beginning of this paragraph as well, the Bank of Albania was established in 1992 after the communist regime collapsed, and was one of the first steps toward the economical transformations that the country would undergo in the

2http://www.bankofalbania.org

3Ibid

future and that was followed by the establishment of many others financial institutions, such as Investments Banks, Commercial Banks, Insurance Companies and Brokerages. According to Investiopedia "a *financial institution is an establishment that conducts financial transactions such as investments, loans and deposits. Almost everyone deals with financial institutions on a regular basis. Everything from depositing money to taking out loans and exchanging currencies must be done through financial institutions."*[4]

As the main financial institution of the country, the National Bank of Albania's activity is regulated by the Law 8269 (27.12.1997/On the Bank of Albania) that sets out "*the objectives, duties and relationships with the banking system and the state, organization and management, ownership equity, financial statements and profit allocation."*[5] The Bank of Albania supervises and regulates all commercial banks, exchange offices and other financial institutions; there is also an institution named "Financial Authority, that is in charge to supervise all non-bank and financial institution" [6]

To realize its objectives, Bank of Albania, sets the operational framework of monetary policy instruments used to intervene in the money market. In 2000 it decided to change the existing monetary framework by stopping the use of direct

4 Http://www.investiopedia.com

5 http://www.bankofalbania.org/web/A_brief_history_of_the_Bank_of_Albania_5338_2.php

6 Cibuku, Dorina. *Microfinance in Albania:* The Role of Financial Institutions in Expanding Access to Credit 2012

instruments of control. In the eight coming years the policy followed consisted in two main instruments (administrative decisions of the Bank of Albania):

1) L*imiting the excessive growth of the lending activity of the commercial banks*

2) Setting an obligation for the state owned banks (or the banks in which the state had a share of capital) to respect the minimum level of interest rates announced by the Bank of Albania for term deposits in Lek[7]

Since the banks were not responding positively the need for redesign was spotted, and since then it was decided that the monetary policy was to be implemented through indirect instruments. [8]

3.2 Monetary Policy

"*Monetary policy is the set of principles, measures and instruments, through which the central bank intervenes in the financial markets and in the economy, to achieve its price stability objective*[9]" By its mere definition from the central bank authorities in Albania, monetary policy is an instrument through which the economy of a country is controlled. As such there are several continual studies that have been developed by being prudent to always make the necessary updates as per recent economic regional and global changes.

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7 http://www.bankofalbania.org/web/Monetary_Instruments_10_2.php

8 Ibid.

9 Monetary Policy document; Bank of Albania (file:///Alex%202014/Monetary_Policy_Document.pdf)

Price stability is thus the main goal of each central bank, as such even of the Albanian one that concretely struggles to keep it within the limit of 3%.

The Supervisory Council of the Bank of Albania, which operates independently, designs monetary Policy in the Republic of Albania. On a year basis the supervisory council generally has 16 scheduled meetings, where in more than half of them the meetings consist in approving as well as reviewing the specific reports related to decision making and strategy applying goals.

To have an effective strategy of the monetary policy designed as well as an accurate implementation, the council must have a close cooperation with the external and internal audits to ensure its members are fully aware and informed about the accuracy, efficiency and effectiveness of Bank of Albania management and internal control systems[10].

Based on the Monetary Policy Document - the main guideline for an effective planning strategy of the Monetary Policy of the country -, there are sets of principles that need to be followed to accurately formulate and implement the monetary policy. Thus, the main ones, which for the purpose of our study need to be highlighted in this paper as well, are:

- *Monetary policy guarantees price stability in the economy*
- *Monetary policy is balanced*
- *Monetary policy is robust*

[10] https://www.bankofalbania.org/web/pub/1_activity_of_the_sc_en_7474_1.pdf

- *Monetary policy is transparent*[11]

3.2.1 Inflation target

Principles are an important mechanism through which monetary policy planners define their objectives. As a rule of thumb, it is already known that the main objective is always price stability. Bank of Albania, by keeping in control the price level to ensure the price stability enhances the growth of the country in long term perspective and reduces the riskiness in the economy. This way, monetary policy can control unexpected fluctuations when they might occur but still cannot be used as a mean that boosts growth.

Price stability - the major goal of the monetary policy – is actually achieved by keeping the inflation target under control. Thus when we said above that the definite macroeconomic goal for Albania is its price stability to be at 3%, what it was meant in quantitative terms was that the change in consumer prices should and must not exceed the level of 3%.

As a matter of fact, keeping the change in consumer prices up to 3% is not always possible due to sudden events out of the scope of central bank policy. Thus, at some point in time consumer prices will fluctuate out of monetary policy benchmark. Still, regardless of the reason of consumer prices deviation, monetary policy and central bank will always focus in keeping its change to 3% for the long-term perspective.

Price stability is of course a reasonable and understandable goal of each monetary policy, as the main way to enhance economic security in a country. When

[11] Bank of Albania, Monetary Policy Document, January 2015

distinguishing the Albanian case we can see that it is specifically defined at the level of 3%. Therefore, after some research, the consecutive paragraph will spot some reasoning behind this choice.

Below table shows the inflation targeting for 26 countries of the world varying from least developed to the most developed ones. Quite noticeable is the fact that developed countries regardless of their geographic position (Europe, America, Canada or Australia) tend to stay toward the same level of the change in consumer prices, namely to the level of 2%. Further, while moving our focus to the developing countries and the less developed ones, we notice that the inflation target keeps an increasing trend that goes in line with the decreasing trend of the economies of the countries of our scope.

Figure3.1 Inflation target

Inflation targeters

There are 26 countries that use inflation targeting, fixing the consumer price index as their monetary policy goal. Three other countries—Finland, the Slovak Republic, and Spain—adopted inflation targeting, but abandoned it when they began to use the euro as their currency.

Country	Inflation targeting adoption date	Inflation rate at adoption date	2009 average inflation rate	Target inflation rate
New Zealand	1990	3.3	0.8	1 – 3
Canada	1991	6.9	0.3	2 +/- 1
United Kingdom	1992	4.0	2.2	2 +/- 1
Sweden	1993	1.8	-0.3	2 +/- 1
Australia	1993	2.0	1.9	2 – 3
Czech Republic	1997	6.8	1.0	3 +/- 1
Israel	1997	8.1	3.3	2 +/- 1
Poland	1998	10.6	3.8	2.5 +/- 1
Brazil	1999	3.3	4.9	4.5 +/- 2
Chile	1999	3.2	1.5	3 +/- 1
Colombia	1999	9.3	4.2	2 – 4
South Africa	2000	2.6	7.1	3 – 6
Thailand	2000	0.8	-0.9	0.5 – 3
Korea	2001	2.9	2.8	3 +/- 1
Mexico	2001	9.0	5.3	3 +/- 1
Iceland	2001	4.1	12.0	2.5 +/- 1.5
Norway	2001	3.6	2.2	2.5 +/- 1
Hungary	2001	10.8	4.2	3 +/- 1
Peru	2002	-0.1	2.9	2 +/- 1
Philippines	2002	4.5	1.6	4.5 +/- 1
Guatemala	2005	9.2	1.8	5 +/- 1
Indonesia	2005	7.4	4.6	4 – 6
Romania	2005	9.3	5.6	3.5 +/- 1
Turkey	2006	7.7	6.3	6.5 +/- 1
Serbia	2006	10.8	7.8	4 – 8
Ghana	2007	10.5	19.3	14.5 +/- 1

Source: International Monetary Found[12]

Thus, obviously, we can conclude that the higher the inflation target of a country the less developed the economy of the country is. Seen from this perspective, Albanian's inflation target stands indeed to quite a strong position by being only 1% higher then the level of consumer prices of the developed countries.

Still, regardless of that, the value of 3% mirrors indeed the fact Albania belongs to the group of countries with an emerging economy. Albania has an open economy, but still a small one. Further, this inflation target reflects the Albanian aspiration toward

[12] http://www.imf.org/external/pubs/ft/fandd/2010/03/roger.htm

the European Union integration while struggling to fulfill its conditions with continual macroeconomic and microeconomic policy developments and strategy updates in accordance with the recent requirements of the European economic evolutions.

3.2.2 Monetary Policy Transparency

The Monetary policy structured and defined by the Supervisory Council of Bank of Albania, enables its transparency through periodical reports available at the Bank of Albania official page on different frequencies. The most popular one is the Quarterly Report, which gives updates on three-month basis regarding the strategy defined for the period and the goals achieved meanwhile. Press conferences of the Governor of the bank of Albania are the most common way of the direct communication with the public where all the decisions from the macroeconomic perspective are communicated. Supervisory Council has its own press releases as well regarding on the issues handled on the specific day of the meeting.

3.3 Financial Sector Structure

Banking sector makes the main pillar of the financial structure of the Albanian market with more then 90 percent of the market. As banking sector will be explained as a separate session, the remainders of the financial sector, which along with the banking sector make the overall financial system in Albania, will follow afterward.

3.3.1 Banking Sector

The chronological summary of the major economic events and implications in Albania since the proper function of its central bank, reveal quite a diverse marathon

of pass-through mechanism performance seen from the perspective of a proper functioning democratic country, and the impact of the global financial crisis and other relevant economic events that might have affected it. As we will go through this further in detail in the following chapters, the first thing to stop by is the number of banks operating in Albania and some background behind it.

As such, based on the Commercial Bank Register information provided at Bank of Albania official page, there are 16 commercial banks that actively operate in Albania namely:

- Banka Kombetare Tragtare (BKT)
- Alpha Bank
- Intesa San Paolo Bank
- Societe Generale Albania
- Credins Bank
- Credit bank of Albania
- Emporiki Bank
- First Investment Bank, Albania sh.a
- International Commercial Bank
- Italian Development Bank
- National Bank of Greece
- Procredit Bank
- Raiffeisen Albania
- Tirana Bank
- Union Bank

- Union Bank of Albania

The below table further summarizes the year when each of the banks was established and its nationality – whether the bank is local, founded from Albanian stakeholders or foreign ones. Likewise, only four banks have been established after the 2000, meanwhile all the rest have been established in the 90' - where Raiffeisen Bank and National Commericial Bank are the oldest ones since 1992. Moreover, after 1992, a pick in the opening of new commercial banks followed in 1994 with four other bank establishments to be continued later on in 1996 and 1999. Among these commercial banks only Union Bank is totally Albanian founded. Credins bank and Societe Genererale bank Albania have partial Albanian founders, and the rest are totally foreign whose majority goes to European founders. This foreign investment toward Albania in terms of the commercial banks, one more time give light to the fact that even though as claimed Albania was not directly impacted by the global financial crisis - since its financial system was new and not so developed compared with the countries where the crisis initially emerged – it is still affected by it indirectly due to the foreign investments and remittances. In other words, the global crisis has weighted on the Albanian economy through degree of exports to the country, where the change in prices had a major impact in the exporting level.

On the banking sector case, one clear example is the general fear people had on continuing their transactions on the Greek banks like Alpha Bank or Tirana Bank the moment Greek had a huge crash due to the crisis.

Table 3.3.1 Commercial banks in Albania

Bank	Year established	Nationality
Raiffeisen Bank	1992	Austria
National Commercial Bank	1993	Turkey

Intesa San Paolo Bank Albania	1994	Italy
Credins Bank	2003	Albania/Netherlands
Tirana Bank	1996	Greece
Alpha Bank Abania	1998	Greece
Societe generale Bank Albania	2007	France/ Albania
NBG Bank Albania	1996	Greece
Pro Credit Bank	1999	Germany
Credit Agricole Bank Albania	1999	France
Union Bank	2006	Albania
Veneto Bank	1994	Italy
First Investment Bank Albania	1999	Bulgaria
International Commercial Bank	1997	Malaysia
United Bank of Albania	1994	Saudi Arabia
Credit Bank of Albania	2002	Kuwait

Source: Bank of Albania

Among them, the top 5 bank deposit providers are shown below. As such Reiffeisen bank is the first bank founded in Albania, and still even today among the biggest ones in providing deposits.

Table 3.3.2 Top 5 banks deposit providers in Albania

Bank	Branch	Founded	Ownership
Raiffeisen Bank Albania	103	1992	Foreign
BKT	61	1993	Local
Credins Bank	47	2003	Local
Societe Generale Albania	43	2007	Foreign
Alpha Bank	42	1998	Foreign

Source: Bank of Albania

As for the lending part, credit sector is mainly intense in the corporate zone where almost 75% of the loans are concentrated. *"Real estate loans account for about 40% of total loans, and overdrafts, equipment purchase, and working capital represented about 25 percent, 17 percent, and 13 percent, respectively, at end-September 2013.*

The share of credit to Small and Medium-Sized Enterprises (SMEs) in total loans was 27 percent in September 2013 (down from 37 percent in 2007) " [13]

3.3.2 Non Banking Sector

Non-banking sector makes a really small percentage of the Albanian financial system, but yet regardless of its size those institutions operate in the market, and the long-term perspective reveals their tendency to hopefully further grow in the future, by making this way banking system less monopolistic in the Albanian financial system. As such, the main non-banking institutions operating in Albania are:

1) Insurance companies – as a matter of fact Albanian insurance companies make one the tiniest insurance market across Europe. As of today there are 10 active insurance companies; Sigma Vienna Insurance Group, Sigal Life Uniqa group Austria, Intersig and SiCRED are the biggest ones. Yet their assets make 1,5 percent of financial system assets, and this low development of insurance companies have been affected by several factors where the main ones to prevail are: low income, lag of the regulation and not a safe record of the claims[14].

2) Investment funds – a new approach on the Albanian financial system, where the first fund began operating just in the beginning of the year 2012. It was Raiffeisen bank Albania that established the first investment fund. The fund was in line with the bank decision to limit its presence in the public debt as a

[13] ALBANIA: Financial System Stability Assessment, IMF, pg 22

[14] Insurance Market in Albania, Ll.M Ina Petraj

way of reducing its risk to the country sovereign. Based on the general director of this bank, Christian Canacaris, this fund will enable clients to invest in government bonds including here treasury bonds, deposits and obligations starting with 5000 ALL [15]. Moreover, the creation of this fund had the huge support of the economic authorities of the country by being considered as a tool that melts the negative impact of restrictions put by the European Union legislation to the banks. The structure of the fund includes Sovereign and Public securities, Cash and Derivatives. For a better overview, the asset allocation of this fund is described by the Prospectus of Raiffeisen invest as in the below table.

Thus, the main instrument of the investment fund is Government securities with the highest target of 80%. Bank Deposit is the second and the last target defined in the fund asset allocation, where clearly the main focus and goal of the fund remain the government securities. Yet its performance and its overall value always depend by the performance of the market and any other external relevant factor.

Table 3.3.2.1 Asset allocation of the first investment fund in Albania

Fund asset allocation			
Instrument	*Minimum*	*Target*	*Maximum*
Securities issued and guaranteed by the government of the Republic of Albania	*30*	*80 percent*	*100 percent*
Securities issued and guaranteed by an EU country or another country approved by AFSA	*0*	*0 percent*	*35 percent*
Bank deposits or CD-s	*0*	*20 percent*	*100 percent*

[15] First Invetsment fund in Albania- topchannel http://top-channel.tv/english/artikull.php?id=4688

Securities issued and guaranteed by local authorities of the Republic of Albania	*0*	*0 percent*	*30 percent*
Units in another collective investment undertaking	*0*	*0 percent*	*30 percent*
Transferable securities and other financial instruments sold in regulated markets or stock exchanges in Albania, EU or other countries approved by AFSA	*0*	*0 percent*	*20 percent*
Financial derivatives	*0*	*0 percent*	*10 percent*

Source: An Investment fund - Prospectus[16]

The following year, by the end of October, it was added another fund by making the whole value of investment fund in Albania to 316000000 EUR.

3) Pension funds – they make a very small percentage of the overall financial system in Albania. In terms of GDP the max value reached was 0,03 percent as per the periodic reports of the central bank.

4) Non Bank Financial Institutions – Investment funds, pension funds and insurance funds are part of the non-bank financial institutions as well, but since they have a relevant share on the market we treated them as separate points.

At the end, despite them, leasing and non-deposit-taking institutions are other small active financial pillars of the financial system in Albania.

3.4 Economic Overview

According to the data provided by the World Bank, Albania's GDP was about 12.92 billion in the 2013 with a population estimated as 2.885 million, that places the

[16] Raiffeisen Invest Sh.A Raiffeisen Invest Euro Fund – An Investment Fund – Prospectus

country through those with upper middle income. [17] In the past two decades Albania has struggled with establishing a credible, multi-party democracy and market economy, and before the global financial crisis it was one of the fastest growing economies in Europe, with a growth rate of 6%, what influenced reductions in poverty. Albania's labor market has experienced dramatic shifts since the early nineties, with employment in the private sector doubling from 1999 to 2013. [18] However, "*key challenges for Albania going forward include early resumption of fiscal consolidation and strengthened public expenditure management, regulatory and institutional reform, reduction of infrastructure deficits, and improvement in the effectiveness of social protection systems and key health services."*[19]

In 2012 Albania experienced a substantial economical slowdown that weakened the economic growth (the growth rate fell from 3.6 % in preceding three years to 1.6 % in 2012) and influenced the budget that left the budget deficit higher than the initially planned. Although the fiscal policy was expansionary in 2013, but by the end of the programmed period what happened is that the country projected an expenditure-led consolidation of public finances.[20] Although the slowdown of the economical growth and the rise of the public debt, the macroeconomic stability has been enhanced by the monetary policy. Headline inflation has been low and stable within the target of the

17 http://www.worldbank.org/en/country/albania/overview

18 Ibid

19 http://www.worldbank.org/en/country/albania/overview

20 http://ec.europa.eu/economy_finance/publications/occasional_paper/2013/pdf/ocp158_en.pdf

Central Bank (2-4%), and reached it lowest moment in 30 January 2013 (3.75 %). [21] But, anyway, this flexibility in the monetary policies is constrained by the high degree of euro-zation of the financial system, "*un hedged borrowers also pose an indirect market risk to the banking system in the event of currency depreciation."* [22]

The European Commission nevertheless suggests that the monetary and fiscal policies should however be accompanied by structural reforms in order to boost the prospects of the future. In other words the legal system should be reinforced and the rule of law strengthen, as well the fight toward corruption and the enhancement of human capital would also boost the prospect of stability. [23]

Still according to the European Commission, Albania tends to break the gridlock by seeking support from the Financial Institution such as IMF and World Bank. This could improve the private sector liquidity and as a result help the re-launching of private investments; although the risks that the economical growth is expected to accelerate from 0.4% in 2013 to 4.2 % in 2016 remains, *"but downside risks remain, in particular as fiscal consolidation needs and the forecast low inflow of remittances will provide little support to domestic demand, while subdued growth in the main foreign markets may dampen export growth prospects."*[24]

Stability and confidence in the monetary policy and in the banking system should be

21 http://ec.europa.eu/economy_finance/publications/occasional_paper/2013/pdf/ocp158_en.pdf

22 Ibid

23 Ibid

24 http://ec.europa.eu/economy_finance/publications/occasional_paper/2014/pdf/ocp198_en.pdf

translated as low inflation expectations. *"A key test of whether a central bank has been conducting successful monetary policy is the extent to which people 'trust' their money."*[25]

An important feature to mention while emphasizing the macroeconomic transmission mechanism is the impact of the crisis of 2008 in Albania. Even though this crisis reshaped the world economic structure and markets, as a matter of fact it was not directly felt in the Albanian economic system, there were shocks but not collapses, and this mainly due to the fact that the Albanian economy is small and the banking system not so sophisticated as compared to the big developed countries directly hit by the crisis [26].

25 http://www.bankofalbania.org/web/pub/BOLLE_MEYER_1310_1.pdf

26 http://www.rebe.rau.ro/RePEc/rau/journl/SU13/REBE-SU13-A3.pdf

4.Methodoly and data

In our paper we sick to evaluate the transmission mechanism of the monetary policy through the interest rate pass-through estimation. We investigate the pass through process from policy rate to market rate for 119 monthly data starting from June 2005 (time series).

There are two stages through which the pass-through mechanism goes, revealing the transmission mechanism of the monetary policy of a country for two intervals. The first interval matches with the transmission mechanism within the market itself, from short –term market rates, to long – term market rates. Meanwhile, the second stage, as a consecutive stage of the first one, reflects how the transmission mechanism within the market further impacts the lending rates and the deposit rates for the banks. This two -step approach is actually called the cost of funds approach developed by DeBondt in 2005[27].

Yet, the costs of funds two-step approach can be merged in one - when assuming the yield curve being stable over time – and measure directly in one single step the impact from policy rate to deposit/loan rates. This method is called Monetary Policy Approach. Moreover, this single step monetary policy approach is believed to have some advantages compared to the previous mentioned cost of funds approach. The first advantage relies on the fact that retail rates are very heterogeneous, and the

[27] Term structure and the sluggishness of retail bank interest rates in euro area countries, Gabe de Bondt, 2005

second one relies on the pass-through analysis estimations. These estimations have recently shown the monetary policy approach to be more important then the cost of funds approach for the transmission mechanism of the monetary policy [28].

All this being said, by taking into account both advantages of one method over the other, and by considering as well the limitations with data source providers, the single step monetary policy approach is chosen for measuring the monetary policy transmission mechanism from policy rate to market rate in the country of our scope, Albania.

Since no study has been done before in this field and by the usage of this method, the contribution given to this work has as well its huge responsibility with it. Thus, going back to the model of scope, the transmission mechanism to be measured would structurally look like:

Policy rate -> Short-term deposit rate

Policy rate-> Long-term deposit rate

Policy rate-> Short-term credit rate

Policy rate-> Long-term credit rate

[28] Convergence in Eurozone Retail Banking? What Interest Rate Pass-Through tells us about Monetary Policy Transmission, Competition and Integration, Harald Sander and Stefanie Kleimeier, 2003

4.1 Reasoning behind unit root estimation and comparative approach among the used tests

As the intention of this thesis is to estimate and evaluate the transmission between the above-defined variables, we will start our work by testing for the stationarity of our data. Thus, unless the variables have the statistical parameters of variance and mean constant with the change of time (integrated of order 0), they are considered to be integrated of order 1, where its mean is expected to become wider and go far from its initial value. This is the moment when such a series is considered to have a unit root [29].

As it is typical for raw data of macroeconomic indicators, our series are non-stationarity and as such they do have unit roots. The presence of unit roots requires us to employ tests for testing their variance.

Augmented Dickey Fuller (ADF) test is the most common test used to test for unit root. Yet there are two more other tests, namely Phillips Perron test and Kwiatkowski-Plillips-Schmidt Shin test to be used for the unit root test. For the most effective measure, we run whole available tests to have optimal accurate results regarding the stationarity of our series.

"*The ADF test tests the null hypothesis that a time series yt is I(1) against the alternative that it is I(0), assuming that the dynamics in the data have an ARMA structure*[30]".

[29] An Introduction to Testing for Unit Roots Using SAS: The case of U.S National Health Expenditures, Donald McCarthy,

[30] Unit root test, page 10 , http://faculty.washington.edu/ezivot/econ584/notes/unitroot.pdf

Phillips-Perron (PP) Unit root test absolutely serves the same purpose like ADF, but there is an important difference between them which makes us to use both test when estimating the data. The difference between them consists on the approach they have for heteroskedasticity and serial correlation found in the errors. Thus, based on the study of Phillips and Perron (1988) when testing for the unit root they decided to skip and be indifferent of any kind of serial correlation during the test estimation. These two tests hold on to the null hypothesis that the series are integrated at order 1. Now while moving on to the next important unit root test used, the first difference we notice is the opposite null hypothesis used. As such Kwiatkowski-Phillips-Schmidt and Shin test - belonging to the group of stationary tests – was introduced for the first time by the year-end 1992. Opposite to the two previous tests, at the null hypothesis of this test it is assumed that the series are integrated of order 0,assuming this way that they are stationary[31].

Running the unit root tests are a crucial step of the model estimation, and further this step is considered as a standard procedure for the econometrics field. The two main reasons of the need of unit root tests are:

1) The information about the order of integration is crucial for the before starting of the estimation of the model
2) As per the intuition of the economic theory, since it is crucial for specific variables to be integrated at some point in time unit root tests are the tool for that estimation.

[31] Unit root test, page 19, http://faculty.washington.edu/ezivot/econ584/notes/unitroot.pdf

4.2 Engle & Granger two-step approach vs Johansen co-integration method

After determining the order of integration of the variables, the following step consists in defining the model where the stationary connection between the variables is present. "*Thus, the necessary criteria for stationarity among non-stationary variables is called co-integration* [32]" Our procedure of work Is consistent toward that criteria, and in the following paragraph the relation between our concrete scope of pass-through estimation with the co-integration method is outlined.

As our macroeconomic series are non-stationary, after testing their unit root, we further continue with the estimation for determining the speed of adjustment of policy rate toward the market rate. To reach our goal we use the two-step procedure by Engle & Granger and determine the long-run relationship between policy rate and market rate for the time frame previously defined. As such, the long – term relationship is very important for determining the effectiveness and efficiency of pass – through mechanism. Yet, at the same time, it is as well quite important to determine how the transmission mechanism behaves in the short run. Therefore, to evaluate immediate reaction of market as the goals are set in the central bank level, through the policy rate, we use the error correction model.

As previously mentioned, our work is inspired by the paper of Tieman. Further, to continue with our methodology explanation, first of all we will define the main equation, based on which the estimations and interpretations will be done. Thus, the relation between the policy rate and market and market rate is expressed by this equation:

[32] Testing for Unit Roots and Co-integration, Bo Sjo, August 2008

$$i_t^{\,m} = \alpha_t + \beta_{11}\, i_t^{\,p} + \varepsilon_1 \quad (1)$$

where the market rate is $i_t^{\,m}$, and $i_t^{\,p}$ $is\ the$ policy rate defined by the central bank. As above shown during the explanation of the monetary policy approach we will use for our estimation, we decided to estimate four separate equations, and to evaluate each of them in turn for coming afterward to the conclusions. The four separate equations depend from the values given to market rate, and we decided to evaluate the transmission mechanism from policy rate to 6MD, 36MD, 6MC, 5YC.

The above-defined equation (1) stands for the long run estimation of the pass through mechanism. Therefore, this equation can be considered as the long run balance toward which fluctuate the short-term movements.

On this scenario Engle and Granger in 1987 suggested the two-step approach where meanwhile the long-run relationship fits in the levels, the following step requires us to regress the first differences of the depended variables from the long-run balance. "*This approach, labeled error-correction, is warranted as long as the dependent and explanatory variables are co-integrated, i.e., both are non-stationary, but there exists a linear combination of these series which Is stationary.*[33]*"* As per our case, the chosen variables, by being macroeconomic indicators, are non-stationary - which as previously explained implies that they are integrated of order 1. The close connection that exists between the two models - error correction and co-integration - is going to be developed during the estimation of the model.

[33] Interest Rate Pass Through in Romania and Other Central European Economies, Alexander Tieman 2011, pg 4

Error correction model is indeed a widely used tool in econometrics decades before even the Engle and Granger approach, where Phillips uses initial versions of the model firstly in 1957, and later on Sargan does the same in 1964. "*The idea is simply that a proportion of the disequilibrium from one period is corrected in the next period. For example, the change in price in one period may depend upon the degree of excess demand in the previous period. Such schemes can be derived as optimal behavior with some types of adjustment costs or incomplete information*[34]*"*.

Thus, all this being said, the error-correction model for the pass-through estimation as suggested by Tieman would be specified like:

$$\Delta {i_t}^m = \gamma_1 + \gamma_2 \Delta {i_{t-1}}^m + \gamma_3 ({i_{t-1}}^m - \beta \ {i_{t-1}}^p - \alpha \ ) + \mu_1$$ [35]

where:

Δ = Difference operator

$\Delta {i_t}^m$ = The first difference of market interest rates

${i_{t-1}}^m - \beta \ {i_{t-1}}^p - \alpha$ = Deviations from the long run relationship in the last period

γ_1 = Constant

γ_3 = indicates the speed of adjustment from the short run to the long run -> this way this coefficient is important to interpret how effective monetary policy is for the

[34] Co-Integration and Error Correction: representation, Estimation, and Testing, Engle and Granger 1987

[35] See Tieman paper again, page 5

transmission mechanism. The higher the value of γ_3, the higher the speed of adjustment and the response of the market toward the policy rate.

Our paper uses ECM to test two main hypotheses:

1) Credit rate has a higher speed of adjustment and as a consequence a more efficient pass through mechanism then deposit rate

2) The global crisis of 2008 was not reflected in Albania in term of macroeconomic indicators, and transmission mechanism performance

Despite Engle & Granger two-step approach we further use Johansen test for the same data estimation, so that we can add further accuracy to our results. Indeed, Johansen test is the most important test when it comes to co-integration [36]. Important point of this step is the reasoning behind the number of lags chosen. Yet both tests are used because they somehow complete each other in the sense that Johansen test is quite fundamental and structured, meanwhile Engel & Granger model has a lot of intuitive interpretation with it.

4.3 Post estimation intuition

After the main econometric model estimations based on the hypothesis we have defined since the beginning, the methodology used in this paper will conclude with some post estimation calculation, which mainly consist of the autocorrelation.

By the general intuition and applied econometric knowledge we know that autocorrelation is a time series estimation that uses the past values to predict the

[36] The Johansen test for Co-integration, Gerald P. Dwyer, April 2014

future As per the meaning of the function itself, autocorrelation correlates this way the series in time to help us predict whether in the future the series will continue the same behavior and be persistent or not. Since autocorrelation is the typical case when future values depend on the past one, it also is the most common tool used for predicting the behavior of the data and estimating whether their behavior is going to be persistent in the future or not. One of the main tools for measuring the future behavior of our variables is the autocorrelation function or as is otherwise known, the correlogram. "*The set of autocorrelation coefficients arranged as a function of separation in time is the sample autocorrelation function, or the acf*[37]"

As the final purpose of our estimation is to evaluate the impact of the crisis in terms of the macroeconomic transmission mechanism, we estimate the model twice depending one two main conditions. In the first case the whole sample is estimated, and the in the second one a double estimation of before and after the crisis is done. To conclude we merge in one the post estimations of the whole sample, and the before and after crisis sample, to have a more clear view of the behavior of the variables in time.

[37] Autocorrelation estimation, Spring 2015, page 3, http://www.ltrr.arizona.edu/~dmeko/notes_3.pdf

5 Model Estimation

5.1 Defining the variables

For estimating the transmission mechanism from policy rate to market rate, a range of variables are taken into consideration including a large time frame of data from June 2005- April 2015 making this way the nr of observation equal to 119.

As such, the chosen variables for the scope of my study are:

Policy rate (IR) – set by the monetary policy of the central bank

6 Month Short term deposit rate (M6D) (market rate)

36 Month Long term deposit rate (M36D) (market rate)

6 Month Short term credit rate (M6C) (market rate)

3-5 Years long term credit rate (Y5C) (market rate)

The data are downloaded from the Bank of Albania.

As a starting point of our transmission mechanism analysis is stationary of the data – measuring whether they have constant mean and constant finite variance over time[38].

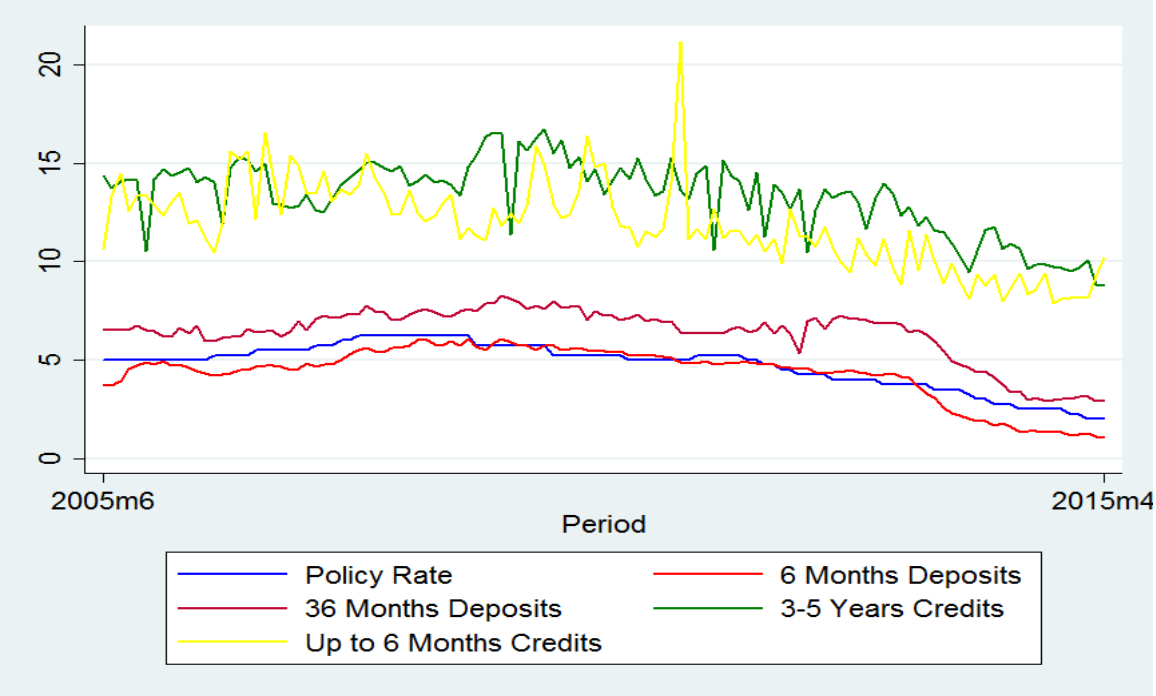
Series of the chosen interest rates exhibit considerable non-stationarity as it is usual for most macro economic indicators. Therefore we check the behavior of the series

[38] Stationarity and non-stationarity times series, G.P Nason April 2014

through the graphical presentation, which provides us the intuitive results to further predict the next steps of the analysis we want to make.

The below graph indeed reveals this non-stationarity, since the data follow some stochastic trend and does not fluctuate around constant mean and constant variance.

Figure 5.1.1: Policy rate and market interest rates (06/2005 – 04/2015)



Source: Author's estimations

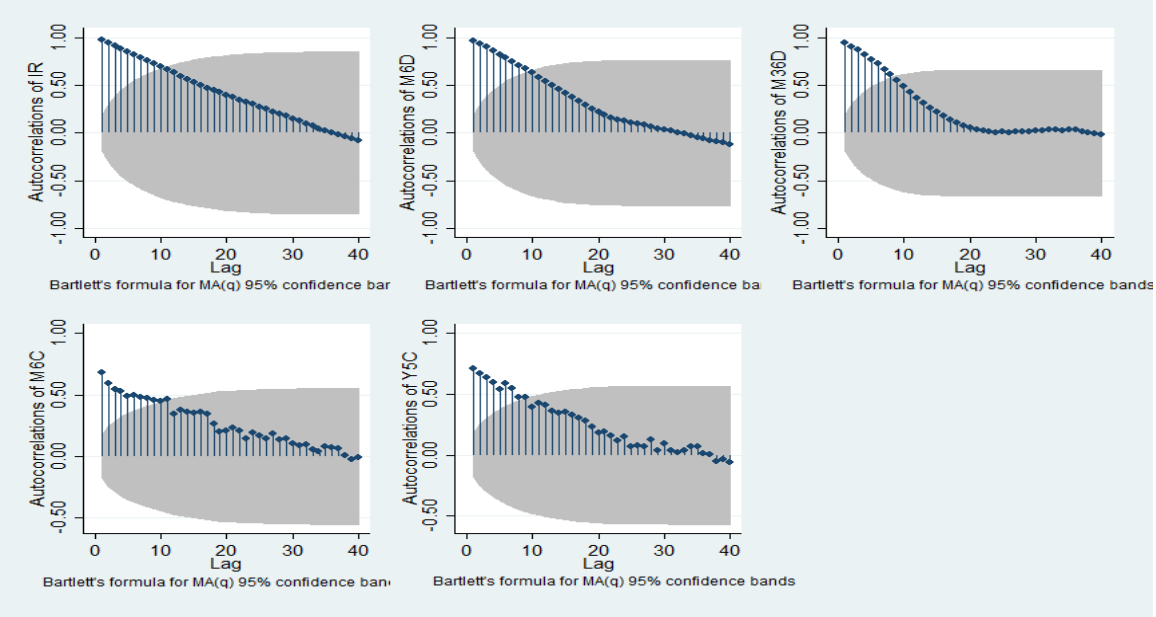
To evaluate the persistence of the series we first look at the serial correlation (the dependence of current period to previous periods) represented by the plot of autocorrelation function (ACF), a moderate estimation of auto covariance and an important mean for evaluating the characteristics of a stationary process[39].

[39] Autocorrelation function analysis, Magherita Gerolimetto 2010

The below autocorrelation function reveal as well that the chosen data are non-stationary, since the significance of correlation coefficients in the autocorrelation function is dying out at a relatively slow pace. Further we can also say that the data are persistent and are strongly serially correlated.

To confirm our intuitive interpretation due to the generated plots, we also test statistically the stationarity of the variables as explained in details in the following session.

Figure 5.1.2: ACF plots for policy rate and market interest rates



Source: Author's estimations

5.2 Stationarity of the variables - Unit root tests

To test stationarity I choose to run 4 statistical unit root tests at the same time, (namely 1) Augmented Dickey – Fuller test (ADF), 2) Phillips-Perron test (PP), 3) Dickey-Fuller GLS test (DF GLS) and 4) Kwiatkowski–Phillips–Schmidt–Shin test

(KPSS)) to increase the accuracy of the results and the confidence of my decision about stationarity of the series, since unit root tests when taken each in turn individually usually have a low power[40].

I run in Stata the 4 tests for each variable. The complete results can be found in the Appendix 1. All tests were performed with added constant and trend (so that it could fluctuate around some deterministic trend). For ADF test, DF-GLS test and KPSS test the max lag was set to 12 according to Schwert rule of thumb, suggested by Schwert in 1989 whose formula looks like:

$$P_{max} = 12\sqrt[4]{\frac{T}{100}}$$

Meanwhile, T stands for the number of observations, which in our case is = 119. This formula was derived due to the Monte Carlo experiment. "*The Monte Carlo experiment examines the effects of model misspecification on the size of unit-root tests* "[41]

To help my interpretation I summarized the main results of these tests in the table below with these specifications:

[40] Volatility Regimes in Macroeconomic Time Series, Stefan Lyocsa, Eduard Baumohl, Tomas Vyrost, 2011, pg 4

[41] Tests for Unit roots: A Monte Carlo Investigation, William Schwert 1989

- For each test I choose Test Statistic and Critical Value at 95% level of confidence.
- For DF-GLS test I choose the optimal lag based on Min MAIC (Modified Akaike Information Criteria). In this case we choose MAIC instead of AIC (Akaike Information Criteria) because such a criteria considers the quasi-likelihood when the function cannot be fully specified [42]
- For KPSS test I choose lag 6 (since max lag is 12 and I evaluated that lag 6 was enough to control for auto correlation)
- PP test was performed for 4 lags using Newey-West heteroscedasticity and auto correlation consistent errors. From the two alternative available test statistic I decided to report the first one, namely statistic **ρ−statistic**, meanwhile τ-statistic can still be found in Appendix 1.

Table 5.2.1 Test for unit root and stationarity

	ADF Test		PP Test		DF-GLS Test			KPSS Test (6 lags)	
	Test stat	Critical value	Test stat	Critical value	Optimal lag	Test stat	Critical value	Test stat	Critical value
IR	-2.344	-3.449	-1.748	-20.772	lag 2	-0.248	-2.991	0.403	0.146
M6D	-1.391	-3.449	-2.208	-20.772	lag 3	-0.328	-2.975	0.419	0.146
M36D	-1.747	-3.449	-2.208	-20.772	lag 3	-0.718	-2.975	0.353	0.146
M6C	-2.736	-3.449	-74.998	-20.772	lag 12	-0.797	-2.776	0.26	0.146
Y5C	-0.558	-3.449	-52.728	-20.772	lag 6	-0.939	-2.918	0.379	0.146

Source: Author's estimation

[42] Model Selection Using Modified Akaike's Information Criterion, Latif, Hossain,2008

ADF test/ PP test/ DF-GLS have the same test hypothesis due to the construction of test:

Null hypothesis: There is unit root present in the series/ Series are not stationary

Hypothesis 1: There is no unit root present in the series/ Series are stationary

KPSS test Hypothesis is different from the ones above, and stands as below:

Null Hypothesis: Series are stationary/ There is no unit root

Hypothesis 1: Series are not stationary/ There is unit root

For IR, M6D and M36D series the ADF, PP and DF-GLS unit root test cannot reject the null hypothesis of the presence of the unit root. At the same time, the KPSS test strongly rejects the null hypothesis of stationarity.

For M6C and Y5C PP rejected the unit root hypothesis, nevertheless the other three tests show that the series are not stationary.

Since none of the series are stationary, we can assume all of them are integrated of order one. Deducing from the Figure 5.1.1, it is unlikely that they have higher order of integration since the pattern otherwise would have been more explosive increasing over time at a higher speed (like for example the exponential or quadratic stochastic trends).

After proving the non-stationarity of the data, to evaluate the transmission mechanism through the Interest rate pass through, we carry on with cointegration analysis and error correction model.

Therefore, to show the transmission mechanism from policy rate (IR) to market rates (M6D, M36D, M6C, Y5C) we start by testing for co-integration.

5.3 Johansen and Engle Granger Co-integration tests

We defined our 4 co-integrated relationships in a way that we assume the particular market interest rate to be driven by the policy rate set by central bank. Hence we will test for co-integration in these four long-term equations:

$$i_t^{SD} = \alpha_1 + \beta_{11}\, i_t^{IR} + \varepsilon_1$$

$$i_t^{LD} = \alpha_2 + \beta_{21}\, i_t^{IR} + \varepsilon_2$$

$$i_t^{SC} = \alpha_3 + \beta_{31}\, i_t^{IR} + \varepsilon_3$$

$$i_t^{LC} = \alpha_4 + \beta_{41}\, i_t^{IR} + \varepsilon_4$$

According to economic theory and monetary policy practice, one can assume that the market deposit and credit rates for various maturities are driven by the policy rate set by central bank and not vice versa. Therefore in co-integrating equations we treat the market rates as dependent variables and policy rate as independent variable. Since policy rate was not being changed for several relatively long periods (see Figure 5.1.1) of time, including its past values would distort the estimation by introducing the (multi) collinearity problem, hence our co-integrating equations reduce to simple linear regression with intercept and current policy rate values on the right hand side. Since we are testing pairs of the variables only, i.e. independent univariate (single) cases, at first we can proceed with simple two-step Engle-Granger procedure.

From the below table we can see the results of the tests for every of the four co-integrated relationships between the particular market rate and the policy rate. Raw results can be found in Appendix 2.

Table 5.3.1 -Augmented Engle-Granger test for co-integration

	Test statistic	5% critical value
M6D	-2.382	-3.388
M36D	-1.705	-3.388
M6C	-4.753	-3.388
Y5C	-4.325	-3.388

Source: Author's estimations

The summary results of Appendix 2 can be found in the above table. To better understand these results, we first state the hypothesis, which in our case would look like below:

Null hypothesis: There is no co-integration

Hypothesis 1: There is co-integration

For the both short-term and long-term deposit rates the particular test statistic is smaller in absolute value than the critical value, thus we do not reject the null hypothesis, which suggest no co-integration of these variables with the policy rate. For the other two series, however, the situation is different; we can reject the null hypothesis of no co-integration at sufficient 95% level of confidence. Thus our first step in measuring the transmission mechanism of pass through due to the Engle Granger model test, reveals that there is no co-integration of deposit rate variables

with the policy rate, but there is between the credit rate ones with the policy rate itself.

To confirm these results, and to make them more robust we also perform the Johansen test for co-integration

As I wanted to know how many co-integrating relationships there are among the chosen variables, I decided to run the Johansen test for co-integration with 2 lags for the underlined model so that we could be sure that there is no serial correlation in residuals of the underlying long term equation and simultaneously not to lose too many degrees of freedom (therefore we choose 2 lags).

Below table reveals the summarized results of Appendix 2 for Johansen test for each of the variables. The test has more than 2 hypotheses depending on the nr of variables as further stated below:

Table 5.3.2 Johansen test for co-integration

	trace statistic	5% critical value
M6D	17.8114	15.41
M36D	15.6524	15.41
M6C	42.8179	15.41
Y5C	33.3344	15.41

Source: Author's estimation

Null Hypothesis: There is at most 0 co-integrating relationship (rank 0)

Hypothesis 1: There is at most 1 co-integrating relationship (rank 1)

Hypothesis 2: There are at most 2 co-integrating relationships (rank 2)

In all cases we can reject the null hypothesis at 95% level of confidence, because trace statistic is higher in absolute value than corresponding critical value. For Engle Granger we didn't reject the first 2, meanwhile for Johansen we reject the null hypothesis for the 4 variables. However the first two variables as per the results of Johansen test are somehow borderline cases, because trace statistic is very close to the critical value. Meanwhile, the credit rates dependent variables clearly show signs of co-integration with the policy rate.

Therefore by the results of both tests, Engle-Granger and Johansen, one can assume that pass through mechanism in this case is stronger for the credit rates than for the deposit rates for whom the relationship might be spurious to some degree.

5.4 Error correction model

After performing the co-integration tests we model the actual relationships with the help of two steps of Engle – Granger procedure.

The first step is to estimate the long-term co-integrated relationships by OLS, which in case of co-integration resulted to be consistent. The results of this first step, are used to perform the second one which lead us to error correction model which models short term relationships and speed of adjustment to long term equilibrium by estimating the parameters on residuals from the first step (long term equitation).

The complete list of equations (estimated one by one) for the long-term co-integrating relationships would look like:

$$i_t^{SD} = \alpha_1 + \beta_{11}\, i_t^{IR} + \varepsilon_1$$

$$i_t^{LD} = \alpha_2 + \beta_{21}\, i_t^{IR} + \varepsilon_2$$

$$i_t^{SC} = \alpha_3 + \beta_{31}\, i_t^{IR} + \varepsilon_3$$

$$i_t^{LC} = \alpha_4 + \beta_{41}\, i_t^{IR} + \varepsilon_4$$

Policy rate (IR) is taken as exogenous variable since it is set from the central bank of the country, and likewise it is never on the left hand side of the equation.

According to our theoretical assumptions in the long horizon the market interest rates depend only on the policy rate set by central bank. Thus, we assume that the other rates except for PR should not influence SD, LD, SC and LC in our co-integrating relationships. After estimating our model, the coefficients of long-term co-integrating relationships together with their standard error are summarized in the table below, meanwhile the whole estimation results can be found in the Appendix 3.

Table 5.4.1 – Estimated parameters of the co-integrated relationships

	α_i	β_{i1}
M6D	-0.927***	1.114 ***
	(0.205)	(0.042)
M36D	1.588***	1.007 ***
	(0.275)	(0.056)
M6C	5.375***	1.369***
	(0.607)	(0.124)
Y5C	7.304***	1.266 ***
	(0.455)	(0.093)

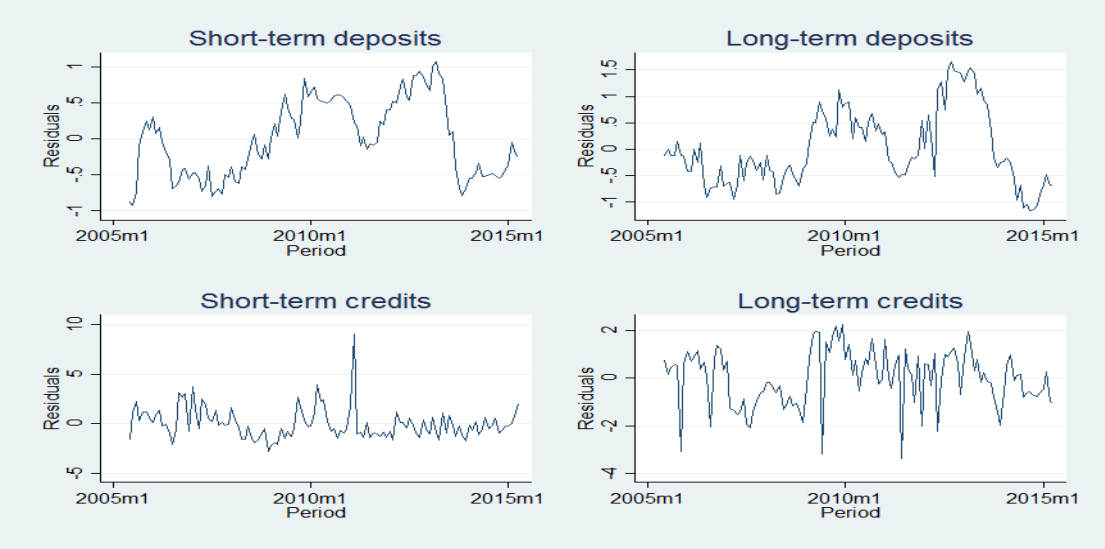
Source: Author's estimations

(*** / p < 0,01)

For all the 4 co-integrating equations the coefficients on policy rate are positive and significant, implying that there is a positive relationship between each of the variables and the policy rate. Based on the summarized results of the above table, one unit increase of policy rate would lead to an increase by more than one unit of the market rate, as per each value of the beta assigned to the table above for each variable (M6D, M36D, M6C, Y5C). In other words, policy rate has a long-term impact on retail deposit and lending rates, revealing an effective transmission mechanism in long term. The intercept values are in line how banks are setting markups to the interest rate benchmark in the long-term, i.e. short-term deposit rate is most of the time even below this rate, while both credit rates exhibit significant positive markup. From the scaling factors (slope coefficient) analysis, which are all above one, we observe the short-term credit rate is the most responsive to the central bank monetary policy, as it changes more than proportionally with percentage change of the base rate.

To further continue with the results of the co-integration, we observe the behavior of the residuals from co-integrated relations over time. The results are shown on Figure 5.4.1:

Figure 5.4.1: Residuals of co-integrated relationships over the observed period



Source: Author's estimation

If we would give a look at the graphs, one would notice that short and long term credit rates are more co-integrated since their particular error series seems to be stationary on the contrary to the deposit error series in the first row of the figure. It is obvious that there are some other factors, not present in the equation, that have an impact on the deposits in both short and long terms making the relationship between these market rates and policy rate spurious to some extent.

While moving on with our estimations, since Co-integration shows the relationship between the variables in the long term, we also use the ECM representation of the previous specifications to account for the short-term adjustments of the variables toward the long run equilibrium.

Therefore, an error-correction model (ECM) of pass-through would look like below shown:

$$\Delta {i_t}^{SD} = \gamma_{10} + \gamma_{11} \Delta {i_{t-1}}^{SD} + \gamma_{12} \left({i_{t-1}}^{SD} - \beta_{11} \, {i_{t-1}}^{IR} - \alpha_1 \right) + \mu_1$$

$$\Delta i_t{}^{LD} = \gamma_{20} + \gamma_{21}\Delta i_{t-1}{}^{LD} + \gamma_{22}\left(i_{t-1}{}^{LD} - \beta_{21}\, i_{t-1}{}^{IR} - \alpha_2\right) + \mu 2$$

$$\Delta i_t{}^{SC} = \gamma_{30} + \gamma_{31}\Delta i_{t-1}{}^{SC} + \gamma_{32}\left(i_{t-1}{}^{SC} - \beta_{31}\, i_{t-1}{}^{IR} - \alpha_3\right) + \mu_3$$

$$\Delta i_t{}^{LC} = \gamma_{40} + \gamma_{41}\Delta i_{t-1}{}^{LC} + \gamma_{42}\left(i_{t-1}{}^{LC} - \beta_{41}\, i_{t-1}{}^{IR} - \alpha_4\right) + \mu_4$$

Table 5.4.2: ECM model estimation results

Source: Author's estimations

While following the same procedure of work, the estimation results can be found in the Appendix 4, meanwhile the below table reveals the summary of main important points ECM estimation:

Table	γ_{i0}	γ_{i1}	γ_{i2}	β_{i1}	α_i
Δ M6D	-0.018	0.179**	-0.095***	1.114***	-0.927***
	(0.016)	(0.088)	(0.029)	(0.042)	0.205
Δ M36D	-0.100	-0.226**	-0.306**	1.007***	1.588***
	(0.029)	(0.090)	(0.041)	(0.056)	0.275
Δ M6C	-0.030	-0.059	-0.582***	1.369***	5.375***
	(0.137)	(0.094)	(0.108)	(0.124)	0.607
Δ Y5C	-0.050	-0.201**	-0.561***	1.266***	7.304***
	(0.102)	(0.090)	(0.107)	(0.093)	0.455

The market rates correct the deviations from the long run equilibrium in various speeds, where Y5C corrects 56% within one period (1 Month), similarly to M6C with speed of adjustment around 58%, while deposit rates adjust at considerably lower pace, namely M36D with 30.6% and the slowest one M6D with just 9.5% in one period. Thus, for example, for short-term deposit rate it takes more than 10 months to get back to long run equilibrium. Meanwhile, for the long-term deposit rates it takes like 3,3 months, and for the credit rates, the short and long one having similar speed of adjustments, it takes less than 2 months. One more time, we conclude that there is

a stronger link or connection of credit rates to policy rates implying that the transmission mechanism works better for these market rates. The error correction term for M36D is significant just at 95%, while for the other market rates at 99%. Even if the error correction term is around -0,306 for the long-term deposit rate, there is moderate degree of uncertainty. The speed of adjustment to the long-term equilibrium might be volatile in this case.

If we observe both, co-integration results, and ECM results, we notice that co-integration results has positive significant coefficients, meanwhile ECM model results has negative significant coefficient. This reality implies that when the average market interest rate is too high, it falls back toward the long run equilibrium set by the policy rate.

5.5 The impact of 2008 global crisis in Albanian pass through mechanism

To add value to our model estimation, and to further give light to the previous research which imply that there was not such a huge impact of the 2008 global crisis in the Albanian economy, a second estimation of the same model was run, which divides the data in two parts, after and before the crisis of 2008.

As a border year was chosen September 2008. Thus, the monthly data from June 2005 until September 2008 were considered for the before crisis estimation, meanwhile the data from October 2008 until April 2015 were considered for the after

crisis estimation. Basically, with the same equation used above, two other estimations were done as per the divisions explained.

When we look closer at the estimated parameters for individual market rates relationships with policy rate, we can observe quite considerable distinction between the transmission mechanism of monetary policy pass-through before and after the crisis outbreak especially for both short-term and long-term credit rates. Yet the detailed description and interpretation follows in the consecutive sub sessions.

5.5.1 Co-integration estimation

Below are shown the summary of the coefficients of long term co-integrating relationships together with their standard error for the before crisis and after crisis period. The whole Stata results can be found in the Appendix 5.

Following the numerical results of the below summaries for the before and after crisis period one can notice that the co-integrating relationships among the variables fit better for the after crisis estimation. Thus despite the fact that all the relations are significant, further each of the β is higher than one, implying that one unit increase of the policy rate would lead to an increase by more than one unit of the market rate. Meanwhile, the same reality does not hold for the before crisis where one unit increase in policy rate increases with less than one unit the market rate for the given variables (still among them, the deposit rates seem to have a stronger transmission then the credit ones)

Table 5.5.1.1 The before crisis pass through estimation

	A	B	R^2
6MD	-0,525	0,970***	0,694
	(0,581)	(0,104)	
36MD	2,117***	0,838***	0,693
	(0,503)	(0,091)	
6MC	11,330***	0,363	0,017
	(2,489)	(0,448)	
5YC	12,311***	0,303	0,023
	(1,758)	(0,316)	

Source: Author's estimation

Table 5.5.1.2 The after crisis pass through estimation

	A	B	R^2
6MD	-1,491***	1,288***	0,922
	(0,192)	(0,42)	
36MD	0,998***	1,188***	0,791
	(0,315)	(0,069)	
6MC	5,499***	1,296***	0,495
	(0,673)	(0,149)	
5YC	6,514***	1,484***	0,708
	(0,492)	(0,109)	

Source: Author's estimations

While the fit of the long-term co-integrating equations for the deposit rates according to R^2 is satisfactory no matter the period considered, the same estimated relationships for the credit rates **before the crisis** seem to be rather loose with non-significant slope coefficient corresponding to the long-term response of the rate to monetary policy decision, hence the model is effectively reduced to intercept only with obviously poor fit explaining just about 2% of the variation in the data.

The measure improves for all four rates after the crisis, however for the credit rates much more rapidly and finally bringing a decent fit, indicating strong link between the rates and monetary policy in a long-term with all slope coefficients significant at 99% level of confidence, following the beginning of what is now known as the Great Recession.

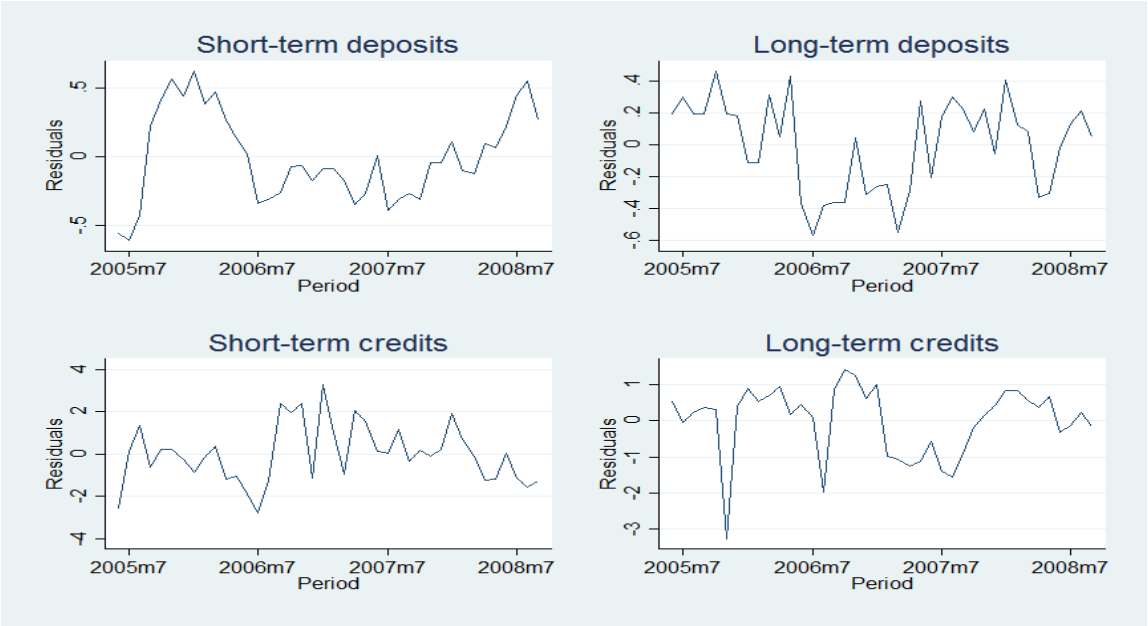


Figure 5.5.1.1 Residuals of co-integrated relationships before the crisis

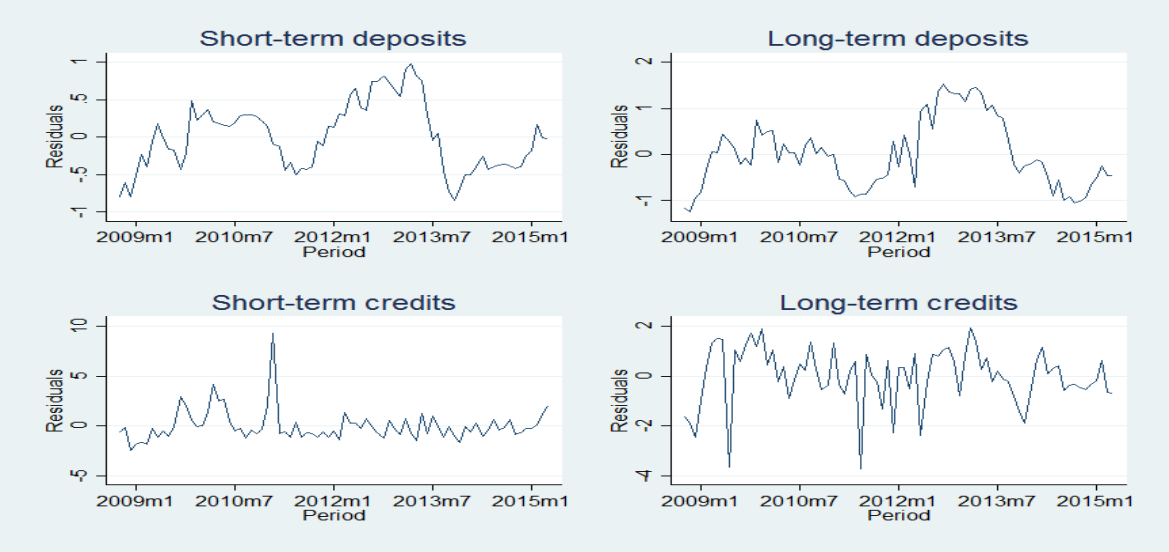
Source: Author's estimation

The predicted co-integrating equation before the crises at the graph above has the right appearance mostly for the credit rates, with namely the short-term ones nicely resembling stationary series. Despite the reasonable fit the relationship between deposit rates and monetary policy looks spurious to some extent, indicating there should be various other factors determining the decision of commercial banks when setting their deposit rates in the long-term. The situation after the crisis at the graph below is very similar, both credit rates look as stationary series, while the same

cannot be concluded about the deposit rates, which tend to deviate from the long-run equilibrium probably due to some shocks caused by different sources than the central bank decisions.

Figure 5.5.1.2 Residuals of co-integrated relationships after the crisis

Source: Author's estimation



Although we can conclude there is a strong co-integrating relationship for the credit rates especially after the crisis, the rates for longer maturities seem to be relatively more volatile.

5.5.2 Error Correction Model estimation

Next we turn to investigation of the short-term adjustment mechanism to the long-term equilibrium set by the already discussed co-integrating equations. This is done again through error-correction model framework.

Following up the estimations, below is shown the summary of ECM estimation, again divided in two tables, where the before and after crisis ECM results are summarized as per the stata estimations that can be found still on the appendix 5 and 6 on the ECM estimations.

Table 5.5.2.1 ECM estimation before the crisis

	γ_{i0}	γ_{i1}	γ_{i2}	R2
6MD	0,040	0,288*	-0,304***	0,291
	(0,027)	(0,151)	(0,085)	
36MD	-0,022	-0,158	-0,475***	0,309
	(0,041)	(0,161)	(0,164)	
6MC	-0,044	0,030	-0,708***	0,339
	(0,214)	(0,163)	(0,200)	
5YC	0,001	-0,009	-0,660***	0,333
	(0,157)	(0,168)	(0,195)	

Source: Author's estimations

One can observe that intercepts (gamma0), as typical for many error-correction models, are not significant except for the special case of 6-month deposits after the start of the crisis. Similarly, the autocorrelation term (gamma1), is not or just marginally significant, suggesting that the first differences of market rates depend only slightly on their own values in the previous period.

Table 5.5.2.2 ECM estimation after the crisis

	γ_{i0}	γ_{i1}	γ_{i2}	R2
6MD	-0,057***	0,051	-0,050	0,022
	(0,019)	(0,113)	(0,038)	
36MD	-0,070*	-0,208*	-0,092*	0,102
	(0,037)	(0,111)	(0,051)	
6MC	-0,056	-0,046	-0,645***	0,329
	(0,172)	(0,094)	(0,137)	
5YC	-0,089	-0,187*	-0,677***	0,438
	(0,127)	(0,109)	(0,140)	

Source: Author's estimations

Nevertheless, the more interesting behavior can be traced through our central parameter of interest, so called error-correction term (gamma2). First of all, signs of the coefficients are negative as expected, thus the model seem to be correctly specified at least at this part. In other words, when market interest rate is above its equilibrium value it falls back to the long-run level at the speed given by the size of adjustment parameters (gamma2).

Before the crisis all market rates exhibited relatively high rate of short-term adjustment from deviation to long-run equlibria ranging from 30.4% to 70.8% in one period, being more pronounced for the credit rates together with relatively fair goodness of fit. After the crisis, however the deposit rates almost completely stopped to adjust to the loosing monetary policy in the short-term, when the central bank started to lower the policy rate. Particularly the differenced 6-month deposit rates series are effectively white-noise with R-squared equal just to 2.2% during the "after"

period. On the other hand, the credit rates remained to follow the development of the repo rate at the similar pace with much stronger long-run equilibrium response.

5.6 Post estimations – Autocorrelation

To assess correct specification of our model we test for remaining autocorrelation in the residuals from error-correction models with Portmanteau test for white noise. The p-values of this test with the null hypothesis stating that tested series are white-noise for the overall sample and both subsamples are shown in the table below. From the large p-values it is clear that there is no problem with serial correlation, hence the model is correctly specified and there is no need to further add another lags of the variables.

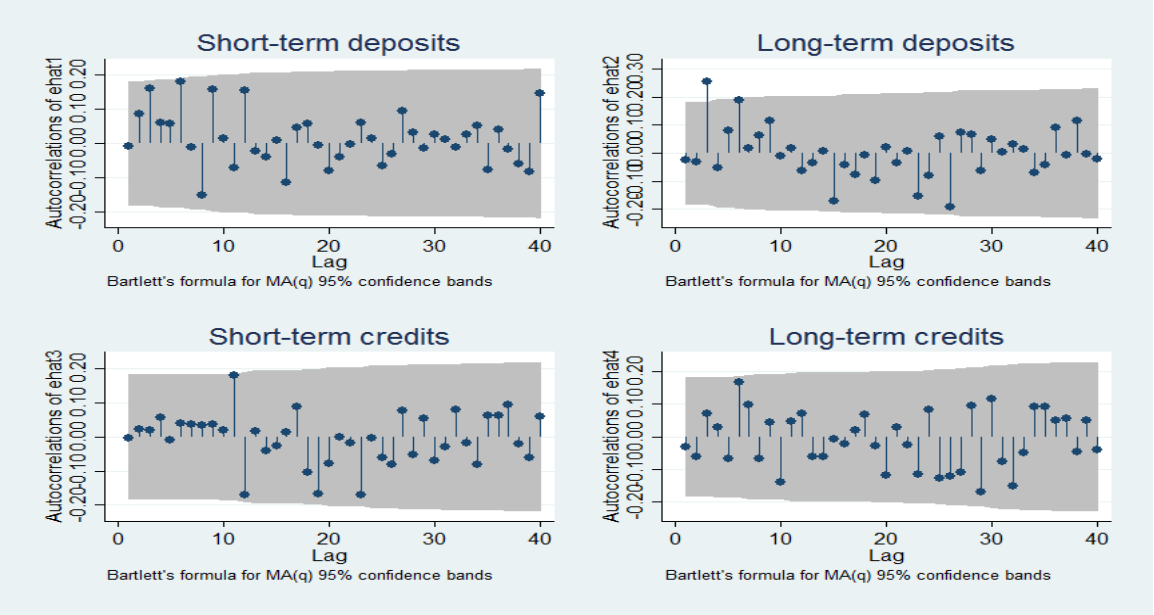
Table 5.6.1 Post estimations summary

	OVERALL	BEFORE	AFTER
6MD	0,744	0,863	0,814
36MD	0,400	0,490	0,364
6MC	0,814	0,993	0,966
5YC	0,360	0,700	0,255

Source: Author's estimations

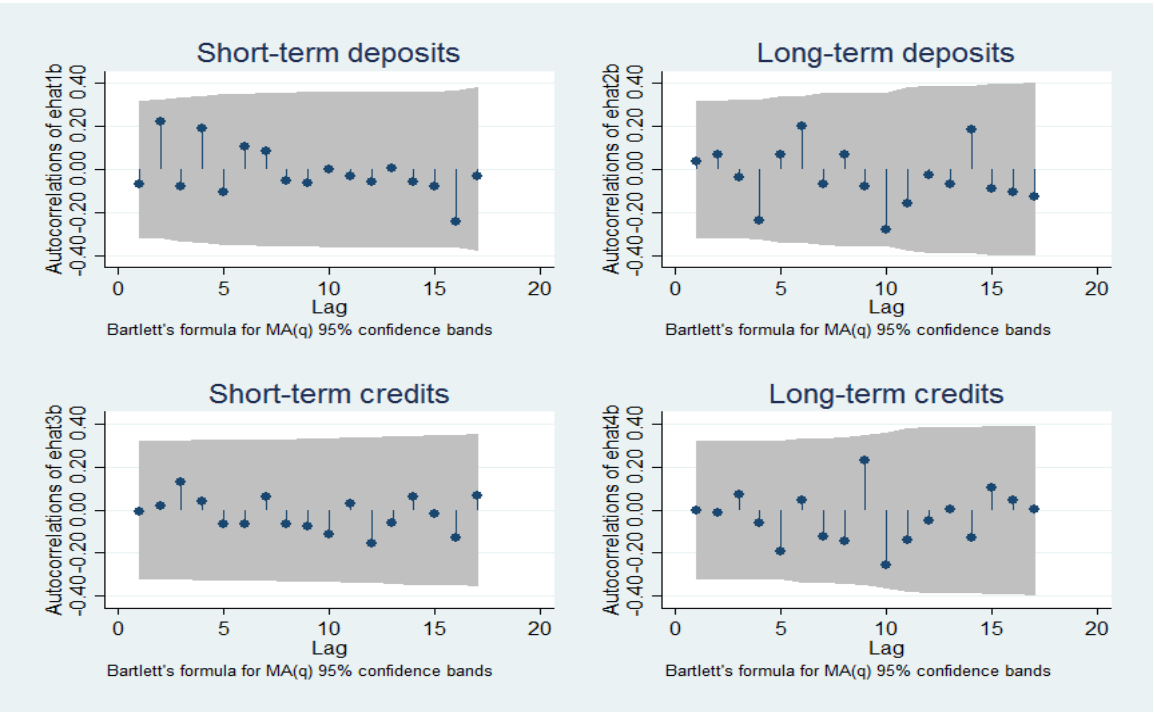
Similarly, one can reach the same conclusion from the correlograms of autocorrelation function for all series in all periods and sub-periods as below shown:

Figure 5.6.1 Autocorrelation error correction model for the whole sample



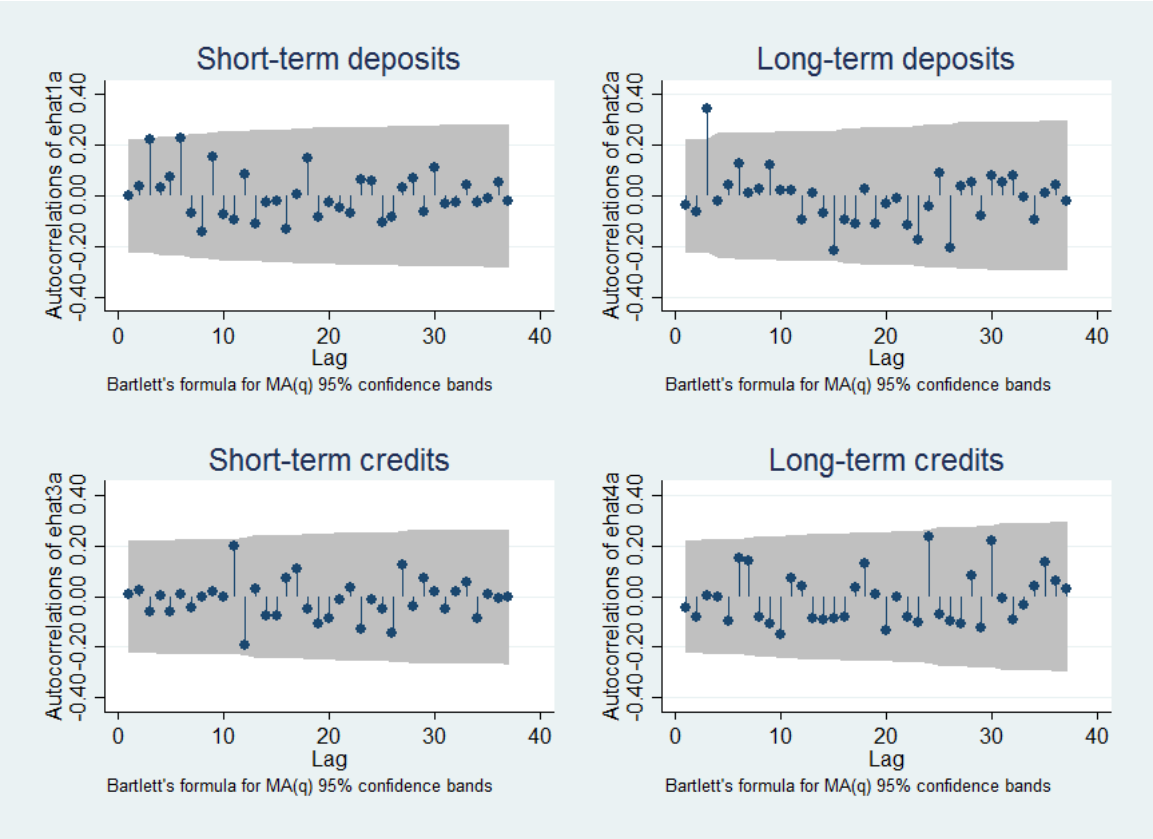
Source: Author's estimations

Figure 5.6.2 Autocorrelation error correction model before the crisis



Source: Author's estimation

Figure 5.6.3 Autocorrelation error correction model after the crisis



Source: Author's estimations

The above figures are the correlograms of the autocorrelation functions, graphical representation that confirm once again that there is no remaining autocorrelation in the residuals from error correction models before and after the crisis, but there is for the whole sample estimations, since the values exceed the significance level, as shown on figure

6. Conclusion

In this thesis we analyzed the interest pass through mechanism for Albania by using the Monetary Policy Approach. The transmission mechanism from market rate to policy rate was estimated through the ECM for short-term co-integrating relationships and Engle Granger and Johansen test for the long-term co-integrating relationship.

This thesis adds value and contributes to the saga of pass-through mechanism estimations by being estimated for the first time in Albania. Moreover we put our focus to the impact the crisis had on this transmission mechanism, by structuring a second model estimation of the performance of pass through before and after the crisis of 2008.

The main findings of our paper are:

1) Based on the estimation of whole sample, deposit rates don't react as credit rates do during the transmission mechanism from policy rate to market rate. Credit rates have likewise a higher and more effective speed of transmission, not the same for the deposit ones.

2) Based on the estimation of the two divided samples, before and after the crisis, a significant co-integrating relationship with strong transmission mechanism and monetary policy interest rate pass-through was found for short- and long-term market credit rates especially after the beginning of global financial crisis in September 2008.

Thus, the main finding of this thesis, based on the results of the econometric model estimated is that not only the financial crisis did not weakened the transmission mechanism, but further it resulted to be stronger after the crisis then before it.

This result though can be justified with the precautions taken, and the reforms done by the financial central authorities of Albania the moment the financial crisis of 2008 was tangentially felt in the economic system of this country.

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Appendix

Appendix 1 - Stationarity of the variables

1) Test for stationarity for IR

```
Augmented Dickey-Fuller test for unit root         Number of obs   = 106

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -2.344            -4.038            -3.449            -3.149
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.4098

------------------------------------------------------------------------------
D.IR            |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------+-------------------------------------------------------------
          IR    |
         L1.    |  -.0493182    .021041    -2.34   0.021    -.0911136   -.0075227
         LD.    |  -.1160795    .102541    -1.13   0.261    -.3197646    .0876057
        L2D.    |   .0890296   .1035376     0.86   0.392    -.1166352    .2946943
        L3D.    |  -.0290425    .104777    -0.28   0.782    -.2371691    .1790842
        L4D.    |  -.0118591    .103805    -0.11   0.909     -.218055    .1943368
        L5D.    |   .0290394   .1017983     0.29   0.776    -.1731705    .2312493
        L6D.    |   .0712459     .10161     0.70   0.485    -.1305899    .2730817
        L7D.    |  -.0788761   .1022308    -0.77   0.442    -.2819451    .1241928
        L8D.    |  -.1703888   .1029674    -1.65   0.101    -.3749209    .0341433
        L9D.    |   .1404052   .1055409     1.33   0.187    -.0692388    .3500492
       L10D.    |   .0770924   .1067646     0.72   0.472    -.1349824    .2891673
       L11D.    |  -.0219602   .1077773    -0.20   0.839    -.2360466    .1921262
       L12D.    |   .0442473   .1077449     0.41   0.682    -.1697747    .2582693
      _trend    |  -.0029904   .0008891    -3.36   0.001    -.0047564   -.0012244
       _cons    |   .4023247   .1478628     2.72   0.008     .1086135    .6960359
------------------------------------------------------------------------------

*******************************************************************************
*

Phillips-Perron test for unit root                 Number of obs   =       118
                                                   Newey-West lags =         4

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)           -1.748           -27.520           -20.772           -17.560
 Z(t)             -1.042            -4.034            -3.448            -3.148
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9381
```

```
------------------------------------------------------------------------------
IR           |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          IR |
         L1. |   .9840558   .0148733    66.16   0.000     .9545947    1.013517
      _trend |   -.001508   .0004956    -3.04   0.003    -.0024897   -.0005263
       _cons |   .1405125    .096524     1.46   0.148    -.0506829    .3317079
------------------------------------------------------------------------------

*******************************************************************************
*

DF-GLS for IR                                              Number of obs =   106
Maxlag = 12 chosen by Schwert criterion

               DF-GLS tau      1% Critical       5% Critical      10% Critical
  [lags]     Test Statistic        Value             Value             Value
------------------------------------------------------------------------------
    12           -1.232           -3.557            -2.776            -2.502
    11           -1.117           -3.557            -2.801            -2.526
    10           -1.106           -3.557            -2.826            -2.549
    9            -0.888           -3.557            -2.850            -2.572
    8            -0.587           -3.557            -2.874            -2.594
    7            -0.739           -3.557            -2.896            -2.615
    6            -0.738           -3.557            -2.918            -2.635
    5            -0.574           -3.557            -2.938            -2.653
    4            -0.458           -3.557            -2.957            -2.671
    3            -0.348           -3.557            -2.975            -2.687
    2            -0.248           -3.557            -2.991            -2.702
    1             0.032           -3.557            -3.006            -2.715

Opt Lag (Ng-Perron seq t) =  9 with RMSE  .1178402
Min SC   = -4.058914 at lag  1 with RMSE   .125751
Min MAIC = -4.141331 at lag  2 with RMSE  .1236675

*******************************************************************************

KPSS test for IR

Maxlag = 12 chosen by Schwert criterion
Autocovariances weighted by Bartlett kernel

Critical values for H0: IR is trend stationary

10%: 0.119  5% : 0.146  2.5%: 0.176  1% : 0.216

Lag order    Test statistic
    0           2.56
    1            1.3
    2           .883
    3           .673
    4           .547
    5           .463
    6           .403
    7           .359
    8           .324
    9           .297
```

```
   10           .275
   11           .256
   12           .241

*******************************************************************************
*
```

2) Test for stationarity for M6D

```
Augmented Dickey-Fuller test for unit root         Number of obs   =       106

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -1.391            -4.038            -3.449            -3.149
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.8634

------------------------------------------------------------------------------
D.M6D        |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         M6D |
         L1. |  -.0234017   .0168194    -1.39   0.168    -.0568114    .0100081
         LD. |   .1011657   .1023139     0.99   0.325    -.1020682    .3043996
        L2D. |  -.0389721   .1022517    -0.38   0.704    -.2420826    .1641384
        L3D. |   .1333213   .1016283     1.31   0.193    -.0685508    .3351935
        L4D. |  -.0389137   .1028809    -0.38   0.706    -.2432739    .1654465
        L5D. |   .1504609   .0973801     1.55   0.126    -.0429728    .3438946
        L6D. |    .092043    .096629     0.95   0.343    -.0998985    .2839846
        L7D. |  -.0246624   .0967647    -0.25   0.799    -.2168737    .1675489
        L8D. |  -.1980793   .0965825    -2.05   0.043    -.3899285   -.0062301
        L9D. |    .133377   .0991017     1.35   0.182    -.0634763    .3302303
       L10D. |  -.0148508   .0938408    -0.16   0.875    -.2012541    .1715524
       L11D. |  -.0772997   .0938483    -0.82   0.412    -.2637178    .1091183
       L12D. |   .1275581   .0936775     1.36   0.177    -.0585208    .3136369
      _trend |  -.0020166   .0007831    -2.58   0.012    -.0035721   -.0004612
       _cons |   .2143403   .1065211     2.01   0.047     .0027493    .4259313
------------------------------------------------------------------------------

. pperron M6D, trend regress

Phillips-Perron test for unit root                 Number of obs   =       118
                                                   Newey-West lags =         4

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)           -2.208           -27.520           -20.772           -17.560
 Z(t)             -1.217            -4.034            -3.448            -3.148
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9070

------------------------------------------------------------------------------
M6D          |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

```
         M6D |
         L1. |   .9837129   .0139651    70.44   0.000     .9560507    1.011375
       _trend |   -.002111   .0005593    -3.77   0.000    -.0032188   -.0010032
       _cons |   .1741778   .0874939     1.99   0.049     .0008693    .3474863
------------------------------------------------------------------------------

. dfgls M6D

DF-GLS for M6D                                              Number of obs =   106
Maxlag = 12 chosen by Schwert criterion

               DF-GLS tau      1% Critical       5% Critical      10% Critical
  [lags]     Test Statistic        Value             Value             Value
------------------------------------------------------------------------------
    12           -1.177           -3.557            -2.776            -2.502
    11           -0.892           -3.557            -2.801            -2.526
    10           -0.905           -3.557            -2.826            -2.549
    9            -0.830           -3.557            -2.850            -2.572
    8            -0.499           -3.557            -2.874            -2.594
    7            -0.783           -3.557            -2.896            -2.615
    6            -0.792           -3.557            -2.918            -2.635
    5            -0.546           -3.557            -2.938            -2.653
    4            -0.333           -3.557            -2.957            -2.671
    3            -0.328           -3.557            -2.975            -2.687
    2             0.025           -3.557            -2.991            -2.702
    1             0.083           -3.557            -3.006            -2.715

Opt Lag (Ng-Perron seq t) = 12 with RMSE  .1409795
Min SC   = -3.597883 at lag  1 with RMSE  .1583518
Min MAIC = -3.691747 at lag  3 with RMSE  .1533095

. kpss M6D

KPSS test for M6D

Maxlag = 12 chosen by Schwert criterion
Autocovariances weighted by Bartlett kernel

Critical values for H0: M6D is trend stationary

10%: 0.119  5% : 0.146  2.5%: 0.176  1% : 0.216

Lag order    Test statistic
    0           2.65
    1           1.35
    2           .919
    3           .701
    4            .57
    5           .482
    6           .419
    7           .373
    8           .336
    9           .307
   10           .284
   11           .264
   12           .248
```

```
*******************************************************************************
*
```

3) Test for stationarity for M36D

```
Augmented Dickey-Fuller test for unit root         Number of obs   =       106

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -1.747            -4.038            -3.449            -3.149
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.7299

------------------------------------------------------------------------------
D.M36D       |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        M36D |
         L1. |  -.0727596   .0416553    -1.75   0.084    -.1555028    .0099836
         LD. |  -.2424206   .1009994    -2.40   0.018    -.4430434   -.0417977
        L2D. |  -.1012674   .1038358    -0.98   0.332    -.3075245    .1049897
        L3D. |   .2052775   .1046192     1.96   0.053    -.0025358    .4130907
        L4D. |   .0058921   .1074404     0.05   0.956    -.2075251    .2193093
        L5D. |     .06023   .1091883     0.55   0.583    -.1566591    .2771191
        L6D. |   .1687578   .1110266     1.52   0.132    -.0517828    .3892985
        L7D. |    .117295   .1148756     1.02   0.310    -.1108912    .3454812
        L8D. |   .1292173   .1164317     1.11   0.270    -.1020601    .3604946
        L9D. |   .1530122   .1166582     1.31   0.193     -.078715    .3847394
       L10D. |   .0761051   .1178553     0.65   0.520    -.1579999    .3102102
       L11D. |   .0539323   .1144115     0.47   0.638    -.1733322    .2811967
       L12D. |  -.0594044   .1043686    -0.57   0.571    -.2667199    .1479111
      _trend |  -.0030869   .0012967    -2.38   0.019    -.0056627   -.0005111
       _cons |   .6572613    .315956     2.08   0.040     .0296535    1.284869
------------------------------------------------------------------------------

. pperron M6D, trend regress

Phillips-Perron test for unit root                 Number of obs   =       118
                                                   Newey-West lags =         4

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)           -2.208           -27.520           -20.772           -17.560
 Z(t)             -1.217            -4.034            -3.448            -3.148
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9070

------------------------------------------------------------------------------
M6D          |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         M6D |
         L1. |   .9837129   .0139651    70.44   0.000     .9560507    1.011375
      _trend |   -.002111   .0005593    -3.77   0.000    -.0032188   -.0010032
       _cons |   .1741778   .0874939     1.99   0.049     .0008693    .3474863
```

```
------------------------------------------------------------------------------

. dfgls M36D

DF-GLS for M36D                                          Number of obs =   106
Maxlag = 12 chosen by Schwert criterion

               DF-GLS tau      1% Critical       5% Critical      10% Critical
  [lags]     Test Statistic        Value             Value             Value
------------------------------------------------------------------------------
    12           -1.766           -3.557            -2.776            -2.502
    11           -1.953           -3.557            -2.801            -2.526
    10           -1.815           -3.557            -2.826            -2.549
    9            -1.711           -3.557            -2.850            -2.572
    8            -1.453           -3.557            -2.874            -2.594
    7            -1.261           -3.557            -2.896            -2.615
    6            -1.113           -3.557            -2.918            -2.635
    5            -0.808           -3.557            -2.938            -2.653
    4            -0.744           -3.557            -2.957            -2.671
    3            -0.718           -3.557            -2.975            -2.687
    2            -0.258           -3.557            -2.991            -2.702
    1            -0.480           -3.557            -3.006            -2.715

Opt Lag (Ng-Perron seq t) =  3 with RMSE  .2975499
Min SC   = -2.248368 at lag  3 with RMSE  .2975499
Min MAIC = -2.356755 at lag  3 with RMSE  .2975499

. kpss M36D

KPSS test for M36D

Maxlag = 12 chosen by Schwert criterion
Autocovariances weighted by Bartlett kernel

Critical values for H0: M36D is trend stationary

10%: 0.119  5% : 0.146  2.5%: 0.176  1% : 0.216

Lag order    Test statistic
    0            2.2
    1           1.13
    2            .77
    3           .587
    4           .478
    5           .405
    6           .353
    7           .314
    8           .285
    9           .262
   10           .243
   11           .228
   12           .215

*******************************************************************************
*
```

4) Test for stationarity for M6C

```
Augmented Dickey-Fuller test for unit root         Number of obs   =       106

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -2.736            -4.038            -3.449            -3.149
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.2213

------------------------------------------------------------------------------
D.M6C           |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------+-------------------------------------------------------------
            M6C |
             L1. |  -.5040319   .1842029    -2.74   0.007    -.8699284   -.1381354
             LD. |  -.1648812   .1871126    -0.88   0.381    -.5365573     .206795
            L2D. |  -.1616083   .1876833    -0.86   0.391     -.534418    .2112015
            L3D. |  -.1614873   .1859233    -0.87   0.387    -.5308011    .2078265
            L4D. |  -.1334112   .1828189    -0.73   0.467    -.4965586    .2297361
            L5D. |  -.1710405   .1787498    -0.96   0.341    -.5261051     .184024
            L6D. |   -.123512   .1738542    -0.71   0.479     -.468852     .221828
            L7D. |  -.1154531   .1666819    -0.69   0.490    -.4465462    .2156399
            L8D. |  -.0666603   .1576325    -0.42   0.673    -.3797779    .2464574
            L9D. |  -.0503244   .1479139    -0.34   0.734    -.3441371    .2434884
           L10D. |  -.0232926   .1351126    -0.17   0.864    -.2916772    .2450921
           L11D. |   .1436049   .1194338     1.20   0.232    -.0936356    .3808455
           L12D. |  -.1026271   .0999341    -1.03   0.307    -.3011338    .0958797
          _trend |  -.0305903   .0099776    -3.07   0.003    -.0504096   -.0107709
           _cons |    7.89728   2.802176     2.82   0.006       2.3311    13.46346
------------------------------------------------------------------------------

. pperron M6C, trend regress

Phillips-Perron test for unit root                 Number of obs   =       118
                                                   Newey-West lags =         4

                                 ---------- Interpolated Dickey-Fuller ---------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)          -74.998           -27.520           -20.772           -17.560
 Z(t)             -7.361            -4.034            -3.448            -3.148
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
M6C             |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------+-------------------------------------------------------------
            M6C |
             L1. |    .394927   .0832734     4.74   0.000     .2299785    .5598755
          _trend |  -.0281624   .0054389    -5.18   0.000    -.0389358   -.0173889
           _cons |   8.873223   1.241594     7.15   0.000     6.413865    11.33258
------------------------------------------------------------------------------

. dfgls M6C
```

```
DF-GLS for M6C                                          Number of obs =   106
Maxlag = 12 chosen by Schwert criterion

               DF-GLS tau      1% Critical       5% Critical      10% Critical
  [lags]     Test Statistic        Value             Value             Value
------------------------------------------------------------------------------
    12           -0.797           -3.557            -2.776            -2.502
    11           -0.976           -3.557            -2.801            -2.526
    10           -0.744           -3.557            -2.826            -2.549
    9            -0.905           -3.557            -2.850            -2.572
    8            -1.029           -3.557            -2.874            -2.594
    7            -1.168           -3.557            -2.896            -2.615
    6            -1.358           -3.557            -2.918            -2.635
    5            -1.586           -3.557            -2.938            -2.653
    4            -1.915           -3.557            -2.957            -2.671
    3            -2.183           -3.557            -2.975            -2.687
    2            -2.672           -3.557            -2.991            -2.702
    1            -3.332           -3.557            -3.006            -2.715

Opt Lag (Ng-Perron seq t) = 11 with RMSE  1.477515
Min SC   =   1.03438 at lag  1 with RMSE  1.605115
Min MAIC =  1.018852 at lag 12 with RMSE    1.4673

. kpss M6C

KPSS test for M6C

Maxlag = 12 chosen by Schwert criterion
Autocovariances weighted by Bartlett kernel

Critical values for H0: M6C is trend stationary

10%: 0.119  5% : 0.146  2.5%: 0.176  1% : 0.216

Lag order    Test statistic
    0            .64
    1           .459
    2           .381
    3           .335
    4           .302
    5           .279
    6            .26
    7           .244
    8            .23
    9           .218
   10           .207
   11           .197
   12           .189
```

5) Test for stationarity for Y5C

```
Augmented Dickey-Fuller test for unit root         Number of obs   =       106

                              ---------- Interpolated Dickey-Fuller ---------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
```

```
------------------------------------------------------------------------------
 Z(t)             0.735            -3.508            -2.890            -2.580
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9905

------------------------------------------------------------------------------
       D.Y5C |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         Y5C |
          L1. |    .065911   .0897169     0.73   0.464    -.1122745    .2440966
          LD. |  -.7571967   .1428562    -5.30   0.000    -1.040921   -.4734721
         L2D. |  -.5121549   .1609137    -3.18   0.002    -.8317434   -.1925665
         L3D. |  -.4060515    .164192    -2.47   0.015     -.732151    -.079952
         L4D. |  -.3510029   .1678935    -2.09   0.039    -.6844538    -.017552
         L5D. |  -.4492916    .168469    -2.67   0.009    -.7838856   -.1146977
         L6D. |  -.2159417   .1719527    -1.26   0.212    -.5574547    .1255712
         L7D. |  -.0606376   .1670638    -0.36   0.717    -.3924408    .2711656
         L8D. |  -.1506876   .1558901    -0.97   0.336    -.4602988    .1589236
         L9D. |  -.0909975   .1493381    -0.61   0.544    -.3875958    .2056008
        L10D. |  -.2159713   .1400663    -1.54   0.127     -.494155    .0622124
        L11D. |  -.0450156   .1283333    -0.35   0.727    -.2998965    .2098654
        L12D. |   .0677567   .1017535     0.67   0.507    -.1343346    .2698479
              |
        _cons |  -1.069151   1.235712    -0.87   0.389    -3.523382     1.38508
------------------------------------------------------------------------------

. pperron Y5C, trend regress

Phillips-Perron test for unit root                 Number of obs   =       118
                                                   Newey-West lags =         4

                                 ---------- Interpolated Dickey-Fuller ---------
                 Test            1% Critical       5% Critical      10% Critical
               Statistic            Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)         -52.728           -27.520           -20.772           -17.560
 Z(t)            -5.602            -4.034            -3.448            -3.148
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
Y5C          |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         Y5C |
          L1. |   .5698479   .0779571     7.31   0.000     .4154298    .7242659
      _trend |   -.015556   .0041926    -3.71   0.000    -.0238608   -.0072513
       _cons |   6.626126   1.214639     5.46   0.000      4.22016    9.032093
------------------------------------------------------------------------------

. dfgls Y5C

DF-GLS for Y5C                                          Number of obs =   106
Maxlag = 12 chosen by Schwert criterion

               DF-GLS tau      1% Critical       5% Critical      10% Critical
  [lags]     Test Statistic        Value             Value             Value
------------------------------------------------------------------------------
```

```
    12           -0.853           -3.557           -2.776           -2.502
    11           -0.728           -3.557           -2.801           -2.526
    10           -0.829           -3.557           -2.826           -2.549
     9           -1.100           -3.557           -2.850           -2.572
     8           -0.942           -3.557           -2.874           -2.594
     7           -1.055           -3.557           -2.896           -2.615
     6           -0.939           -3.557           -2.918           -2.635
     5           -1.144           -3.557           -2.938           -2.653
     4           -1.661           -3.557           -2.957           -2.671
     3           -1.803           -3.557           -2.975           -2.687
     2           -2.145           -3.557           -2.991           -2.702
     1           -2.833           -3.557           -3.006           -2.715

Opt Lag (Ng-Perron seq t) =  5 with RMSE  1.081576
Min SC   =  .3533001 at lag  1 with RMSE  1.141856
Min MAIC =   .288938 at lag  6 with RMSE  1.075718

. kpss Y5C

KPSS test for Y5C

Maxlag = 12 chosen by Schwert criterion
Autocovariances weighted by Bartlett kernel

Critical values for H0: Y5C is trend stationary

10%: 0.119  5% : 0.146  2.5%: 0.176  1% : 0.216

Lag order    Test statistic
    0            1.5
    1           .964
    2           .719
    3           .579
    4           .489
    5           .427
    6           .379
    7           .342
    8           .313
    9            .29
   10           .271
   11           .255
   12           .241
```

Appendix 2 - Test for cointegration between IR and particular market rates

Appendix 2.1 Cointegration tests for IR and M6d

```
Augmented Engle-Granger test for cointegration        N (1st step)  =      119
Number of lags   =  2                                 N (test)      =      116
------------------------------------------------------------------------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -2.382           -3.991            -3.388            -3.081

Critical values from MacKinnon (1990, 2010)
------------------------------------------------------------------------------
```

Engle-Granger 1st-step regression

M6D	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
IR	1.113522	.041835	26.62	0.000	1.03067	1.196374
_cons	-.9266687	.2047962	-4.52	0.000	-1.332257	-.5210806

Engle-Granger test regression

D._egresid	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_egresid						
L1.	-.0829485	.0348197	-2.38	0.019	-.1519325	-.0139644
LD.	.0610327	.0924704	0.66	0.511	-.1221678	.2442332
L2D.	.0518139	.0929151	0.56	0.578	-.1322677	.2358954

Johansen tests for cointegration
Trend: constant — Number of obs = 117
Sample: 2005m8 - 2015m4 — Lags = 2

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value	1% critical value
0	6	129.66705		17.8114*1	15.41	20.04
1	9	137.7755	0.12943	1.5944*5	3.76	6.65
2	10	138.57272	0.01354			

maximum rank	parms	LL	eigenvalue	SBIC	HQIC	AIC
0	6	129.66705		-1.972317	-2.056459	-2.113967
1	9	137.7755	0.12943	-1.988816*	-2.115028*	-2.201291
2	10	138.57272	0.01354	-1.961741	-2.101977	-2.197824

Appendix 2.2 Cointegration tests for IR and M36d

Augmented Engle-Granger test for cointegration — N (1st step) = 119
Number of lags = 2 — N (test) = 116

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.705	-3.991	-3.388	-3.081

Critical values from MacKinnon (1990, 2010)

Engle-Granger 1st-step regression

M36D	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
IR	1.00655	.0561943	17.91	0.000	.8952599	1.11784
_cons	1.587671	.2750898	5.77	0.000	1.04287	2.132472

```
Engle-Granger test regression
------------------------------------------------------------------------------
  D._egresid |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    _egresid |
         L1. |  -.0767827    .045039    -1.70   0.091     -.166013    .0124477
         LD. |   -.258122   .0964857    -2.68   0.009    -.4492775   -.0669665
        L2D. |  -.0856346   .0941227    -0.91   0.365    -.2721086    .1008393
------------------------------------------------------------------------------


Johansen tests for cointegration
Trend: constant                                          Number of obs =     117
Sample:  2005m8 - 2015m4                                       Lags =       2
------------------------------------------------------------------------------
maximum                                          trace     5% critical  1% critical
  rank    parms       LL       eigenvalue  statistic      value        value
    0      6       53.411955                 15.6524*1    15.41        20.04
    1      9        60.83064     0.11910      0.8151*5     3.76         6.65
    2      10      61.238177     0.00694
------------------------------------------------------------------------------
maximum
  rank    parms       LL       eigenvalue     SBIC       HQIC       AIC
    0      6       53.411955                -.6688108  -.7529526  -.8104608
    1      9        60.83064     0.11910   -.6735189* -.7997317* -.8859939
    2      10      61.238177     0.00694    -.639783  -.7800194  -.8758663
```

Appendix 2.3 Cointegration tests for IR and M6C

```
Augmented Engle-Granger test for cointegration        N (1st step)  =      119
Number of lags   =  2                                 N (test)      =      116
------------------------------------------------------------------------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -4.753           -3.991            -3.388            -3.081

Critical values from MacKinnon (1990, 2010)
------------------------------------------------------------------------------
Engle-Granger 1st-step regression
------------------------------------------------------------------------------
         M6C |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          IR |   1.369119   .1240849    11.03   0.000     1.123375    1.614863
       _cons |   5.375115   .6074368     8.85   0.000     4.172118    6.578112
------------------------------------------------------------------------------
Engle-Granger test regression
------------------------------------------------------------------------------
  D._egresid |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    _egresid |
         L1. |  -.5715987   .1202507    -4.75   0.000    -.8098369   -.3333604
         LD. |  -.0915992   .1121361    -0.82   0.416    -.3137611    .1305627
        L2D. |   -.044948   .0930545    -0.48   0.630    -.2293057    .1394098
------------------------------------------------------------------------------
```

```
Johansen tests for cointegration
Trend: constant                                          Number of obs =     117
Sample:  2005m8 - 2015m4                                       Lags =       2
------------------------------------------------------------------------------
maximum                                        trace     5% critical  1% critical
  rank    parms       LL       eigenvalue  statistic      value        value
    0      6       -138.4431                 42.8179      15.41        20.04
    1      9      -118.23917     0.29204      2.4101*1*5   3.76         6.65
    2      10     -117.03415     0.02039
------------------------------------------------------------------------------
maximum
  rank    parms       LL       eigenvalue     SBIC       HQIC       AIC
    0      6       -138.4431                 2.610763   2.526621   2.469113
    1      9      -118.23917     0.29204     2.387504*  2.261291*  2.175029
    2      10     -117.03415     0.02039     2.407607   2.267371   2.171524
------------------------------------------------------------------------------
```

Appendix 2.4 Cointegration tests for IR and Y5C

```
Augmented Engle-Granger test for cointegration        N (1st step)  =      119
Number of lags   =  2                                 N (test)      =      116
------------------------------------------------------------------------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -4.325           -3.991            -3.388            -3.081

Critical values from MacKinnon (1990, 2010)
------------------------------------------------------------------------------
Engle-Granger 1st-step regression
------------------------------------------------------------------------------
         Y5C |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          IR |   1.265772   .0928769    13.63   0.000     1.081834     1.44971
       _cons |   7.303639   .4546636    16.06   0.000     6.403202    8.204077
------------------------------------------------------------------------------
Engle-Granger test regression
------------------------------------------------------------------------------
  D._egresid |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    _egresid |
          L1. |  -.5256742   .1215569    -4.32   0.000    -.7665003   -.2848481
          LD. |  -.2260945   .1162744    -1.94   0.054     -.456455     .004266
         L2D. |  -.0764532   .0942544    -0.81   0.419    -.2631882    .1102819
------------------------------------------------------------------------------


Johansen tests for cointegration
Trend: constant                                          Number of obs =     117
Sample:  2005m8 - 2015m4                                       Lags =       2
------------------------------------------------------------------------------
maximum                                        trace     5% critical  1% critical
  rank    parms       LL       eigenvalue  statistic      value        value
    0      6      -104.83471                 33.3344      15.41        20.04
```

```
    1      9      -90.493295      0.21741      4.6515*1     3.76         6.65
    2      10     -88.167531      0.03898
-----------------------------------------------------------------------------
maximum
  rank    parms       LL       eigenvalue     SBIC       HQIC       AIC
    0      6      -104.83471                  2.03626   1.952119    1.89461
    1      9      -90.493295      0.21741    1.913215*  1.787002*   1.70074
    2      10     -88.167531      0.03898    1.914161   1.773924   1.678077
```

APPENDIX 3 - COINTEGRATED RELATIONSHIPS

Appendix 3.1 – Coointegrated relationships between IR and M6D

```
      Source |       SS           df       MS      Number of obs   =       119
-------------+----------------------------------   F(1, 117)       =    708.47
       Model |  197.995736         1  197.995736   Prob > F        =    0.0000
    Residual |  32.6981431       117  .279471309   R-squared       =    0.8583
-------------+----------------------------------   Adj R-squared   =    0.8571
       Total |  230.693879       118  1.95503287   Root MSE        =    .52865

------------------------------------------------------------------------------
         M6D |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          IR |   1.113522    .041835    26.62   0.000      1.03067    1.196374
       _cons |  -.9266687   .2047962    -4.52   0.000    -1.332257   -.5210806
------------------------------------------------------------------------------
```

Appendix 3.2 – Coointegrated relationships between IR and M36D

```
      Source |       SS           df       MS      Number of obs   =       119
-------------+----------------------------------   F(1, 117)       =    320.84
       Model |  161.781388         1  161.781388   Prob > F        =    0.0000
    Residual |   58.996785       117  .504246026   R-squared       =    0.7328
-------------+----------------------------------   Adj R-squared   =    0.7305
       Total |  220.778173       118  1.87100147   Root MSE        =     .7101

------------------------------------------------------------------------------
        M36D |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          IR |    1.00655   .0561943    17.91   0.000     .8952599     1.11784
       _cons |   1.587671   .2750898     5.77   0.000      1.04287    2.132472
------------------------------------------------------------------------------
```

Appendix 3.3 – Coointegrated relationships between IR and M6C

```
      Source |       SS           df       MS      Number of obs   =       119
-------------+----------------------------------   F(1, 117)       =    121.74
       Model |  299.323221         1  299.323221   Prob > F        =    0.0000
    Residual |  287.661449       117  2.45864487   R-squared       =    0.5099
```

```
-------------+----------------------------------   Adj R-squared   =    0.5057
       Total |  586.984671       118  4.97444636   Root MSE        =     1.568

------------------------------------------------------------------------------
         M6C |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          IR |   1.369119   .1240849    11.03   0.000     1.123375    1.614863
       _cons |   5.375115   .6074368     8.85   0.000     4.172118    6.578112
------------------------------------------------------------------------------
```

Appendix 3.4 – Coointegrated relationships between IR and Y5C

```
      Source |       SS           df       MS      Number of obs   =       119
-------------+----------------------------------   F(1, 117)       =    185.74
       Model |  255.840326         1  255.840326   Prob > F        =    0.0000
    Residual |  161.160938       117  1.37744392   R-squared       =    0.6135
-------------+----------------------------------   Adj R-squared   =    0.6102
       Total |  417.001264       118  3.53390902   Root MSE        =    1.1736

------------------------------------------------------------------------------
         Y5C |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          IR |   1.265772   .0928769    13.63   0.000     1.081834     1.44971
       _cons |   7.303639   .4546636    16.06   0.000     6.403202    8.204077
------------------------------------------------------------------------------
```

APPENDIX 4 – ERROR CORRECTION MODEL

Appendix 4.1 – ECM for IR and M6D

```
      Source |       SS           df       MS      Number of obs   =       117
-------------+----------------------------------   F(2, 114)       =      7.63
       Model |  .405070941         2   .20253547   Prob > F        =    0.0008
    Residual |  3.02729829       114  .026555248   R-squared       =    0.1180
-------------+----------------------------------   Adj R-squared   =    0.1025
       Total |  3.43236923       116   .02958939   Root MSE        =    .16296

------------------------------------------------------------------------------
       D.M6D |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       uhat1 |
         L1. |  -.0950558   .0288742    -3.29   0.001    -.1522555   -.0378562
             |
         M6D |
         LD. |   .1786007   .0879701     2.03   0.045     .0043326    .3528689
             |
       _cons |  -.0178032   .0152023    -1.17   0.244    -.0479189    .0123125
------------------------------------------------------------------------------
```

Appendix 4.2 – ECM for IR and M36D

```
      Source |       SS           df       MS      Number of obs   =       117
-------------+----------------------------------   F(2, 114)       =      7.61
```

```
      Model |  1.44154967         2  .720774833   Prob > F        =    0.0008
   Residual |  10.7971734       114  .094712047   R-squared       =    0.1178
-------------+------------------------------   Adj R-squared   =    0.1023
      Total |  12.2387231       116  .105506233   Root MSE        =    .30775

------------------------------------------------------------------------------
      D.M36D |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       uhat2 |
         L1. |  -.1001871   .0409795    -2.44   0.016     -.181367   -.0190071
             |
        M36D |
         LD. |  -.2256378   .0895344    -2.52   0.013    -.4030048   -.0482709
             |
       _cons |  -.0377565   .0285899    -1.32   0.189    -.0943929    .0188798
------------------------------------------------------------------------------
```

Appendix 4.3 – ECM for IR and M6C

```
      Source |       SS           df       MS      Number of obs   =       117
-------------+------------------------------   F(2, 114)       =     24.88
       Model |  108.911271         2  54.4556356   Prob > F        =    0.0000
    Residual |  249.481129       114  2.18843095   R-squared       =    0.3039
-------------+------------------------------   Adj R-squared   =    0.2917
       Total |    358.3924       116  3.08958966   Root MSE        =    1.4793

------------------------------------------------------------------------------
       D.M6C |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       uhat3 |
         L1. |   -.582381   .1076908    -5.41   0.000    -.7957157   -.3690464
             |
         M6C |
         LD. |   -.058199   .0944777    -0.62   0.539    -.2453585    .1289606
             |
       _cons |  -.0296425   .1367674    -0.22   0.829    -.3005778    .2412927
------------------------------------------------------------------------------
```

Appendix 4.4 – ECM for IR and Y5C

```
      Source |       SS           df       MS      Number of obs   =       117
-------------+------------------------------   F(2, 114)       =     34.41
       Model |  83.3599505         2  41.6799753   Prob > F        =    0.0000
    Residual |  138.084219       114  1.21126508   R-squared       =    0.3764
---------------------------------------------
   Adj R-squared   =    0.3655
       Total |  221.444169       116  1.90900146   Root MSE        =    1.1006

------------------------------------------------------------------------------
       D.Y5C |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       uhat4 |
         L1. |  -.5605635   .1065345    -5.26   0.000    -.7716076   -.3495195
             |
         Y5C |
         LD. |  -.2006082   .0903472    -2.22   0.028    -.3795854   -.0216311
```

```
      |
_cons |  -.0506022   .1018452    -0.50   0.620    -.2523567    .1511524
```

Appendix 5 – Before crisis estimation Co-integration and ECM

```
. reg M6D IR if t in 1/40

      Source |       SS           df       MS      Number of obs
=        40
-------------+----------------------------------   F(1, 38)
=     86.17
       Model |  9.24707263         1  9.24707263   Prob > F
=    0.0000
    Residual |  4.07780487        38  .107310654   R-squared
=    0.6940
-------------+----------------------------------   Adj R-squared
=    0.6859
       Total |  13.3248775        39  .341663526   Root MSE
=    .32758

------------------------------------------------------------------------------
         M6D |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------------
-------------
          IR |   .9704519   .1045426     9.28   0.000
.7588165    1.182087
       _cons |  -.5246276   .5812172    -0.90   0.372     -
1.70124     .651985
------------------------------------------------------------------------------

. reg D.M6D LD.M6D L.uhat1b in 1/40

      Source |       SS           df       MS      Number of obs
=        38
-------------+----------------------------------   F(2, 35)
=      7.20
       Model |   .36709196         2   .18354598   Prob > F
=    0.0024
    Residual |   .89205804        35  .025487373   R-squared
=    0.2915
-------------+----------------------------------   Adj R-squared
=    0.2511
       Total |     1.25915        37  .034031081   Root MSE
=    .15965

------------------------------------------------------------------------------
       D.M6D |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------------
---
         M6D |
         LD. |   .2883595   .1512912     1.91   0.065     -
.018778    .5954971
```

```
             |
      uhat1b |
         L1. |  -.3038009   .0846756    -3.59   0.001    -
.4757016   -.1319003
             |
       _cons |      .0397    .027462     1.45   0.157    -
.0160508    .0954508
------------------------------------------------------------------------------
```

```
. wntestq ehat1b in 1/40

Portmanteau test for white noise
---------------------------------------
 Portmanteau (Q) statistic =    10.8703
 Prob > chi2(17)           =     0.8632
```

```
. reg M36D IR in 1/40

      Source |       SS           df       MS      Number of obs
=        40
-------------+----------------------------------   F(1, 38)
=     85.78
       Model |  6.90314254         1  6.90314254   Prob > F
=    0.0000
    Residual |  3.05815496        38  .080477762   R-squared
=    0.6930
-------------+----------------------------------   Adj R-squared
=    0.6849
       Total |   9.9612975        39  .255417885   Root MSE
=    .28369

------------------------------------------------------------------------------
        M36D |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------------
-------------
          IR |    .838485   .0905336     9.26   0.000
.6552093    1.021761
       _cons |   2.116639   .5033325     4.21   0.000
1.097696    3.135582
------------------------------------------------------------------------------
```

```
. reg D.M36D LD.M36D L.uhat2b in 1/40

      Source |       SS           df       MS      Number of obs
=        38
-------------+----------------------------------   F(2, 35)
=      7.84
       Model |  .981881205         2  .490940603   Prob > F
=    0.0015
    Residual |  2.19167669        35  .062619334   R-squared
=    0.3094
-------------+----------------------------------   Adj R-squared
=    0.2699
```

```
       Total |  3.17355789        37  .085771835   Root MSE
=    .25024

------------------------------------------------------------------------------
      D.M36D |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------------
-------------
        M36D |
         LD. |   -.158942   .1605302    -0.99   0.329    -
.4848357    .1669517
             |
      uhat2b |
         L1. |  -.4748591    .163937    -2.90   0.006    -
.8076689   -.1420493
             |
       _cons |   .0224819    .040914     0.55   0.586    -
.0605778    .1055417
------------------------------------------------------------------------------

. wntestq ehat2b in 1/40

Portmanteau test for white noise
---------------------------------------
 Portmanteau (Q) statistic =    16.4867
 Prob > chi2(17)           =     0.4896
```

```
. reg M6C IR in 1/40

      Source |       SS           df       MS      Number of obs
=        40
-------------+----------------------------------   F(1, 38)
=      0.66
       Model |  1.29710773         1  1.29710773   Prob > F
=    0.4220
    Residual |  74.7966423        38  1.96833269   R-squared
=    0.0170
-------------+----------------------------------   Adj R-squared
=   -0.0088
       Total |    76.09375        39  1.95112179   Root MSE
=     1.403

------------------------------------------------------------------------------
         M6C |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------------
-------------
          IR |   .3634628   .4477351     0.81   0.422    -
.5429296    1.269855
       _cons |   11.32982   2.489237     4.55   0.000
6.290628    16.36902
------------------------------------------------------------------------------

. reg D.M6C LD.M6C L.uhat3b in 1/40
```

```
      Source |       SS           df       MS      Number of obs
=        38
-------------+----------------------------------   F(2, 35)
=      9.00
       Model |  31.3772178         2  15.6886089   Prob > F
=    0.0007
    Residual |  61.0227085        35  1.74350596   R-squared
=    0.3396
-------------+----------------------------------   Adj R-squared
=    0.3018
       Total |  92.3999263        37  2.49729531   Root MSE
=    1.3204
```

```
       D.M6C |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------
-------------
         M6C |
         LD. |   .0298738   .1634279     0.18   0.856    -
.3019025    .3616501
             |
      uhat3b |
         L1. |   -.708295   .2000536    -3.54   0.001    -
1.114425   -.3021647
             |
       _cons |   .0440841   .2148894     0.21   0.839    -
.3921646    .4803328
```

```
. wntestq ehat3b in 1/40

Portmanteau test for white noise
---------------------------------------
 Portmanteau (Q) statistic =     5.9744
 Prob > chi2(17)           =     0.9934
```

```
. reg Y5C IR in 1/40

      Source |       SS           df       MS      Number of obs
=        40
-------------+----------------------------------   F(1, 38)
=      0.92
       Model |  .900188822         1  .900188822   Prob > F
=    0.3445
    Residual |  37.3242512        38  .982217136   R-squared
=    0.0236
-------------+----------------------------------   Adj R-squared
=   -0.0021
       Total |    38.22444        39  .980113846   Root MSE
=    .99107
```

```
        Y5C |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
------------+----------------------------------------------------
------------
         IR |    .302788   .3162829     0.96   0.344    -
.3374931    .9430692
      _cons |   12.31131   1.758413     7.00   0.000
8.751591    15.87103
------------------------------------------------------------------
------------

. reg D.Y5C LD.Y5C L.uhat4b in 1/40

      Source |       SS           df       MS      Number of obs
=        38
-------------+----------------------------------   F(2, 35)
=      8.73
       Model |  16.4016937         2  8.20084687   Prob > F
=    0.0008
    Residual |  32.8605931        35  .938874089   R-squared
=    0.3329
-------------+----------------------------------   Adj R-squared
=    0.2948
       Total |  49.2622868        37  1.33141316   Root MSE
=    .96896

------------------------------------------------------------------
------------
      D.Y5C |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
------------+----------------------------------------------------
------------
        Y5C |
         LD. |  -.0085387   .1684921    -0.05   0.960    -
.3505959    .3335185
            |
      uhat4b |
         L1. |   -.659945   .1947875    -3.39   0.002    -
1.055385   -.2645052
            |
       _cons |   .0008589   .1572011     0.01   0.996    -
.3182763     .319994
------------------------------------------------------------------
------------

. wntestq ehat4b in 1/40

Portmanteau test for white noise
---------------------------------------
 Portmanteau (Q) statistic =    13.5313
 Prob > chi2(17)           =     0.7000
```

Appendix 6 – After crisis estimation for co-integration and ECM

```
. reg M6D IR if t in 41/119
```

```
      Source |       SS           df       MS      Number of obs
=        79
-------------+----------------------------------   F(1, 77)
=    915.50
       Model |  187.717454         1  187.717454   Prob > F
=    0.0000
    Residual |    15.78829        77  .205042727   R-squared
=    0.9224
-------------+----------------------------------   Adj R-squared
=    0.9214
       Total |  203.505744        78    2.609048   Root MSE
=    .45282

------------------------------------------------------------------------------
         M6D |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------------
---

          IR |    1.28835   .0425798    30.26   0.000
1.203563    1.373137
       _cons |  -1.491475   .1925426    -7.75   0.000    -
1.874876   -1.108073
------------------------------------------------------------------------------


. reg D.M6D LD.M6D L.uhat1a in 41/119

      Source |       SS           df       MS      Number of obs
=        79
-------------+----------------------------------   F(2, 76)
=      0.89
       Model |  .041914997         2  .020957498   Prob > F
=    0.4151
    Residual |  1.79047994        76  .023558947   R-squared
=    0.0229
-------------+----------------------------------   Adj R-squared
=   -0.0028
       Total |  1.83239494        78  .023492243   Root MSE
=    .15349

------------------------------------------------------------------------------
       D.M6D |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------------
-------------
         M6D |
         LD. |   .0514763   .1133115     0.45   0.651     -
.174203    .2771557
             |
      uhat1a |
         L1. |  -.0502873   .0384197    -1.31   0.195    -
.1268067    .0262321
             |
       _cons |  -.0574441   .0186871    -3.07   0.003    -
.0946627   -.0202255
------------------------------------------------------------------------------
```

```
. wntestq ehat1a in 41/119

Portmanteau test for white noise
---------------------------------------
 Portmanteau (Q) statistic =    29.2657
 Prob > chi2(37)           =     0.8137
```

```
. reg M36D IR in 41/119

      Source |       SS           df       MS      Number of obs
=        79
-------------+----------------------------------   F(1, 77)
=    291.38
       Model |   159.70101         1   159.70101   Prob > F
=    0.0000
    Residual |  42.2022788        77  .548081543   R-squared
=    0.7910
-------------+----------------------------------   Adj R-squared
=    0.7883
       Total |  201.903289        78   2.5885037   Root MSE
=    .74033

------------------------------------------------------------------------------
        M36D |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------------
          IR |   1.188325   .0696152    17.07   0.000
1.049704    1.326947
       _cons |   .9983796   .3147945     3.17   0.002
.3715436    1.625216
------------------------------------------------------------------------------

. reg D.M36D LD.M36D L.uhat2a in 41/119

      Source |       SS           df       MS      Number of obs
=        79
-------------+----------------------------------   F(2, 76)
=      4.33
       Model |  .911143664         2  .455571832   Prob > F
=    0.0166
    Residual |   7.9983652        76  .105241647   R-squared
=    0.1023
-------------+----------------------------------   Adj R-squared
=    0.0786
       Total |  8.90950886        78  .114224473   Root MSE
=    .32441

------------------------------------------------------------------------------
      D.M36D |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------------
        M36D |
```

```
         LD. |  -.2080503   .1113944    -1.87   0.066    -
.4299114    .0138109
             |
      uhat2a |
         L1. |  -.0915235   .0507126    -1.80   0.075    -
.1925264    .0094794
             |
       _cons |  -.0697307   .0370709    -1.88   0.064    -
.1435637    .0041024
```

```
. wntestq ehat2a in 41/119

Portmanteau test for white noise
---------------------------------------
 Portmanteau (Q) statistic =    39.3676
 Prob > chi2(37)           =     0.3644
```

```
. reg M6C IR in 41/119

      Source |       SS           df       MS      Number of obs
=        79
-------------+----------------------------------   F(1, 77)
=     75.62
       Model |  189.901325         1  189.901325   Prob > F
=    0.0000
    Residual |  193.354774        77  2.51110096   R-squared
=    0.4955
-------------+----------------------------------   Adj R-squared
=    0.4889
       Total |  383.256099        78  4.91353973   Root MSE
=    1.5846
```

```
         M6C |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------
-------------
          IR |   1.295822   .1490094     8.70   0.000
.9991068    1.592538
       _cons |   5.499357   .6738088     8.16   0.000
4.157632    6.841082
```

```
. reg D.M6C LD.M6C L.uhat3a in 41/119

      Source |       SS           df       MS      Number of obs
=        79
-------------+----------------------------------   F(2, 76)
=     18.65
       Model |  87.5585043         2  43.7792521   Prob > F
=    0.0000
    Residual |  178.433926        76  2.34781482   R-squared
=    0.3292
-------------+----------------------------------   Adj R-squared
=    0.3115
```

```
       Total |   265.99243        78  3.41015936   Root MSE
=    1.5323
```

```
       D.M6C |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------
-------------
         M6C |
         LD. |  -.0455318   .1162403    -0.39   0.696    -
.2770444    .1859808
             |
      uhat3a |
         L1. |  -.6450364   .1371721    -4.70   0.000    -
.9182384   -.3718344
             |
       _cons |  -.0561614   .1724585    -0.33   0.746    -
.3996422    .2873194
```

```
. wntestq ehat3a in 41/119

Portmanteau test for white noise
---------------------------------------
 Portmanteau (Q) statistic =    22.9255
 Prob > chi2(37)           =     0.9661
```

```
. reg Y5C IR in 41/119

      Source |       SS           df       MS      Number of obs
=        79
-------------+----------------------------------   F(1, 77)
=    186.41
       Model |  249.255825         1  249.255825   Prob > F
=    0.0000
    Residual |  102.958309        77   1.3371209   R-squared
=    0.7077
-------------+----------------------------------   Adj R-squared
=    0.7039
       Total |  352.214134        78  4.51556582   Root MSE
=    1.1563
```

```
         Y5C |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------
-------------
          IR |   1.484582   .1087344    13.65   0.000
1.268064      1.7011
       _cons |   6.513944   .4916884    13.25   0.000
5.534868    7.493021
```

```
. reg D.Y5C LD.Y5C L.uhat4a in 41/119

      Source |       SS           df       MS      Number of obs
=        79
-------------+----------------------------------   F(2, 76)
=     29.67
       Model |  75.4258675         2  37.7129337   Prob > F
=    0.0000
    Residual |  96.6127629        76  1.27122056   R-squared
=    0.4384
-------------+----------------------------------   Adj R-squared
=    0.4236
       Total |   172.03863        78  2.20562347   Root MSE
=    1.1275

------------------------------------------------------------------------------
       D.Y5C |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------------
-------------
         Y5C |
          LD. |  -.1871221   .1093135    -1.71   0.091    -
.4048387    .0305946
              |
      uhat4a |
          L1. |  -.6769147   .1396811    -4.85   0.000    -
.9551138   -.3987156
              |
       _cons |   -.088979   .1270329    -0.70   0.486    -
.3419869    .1640289
------------------------------------------------------------------------------

. wntestq ehat4a in 41/119

Portmanteau test for white noise
---------------------------------------
 Portmanteau (Q) statistic =    42.2450
 Prob > chi2(37)           =     0.2547
```